E. Balancing shall be performed with controls set for full flow through the device being tested.
F. A sufficient quantity of VAV's, FPB's and/or automatic throttling valves shall be in the full-open position or full-closed position to simulate design diversity.
G. Each system shall be balanced to ensure design flow to the most remote equipment.
H. Recorded data shall represent actual measured or observed condition.
I. Permanently mark setting of valves, dampers and other adjustment devices, allowing for settings to be restored. Set and lock memory stops.
J. Leave systems in proper working order, replacing belt guards, coupling guards, closing access doors and doors to electrical switch boxes and restoring thermostats to specified settings.
K. Any defects or deficiencies that are observed during the testing and balancing shall be recorded and submitted with the testing and balancing reports.

3.6 BALANCING AIR SYSTEMS

A. Balance all air systems to obtain design air quantities at the least static pressure. Follow the AABC National Standards for balancing the air system.
B. Fans and duct systems shall be completely balanced to obtain the air quantities indicated on the design drawings by the adjustment of sheaves, controllable or adjustable pitch blades, air valves, dampers, registers and other volume and diverting control devices.
C. During this testing period, make all necessary settings and adjustments of temperature-regulating equipment with the assistance of the various control manufacturers and/or installers.
D. All main air ducts shall be traversed using a pitot tube and manometer. The manometer shall be calibrated to read two (2) significant figures in all velocity pressure ranges. The intent of this operation is to measure by traverse the total air quantity supplied by the fan and to verify the distribution of air to zones.
E. Verify static pressure control and fan tracking with controllable pitch and variable frequency drives in VAV systems. Follow the approved manufacturers' standards for balancing DDC VAV boxes.
F. If, when balancing a system, a fan speed other than what can be attained with the provided sheaves should be required, this Contractor shall advise the Contractor responsible for the installation, the Construction Manager/General Contractor and the Engineer of the changes in writing.
G. Outside air dampers shall be adjusted to deliver the correct air quantity at all damper positions. Record and submit the outside air temperatures for both cycles after final adjustments.
H. Submit data in support of all fan deliveries by the following methods:
    1. Summation of the air quantity readings at all outlets.
    2. Duct traverses of main supply ducts.
    3. Verification of airflow quantities at the air volume sensors at the inlet to each VAV box.

3.7 BALANCING hydronic SYSTEMS

A. Pumps and piping systems shall be balanced by the adjustment of plug cocks, globe valves or other control devices to obtain the flow quantities indicated on the design drawings. Balancing shall be performed with all controls set for full flow through coils. A sufficient quantity of automatic throttling valves shall be in the full-open position or full-closed position to simulate design diversity. All automatic three-way valves shall have the bypass port closed. System shall be balanced to ensure design flow to the most remote hydraulic equipment.
B. Balance and record the water flow and pressure drops through all: chillers, condensers, coils, balancing valves, fan coil units, computer air handling units, etc., in accordance with design and/or approved equipment submittal requirements.
C. Flow through all equipment and coils shall be balanced by means of pressure drop and calibrated flow control valves. Obtain curves from the various manufacturers indicating the relationship between flow and pressure drop through the coils and equipment. Readings shall be taken on calibrated test gauges. Submit curves with the final report.
D. For all orifice plates, record the pipe size, orifice size, flow factor, required differential pressure,

final differential pressure and calculated final flow quantity.

E. For all Venturi-type, flow-tube, pitot-tube, or other flow-measuring devices, record the pipe size, manufacturer and size of device, the direct reading or the differential pressure, and calculated final flow.

F. Upon completion of the water balance, reconcile the total heat transfer through all coils and heat exchangers by recording the entering and leaving water temperatures and the entering and leaving air dry bulb and wet bulb temperatures, along with water and air quantities.

G. Where pump impellers are required to be trimmed to produce no more than 110 percent of their scheduled flow with the discharge valve wide open, this Contractor shall establish the new impeller size and submit this data with the balancing reports.

END OF SECTION 23 05 93

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SECTION 23 07 00

HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Provide insulation systems for all piping, ductwork, casings, plenums and equipment as indicated on the drawings and in accordance with the requirements of the Contract Documents.

B. Section includes:

1. Pipe insulation.
2. Duct insulation.
3. Plenum and casing insulation.
4. Equipment insulation.
5. Insulating cements.
6. Adhesives.
7. Mastics.
8. Sealants.
9. Factory-applied jackets.
10. Field-applied jackets.
11. Tapes.
12. Insulated pipe shields.

1.1 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.

1.2 REFERENCES

A. Insulating systems and their components shall be manufactured and installed in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for the New York City and New York State.
   a. Building Code of the State of New York.
   b. Fire Code of the State of New York.
   c. Mechanical Code of the State of New York.
   d. Energy Conservation Code of the State of New York.
   e. New York City Building Code.
   f. New York City Mechanical Code.
   g. New York City Energy Conservation Code.
   h. New York City Fire Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
      1). ASHRAE 90.1: Energy Standard for Buildings Except Low-Rise Residential Buildings.
   b. ASTM International
   c. Greenguard Environmental Institute.
   d. Manufacturers Standardization Society of the Valve and Fittings Industry
      1). MSS SP 69: Pipe Hangers and Supports - Selection and Application.
      2). MSS SP 89: Pipe Hangers and Supports - Fabrication and Installation Practices.

e. National Fire Protection Association, Inc.
   1). NFPA 90A: Installation of Air-Conditioning and Ventilating Systems.
   2). NFPA 255: Method of Test of Surface Burning Characteristics of Building Materials.
f. North American Insulation Manufacturers Association.
g. Sheet Metal and Air Conditioning Contractors National Association, Inc.
   1). SMACNA: HVAC Duct Construction Standards - Metal and Flexible.
h. Underwriters Laboratories, Inc.
   1). UL 723: Test for Surface Burning Characteristics of Building Materials.
   2). UL 2824: GREENGUARD Certification Program Method for Measuring Microbial Resistance from Various Sources Using Static Environmental Chambers.

1.3 SUBMITTALS
A. Submittals shall be furnished in accordance with the requirements of Section 23 00 00.

1.4 WARRANTY
A. Comply with Division 01 and Section 23 00 00 requirements for product warranties.
B. Furnish a one- (1-) year installation warranty and a five- (5-) year manufacturer's warranty for all insulation.
C. Warranty periods shall initiate upon Final Acceptance by Owner.

1.2 COMMISSIONING
A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Contract Documents.
B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Contract Documents will be revised to reflect the substitution.
C. Adhesives
   1. Carlisle.
   2. Childers.
   3. Duct Mate.
   4. Duro Dyne.
   5. Elgen.
   6. Foster.
   7. Miracle-Kingco.
   8. Precision Adhesives.
D. Fiberglass Insulation
   1. Certain Teed Corp.
   2. Johns-Manville.
   3. Knauf/Manson.
   4. Owens-Corning.
E. Field-Applied Insulation Jackets
   1. Alpha Associates, Inc.

2. Johns-Manville.
3. Knauf/Manson.
4. MFM Building Products Corp.
5. Polyguard.
6. Proto Corporation.
7. Venture Tape Corp.

F. Flexible Elastomeric Insulation
1. Aeroflex USA, Inc.
2. Armacell.
3. K-Flex USA.
4. Nomaco.

G. Insulated Pipe Shields
1. Buckaroos, Inc.
2. Insulation Pipe Shields.
3. Pipe Shields Inc.
4. Thermal Pipe Shields, Inc.
5. Value Engineered Products, Inc.

H. Mineral Wool Insulation
1. Amerrock Products LP.
2. Industrial Insulation Group, LLC.
3. Thermafiber, Inc.

I. PVC Fitting Covers
1. Johns-Manville.
2. Proto Corporation.
3. Speedline Corporation.

2.2 GENERAL REQUIREMENTS

A. All thermal and acoustical insulation jackets, facings, membranes, adhesives, mastics, coatings and accessory materials shall be tested in accordance with the latest versions of ASTM E-84, ASTM 1338, MSS SP-69, NFPA 255 and/or UL 723 procedures. All materials shall comply with these requirements and the requirements of NFPA 90A. They shall be listed and labeled by Underwriters Laboratories, Inc. for a fire hazard classification not to exceed the following:
1. Insulation Installed Indoors: Flame Spread 25 - Smoke Developed 50
2. All Acoustic Lining: Flame Spread 25 - Smoke Developed 50
3. Insulation Installed Outdoors: Flame Spread 75 - Smoke Developed 150

B. The rating for insulation with factory-applied jackets or facings shall be on a composite basis of insulation, jacket or facing, and the adhesive used to adhere the jacket or facing to the insulation.

C. Materials and products required for the work of this section shall not contain asbestos, lead, mercury or mercury compounds, polychlorinated biphenyls (PCB's) or other hazardous materials.

D. Insulation materials shall certified by SCS Global Services to contain a minimum 50% recycled glass content.

E. Products that come in contact with austenitic stainless steel must pass the preproduction test requirements of ASTM C692 for stress corrosion effects on austenitic stainless steel, and the confirming quality control chemical requirements when tested in accordance with ASTM C871.

F. Insulation for fittings, valves, flanges and accessories shall maintain the same thermal conductivity as the adjacent pipe insulation.

G. Shipping containers for insulation and accessory materials shall be labeled to indicate conformance to the fire hazard classification.

H. All vapor barriers shall be completely sealed against moisture penetration.

2.3 PIPE INSULATION

A. Glass-Fiber Pipe Insulation: Glass-fiber pipe insulation shall be molded one-piece insulation with white Kraft, fiberglass-reinforced, and aluminum foil-laminated, self-sealing all-service jacket

(ASJ). Pipe insulation shall be capable of continuous service at a pipe temperature of 450°F (232°C) without oxidation or burnout of binders or the development of odors or smoke by any constituent of the material. Physical characteristics shall be as follows:

1. Minimum Density: 3.3 lbs/cu.ft. (53 kg/cu.m) to 5.5 lbs/cu.ft. (88 kg/cu.m) based on pipe diameter.
2. Thermal Conductivity: 0.23 Btu-in./hr/sq.ft./°F (0.033 W/m at 24°C).
3. Jacket Vapor Permeability: 0.02 perms.
4. Jacket Puncture Resistance: 50 units (Beach).

B. Pipe fittings shall be insulated with pre-molded fiberglass sections and pre-molded thermoplastic covers for the sizes manufactured. For other types and sizes, fittings shall be insulated with radially mitered segments of pipe covering secured in place with 16 gauge copper-plated, annealed steel wire. Pre-molded (PVC) fitting covers shall be suitable for same service temperature as pipe insulation.

C. Flexible Elastomeric Insulation: Flexible EPDM-based elastomeric insulation shall be manufactured without the use of CFC's, HFC's or HCFC's. It shall be furnished with a smooth skin on the outer exposed surface. The insulation shall incorporate an antimicrobial protection for defense against mold. Insulation sections shall be furnished with an acrylic-based adhesive seal on the longitudinal seam and an additional layer of EPDM tape over the seam. The butt joints of each section shall be sealed with contact adhesive. The physical characteristics shall be as follows:

1. Thermal Conductivity: 0.25 Btu-in./hr/sq.ft./°F (0.036 W/m at 24°C).
2. Maximum Service Temperature: 220°F (105°C).
3. Jacket Vapor Permeability: 0.05 perms.

D. Insulation for piping systems shall be furnished and installed in accordance with the following schedule:

Service	Pipe Size	Temp	Thickness - Type
Hot Water Systems	1-1/4 inches (32 mm) and less	450°F (232°C)	1-1/2 inches (38 mm) Fiberglass (R = 5.4)
	1-1/2 inches (38 mm) and larger	450°F (232°C)	2 inches (50 mm) Fiberglass (R = 7.2)
Heat Recovery less than 140°F	1-1/4 inches (32 mm) and smaller	450°F (232°C)	1 inch (25 mm) Fiberglass (R = 4.2) or 1 inch (25 mm) EPDM
	1-1/2 inches (25 mm) and larger	450°F (232°C)	1-1/2 inches (32 mm) Fiberglass (R = 6.3) or 1-1/2 inches (32 mm) EPDM
Chilled Water 40°F to 60°F	1-1/4 inches (32 mm) and less	450°F (232°C)	1/2 inches (12.5 mm) Fiberglass (R = 2.1)
	1-1/2 inches (38 mm) and larger	450°F (232°C)	1 inch (25 mm) Fiberglass (R = 4.2)

Service	Pipe Size	Temp	Thickness - Type
	8 inches (200 mm) and larger	450°F (232°C)	1-1/2 inches (38 mm) Fiberglass (R = 6.3)
Refrigerant	All	-	1-1/2 inches (38 mm) Fiberglass (R = 6.3)
Fresh Water Makeup	All	-	1 inch (25 mm) Fiberglass (R = 4.2) or 1 inch (25 mm) EPDM
Cold Condensation Drains - Risers, Mains and Branches	All	-	1/2 inch (12.5 mm) Fiberglass (R = 2.1) or 1/2 inch (12.5 mm) EPDM

2.4 SHEET METAL INSULATION

A. Insulation for sheet metal work shall comply with the following based on the table below:

1. 1 inch (25 mm) thick, 6 lbs/cu.ft. (96 kg/cu.m) density, (R-4.5) fiberglass, rigid insulation board with white Kraft, fiberglass-reinforced, aluminum foil-laminated, all-service jacket (ASJ).
2. 2 inch (50 mm) thick, 6 lbs/cu.ft. (96 kg/cu.m) density, (R-9) fiberglass, rigid insulation board with white Kraft, fiberglass-reinforced, aluminum foil-laminated, all-service jacket (ASJ).
3. 1-1/2 inch (38 mm) thick, 1 lb./cu.ft. (16 kg/cu.m) density, (R-4.5) fiberglass blanket with factory-applied foil-faced, scrim-reinforced Kraft vapor barrier (FSK).
4. 2 inch (50 mm) thick, 1 lb./cu.ft. (16 kg/cu.m) density, (R-6) fiberglass blanket with factory-applied foil-faced, scrim-reinforced Kraft vapor barrier (FSK).

B. Insulation for sheet metal work shall be furnished and installed in accordance with the following schedule:

Service	Type
Air intake and discharge/exhaust plenums	Two (2) layers of 2 inch (100 mm) thick, 6 lbs/cu.ft. (96 kg./cu.m) density (R-9) rigid board insulation. Outer layer shall be continuous with joints taped, and fully encased with white Kraft, fiberglass-reinforced, aluminum foil-laminated, all-service jacket (ASJ).
Exhaust/spill/discharge ducts between connections to plenums and isolation dampers	2 inch (50 mm) thick, 6 lbs/cu.ft. (96 kg/cu.m) density, (R-9) fiberglass, rigid insulation board with white Kraft, fiberglass-reinforced, aluminum foil-laminated, all-service jacket (ASJ).
Air intake ducts between plenums and air handling apparatus and/or heating coils	2 inch (50 mm) thick, 6 lbs/cu.ft. (96 kg/cu.m) density, (R-9) fiberglass, rigid insulation board with white Kraft, fiberglass-reinforced, aluminum foil-laminated, all-service jacket (ASJ).
Exposed rectangular air conditioning supply ductwork within all unconditioned Mechanical Equipment Rooms.	2 inch (50 mm) thick, 6 lbs/cu.ft. (96 kg/cu.m) density, (R-9) fiberglass, rigid insulation board with

Service	Type
	white Kraft, fiberglass-reinforced, aluminum foil-laminated, all-service jacket (ASJ).
Exposed rectangular air conditioning supply and return ductwork serving Mechanical Equipment Rooms.	Uninsulated except where external insulation or internal acoustic treatment is required by the drawings or specifications.
Supply and return ductwork located outdoors and exposed to the elements.	2 inch (50 mm) thick, 6 lbs/cu.ft. (96 kg/cu.m) density, (R-9) fiberglass, rigid insulation board installed internally to the ductwork between double wall duct construction. Acoustic liner may be substituted for insulation provided it meets the R-value of the specified insulation.
Exposed rectangular return air ductwork within all unconditioned Mechanical Equipment Rooms	1 inch (25 mm) thick, 6 lbs/cu.ft. (96 kg/cu.m) density, (R-4.5) fiberglass, rigid insulation board with white Kraft, fiberglass-reinforced, aluminum foil-laminated, all-service jacket (ASJ).
Rectangular air conditioning supply duct risers within shafts.	2 inch (50 mm) thick, 1 lb./cu.ft. (16 kg/cu.m) density, (R-6) fiberglass blanket with factory-applied foil-faced, scrim-reinforced Kraft vapor barrier (FSK).
Rectangular air conditioning return duct risers within shafts.	Uninsulated except where external insulation or internal acoustic treatment is required by the drawings or specifications.
All concealed medium- and low-pressure supply air ductwork except within Mechanical Equipment Rooms	2 inch (50 mm) thick, 1 lb./cu.ft. (16 kg/cu.m) density, (R-6) fiberglass blanket with factory-applied foil-faced, scrim-reinforced Kraft vapor barrier (FSK).
All exposed medium- and low-pressure supply air ductwork within the space that it's served.	1 inch (25 mm) thick, 6 lbs/cu.ft. (96 kg/cu.m) density, (R-4.5) fiberglass, rigid insulation board with white Kraft, fiberglass-reinforced, aluminum foil-laminated, all-service jacket (ASJ).
Rectangular heated air supply ducts, concealed.	1 inch (38 mm) thick, 6 lb./cu.ft. (96 kg/cu.m) density, (R-4.5) fiberglass blanket with factory-applied foil-faced, scrim-reinforced Kraft vapor barrier (FSK).
All return air and exhaust air ducts.	Uninsulated except where external insulation or internal acoustic treatment is required by the drawings or specifications.
Return ducts within unconditioned spaces.	2 inch (50 mm) thick, 1 lb./cu.ft. (16 kg/cu.m) density, (R-6) fiberglass blanket with factory-applied foil-faced, scrim-reinforced Kraft vapor barrier (FSK).).

2.5 EQUIPMENT INSULATION

A. Equipment insulation shall be one (1) of the following methods:

1. 2 inch (50 mm) thick, 6 lbs/cu.ft. (96 kg/cu.m) density, fiberglass, rigid insulation board with white Kraft, fiberglass, aluminum foil laminate, all-service jacket (ASJ).
2. 2 inch (50 mm) thick, 3 lbs/cu.ft. (48 kg/cu.m) density, fiberglass, rigid insulation board with

white Kraft, fiberglass, aluminum foil laminate, all-service jacket (ASJ).

B. Equipment insulation shall be furnished and installed in accordance with the following schedule:

Service	Thickness - Type
Air conditioning axial flow supply fans installed downstream of cooling coils and outside of casings.	2 inch (50 mm) thick, 6 lb. (96 kg/cu.m) density, fiberglass, rigid board with all-service jacket (ASJ).
Chillers and chilled water expansion tanks.	2 inch (50 mm) thick, 6 lb. (96 kg/cu.m) density, fiberglass, rigid board with All-Service Jacket (ASJ).
Chilled water pumps	2 inch (50 mm) thick, 3 lb. (48 kg/cu.m) density, unfaced fiberglass rigid board applied and secured to the inside of an 18 gauge aluminum sheet metal housing with adhesive, weld pins and speed washers. Details as described hereinbelow under "Removable Head Insulation".
Plate-and-frame heat exchangers.	2 inch (50 mm) thick, 1 lb. (16 kg/cu.m) density fiberglass blanket with foil-faced, scrim-reinforced Kraft jacket (FSK).

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL REQUIREMENTS

A. All materials shall be installed by skilled labor regularly engaged in this type of work and that has successfully completed an apprenticeship program and/or craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. All materials shall be installed in strict accordance with the manufacturer’s recommendations, building codes and industry standards.

3.2 CLEANING

A. Comply with Division 01 requirements for cleaning and protection of installed work.

B. Upon completion of the installation, repair all and/or replace any and all damaged insulation, insulation jackets or vapor barriers.

3.3 FINAL ADJUSTMENT

A. Upon completion of insulation, hangers for piping, ducts and at equipment shall be adjusted to ensure that the loads are distributed evenly and that there are no loads imposed by the piping or ducts on the equipment that it is connected to.

B. Securely tighten clevis hanger load nuts first to ensure proper hanger performance. Tighten top nut after adjustment.

END OF SECTION 23 07 00

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SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 Summary

A. Section includes:

1. Direct digital control system components.
2. Temperature transmitters.
3. Thermistors.
4. Static pressure transmitters.
5. Protective thermostats and detectors.
6. Relative humidity transmitters.
7. Humidity and temperature transmitters - outdoor air.
8. Thermowells.
9. Resistance temperature detectors.
10. Differential pressure transmitters.
11. Airflow-measuring station.
12. Differential pressure switch.
13. High-temperature room thermostat.
14. Current-sensing relay.
15. Leak detector.
16. Time delay relay.
17. Carbon dioxide transmitter.
18. Carbon monoxide detection system.
19. Electromagnetic meter.
20. Water energy meter.
21. Addressable thermostats.
22. Automatic control valves.
23. Damper actuators.
24. Motorized butterfly valves.
25. Field equipment cabinets.
26. Electrical wiring and material.

1.2 Related Documents

A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.

1.3 References

A. American Society of Heating, Refrigerating and Air-Conditioning Engineers

1. ASHRAE 62 - Ventilation for Acceptable Indoor Air Quality.
2. ASHRAE 135 - BACnet - A Data Communication Protocol for Building Automation and Control Networks.

B. ASTM International

1. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
2. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).
3. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
4. ASTM D2737 - Standard Specification for Polyethylene (PE) Plastic Tubing.

C. American Welding Society

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

D. National Electrical Manufacturers Association
   1. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).
E. National Fire Protection Association
   1. NFPA 72 - National Fire Alarm Code.
   2. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
F. Underwriters Laboratories, Inc.
   1. UL 1820 - Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics.

1.4 Technical Proposal
A. Each of the vendors shall submit for consideration a system that is the best and most current system he has to offer. **FAILURE TO COMPLY WITH THIS SECTION WILL RESULT IN A REJECTION OF VENDOR'S BID AND SHALL AUTOMATICALLY ELIMINATE THE VENDOR FROM ANY FURTHER CONSIDERATION.**
B. To allow for a complete and accurate evaluation of each vendor's capabilities, each bid shall include a detailed project proposal.

1.5 Submittals
A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
B. Submittals shall include the following:
   1. Compliance document consisting of Sections 23 09 00 and 23 09 93 of the specifications.
C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
D. Manufacturer's guarantee and warranty.

1.6 Warranty
A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
B. Warranty the direct digital control system to be free from defects in workmanship and material for a period of one (1) year from completion of final commissioning, which may occur beyond equipment acceptance and initial occupancy by the Owner. During this period, the Contractor shall furnish all labor to repair or replace all items or components that fail due to defects in workmanship or material. Failures on control systems, including all computer equipment, transmission equipment and all sensors and control devices during the warranty period, shall be adjusted, repaired or replaced at no additional cost or reduction in service to the Owner.

1.7 Identification of Systems
A. Automatic control valves, damper actuators and instruments, as well as other equipment provided under this section, shall be tagged for identification. Tags shall be brass with identification lettering stamped with letter punches and attached with brass wire or chain.
B. Tag electrical wiring with Brady clip-sleeve-type, non-metallic wire markers, or as approved.
C. Furnish lists of panelboards where power has been taken. Lists shall include panel name, load served, amperage and wattage.

1.8 Ownership Of Proprietary Material
A. Project-specific software and documentation shall become Owner's property. This includes, but not limited to:
   1. Graphics.
   2. Record drawings (linked to system "as-builts").
   3. Database.
   4. Direct digital control unit and unitary controller programming code.
   5. Programming tools.
   6. Graphics modification tools.
   7. Database editing tools.

1.9 Operating And Maintenance Instructions
A. Ten (10) sets of printed operating and maintenance instruction manuals and two (2) sets of electronic copies in portable document format (.pdf) loaded onto CD's.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Furnish all major items of equipment and materials as made by the following manufacturers. The successful vendor must be a factory branch office of the following manufacturer.

1. Automatic Temperature Controls
   a. Alerton
   b. Automated Logic Corporation
   a. Distech Controls Eclypse Series
   c. Honeywell
   d. Johnson Controls - Metasys
   e. Schneider Electric - EcoStruxure
   f. Siemens - Apogee with Desigo Web-Based Software
   g. Trane Tracer SC .

2.2 Direct Digital Control System

A. The direct digital control system shall consist of a network of microprocessor-based direct digital control units (DDC's). Each direct digital control unit shall perform all specified control and monitoring functions independently. Failure of one (1) control unit shall have no effect upon any other unit in the network. The direct digital control units shall communicate with each other and an operator workstation. The DDC system shall provide full graphic software and graphical operator interface.

B. The direct digital control system shall utilize web-based technology and shall be interfaced to the Owner's network for access at multiple Owner furnished workstations.

C. Communications between the direct digital control units and the workstation shall be by way of a high-speed communications network utilizing Ethernet technology. The Ethernet network shall utilize industry-standard TCP/IP IEEE 802.3

D. System input/output point capacity shall be expandable by the addition of DDC units and unitary controllers to the communications network.

E. The operator, through a workstation, shall have the ability to monitor DDC application and sensor data, override set points and schedules, set and reset control points and download programs to the local direct digital control units. The workstation shall be furnished programmed and debugged.

F. Communication protocol between workstation, DDC and unitary controllers shall utilize ASHRAE Standard 135 BACnet. In addition, the DDC system shall be capable of providing industry-standard open-protocol communication (BACnet, Lonwork, Modbus, OPC, SOAP, SNMP, XML) to other equipment and/or building systems.

G. The direct digital control units shall be UL 916 (Energy Management Equipment) listed.

H. DDC units shall communicate via BACnet IP.

2.3 System Functions and Performance

A. System Architecture

1. The system architecture shall consist of a network of independent, stand-alone direct BACnet I/P-based digital control units and BACnet MSTP unitary controllers communicating over a two-tier local area network. Each control unit shall perform all specified control functions independently, including scheduling, alarming and storage of trend data. Failure of one (1) control unit shall have no effect upon any other unit in the network.

2. Each direct digital control unit shall communicate with each other and with a workstation. The main communication network interconnection with the communication switches shall utilize either Category 6A copper cabling or fiberoptic cable based on distance limitations. Distance limitation for Category 6A cable shall not exceed 100 meters. In cases where distance is in excess of 100 meters, fiberoptic cable and associated media converters shall

be used.

3. The communication network interconnected to the Ethernet switches shall be designed for a collapsed topology with remote communication switched collapsing to the main communication switch located at the workstation.
4. Interface to the communications network shall be via network service panels that shall contain power supply, fiberoptic patch panels and Ethernet switches. Each network service panel shall include a key-locked hinged door enclosure. Connections from the network service panels to the DDC units shall be IEEE 100Base-TX Category 6A copper cabling using industry-standard RJ-45 connectors or fiberoptic cable as described above. Ethernet switches shall be managed industrial-grade type with associated power supply. Switches shall contain integrated fiber media conversion devices, eliminating the need for external converters.
5. Workstation shall be connected to any Ethernet switch.
6. This section shall furnish and install all required cabling, routers, switches, fiber patch panels, software, fiberoptic cable, Category 6A cable, computer products, etc., to provide the entire communications network.
7. Workstation shall be configured to function as a fully functional graphical user interface and/or alarm annunciation graphic. The fully functional graphical user interface workstation shall allow an operator access to all system graphics, set points, system variables, trends, alarms, historical data, programming functions, etc. The alarm annunciation function shall allow the operator to access alarms. The workstations shall automatically annunciate a new alarm, and maintain an alarm history indicating the time of the alarm, time of alarm reset (either automatic or manual) and time of alarm acknowledgement.
8. Quantity of unitary controllers shall not exceed 80% of maximum allowable controllers per BACnet MSTP or BACnet IP communication bus.

B. Direct Digital Field Control Units and Unitary Controllers
   1. Field monitoring and control shall be by stand-alone site-programmable microprocessor-based direct digital control (DDC) units. Each DDC unit shall provide the following:
      a. All control functions shall be by means of software in the DDC units.
      b. Specified software functions.
      c. Specified energy management functions.
   2. Each DDC unit and unitary controller shall provide the following features:
      a. The DDC unit shall be a completely self-contained, site-programmable, real-time, microprocessor-based controller.

C. Direct Outdoor Air Systems (DOAS)
   1. The DDC system vendor shall ship for mounting and wiring to the DOAS terminal unit manufacturer.

D. Operator Workstation
   1. The operator workstation equipment shall be arranged to present an efficient and organized appearance. The following components shall be located with the workstation:
      a. PC-based computer (as manufactured by Dell or Engineer-approved equal).
      b. Two (2) color graphic displays per workstation (as manufactured by Dell or Engineer-approved equal).
   2.

E. DDC Unit and Unitary Controller Software
   1. The DDC unit and unitary controller programming language shall be designed for automation and control applications and shall utilize industry-standard ASHRAE 135 BACnet protocol. System controller programming, editing and database generation, control and reporting functions shall be performed at the workstation.
   2. The DDC unit and unitary controller shall contain resident software as follows:
      a. Mathematical, logic and utility functions.

b. Standard energy calculations and control functions.

3. Sensing and Control
   a. Monitor and control functions indicated on the point list or as specified.
   b. Resident programs shall include:
      1). Control algorithms to permit proportional, integral and derivative control modes to meet the needs of the application.
      2). Other control modes, such as incremental, floating or two (2) positions.
      3). Control routines to bypass or suppress integral and derivative time constants in two-mode and three-mode control algorithms during start-up of systems to prevent reset windup.
      4). Automatic control loop tuning.
   c. Analog-to-digital conversion for analog point monitoring shall be provided at the DDC unit before digital transmission to the workstation. The conversion resolution shall be preferably not less than 12 bit.
4. Power Fail Restart
   a. The operating programs and database shall be protected against loss of normal power by 500 hour (minimum) volatile memory battery backup. When normal power is restored after failure, a software restart program shall be automatically initiated.
   b. Following recovery from a power failure, all control points in the local controllers, workstations shall be updated to current status.
5. DDC units shall be capable of automatic synchronization of the real-time clocks in all DDC panels.
6. Control Loop Tuning:
   a. Control loops shall be tuned such that process variable is within acceptable tolerances, within 60 seconds of a change of set point or process variable.

F. Workstation Software
1. The operating system shall be a Microsoft Window- based real-time, multitasking operating system. The workstation software shall be provided with operator interface software containing an ASHRAE Standard 135 BACnet driver.
2. Each workstation shall be provided with the latest edition of Microsoft Office software and McAfee VirusScan software.
3. Password
   a. System software shall provide for a log-on procedure to gain access to the system. A minimum of eight (8) unique passwords shall be available, with five (5) access levels available.
   b. Password access shall segment the capabilities of the system programmers and the system operators to access any DDC unit online and to manually execute from the workstation the following functions based upon access level.

LEVEL	ACCESS
1	Full access, including password definition and summary.
2	Level 3 + Full access (except Password definition and summary), including ability to define new objects, nodes, and database. Allows additions to an existing network.
3	Level 4 + Access to modify object attributes.
4	Level 5 + Access to override commands. Allows manual control/adjustment of individual objects.
5	Access to activity/error logs, system summaries and alarm acknowledgment.

4. Security: System software shall provide an audit trail that logs all user actions. The audit

trail can only be viewed or modified by the administrator with a Level 1 password. As an example, the audit trail shall show the system modified, value modified and date/time of modification.

5. Program Availability: The Owner shall be furnished with all software programs required to modify and create new workstation software programs. The programs shall become the property of the Owner on completion of the project at no additional cost. All software graphics created for this project and associated software tools shall become property of the Owner on completion of the project.
6. Graphics
   a. The graphics package shall minimize the use of a typewriter-style keyboard through the use of a mouse.
      1). Graphics software package shall be fully implemented and operational and shall provide dynamic graphic displays and controls for each system. The graphics shall contain point information from the database including any attributes associated with the point (engineering units, etc.). Graphics shall detail the mechanical, electrical and control features of each system, and shall continuously update to provide a dynamic mimic of system operation.

G. Remote Alarm Notification System
1. The DDC system shall be configured to transmit messages to numeric pagers, alphanumeric pagers, SMS (Short Message Service, text messaging) devices, and e-mail accounts based on a point's alarm condition.
2. There shall be no limit to the number of points that can be configured for remote notification of alarm conditions and no limit on the number of remote devices that can receive messages from the system.

H. Performance Standards
1. Graphic Display: A graphic with twenty (20) dynamic points shall display with current data within 10 seconds of request.
2. Graphic Refresh: A graphic with twenty (20) dynamic points shall update with current data and shall automatically refresh every 15 seconds.
3. Configuration and Tuning Screens: Screens used for configuring, calibrating or tuning points, PID loops and similar control logic shall automatically refresh within 6 seconds.
4. Object Command: Devices shall react to command of a digital object within 2 seconds. Devices shall begin reacting to command of an analog object within 2 seconds.
5. Alarm Response Time: An object that goes into alarm shall be annunciated at the workstation within 5 seconds. Multiple workstations must receive alarms within 5 seconds of each other.

2.4 Temperature Control Instruments

A. Instruments and control devices shall be provided for all required points detailed hereinafter. Instruments shall have accuracies as stated herein. Instrument characteristics such as hysteresis, relaxation time, span, and maximum and minimum limits shall be accounted for in applications of instruments and controls. *Not all devices specified may be required for this project.*

B. Field-wiring for each digital device shall be manufacturer's standard. The details of the wiring shall be included in the proposal.
1. Combination temperature and humidity transmitters are not acceptable.
2. Transmitter maximum spans shall be (normal operating point at mid-scale):
   a. Room temperature: 50ºF.
   b. Chilled water: 50ºF.
   c. Condenser water: 50ºF.
   d. Hot water: 100ºF.
   e. Duct Air Temperature

1). Heating: 100ºF or as required by maximum duct temperature.
2). Cooling: 50ºF.

f. Outside air temperature: 150ºF (-30ºF to 120ºF).

C. Static Pressure Transmitters: Duct static pressure transmitters shall consist of static pressure probe, transmitter and electrical box for wiring connections. The static pressure probe shall extend across the width of the duct. Duct wall pressure taps shall be acceptable. Reference pressure-sensing connections to duct static pressure transmitters shall be made through an ambient pressure probe or chamber that shall minimize effects of air disturbances and maintain a steady, uniform reference pressure. Transmitter shall provide 2-wire, 4 - 20 mA DC output linear over a specified pressure range, with an accuracy of ± 0.4% of span. Transmitter range shall be selected to ensure that the normal set point is in the center of the device range. Device shall be capable of withstanding the maximum pressure that could occur at the location. Transmitter shall be Setra Model 267 or as approved by the Engineer.

D. Protective Thermostats and Detectors

1. Electric low-temperature (freeze protection) thermostats shall have 20 foot capillary (not averaging type) installed to cover the entire cross-sectional area of coil face. Switch actuation shall occur if any 12 inch length of capillary senses a temperature below set point. At a minimum, one (1) thermostat shall be furnished and installed for each cooling coil. If one (1) thermostat is not sufficient to provide adequate coverage of coil, this Contractor shall furnish and install additional thermostats to provide sufficient coverage. Sufficient coil coverage shall be field-verified by the Engineer. These thermostats shall be two-position automatic-reset type. The elements shall be suspended at least 6 to 8 inches downstream of the preheat coils. Thermostats shall be automatic-reset type. Furnish a hardwired time delay relay to delay fan shutdown and alarming at the workstation for 180 seconds (adjustable), unless otherwise stated. For all low-temperature thermostat capillaries, provide manufacturer-specific capillary supports to prevent unnecessary capillary crimping.

E. Humidity and Temperature Transmitter - Outside Air

1. Assembly shall be as manufactured by Vaisala HMS112 Series, or as approved by the Engineer.

F. Thermowells

1. Provide a thermowell for every temperature-sensing element installed in piping and equipment, including transmitter sensing bulbs, RTD’s and temperature switches.

G. Differential Pressure Switch - Air

1. Switch shall be Cleveland Controls Model AFS-460, or as approved by the Engineer.

H. Current-Sensing Relays: Relay shall be field-adjustable for detecting AC current levels in equipment served. Relay shall be non-latching and shall have no time delay. Nominal input voltage and current-sensing range shall be selected based on electrical characteristics of equipment served. Relay shall be installed on one (1) lead of the load side of motor feed. Relay contacts shall be Form C-rated for 5A at 120 VAC.

I. Point-Type Leak Detector: Leak detector shall provide single-point detection of leaks. Sensing probe shall be gold-plated to prevent corrosion. Sensor shall be provided with adjustable mounting brackets to allow for height and leveling adjustment. Sensing probes shall be adjusted to 1/8 in. of floor. Power requirements shall be 24 VAC, 100 mA. Enclosure shall be NEMA 1. Output relays shall be 2 Form C, 3A rating at 24 VAC. Detector shall be manufactured by Liebert Model LT-410 or as approved.

J. Carbon Dioxide (CO_2) Transmitter

1. Transmitter shall be as manufactured by Vaisala Model GMD90 (duct-mounting) or GMW90 (wall-mounting), or as approved by the Engineer.

K. Carbon Monoxide Detection System

1. The CO detection system shall be Z-Gard CX II Series as manufactured by Mine Safety Appliances Co. (MSA), and represented by Vanguard Controls Inc., or as approved by the

Engineer.

2. Control Panel
   a. The control panel shall be NEMA 4X wall mount type, and shall provide readout and alarm output capability for up to ninety-nine (99) remote sensors grouped in up to eight (8) control zones.
3. CO Sensor/Transmitters
   a. The CO sensor/transmitters shall be the Mine Safety Appliances Inc. Z-Gard S Sensor or as approved by the Engineer.
4. Warning Light and Horn
   a. Warning light shall consist of a Xenon strobe light with effective light output of 90cd. Light and horn assembly shall be outdoor rated surface mount. Operating voltage shall be 120VAC. Strobe current shall be 0.115A. Horn current shall be 0.033A. Lens color shall be amber.
5. Remote Visual and Audible Alarms and Interlocks
   a. The gas detection system shall provide automatic activation of ventilation and exhaust fans serving the Parking Garage, wall mounted waring lights, horns and central alarms via the DDC system.
   b. Warning Lights and Horns: Lights and horns shall be automatically activated in each parking level based on any of the following conditions. Lights and horns shall remain active until the reset via a manual command from the workstation.
6. Calibration Accessories: The CO detection system manufacturer shall provide a calibration kit and test gas cylinders containing 100 ppm CO in air. Enough gas shall be provided to accomplish all start-up and training work and quarterly calibrations for the first two (2) years of operation.
7. Start-Up and Training Service: The NO_2 detection system manufacturer shall provide the services of a technician onsite for purposes of fully verifying the proper installation of the system, testing and calibrating the system, and training the Owner's personnel on the proper maintenance of the system. A minimum of two (2) full days shall be allowed.
8. The carbon monoxide detection system shall be installed in accordance with NFPA 720 Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment. All detectors shall be listed in accordance with UL 2075 and installed in accordance with their listing and the manufacturers' instructions.

L. Addressable Thermostat
1. Thermostat shall be microprocessor-based, communicating via BACnet MSTP with the DDC system. Thermostat shall be capable of controlling multi-speed (up to three- [3-] speed), as well as on/pff, 0 - 10 VDC analog, staged, three-point floating heating/cooling applications.
2. Thermostat shall be UL 873-listed. Thermostat shall be Viconics Model VT7300 Series with/without VC3000 Series relay packs as required by application or as approved by the Engineer.

2.5 Automatic Control Valves

A. Automatic Control Valves Serving Air Handling Unit and Heating and Ventilation Unit Heating and Cooling Coils
1. Automatic control valves shall be single-seated globe valves and shall have equal percentage flow characteristics unless specified otherwise. Control valves 2 inches and smaller shall have bronze bodies and stainless steel trim and stem. End connections shall be threaded. Control valves 2-1/2 in. and larger in a service where pressure does not exceed 125 psig at 350°F, or where steam pressure does not exceed 100 psig, shall have 125 pound cast iron bodies. Trim and stem shall be stainless steel. End connections shall be flanged. Valves 2-1/2 in. and larger in a service where pressure does not exceed 250 psig at 400°F shall have 250 pound cast iron bodies. Trim and stem shall be stainless

steel. End connections shall be flanged. Valves shall have sufficient stuffing box protection to ensure against leakage at hydrostatic head involved.

a. Single-seated valves shall meet ANSI Class IV leakage (0.01% of Cv).

B. Automatic Control Valves Serving Terminal Unit Coils

1. Valve shall be suitable for chilled and hot water service. Flow characteristic shall be equal percentage. Body shall be forged brass. Ball and stem shall be chrome-plated brass. Seat shall be fiberglass-reinforced Teflon PTFE. Valve shall be provided with characterized disk. Pressure rating shall be 600 psi for 1 in. valve and below, 400 psi for all others. Media temperature range shall be 0°F to 250°F. Leakage shall be ANSI Class IV. Valve actuator shall be spring-return type with 24 VAC power supply, 2 -10 VDC control signal and manual override.
2. Ball-type valves shall not be used for steam service.

C. Actuators used in modulating applications shall be proportional type with 2 - 10 VDC or 4 - 20 mA control signal. Floating-type actuators shall not be used.

D. Actuators shall be manufactured in accordance with NEC Section 430.32(B)(2), (3) or (4).

2.6 Automatic Control and Automatic Smoke Dampers

A. Low-leakage automatic control dampers, automatic smoke dampers and/or combination smoke/fire dampers shall be furnished under the Mechanical Section of the specifications.

B. This section of the specification shall be responsible for furnishing and installing electrical spring-return actuators for all automatic louvered dampers (non-fire and/or smoke-rated dampers). Smoke dampers and combination smoke/fire dampers shall be furnished with electric actuators.

C. All electrical wiring (power and control) for all automatic louvered dampers (ALD's), smoke dampers and combination fire/smoke dampers shall be furnished and installed by this section.

D. Damper Operators

1. All automatic louvered damper operators in two-position (open/closed) service shall be 120 VAC electrically actuated spring-return type. Spring-return running time shall not exceed 20 seconds. Power running time shall not exceed 20 seconds.
2. All automatic louvered damper operators in modulating service shall be either 120 VAC or 24 VAC, electrically actuated spring-return type, and shall be fully proportioning, unless otherwise specified. Spring-return running time shall not exceed 20 seconds. Power running time shall not exceed 45 seconds.
3. Ambient temperature operation shall be -22°F to 122°F. Storage temperature operation shall be -40°F to 176°F. Housing shall be NEMA 2.
4. Actuators shall be UL-listed.
5. Actuators shall be manufactured in accordance with NEC Section 430.32(B)(2), (3) or (4).
6. Maximum quantity of actuators that may be "tandem" mounted is two (2) provided the mounting application is approved, in writing, by the damper actuator manufacturer. Include documentation with shop drawing submission.

E. Damper actuators shall be manufactured by Belimo, Johnson Controls, Siemens and Honeywell.

2.7 Electrical Wiring And Materials

A. Power circuits for all devices included under this specification section shall derive from a power panel appropriate for the system served, per the guidelines of the National Electrical Code Articles 701 and 702. Legally required standby systems (NEC Article 701) include (but are not limited to) stair pressurization systems. All other systems will be categorized as optional standby (NEC Article 702).

B. Install, connect and wire the items included under this section.

C. For wiring, conduit fittings, terminal junction boxes, sheet metal boxes conduit hangers and supports, expansion joints, sleeves and wiring devices, see applicable paragraphs of the Electrical Section.

PART 3 - EXECUTION

3.1 Examination
- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify that building systems to be controlled are ready to operate.

3.2 Electrical Wiring
- A. Wiring and conduit installation shall be in accordance with all local and national codes.
- B. Install all line-voltage wiring, concealed or exposed, in conduit in accordance with the Division 26 specifications.

3.3 Field Quality Control
- A. Section 01 40 00 - Quality Requirements and Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting and balancing.
- B. After completion of the installation of work in this section, test, regulate and adjust system equipment, controllers, alarms, sensors, transmitters, switches, relays, automatic control valves, automatic damper motors and related system accessories, and the entire automation system, including interconnections with the building life safety, plumbing, fire protection and electrical systems, and place these items in complete and satisfactory operating condition. Submit data showing set points and final adjustments of controls.

3.4 Servicing And Maintenance Requirements
- A. Ten (10) complete sets each of the following shall be provided: Written operating and maintenance instructions, as-built drawings, specification data sheets and maintenance schedules.

3.5 Demonstration And Training
- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate complete operation of systems, including sequence of operation prior to date of Substantial Completion.
- C. Demonstrate complete and operating system to Owner.

3.6 Commissioning And System Start-Up
- A. The building systems on this project shall be formally commissioned by a Commissioning Agent (CxA) engaged directly by the Owner. The commissioning process and methods employed shall enable the building to meet the design criteria, to ensure proper operation of all equipment per the Contract Documents.
- B. The scope and procedures that are described in this section may be redundant to the requirements in other sections of this specification. It is not the intent for the Contractors to duplicate checks and tests for the commissioning process.
  1. Pre-Functional Checkout: This Contractor shall submit a written plan for approval by the Commissioning Agent indicating the procedures to test, check out and adjust the control system prior to formal full system functional testing by the commissioning team.
  2. Commissioning Documentation
     - a. This Contractor shall provide the following documentation prior to commencement of the formal Acceptance Phase:
       1). Full “as-built” set of submittals, control drawings and sequence of operations.
       2). List of schedules and set points
       3). Copy of control software on hard media.
       4). Screenshots of all operator workstation graphics.
       5). Marking of all system sensors, control valves and dampers, and thermostats on the Mechanical Drawings and floor plans.
     - b. Test Equipment: Where special testing equipment, tools and instruments are required to accomplish start-up, testing and adjustments, provide such at no extra cost to the Owner and/or Commissioning Agent for use during acceptance testing.
  3. Point-to-Point Checkout: Each input/output device and control point shall be inspected and

verified for proper installation and functionality. Each control point's wiring, signal and response shall be checked and documented by the Contractor. A checkout sheet itemizing each device shall be filled out, dated and approved by the Construction Manager for submission to the Commissioning Agent. The point-to-point checkout must be complete before the commencement of the commissioning functional tests.

4. Controller and Workstation Checkout: A field-checkout of all controllers and front-end equipment (computers, printers, modems, etc.) shall be conducted to verify proper operation of both hardware and software. A checkout sheet itemizing each device and a description of the associated tests shall be prepared and submitted to the Commissioning Agent and Owner or Owner's Representative before the commencement of the commissioning functional tests.
5. System Acceptance Testing
    a. Cooperate with the Commissioning Agent in development of the functional test procedures, and furnish additional information as requested by the Commissioning Agent.
    b. Using a skilled technician familiar with the specific building control system and programming, assist the Commissioning Agent with the functional performance tests. Technicians shall be available throughout the commissioning process without any time restrictions. Control Contractor shall be responsible for any and all adjustments, troubleshooting, retesting, reprogramming or modifications as requested by the Commissioning Agent to ensure that the DDC system meets contractual requirements.
    c. All application software shall be verified and compared against the sequences of operation. Control loops shall be exercised by inducing a set point shift of at least 10% and observing whether the system successfully returns the process variable to set point. Record all test results on the start-up reports.
    d. Test each alarm in the system and validate that the system generates the appropriate alarm message, that the message appears at all prescribed destinations (workstations or printers), and that any other related actions occur as defined (i.e., graphic panels are invoked, reports are generated, etc.). Submit a Test Results Sheet.
    e. Perform an operational test of each unique graphic display and report to verify that the item exists, that the appearance and content are correct, and that any special features work as intended. Submit a Test Results Sheet to the Owner and Commissioning Agent.
    f. Perform an operational test of each third-party interface that has been connected to the automation system. Verify that all points are properly polled, that alarms have been configured, and that any associated graphics and reports have been completed. Coordinate with the control equipment vendor to integrate all required inputs and outputs and related logic commands. If the interface involves a file transfer over Ethernet, test any logic that controls the transmission of the file and verify the content of the specified information.
6. System Demonstration: Demonstrate to the Commissioning Agent
    a. All specified functions and features are set up, debugged and fully operable.
    b. Scheduling features are set per Owner requirements and are functional.
    c. All graphic screens are complete and operable.
    d. Power failure and battery backup and restart functions.
    e. Security and access codes.
    f. Occupant overrides and set point changes are functional (manual, remote, internet, etc.).
    g. Communications to remote sites.

h. Fire alarm interlocks and response.

7. Seasonal Commissioning Tests: This Contractor shall assist the Commissioning Agent with the execution of the functional performance testing in the season after the initial commissioning. For example, if the building air conditioning system is commissioned during the Summer cooling season, then the air conditioning system shall be rechecked in the following Winter season to verify that the heating systems function properly. This testing is estimated to last one (1) to three (3) days. This Contractor shall be responsible for making any adjustments or program changes resulting from the seasonal tests.

END OF SECTION 23 09 00

SECTION 23 09 93

HVAC SEQUENCES OF OPERATION

PART 1 - GENERAL
1.1 Summary
A. Section includes:
1. Sequences of operation for HVAC system and equipment.
1.2 Related Documents
A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.
B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.
1.3 Submittals
A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
B. Coordinate submittals with information requested in Section 23 09 00 - Building Automation and Temperature Controls.
1.4 Closeout Submittals
A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

PART 2 - PRODUCTS
2.1 Not Used.

PART 3 - EXECUTION
3.1 General
A. Control of each air handling unit, ventilating unit, exhaust fan, water system, etc., shall be accomplished by a DDC system.
B. All control algorithms, computation functions and energy management functions shall be software-based and resident in the DDC system. The operator shall have the capability through the workstation operator's keyboard to access all programs, display all data resident in the DDC system memory, and perform analog and digital functions at each local direct digital control unit or at the workstation.
C. The DDC system operator workstation shall be the primary location for operator access to the system.
3.2 Sequence Of Operation
A. Energy Recovery Air Conditioning System
1. The air conditioning system is a 100% outdoor air variable air volume air conditioning system. The system shall consist of one (1) supply fan and one (1) general exhaust fan. Each fan shall be variable speed provided with a variable frequency drive. The unit shall be controlled by a factory-furnished and -installed microprocessor control unit.
2. The air conditioning system shall be started and stopped via a DDC software 7-day programmable time program.
3. Normal Operation
a. Discharge Air Temperature Control
1). A temperature control program resident within the unit's controller shall sequence the preheat coil control valve(s) and direct expansion coil to maintain discharge air temperature set point.
2). The discharge air temperature set point shall be reset based on exhaust air intake temperature, as sensed by a duct-mounted temperature transmitter located at the exhaust intake of the unit.
3). The temperature control program shall include a 5°F deadband between heating and cooling to prevent simultaneous operation.

b. Heating Mode
   1). When the unit is sequenced for heating mode, the temperature control program shall sequence the preheat coil control valve(s) to maintain discharge air temperature set point.
   2). When the unit is sequenced for heating mode, the direct expansion coil shall be locked out. No control signal shall be transmitted between the unit's microprocessor control unit and the direct expansion coil's control unit.

c. Cooling Mode
   1). When the unit is sequenced for cooling mode, the temperature control program shall sequence the direct expansion coil to maintain discharge air temperature set point.
   2). When the unit is sequenced for cooling mode, the preheat coil control valve(s) shall be locked out and fully closed.

4. Enthalpy Wheel Control
   a. Normal Operation
      1). The enthalpy wheel shall be off when the following criteria are satisfied:
      2). Outdoor Air Temperature is less than discharge air temperature set point and exhaust air enthalpy is less than outdoor air enthalpy; or
      3). Outdoor Air Temperature is greater than discharge air temperature set point and exhaust air enthalpy is greater than outdoor air enthalpy.
      4). The enthalpy wheel shall be on and it's speed shall be modulated to maintain discharge air temperature set point when the following criteria are satisfied:
      5). Outdoor air temperature is less than discharge air temperature set point and exhaust air enthalpy is greater than outdoor air enthalpy.
      6). The enthalpy wheel shall be on and operating at maximum speed set point when the following criteria are satisfied:
      7). Outdoor air temperature is greater than discharge air temperature set point and exhaust air enthalpy is less than outdoor air enthalpy.
   b. Frost Protection
      1). The operation of the enthalpy wheel shall be overridden based on a condensation and frosting determination program resident within the unit's controller which shall determine if and at what exhaust air leaving wheel temperature a point of intersection will occur, representing frost conditions between the following functions plotted on a psychometric chart:
      2). Humidity ratio versus the dry bulb for saturated air.
      3). Humidity ratio versus dry bulb temperature of the exhaust air leaving the enthalpy wheel.
      4). Upon sensing an exhaust air leaving wheel temperature below the intersection point, the unit's controller shall override the operation of the enthalpy wheel and modulate it's speed to maintain an exhaust air leaving wheel temperature above the intersection point. If the unit's controller is unable to maintain exhaust air leaving wheel temperature above the intersection point for an adjustable time period, the wheel shall be stopped and an alarm shall be annunciated at the operator workstation.

5. Supply Fan Static Pressure Control
   a. A static pressure transmitter located in the supply duct, upstream of the furthest floor served, shall sense duct riser static pressure. The points of measurement in the riser shall be located by the Engineer. There shall be one (1) transmitter. Transmitter shall be a hardwired analog input to the controller serving the air

conditioning system.

b. A static pressure control program resident in the unit's controller shall monitor its static pressure transmitter. The output of this controller shall modulate the air conditioning system supply fan to maintain supply static pressure set point.

c. As duct static pressure decreases, the controller output shall increase to increase fan speed. On an increase in duct static pressure, the output of the controller shall decrease, to decrease fan speed.

6. General Exhaust Fan Static Pressure Control

a. A static pressure transmitter located in the exhaust duct, upstream of the furthest floor served, shall sense duct riser static pressure. The points of measurement in the riser shall be located by the Engineer. There shall be one (1) transmitter. Transmitter shall be a hardwired analog input to the controller serving the air conditioning system.

b. A static pressure control program resident in the unit's controller shall monitor its static pressure transmitter. The output of this controller shall modulate the general exhaust fan to maintain exhaust static pressure set point.

c. As duct static pressure decreases, the controller output shall decrease to decrease fan speed. On an increase in duct static pressure, the output of the controller shall increase, to increase fan speed.

7. Supply Fan Airflow Quantity Monitoring: The supply fan shall be provided with a Piezo ring. This Section shall furnish and install a differential pressure transmitter for the Piezo ring. The transmitter shall provide an input to the unit's controller which shall calculate the total airflow of the fan system. The unit's controller shall contain a software-based airflow monitoring program that shall receive an input signal from the differential pressure transmitter and totalize, linearize and scale it. The DDC system shall monitor and trend the airflow rate on a real-time basis.

8. General Exhaust Fan Airflow Quantity Monitoring: The general exhaust fan shall be provided with a Piezo ring. This Section shall furnish and install a differential pressure transmitter for the Piezo ring. The transmitter shall provide an input to the unit's controller which shall calculate the total airflow of the fan system. The unit's controller shall contain a software-based airflow monitoring program that shall receive an input signal from the differential pressure transmitter and totalize, linearize and scale it. The DDC system shall monitor and trend the airflow rate on a real-time basis.

9. High Discharge Pressure Switches and Low Suction Pressure Switches.

10. Low Temperature Switches.

11. Fan Run Status Monitoring and Alarm: The run status of the supply and general exhaust fans shall be monitored via a communication interface to variable frequency drives. On failure of any fan to operate, the DDC system shall activate an alarm at the workstation.

12.

B. Heating and Ventilation System and General/Smoke Exhaust Fan Serving Back of House

1. The heating and ventilation unit shall consist of one (1) supply fan provided with variable frequency drive. There shall be one (1) general/smoke exhaust fan provided with variable frequency drive.

2. The heating and ventilation system and general/smoke exhaust fan shall be controlled by a dedicated DDC unit.

C. arking Garage Exhaust Fan

1. The parking garage exhaust fan shall each be provided with a variable frequency drive.

2. The fan shall be started and stopped from the DDC system. The fan shall be capable of being scheduled via a software time program or operate continuously via a manual command from the operator workstation.

D. Toilet Exhaust Fan

1. Each fan shall be constant volume.
2. When the exhaust fan is off, its discharge damper shall be closed. All floor combination fire/smoke dampers shall be closed.

E. Packaged Air-Cooled Air Conditioning Units (Typical for Each)
1. Packaged air conditioning units shall be air-cooled split air conditioning units. Refer to Mechanical Drawings for type and location. Interlock wiring between compressor and evaporator shall be provided by this Contractor.

F. Hot Water Unit Heaters: For each unit, an electric thermostat, mounted on the unit heater shall start and stop the unit heater and open or close the two-position electrically actuated spring return fail-open valve in the hot piping to the heater to maintain an adjustable room temperature. An aquastat on the return line of each unit shall stop the unit when hot is not available. Control wiring shall be by this Contractor. Power wiring shall be by the Electrical Contractor. The two-position valve shall be furnished by this Contractor and installed by the Mechanical Contractor. The thermostat and aquastat shall be furnished, installed and wired by this Contractor.

G. Post-Fire Purge Control System
1. A complete post-fire purge system shall be provided for all air conditioning systems in the building interfaced with the automatic sprinkler system and manual fire alarm system. Smoke detectors shall be furnished by the Fire Alarm Contractor.

H. Air Source Heat Pump System
1. The air source heat pump system shall be provided to provide hot water. The system shall be furnished with packaged circulating pumps. Each pump shall be furnished with a variable frequency drive.
2. The system shall be provided with a factory installed and wired microprocessor controller and all associated sensors, safety devices, relays, etc., to provide fully functional self-contained control of the respective heat pump and its dedicated hot water circulating pumps.

I. Power Restart Program
1. The DDC system shall contain an automatic restart program for mechanical equipment. When power is restored, the program shall automatically start equipment that was operating prior to a loss of power.

J. Variable Frequency Drive Interface
1. Furnish and install a communication interface between each fan and pump variable frequency drive and the direct digital control system. VFD's shall be interfaced to the DDC system. All communication wiring between each variable frequency drive and the DDC system, and mounting and wiring of communication gateways shall be furnished by this section. This Contractor shall interface each variable frequency drive with the DDC system to enable simultaneous two-way communications. This functionality shall allow an operator to remotely monitor and adjust all variables via the user interface of the DDC system operator workstation. Furnish and install all software, hardware, system programming, and engineering required to interface the systems. Refer to mechanical and electrical drawings for quantity and location of all variable frequency drives.

K. Trending of Air Economizer Modes
1. The DDC system shall contain a trending program which shall monitor each outdoor air economizer air conditioning system to determine if the system is operating in the air economizer mode (i.e., winter mode).
2. The DDC system shall contain all required trending software program to trend the daily, weekly, monthly and yearly hours of outdoor air economizer operation. The DDC system shall be furnished with the above-listed trend programs installed, set up and operational. The DDC system shall be programmed to automatically issue a report at a frequency rate determined by the Owner.

L. Trending of Water Flow Meters

1. The DDC system shall contain a trending program which shall monitor each water flow meter.
2. The DDC system shall contain all required trending software program to trend the daily, weekly, monthly and yearly consumption of each water flow meter. The DDC system shall be furnished with the above-listed trend programs installed, set up and operational. The DDC system shall be programmed to automatically issue a report at a frequency rate determined by the Owner.

M. Trending of Air Side Duct Static Pressure Transmitters, Supply and Return Fan System Air Flow Rates and Minimum Outdoor Air Air Flow Rates
1. The DDC system shall contain a trending program which shall monitor all:
   a. Duct static pressure transmitters.
   b. Supply fan air flow measuring stations.
   c. Return fan air flow measuring stations.
   d. Minimum outdoor air air flow measuring stations.
2. The DDC system shall contain all required trending software programs to trend each of the above variables based on a daily, weekly, monthly and yearly schedule. The DDC system shall be furnished with the above-listed trend programs installed, set up and operational. The DDC system shall be programmed to automatically issue a report at a frequency rate determined by the Owner.

N. Trending of Constant Motor Loads: The DDC system shall contain all required trending software programs to trend the daily, weekly, monthly and yearly hours of operation of constant motor loads. The hours of operation shall be determined by totalizing the run status of constant speed fans and pumps which are monitored via the DDC system. The DDC system shall be furnished with the above-listed trend programs installed, set up and operational. Programs shall be configured to automatically generate a report on a monthly basis.

O. Plumbing Leak Alarms: Provide a leak detector in drips pans serving plumbing services. Each leak detector shall be monitored at the DDC system. All required power and control wiring for the leak detectors shall be provided by this Contractor. Refer to Plumbing Drawings for quantity and location.

P. System Points
1. The following system hardwired points shall be monitored and/or controlled via the DDC system. For additional points, refer to the “Description of Control Operation”. Note: Points identified with “♦” shall be made alarmed. Analog alarm set points shall be coordinated with the Owner.
2. Energy Recovery Air Conditioning System (Note: The following points do not include the BACnet interface points described within sequence of operation above.)
   a. Heat Wheel run status – via current sensing relay.
   b. Preheat pump start/stop.
   c. Preheat pump run status via current sensing relay.
3. Dedicated Outdoor Air System (DOAS) Serving Perimeter Areas
   a. Space temperature.
   b. Space humidity.
   c. Space CO_2.
   d. Discharge air temperature.
   e. Leak alarm.
   f. Primary air duct airflow rate (cfm).
   g. Damper control.
   h. Fan start/stop.
   i. Fan status.
   j. Fan speed control.
   k. Hot water valve control.

l. Chilled water valve control.

4. Dedicated Outdoor Air System (DOAS) Serving Interior Areas
   a. Space temperature.
   b. Space humidity.
   c. Space CO_2.
   d. Discharge air temperature.
   e. Leak alarm.
   f. Primary air duct airflow rate (cfm).
   g. Damper control.
   h. Fan start/stop.
   i. Fan status.
   j. Fan speed control.
   k. Chilled water valve control.
5. Heating and Ventilation System and General/Smoke Exhaust Fan Serving Back of House
   a. Supply fan start/stop.
   b. Supply fan run status – via current sensing relay.
   c. Supply fan speed control.
   d. Supply fan safety stop.
   e. General exhaust fan start/stop.
   f. General exhaust fan run status – via current sensing relay.
   g. General exhaust fan speed control.
   h. General exhaust fan safety stop.
   i. Preheat pump start/stop.
   j. Preheat pump run status via current sensing relay.
   k. Preheat coil valve control.
   l. Preheat coil discharge temperature.
   m. Low temperature thermostat
   n. Supply air temperature
   o. High discharge pressure switch – each supply and exhaust fan.
   p. Low suction pressure switch – each supply and exhaust fan.
   q. Supply duct static pressure.
   r. General exhaust duct static pressure.
6. Carbon Monoxide Detection System:
   a. System ok.
   b. Warning.
   c. Alarm.
   d. Sensor Fail.
7. Parking Garage Exhaust Fan
   a. Exhaust fan start/stop.
   b. Exhaust fan run status – via current sensing relay.
   c. Exhaust fan speed control.
   d. Exhaust fan safety stop.
8. Toilet Exhaust Fan
   a. Fan start/stop.
   b. Fan run status – via current sensing relay.
9. Packaged Air-Cooled Air Conditioning Units (Typical for Each)
   a. Start/stop
   b. Run status
   c. Common alarm.
   d. Space temperature
   e. Leak/condensate alarm.

10. Air Source Heat Pump
    a. Start/stop.
    b. Common alarm.
11. Outdoor air temperature.
12. Outdoor air humidity.
13. Alarms called for under Plumbing Section of the specifications, as follows:
    a. To be determined – Include 20 hardwired input points.
14. Alarms called for under the Electrical Section of the specifications, as follows:
    a. Diesel Generator
        1). Generator fail to run.
        2). Generator running.
        3). Generator Pre-alarm.
        4). Fuel tank low level.
    b. Automatic Transfer Switch (each)
        1). Switch connected to normal.
        2). Switch connected to emergency.
        3). Load on normal.
        4). Load on emergency.
15. Signal Devices
    a. All signal devices for equipment furnished and installed under the Heating, Ventilating and Air Conditioning, Electrical, and Plumbing Sections shall be furnished and installed by the respective Trade on the applicable equipment.
    b. All wiring between the signal devices (alarm contacts) and this system shall be installed as part of this section.

END OF SECTION 23 09 93

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SECTION 23 21 13

PIPING FOR HVAC SYSTEMS AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all piping, pipe fittings, gaskets, etc., as indicated and scheduled on the drawings and in accordance with the Construction Documents.

B. Section includes:

1. Pipe and pipe fittings for the following systems:
   a. Hot water heating system.
   b. Hot water reheat system.
   c. Glycol piping.
   d. Chilled water system.
   e. Cooling coil condensate drains.
   f. Equipment drains and overflows.
   g. Refrigerant piping.
   h. Fittings.
   i. Unions and flanges.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.

1.3 REFERENCES

A. Piping, fittings and associated components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the State of New York.
   b. Fire Code of the State of New York.
   c. Mechanical Code of the State of New York.
   d. Energy Conservation Construction Code of New York State.
   e. New York City Building Code.
   f. New York City Mechanical Code.
   g. New York City Fire Code.
   h. New York City Fuel Gas Code.
2. Reference Standards: Perform work in accordance with, but not limited to, the following standards:
   a. American Society of Mechanical Engineers
   b. ASTM International
   c. American Welding Society
      1). .
   d. Manufacturers Standardization Society
   e. National Fire Protection Association
      1). NFPA 30: Flammable and Combustible Liquids Code.
      2). NFPA 31: Standard for the Installation of Oil-Burning Equipment.
      3). NFPA 37: Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.
      4). NFPA 54: National Fuel Gas Code.

5). NFPA 58: Liquefied Petroleum Gas Code.
6). NFPA 211: Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances.

1.4 SUBMITTALS
A. Submittals shall be furnished in accordance with the requirements of Section 23 00 00.

1.5 WARRANTY
A. Comply with Division 01 - General Requirements and Section 23 00 00 requirements for product warranties.
B. Furnish a three- (3-) year manufacturer's warranty for underground piping systems, mill-wrapped steel pipe, associated accessories and components provided.
C. Warranty period shall initiate upon Final Acceptance by Owner.

1.6 COMMISSIONING
A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Construction Documents.
B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying that the products are equivalent in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Construction Documents will be revised to reflect the substitution.
C. If they comply with these specifications, pipe and fittings manufactured by one (1) of the following manufacturers will be acceptable:
1. Copper Pipe
a. Ansonia Copper and Brass, Inc.
b. Alaskan Copper and Brass Company.
c. Cerro Copper Products.
d. Kobe Wieland Copper Products, LLC.
e. National Bronze & Metals, Inc.
2. Copper Pipe Fittings
a. Chase Brass.
b. Elkhart Products Corporation.
c. Mueller Brass Company.
d. NIBCO.
e. Wolverine Tube Co.
3. CPVC Pipe and Fittings
a. Georg Fischer Harvel LLC.
b. IPEX Inc.
c. Spears Manufacturing Company.
4. Gaskets
a. Garlock.
b. Flexitallic.
c. Lamons.
d. Victaulic.
5. Steel Pipe

a. Allies Tube.
b. Indutech.
c. Ipsco (TMK Ipsco).
d. Koppel.
e. Lakeside.
f. Lonestar.
g. Tex-Tube.
h. USS.
i. V & M Star.
j. Wheatland/Sharon Tube/Sawhill.

6. Steel Pipe Fittings
a. Anvil International.
b. Bonney Forge.
c. Kerkau.
d. Mills Iron Works.
e. Phoenix Forge.
f. Penn Machine.
g. Tube Forging of America.
h. Weldbend.

2.2 MATERIALS

A. Black Steel Pipe: ASTM A53/A53M Grade B.
B. Copper Tubing: ASTM B88 , Type L hard-drawn.

2.3 SYSTEM MATERIALS SCHEDULE

Size	Pipe Type	Weight	Fitting Type
CHILLED WATER SYSTEMS			
3 inches (75 mm) and under (except risers)	Seamless black steel	Schedule 40	Malleable iron - screwed 250 psi (17 bar)
	Copper tube	Type L	Wrought copper - soldered or brazed below 375 psi (25.8 bar)
Risers and 4 inches (100 mm) to 10 inches (250 mm)	Seamless black steel	Schedule 40	Forged steel butt-welded
HOT WATER SYSTEMS			
3 inches (75 mm) and under (except risers)	Seamless or ERW black steel	Schedule 40	Malleable iron - screwed 370 psi (25 bar) WOG
	Copper tube	Type L	Wrought copper - soldered or brazed below 375 psi (25.8 bar) Mechanical press fittings – up to 150 psi (10.3 bar)
Risers and 4 inches (100 mm) to 10 inches (250 mm)	Seamless or ERW black steel	Schedule 40	Forged steel butt-welded
12 inches (300 mm) and over	Seamless or ERW black steel	0.375 inch (10 mm) wall	Forged steel butt-welded

Size	Pipe Type	Weight	Fitting Type
4 inches (100 mm) to 10 inches (250 mm) (exposed in Equipment Rooms)	Seamless or ERW black steel with rolled grooves	Schedule 40	Mechanical couplings
12 inches (300 mm) and over (exposed in Equipment Rooms)	Seamless or ERW black steel with rolled grooves	0.375 inch (10 mm) wall	Mechanical couplings
HOT WATER SYSTEMS			
3 inches (75 mm) and under (except risers)	Seamless black steel	Schedule 80	Malleable iron - screwed 400 psi (28 bar) WOG
	Copper tube	Type L	Wrought copper - soldered or brazed below 375 psi (25.8 bar)
Risers and 2-1/2 inches (65 mm) to 10 inches (250 mm)	Seamless black steel	Schedule 80	Forged steel butt-welded
FUEL Oil Fill and Vent			
All sizes	Seamless black steel	Schedule 40	Socket-welded (except headers which shall be butt-welded)
All sizes	Seamless or ERW Black Steel within a minimum 10 gauge all-welded black steel outer casing		
DIESEL ENGINE EXHAUST			
All sizes	ERW black steel	0.375 inch (10 mm) wall	Forged steel butt-welded
REFRIGERANT			
All sizes	ACR copper tube	Type L	Wrought copper - brazed
FRESH WATER			
All sizes	Copper tube	Type L	Wrought copper - soldered
COOLING COIL CONDENSATE DRAINS (unpressurized)			
All sizes	CPVC	Schedule 40	Solvent welded - socket
	Copper tube	Type L	Wrought copper – soldered Mechanical press fittings – up to 150 psi (10.3 bar)
COOLING COIL CONDENSATE DRAINS (pressurized)			
All sizes	Copper tube	Type L	Wrought copper – soldered Mechanical press fittings – up to 150 psi (10.3 bar)
CONDENSING BOILER DRAINS AND CHIMNEY DRAINS			
All sizes	CPVC	Schedule 40	Solvent welded - socket
HOT WATER AND VENTS and DRAINS			
All sizes	Galvanized steel	Schedule 40	Malleable iron - screwed 125 psi steam
	Copper tube	Type L	Wrought copper - soldered

Size	Pipe Type	Weight	Fitting Type
GAS METER ROOM VENTS			
All Sizes	Seamless or ERW black steel ASTM A-53 Grade B	Schedule 40	Forged steel butt-welded
COMPRESSED AIR			
All sizes	Copper tube	Type L	Wrought copper - soldered

2.4 PIPE FITTINGS

A. All fittings shall be of a type that maintains full wall thickness at all points, full radius and fillets, and proper bevels or shoulders at ends.

B. Gaskets: Gaskets shall conform to the following requirements:

Media	Maximum Temperature	Maximum Pressure	Material	Thickness
Glycol	125°F (52°C)	180 psig (12.5 bar)	Red Rubber or Neoprene	1/8 inch (3 mm)
Glycol	100°F (38°C)	400 psig (27.5 bar)	Garlock IFG 5500	1/16 inch (1.5 mm)
Diesel Engine Exhaust	1,100°F (593°C)	5 psig (34.5 kPa)	Asbestos-Free Vermiculite	1/8 inch (3 mm)

2.5 SCHEDULE OF SYSTEM operating temperatures and WORKING PRESSURES

System	Design Working Temperature	Floors Served	Design Working Pressure
Chilled Water	55°F (13°C)	All	150 psi (10.3 bar)
Hot Water	200°F (93°C)	3 - Roof	150 psi (10.3 bar)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Carefully check space requirements with other trades to ensure that all material can be installed in the spaces allotted thereto.

3.2 GENERAL INSTALLATION OF PIPING

A. Pipe fitters shall be certified by the National Certified Pipe Welding Bureau of the Mechanical Contractors Association of America and/or ASME Section 9. Fitters shall possess and maintain current Procedure Qualification Records for the service for which they are employed and on which they work.

3.3 INSTALLATION - WELDED PIPING SYSTEMS

A. Where so shown on drawings, specified or directed, welded joints, outlets and flanges shall be used. Welded joints may also be provided elsewhere at points where it may be explicitly specified or directed to leave flanged joints in order to facilitate future changes.

B. All welds shall bear the identifying number, letter or symbol of the welder or welding operator.

3.4 INSTALLATION - BRAZED PIPING SYSTEMS

A. Filler metal shall conform to the requirements of the latest edition of ANSI/AWS A5.8 Specifications for Brazing Filler Metal with the following classifications: BCuP-2, BCuP-3, BCuP-4, BCuP-5, BAg-5 or BAg-7.

B. Flux shall be compatible with the materials brazed and with the filler metal used, and shall conform to the requirements of the latest edition of ANSI/AWS A5.31 Specifications for Fluxes for Brazing

and Braze Welding. All flux residue must be removed after joint is completed.

3.5 INSTALLATION - SOLDERED PIPING SYSTEMS

A. Filler metal shall conform with the requirements of the latest edition of ASTM B32 Specifications for Solder Metal.

B. All joints shall be made with 95% tin and 5% antimony solder, having a melting point of not less than 460°F (238°C).

3.6 FIELD QUALITY CONTROL

A. Piping shall be pressure-tested in sections as directed by the Construction Manager/General Contractor in order to permit construction to proceed. All testing shall be per Section 23 05 93 – Testing, Adjusting and Balancing.

B. Piping for which inspection is required shall be inspected during construction and after completion and at the option of the Inspection Agency at such stages of the work as they may designate.

C. Welding Quality Control: An independent testing agency retained by this Contractor shall observe the fitting-up and making of welds as prescribed in ASME/ANSI B31.1 - Power Piping (HP Steam) and/or ASME/ANSI B31.9 - Building Service Piping.

3.7 CLEANING

A. During construction, properly cap all lines so as to prevent the entrance of sand, dirt, etc. Each system of piping shall be blown-through after completion (for the purpose of removing grit, dirt, sand, etc., from coils and piping), for as long a time as required to thoroughly clean the apparatus. Bypass arrangements shall be provided at all coils and equipment such that water can be circulated through all mains during the flushing and cleaning of the system.

B. Each recirculating water system and fuel oil system shall be thoroughly cleaned after successful hydrostatic testing to remove all debris, oil, mill scale and surface corrosion.

C. Prior to circulating water through the system for cleaning, make sure that all valves to equipment are closed and that bypass valves are open.

D. The chemicals used for cleaning and passivation shall not be injurious to persons, piping, pipe joint compounds, packings, coils, valves, pumps and their mechanical seals, tubes or other parts of the system.

3.8 FINAL ADJUSTMENT

A. Upon completion of insulation, hangers for piping and at equipment shall be adjusted to ensure that the loads are distributed evenly and that there are no loads imposed by the piping or the equipment that it is connected to.

B. Securely tighten clevis hanger load nuts first to ensure proper hanger performance. Tighten top nut after adjustment.

END OF SECTION 23 21 13

SECTION 23 21 16

HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Perform all work necessary to provide and install all air and dirt separators, air purgers, air vents and expansion tanks required for the complete and proper operation of all systems as indicated herein and on the Construction Documents.

B. Section includes:

1. Air and dirt separators.
2. Air purgers.
3. Air vents.
4. Expansion tanks.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.

1.3 REFERENCES

A. Air and dirt separators, air purgers, air vents and expansion tanks and their components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the State of New York.
   b. Fire Code of the State of New York.
   c. Mechanical Code of the State of New York.
   d. Energy Conservation Construction Code of New York State.
   e. New York City Building Code.
   f. New York City Mechanical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. American Society of Mechanical Engineers (ASME)
   b. Manufacturers Standardization Society (MSS)
   c. NSF International (NSF)
      1). NSF/ANSI 61: Drinking Water System Components - Health Effects.

1.4 SUBMITTALS

A. Submittals shall be furnished in accordance with the requirements of Section 23 00 00

1.5 WARRANTY

A. Comply with Division 01 - General Requirements and Section 23 00 00 requirements for product warranties.

B. Furnish five- (5-) year manufacturer’s warranty for all equipment specified herein.

C. Warranty period shall initiate upon Final Acceptance by Owner.

1.6 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide

standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Construction Documents.

B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Construction Documents will be revised to reflect the substitution.

C. Air and Dirt Separators
   1. Adamson.
   2. Amtrol.
   3. Armstrong International.
   4. Bell & Gossett.
   5. Flamco.
   6. Spirotherm.
   7. Taco.
   8. Thrush.

D. Air Purgers
   1. Amtrol.
   2. Bell & Gossett.
   3. Cash Acme.
   4. Thrush.

E. Air Vents
   1. Amtrol.
   2. Armstrong International.
   3. Bell & Gossett.
   4. Hoffman Specialty.
   5. Spirax Sarco.
   6. Taco.
   7. Thrush.
   8. Watson McDaniel.
   9. Watts.

F. Expansion Tanks
   1. Adamson.
   2. Amtrol.
   3. Bell & Gossett.
   4. John Woods.
   5. RECO.
   6. Taco.
   7. Thrush.

2.2 GENERAL REQUIREMENTS

A. Provide air and dirt separators, air purgers, air vents and expansion tanks of sizes and types as specified and as shown on the drawings. The intention is to protect all systems and apparatus whose proper functioning would be interfered with by air, dirt or overpressurization.

B. Air and dirt separators shall comply with the following:
   1. Manufacturer shall be a holder of an ASME U stamp.

C. Air purgers shall be one-piece cast iron construction with internal baffles designed to eliminate air by entraining air in the top of the unit and venting through an air vent.

D. Expansion tanks shall be designed and manufactured in accordance with the latest applicable industry standards, applicable codes and the requirements of local authorities including, but not

limited to, the following:

1. Provide vertical pneumatic tanks and appurtenances of the dimensions and storage capacities scheduled. Tanks shall be built in accordance with ASME Code and NSF standards, all seams double butt-welded by certified code welders, Underwriters' Certificates to be furnished. Tanks shall be pre-charged at the factory with air pressures set as indicated on drawings.
2. Each expansion tank shall be welded steel, constructed, tested and stamped in accordance with Section VIII of the ASME Code for a working pressure of not less than 125 psig (8.6 bar) with replaceable flexible heavy-duty butyl rubber bladder FDA-approved material, NSF 61 rated for potable water service. All wetted metal parts must be brass or stainless steel.
3. Bladder shall be able to accept the full volume of the expansion tank and shall be removable and replaceable.
4. Tanks shall be provided with suitable tappings for cold water inlet, quick-connect air charging valve, drain connection and an approved-type hand-hole of adequate size.
5. Tank capacity shall be equal to or greater than specified units.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Vent connections shall be provided at all high points, at the uppermost connection to hydraulic coils, connected to expansion tanks or to air traps, or to valve blowoffs, as shown or directed. Where valve blowoffs are used, valves shall be installed no higher than 6 feet 0 inches (1.8 M) above finished floor. Automatic air and vent traps of the ball float type shall be installed at all high points of the chilled water system and be installed with copper drain lines piped to the nearest funnel drain. Provide a manual shutoff valve ahead of all vents.

B. Install air and dirt separators on the main return header on all closed recirculating water systems.

C. Air purgers shall be installed on the makeup to all expansion tanks.

D. Install air vents at the highest point in all piping, at the top of all risers and where shown on the drawings.

E. Furnish and install expansion tanks as required by code, where shown on the drawings and/or for the following systems:
   1. Secondary condenser water.
   2. Primary chilled water.
   3. Secondary chilled water.
   4. Boiler circulating water.
   5. Primary hot water.
   6. Secondary hot water.

3.2 ADJUSTING

A. Where required, adjust pressure settings as necessary prior to being put into service.

B. Coordinate pressure settings with Section 23 09 00 - Instrumentation and Control for HVAC Contractor to ensure proper operation of alarms.

END OF SECTION 23 21 16

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SECTION 23 21 23

HYDRONIC PUMPS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all hydronic pumps as indicated and scheduled on the drawings and in accordance with the Construction Documents.

B. Section includes:

1. Vertical in-line pumps.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.

1.3 REFERENCES

A. Pumps and their components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the State of New York.
   b. Fire Code of the State of New York.
   c. Mechanical Code of the State of New York.
   d. Energy Conservation Construction Code of New York State.
   e. New York City Building Code.
   f. New York City Mechanical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. American Bearing Manufacturers Association (ABMA)
   b. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
      1). ASHRAE: HVAC Systems and Equipment Handbook.
   c. American National Standards Institute (ANSI)
      1). ANSI BS 2035: Specifications for Cast Iron Flanges for Pipes and Pipe Fittings.
      2). ANSI/HI 1.3: Rotodynamic (Centrifugal) Pump Applications
   d. American Water Works Association (AWWA)
      1). AWWA E101: Vertical Turbine Pumps - Line Shaft and Submersible Types.
      2). AWWA E103: Horizontal and Vertical Line Shaft Pumps.
   e. International Organization for Standardization (ISO)
      1). ISO 21049: Shaft Sealing Systems for Centrifugal and Rotary Pumps.
   f. Occupational Safety and Health Administration (OSHA)
      1). OSHA 1910.212: Machinery and Machine Guarding.
   g. Underwriters Laboratories (UL)
      1). UL 778: Standard for Motor-Operated Water Pumps.

1.4 SUBMITTALS

A. Submittals shall be furnished in accordance with the requirements of Section 23 00 00.

1.5 WARRANTY

A. Comply with Division 01 - General Requirements and Section 23 00 00 requirements for product warranties.

B. Furnish a one- (1-) year manufacturer's warranty against manufacturing defects for all systems and components.
C. Furnish a five- (5-) year warranty for bearings.
D. Warranty period shall commence upon Final Acceptance by Owner.

1.6 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACtURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Construction Documents.
B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Construction Documents will be revised to reflect the substitution.
C. If they comply with these specifications, hydronic pumps manufactured by one (1) of the following manufacturers will be acceptable:
    1. Vertical In-Line Pumps
        a. Armstrong.
        b. Aurora.
        c. Bell & Gossett.
        d. Paco.
        e. Peerless.
        f. Taco.
        g. Weinman.
    2. Water Makeup Pump Sets for Expansion Tanks
        a. Aurora.
        b. Burks.
        c. Federal.
        d. Hartell.
        e. Mepco.
        f. Shipco.
        g. Skidmore.
        h. Weinman.
        i. Weinman.

2.2 GENERAL REQUIREMENTS

A. Provide pumps of sizes, types and performance ratings as scheduled on the drawings. Each pump shall be guaranteed to circulate not less than the specified quantity of water against the specified circulating head when operating continuously without overheating the motor or bearings and without producing noise audible anywhere in the building.
B. Pumps shall be driven by constant or variable speed premium-efficiency motors as scheduled and as specified under Section 23 05 13 - Common Motor Requirements for HVAC Equipment. Motors shall be of proper size to drive pumps continuously under the total head specified with a maximum operating temperature of 194°F (90°C). Motor windings shall be compatible with starters and variable speed controllers as specified. Pump brake horsepower at design speed shall not exceed the nominal motor horsepower under any operating condition.

C. Casings shall be designed for the specified working pressure scheduled on the drawings and shall be tested at 1-1/2 times this pressure and proven tight.
D. The suction and discharge of each pump shall be provided with tapped openings suitable for mounting pressure gauges.
E. Impellers shall be no greater than 85% of the largest impeller designed to fit pump casing.
F. Pumps shall be factory-tested, thoroughly cleaned, and painted with one (1) coat of machinery enamel prior to shipment.
G. Each pump shall be provided with a nameplate containing the serial number, model number, size, rpm, gpm and total dynamic head.

2.3 VERTICAL IN-LINE PUMPS

A. In addition to the requirements listed in Article 2.2 - General Requirements, vertical in-line pumps shall comply with the following:
1. All pumps and motors shall be the products of one (1) manufacturer.
2. Casings shall be made of high-tensile cast iron with ANSI/PN16 Class 125 flanges for working pressures below 175 psig (12 bar) at 150°F (65°C) and ductile iron with ANSI/PN25 Class 250 flanges for working pressures to 375 psig (25 bar) at 150°F (65°C). Suction and discharge connections shall be flanged and the same size and shall be drilled and tapped for seal flush and gauge connections.
3. Impellers shall be bronze, fully enclosed type, statically and dynamically balanced in two (2) planes where the installed impeller diameter is less than six (6) times the impeller width. They shall be trimmed for the specific design conditions.
4. Shafts shall be stainless steel.
5. Seals shall be bellows type with Viton bellows, siliconized graphite primary ring, stainless steel retainer, disc, drive band, spring and spring holder and tungsten carbide or silicon carbide stationary seat. Seals on pumps where the stuffing box pressures are in excess of 100 psi shall be balanced type. Bronze or stainless steel shaft sleeves shall be provided where required.
6. The seal chamber shall be furnished with a throttle bushing to ensure that seals maintain positive cooling and lubrication.
7. Seal flush lines on pumps operating at differential pressures of 60 feet (179 kPa) or greater shall be furnished with stainless steel abrasive separators, pressure gauges and sight flow indicators.
8. All pumps shall be furnished with grease-lubricated bearings provided with drain plugs and fittings suitable for in-service lubrication. Bearings shall have an average bearing life (AFBMA L_{50}) of 200,000 hours at maximum horsepower and operating speed.
9. Couplings shall be rigid spacer type of high-tensile aluminum alloy, designed to be easily removed and with sufficient space between the pump and motor shafts to remove all mechanical seal components for servicing and permit replacement without disturbing the pump or motor.

2.4 WATER MAKEUP PUMP SETS FOR EXPANSION TANKS

A. All makeup water pumping units and motors shall be the products of one (1) manufacturer.
B. Furnish simplex makeup water pumping units having capacities as listed in the schedule on the drawings. The units shall be complete with steel receiver, pumps, motors and base, float switches, supports and other incidental items necessary to complete the units. The units shall consist of the following elements:
1. A steel or cast iron base and receiver with all necessary threaded connections, holes for foundation bolts, etc., arranged to support the receiver, pumps and motor and to keep all of the equipment aligned.
2. The receiver shall be equipped with a glass water level gauge.
3. Close-coupled pump of approved pattern and construction with the pump inlet piped to the receiver, and with the motor securely supported on the base plate.

4. An approved oversized funnel at the inlet connection to the receiver. Note that the receiver inlet size shall be not less than 2 inches.
   a. At a minimum, the makeup line and solenoid valve to the receiver shall be sized to deliver 150% of the rate of the makeup water pump.
5. A factory-mounted NEMA-rated control panel completely pre-wired with surface-mounted disconnect switch, hand/off/auto switch and pump status indicator light. The control equipment shall be factory-mounted and -wired on each unit, including a float in the receiving tank, a float switch, the associated automatic controls for activation of the makeup water solenoid, and activation of the pump start/stop as hereinafter specified.

C. Control Sequence: Domestic water makeup to the receiver shall be controlled by a float-type liquid-level controller connected to a solenoid valve. Control of the pump shall be via pressure switches mounted on the expansion line of the system served or via water-level probes mounted on the expansion tank.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Pumps shall be installed on housekeeping pads, inertia bases and resilient isolators as required in Section 23 05 48.13 - Seismic Controls for HVAC Piping, Ducts and Equipment and Section 23 05 48.16 - Vibration Isolation for HVAC Piping, Ducts and Equipment.

B. After each pump has been placed on its inertia base, the coupling should be disconnected. Coupling should not be reconnected until pump has been piped and finally aligned.

C. Pumps and/or pump sets shall be leveled with tapered steel wedges, allowing a minimum of 3/4 inch of non-shrink grout between pump base and inertia base or concrete pad. Grouting must be performed in accordance with pump manufacturer’s recommendations.

D. Connections to pumps shall be made with long radius reducing elbows or eccentric reducers. In lieu of a long radius reducing elbow, a suction strainer may be installed at the inlet to the pump.

E. Both the suction and discharge piping shall be independently supported to ensure that the piping does not exert any strain on the pump.

F. All piping shall be aligned with the pump inlet and discharge prior to making final connections.

3.2 CLEANING AND PROTECTION

A. Comply with Division 01 requirements for cleaning and protection of installed work.

B. Comply with the requirements of Section 23 25 00 - HVAC Water Treatment for cleaning and protection of installed work.

C. Upon completion of the installation, remove all protective materials.

D. Replace cartridge filters on seal flush lines.

3.3 INSPECTION AND STARTUP

A. A factory-authorized service representative shall inspect and perform the final alignment of all pumps to ensure proper installation and operation of each system.

B. Verify the following prior to starting pumps:
   1. All blocking and bracing has been removed from beneath inertia bases.
   2. Vibration isolation devices have been adjusted correctly.
   3. The pumps have been leveled, the grouting has been performed correctly, and the pump and motor assembly have been properly aligned.
   4. Pump rotation is correct.
   5. Pumps have been primed and are full of water.
   6. Piping has been chemically cleaned and strainers are free of debris.

C. Manufacturer shall guarantee components for one (1) year against defective materials and workmanship. Defective parts shall be returned, freight prepaid, and shall be replaced FOB from the manufacturer's plant.

3.4 ADJUSTING AND BALANCING

A. All testing, adjusting and balancing shall be in accordance with the requirements of Section

23 05 93 - Testing, Adjusting and Balancing for HVAC.

END OF SECTION 23 21 23

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SECTION 23 25 00

HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install all water treatment chemicals, feed, control and test equipment and filtration equipment required for the project and as indicated on and in accordance with the requirements of the Contract Documents.

B. Section includes:

1. Alarms.
2. Bromine feeder.
3. Bypass pot feeder.
4. Chemicals.
5. Chemical solution tanks.
6. Closed system filtration.
7. Closed system glycol feeder.
8. Conductivity controller.
9. Corrosion coupon racks.
10. Injection quills and corporation stops.
11. Solution metering pumps.
12. Solenoid valves.
13. Test equipment.
14. Water meters.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.

1.3 REFERENCES

A. All water treatment systems and components shall be designed, manufactured, tested and installed in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. All chemicals used for the water treatment system shall be acceptable for use by the New York State and New York City Departments of Health.
2. All biocides shall be registered with the United States EPA under the FIFRA Act and the state. Applicators must hold valid New York pesticide applicator licenses for Commercial Pesticide Category 7G (Cooling Towers, Pulp & Paper Process).
3. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. New York City Building Code.
   b. New York City Mechanical Code.
   c. Energy Conservation Construction Code of New York State.
   d. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   e. American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
      1). SPC 188P: Legionellosis.
   f. American Society of Mechanical Engineers (ASME)
      1). ASME B40.100: Pressure Gauges and Attachments.

g. ASTM International (ASTM)
h. American Water Works Association (AWWA)
i. Association of Water Technologies (AWT)
j. Cooling Technology Institute (CTI)

1.4 SUBMITTALS

A. The following submittal data shall be furnished according to the Conditions of the Contract, Division 01 and Section 23 00 00 and shall include, but not be limited to:
1. A complete list of services, which will be supplied by the proposed water treatment system supplier. The list shall include the extent of field supervision required to certify that the required cleaning and passivation results have been achieved.

1.5 PERFORMANCE REQUIREMENTS

A. water available at the project site maintaining the following characteristics of water in the closed systems at or below the following limits:
1. Closed Water Systems
a. Iron: 3.0 ppm.
b. Copper: 0.5 ppm.
c. pH: 8.5 - 11.0 units.
d. Azole inhibitor shall be greater than 10 ppm.

B. Provide a water treatment program to maintain the open and closed water systems at or below the following corrosion and biofouling limits:
1. Open Condenser Water Systems

Corrosion rate on mild steel	Less than 1.0 mpy, no pitting
Corrosion rate on brass and copper	Less than 0.2 mpy
Scaling rate	No loss in performance
Biofouling	No loss in performance
	No visible algae/slime
	No health hazards
	Planktonic CFU less than 10^3/ml

2. Closed Water Systems

Corrosion rate on mild steel	Less than 0.5 mpy, no pitting
Corrosion rate on brass and copper	Less than 0.2 mpy
Scaling rate	No loss in performance
Biofouling	No loss in performance
	No visible algae/slime
	No health hazards
	Planktonic CFU less than 10^3/ml

3. Pitting or under-deposit gouging is not acceptable during inspection and analysis for any recirculating water system.

1.6 WARRANTY

A. Comply with the requirements of Division 01 and Section 23 00 00.
B. Furnish a five- (5-) year manufacturer's warranty for solution injection pumps, valves and water meters in the treatment system.
C. Furnish a two- (2-) year manufacturer's warranty for the entire water treatment control system.
D. Furnish test kits, all chemicals for treatment, and perform all testing required during the warranty period.
E. Warranty period shall commence upon Final Acceptance by the Owner.

1.7 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Contract Documents.

B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Contract Documents will be revised to reflect the substitution.

C. Alarm Devices
1. Advantage.
2. Flowline.
3. Milton Roy (Liquid Metronics Inc.).
4. Nalco.
5. Pulsafeeder.
6. Walchem.

D. Bromine Feeder
1. Ashland Hercules Water Treatment.
2. GE Water and Process Technologies.
3. Nalco.
4. Neptune Chemical Pump Co. (PSG Dover).

E. Bypass Pot Feeder
1. Ashland Hercules Water Treatment.
2. Great Lakes Chemical Co.
3. Griswold Water Systems.
4. Nalco.
5. Neptune Chemical Pump Co. (PSG Dover).

F. Chemicals
1. Ashland Inc.
2. ChemTreat.
3. GE Water and Process Technologies.
4. Nalco.
5. U.S. Water Services.

G. Chemical Solution Tanks
1. Assmann Corporation
2. Alltanks.com LLC.
3. Nalco.
4. PolyProcessing.
5. Snyder Industries, Inc.
6. Walchem.

H. Closed System Filtration
1. Ameriwater.
2. Amiad (P.E.P. Filtration).
3. Diamond.
4. Orival.

I. Closed System Glycol Feeder
1. Ashland Hercules Water Treatment.
2. General Treatment Products, Inc.

3. J.L. Wingert Co.
4. Neptune Chemical Pump Co. (PSG Dover).
5. Walchem.

J. Conductivity Controller
1. Advantage Controls Inc.
2. Nalco.
3. Pulsafeeder.
4. Walchem.

K. Corrosion Coupon Rack
1. Advantage Controls Inc.
2. GE Water and Process Technologies.
3. Griswold Water Systems.
4. GTP Company.
5. J.L. Wingert Company.
6. Nalco.
7. Pulsafeeder.
8. Walchem.

L. Injection Quills and Corporation Stops
1. Koflo Company.
2. Mueller Company.
3. Nalco.
4. Neptune Chemical Pump Co. (PSG Dover).
5. Saf-T-Flo Water Services.

M. Solution Metering Pumps
1. Milton Roy (Liquid Metronics Inc.).
2. Nalco.
3. Neptune Chemical Pump Co. (PSG Dover).
4. Prominent.
5. Pulsafeeder.
6. Walchem.

N. Solenoid Valves and Motorized Ball Valves
1. ASCO (Redhat).
2. Belimo.
3. Danfoss.
4. Mueller.
5. Parker Fluid Control.

O. Test Equipment
1. Aqua Phoenix, Inc.
2. Fisher Scientific.
3. Hach.
4. Hanna Instruments.

P. Water Meters
1. Badger.
2. Carlon.
3. Hershey.

Q. Water Softeners
1. Culligan.
2. GE Water and Process Technologies.
3. Marlow Industries.
4. Siemens Water Technologies.

2.2 GENERAL REQUIREMENTS

A. All materials and equipment shall be new, in good condition and free from defect. The commercially standard items of equipment and the specific names mentioned herein are intended to identify standards of quality and performance necessary for the proper functioning of the work.

B. Since manufacturing methods vary, reasonable minor variations are expected; however, performance and material requirements specified herein are the minimum standards acceptable. The Engineer retains the sole right to judge the equality of equipment that deviates from the Contract Documents, to reject any alternative submitted by the Contractor, and to require that the specified materials and equipment which conform to the requirements of the Contract Documents be furnished.

C. Materials and equipment that are found to have factory defects shall be replaced or repaired in a manner acceptable to the Owner and Engineer at no additional cost to the Owner. The Contractor shall be responsible for all costs associated with testing, replacement or repair including, but not limited to, all replacement or repair costs, preparations prior to testing, all testing costs, extended warranties, recommissioning of the equipment, etc.

2.3 ALARM DEVICES

A. Provide all alarm devices and sensors directly connected to the water treatment equipment and piping required for a complete control system.

2.4 CHEMICALS

A. Furnish all chemicals used in treating the closed-loop systems in accordance with New York State and the Authority Having Jurisdiction.

B. Closed System Treatment

1. Closed system treatment shall consist of the following:
   a. pH buffering compounds to maintain pH in the range of 8.0 to 9.5.
   b. Provide a corrosion inhibitor utilizing molybdate, nitrite or similar chemistry.
   c. Provide a copper alloy corrosion inhibitor (azole or similar) at greater than 15 ppm in the closed-loop water.

2.5 CHEMICAL SOLUTION TANKS

A. Provide chemical solution tanks for open condenser water and closed-loop systems where chemical agents are automatically dispensed into the system by means of solution-metering pumps.

2.6 CLOSED SYSTEM FILTRATION

A. Provide a closed-loop filtration system for each closed loop recirculating system

PART 3 - EXECUTION

3.1 EXAMINATION

A. Accept all materials and equipment in factory packaging and examine for visible damage. All damaged material and equipment shall be removed from the job site and replaced by the manufacturer.

B. Verify existing conditions prior to starting work.

C. Carefully check space requirements with other trades to ensure that all materials can be installed in the spaces allotted thereto.

D. Closed System Treatment

1. Introduce closed system water treatment through bypass feeder when required or indicated by test.
2. Control levels indicated are provided as a reference guide. These levels should be adjusted based on the water treatment program submitted.

System	Treatment and Chemical Conditions	Control Level
Chilled Water and Secondary Condenser Water	Buffered sodium nitrite (as NO2 with triazole nonferrous metal organic inhibitor and polymeric deposit inhibitor.	500 - 1,000 ppm (as NO2)
	Organic growths	None
	pH	8.5 - 11.0
Hot Water	Buffered sodium nitrite (as NO2) with triazole nonferrous metal organic inhibitor and polymeric deposit inhibitor	1,000 - 1,500 ppm (as NO2)
	Organic growths	None
	pH	8.5 - 11.0

3.2 CLOSEOUT SUBMITTALS

A. Provide project record documents and operation and maintenance data in accordance with Section 23 01 00 - Operation and Maintenance of HVAC.

B. Project Record Documents: Record actual locations of equipment and piping, including sampling points and location of chemical injectors.

C. Operation and Maintenance Data: Submit data on chemical feed pumps, agitators and other equipment, including spare parts lists, procedures and treatment programs. Include step-by-step instructions on test procedures, including target concentrations.

3.3 ADJUSTING AND BALANCING

A. Upon completion of the piping, hangers for piping and at equipment shall be adjusted to ensure that the loads are distributed evenly and that there are no loads imposed by the piping or the equipment that it is connected to.

B. Securely tighten clevis hanger load nuts first to ensure proper hanger performance. Tighten top nut after adjustment.

C. All equipment, valves, quick-closing devices and the like shall be adjusted in accordance with manufacturers' recommendations to function properly with capacities required and/or specified.

D. Adjust all solution-metering pumps to maintain the chemical concentrations specified in the water treatment program necessary to minimize corrosion and microbial growth.

E. Adjust flow through each corrosion coupon rack to maintain the minimum velocities specified hereinabove for best possible monitoring.

F. Adjust all time clocks and timers on chemical injection equipment, water softeners, brine tanks and system controllers maintaining chemical concentrations required for the water treatment program.

G. Adjust all system controllers, alarm devices and sensors to maintain accuracy of system measurements taken by the controller and transmitted to the building management system.

END OF SECTION 23 25 00

SECTION 23 25 17

HVAC WATER FILTRATION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide water filtration systems and accessories, etc., as indicated and scheduled on the drawings and in accordance with the Construction Documents.

B. Section includes:

1. Water filtration systems.
2. Backwash surge tanks.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.

1.3 REFERENCES

A. All filtration systems and associated components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the State of New York.
   b. Fire Code of the State of New York.
   c. Mechanical Code of the State of New York.
   d. Energy Conservation Construction Code of New York State.
   e. New York City Building Code.
   f. New York City Mechanical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. American Society of Mechanical Engineers (ASME)
      1).

1.4 SUBMITTALS

A. Submittals shall be furnished in accordance with the requirements of Section 23 00 00.

1.5 WARRANTY

A. Comply with Division 01 - General Requirements and Section 23 00 00 requirements for product warranties.

B. Furnish a five- (5-) year manufacturer’s warranty for all water filtration systems.

C. Warranty period shall initiate upon Final Acceptance by Owner.

1.6 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Contract Documents.

B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product’s equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be

inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Contract Documents will be revised to reflect the substitution.

C. Following is the list of acceptable manufacturers:
   1. AmeriWater.
   2. Diamond Water Systems, Inc.
   3. Process Efficiency Products, Inc. (P.E.P.).
   4. Puroflex.
   5. Tower-Flo.

2.2 GENERAL REQUIREMENTS

A. Provide skid-mounted packaged water filtration systems consisting of filter tanks, filter media, pumps, valves, piping, electrical controls, etc., as required to maintain cleanliness in the following systems.
   1. Chilled water system.
   2. Hot water system.

B. The design flow rate shall be a minimum of 20 gpm per square foot of media surface area. Filter shall remove at least 50% (by count) of 0.5 micron particles and at least 80% (by count) of 2 micron particles typically found in open condenser water systems within 30 days of startup.

C. Filter shall operate continuously, removing suspended particles from the condenser water until either a pressure drop across the filter bed of 18 psi is reached or twenty-four (24) hours has elapsed. At either point the filter shall automatically backwash each vessel utilizing city water sequentially for 5 minutes. The maximum backwash flow rate shall be 10 gpm per square foot of filter surface area. After the backwash cycle, the filter shall automatically return to filtration mode.

2.3 FILTRATION SYSTEMS EQUIPMENT

A. Filter system shall consist of media vessel(s) with a single permanent media (sand) prefilter with removable basket, recirculating pump, control cabinet and bronze directional valves for flow control. The components shall be fully assembled, tested and adjusted at the manufacturer's plant and mounted on a channel iron base

PART 3 - EXECUTION

3.1 INSTALLATION

A. All water piping connections to equipment shall include all necessary isolation valves, air vent valves, drain connections, balancing valves and the automatic valves arranged as detailed on the drawings.

END OF SECTION 23 25 17

SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.1 Summary

A. Provide all ducts, duct fittings, acoustical lining, sealants, tapes, gaskets and other specialties as indicated and scheduled on the drawings and in accordance with the Contract Documents.

B. Section includes:

1. Rectangular metal ducts.
2. Round, spiral and flat-oval ducts.
3. Metal duct fittings.
4. Fire-rated duct systems.
5. Blast-resistant fire-rated duct systems.
6. Underground corrosion-resistant duct systems.
7. Acoustical duct liner board.
8. Hangers and supports.
9. Attachments to structure.
10. Sealants, tapes and gaskets.

1.2 Related Sections

A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.

1.3 References

A. Ducts, duct fittings, acoustical lining, sealants, tapes, gaskets and other specialties shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the State of New York.
   b. Fire Code of the State of New York.
   c. Mechanical Code of the State of New York.
   d. Energy Conservation Construction Code of New York State.
   e. New York City Building Code.
   f. New York City Mechanical Code.
   g. New York City Fire Code.
   h. New York City Energy Conservation Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
      1). ASHRAE: HVAC Systems and Equipment Handbook.
   b. American Society of Testing and Materials (ASTM)
   c. American Welding Society (AWS)
   d. International Organization for Standardization (ISO)
      1). ISO 6944: Fire Containment - Elements of Building Construction Part 1 Ventilation Ducts.
   e. National Fire Protection Association (NFPA)
      1). NFPA 90A: Standard for the Installation of Air-Conditioning and Ventilating Systems.

2). NFPA 90B: Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
3). NFPA 92A: Recommended Practice for Smoke-Control Systems.
4). NFPA 255: Standard Method of Test of Surface Burning Characteristics of Building Materials.

f. North American Insulation Manufacturers Association (NAIMA)
1). NAIMA AH124: Fibrous Glass Duct Liner Standard.

g. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA)
1). ANSI/SMACNA HVAC Duct Construction Standards - Metal and Flexible.
2). SMACNA Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems.
3). SMACNA HVAC Systems Duct Design.
4). SMACNA HVAC Systems Testing, Adjusting and Balancing.
5). SMACNA HVAC Air Duct Leakage and Testing Manual.
6). SMACNA HVAC Duct Systems Inspection Guide.
7). SMACNA HVAC Duct Cleanliness for New Construction

h. Underwriters Laboratories, Inc. (UL)
1). UL 181: Factory-Made Air Ducts and Air Connectors.
2). UL 181A: Closure Systems for Use with Rigid Air Ducts and Air Connectors.
3). UL 723: Standard for Test for Surface Burning Characteristics of Building Materials.
4). UL 1479: Standard for Fire Tests of Penetration Firestops.
5). UL 1978: Standard for Grease Ducts.

1.4 Submittals
A. Submittals shall be furnished in accordance with the requirements of Section 23 00 00.

1.5 Warranty
A. Comply with Division 01 and Section 23 00 00 requirements for product warranties.
B. Furnish a one (1)-year manufacturer's warranty for all duct systems, associated accessories and components provided.
C. Furnish a one (1)-year installation warranty against any and all defects for all duct systems, associated accessories and components provided.
D. Warranty period shall initiate upon Final Acceptance by Owner.

1.6 Commissioning
A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers
A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Contract Documents.
B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Contract Documents shall be revised to reflect the substitution.

C. Adhesive and Sealants
   1. Carlisle.
   2. Childers.
   3. Duct Mate.
   4. Duro Dyne.
   5. Elgen.
   6. Foster.
   7. Miracle-Kingco.
   8. Precision Adhesives.

D. Sheet Metal Transverse Duct Connections
   1. Duct Mate.
   2. Duro Dyne.
   3. TDC.
   4. TDF.
   5. Empire Industries, Inc.

2.2 General Requirements

A. Ducts shall be designed and constructed in accordance with ANSI/SMACNA HVAC Duct Construction Standards - Metal and Flexible and SMACNA HVAC System Duct Design.

B. All construction standards, figure numbers and details referred to are from SMACNA “HVAC Duct Construction Standards (Metal & Flexible)”, Third Edition - 2005.

C. Galvanized sheet steel shall conform to ASTM A653/A653M coating designation G90, free of imperfections such as pitting or other physical imperfections. Where exposed to view, sheet metal shall be mill phosphatized to accept paint.

D. Aluminum sheets shall conform to ASTM B209/B209M.

E. Stainless steel sheets shall conform to ASTM A240/A240M.

F. Welding shall be performed in accordance with ASW D1.1 for hangers and supports and in accordance with AWS D9.1 for sheet metal. Any aluminum welding shall be in accordance with AWS D1.2.

G. Other fabricated parts (e.g., plates, bars and strips) shall be hot-dip galvanized in accordance with ASTM A123/A123M and shall be structurally reinforced.

H. Each duct system shall be constructed for the specific duct pressure classifications shown in the Contract Drawings and/or specified herein.

2.3 Rectangular Ducts

A. Rectangular duct joinery and fabrication shall be in strict accordance with the following:
   1. Seams: Pittsburgh Lock minimum 3/8 inch (9.5 mm).
   2. The following longitudinal seams are not permitted:
      a. Button punch/snap lock (L-2)
      b. Standing seam (L-4)
      c. Single-corner seam (L-5)
   3. The following transverse joints are not permitted:
      a. Lap (T-4)
      b. Reinforced S slip (T-7)
      c. Standing seam (T-15)
      d. Reinforced standing seam (T-16)
      e. Pocket lock (T-17)
      f. Reinforced pocket lock (T-18 and T-19)
      g. Capped flange (T-20)
   4. Where manufactured transverse joints are used (SMACNA T-25a, T-25b, i.e., Ductmate, TDC, TDF, etc.), they shall be submitted with the manufacturer's standards for construction and installation and installed in accordance with those standards.

2.4 Duct Construction Classifications
- A. Refer to table in Appendix A for all duct construction classifications.

2.5 Sealants, Gaskets And Adhesives
- A. Provide sealants, tapes, and gaskets as specified in Section 07 90 00 - Joint Protection and conforming to ANSI/SMACNA HVAC Duct Construction Standards - Metal and Flexible and following the recommendations found in the SMACNA HVAC Air Duct Leakage Test Manual for estimated and practical leakage allowances.
- B. Sealants and gaskets shall have a maximum flame spread index of 25 and a maximum smoke development index of 50 in accordance with ASTM E84
- C. Seam and joint sealants shall be water-based, having the following characteristics:
  1. Solids Content: Minimum 50%.
  2. Non-flammable.
  3. VOC: Maximum 30 gms/ltr.
  4. Service: Indoor or outdoor.
  5. Application Method: Brush, trowel or caulking gun.
- D. Gaskets shall be one (1) of the following types:
  1. Non-skinning, non-drying butyl rubber polymer tape.
  2. Closed-cell neoprene, PVC and nitrile.
- E. Insulation adhesives shall be solvent-based, having the following characteristics:
  1. Type: Elastomer rubber or synthetic elastomer rubber.
  2. Solids Content: Minimum 30%.
  3. Non-flammable.
  4. VOC: Maximum 540 g/L.
  5. Application Method: Spray, brush or roller.
  6. Service: Indoor or outdoor.

PART 3 - EXECUTION

3.1 Examination
- A. Verify existing conditions before starting work.
- B. Carefully check space requirements with other trades to ensure that all material can be installed in the spaces allotted thereto.
- C. Wherever this Contractor's work interconnects with work of other Contractors, this Contractor shall coordinate his work with these Contractors to ensure that all Contractors have the information necessary so that they may properly install all the necessary connections and equipment. Identify all work items (valves, etc.) in an approved manner in order that the Ceiling Contractor may know where to install access doors and panels.
- D. The Construction Manager/General Contractor shall provide benchmarks, monuments and other reference points on the job which shall be available for this Contractor's use.
- E. Maintain all existing benchmarks, monuments and other reference points and perform all field engineering required to ensure that work under this section shall conform with grades, elevations and lines required.

3.2 Installation
- A. Provide all ductwork, sheet metal flues, register boxes, air chambers, dampers and all auxiliary work of any kind necessary to make the various air conditioning, ventilating and heating systems of the building complete and ready for satisfactory operation.

3.3 Adjusting And Balancing
- A. Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for adjusting and balancing the air system. Refer to SMACNA HVAC Systems Testing, Adjusting and Balancing for system balancing requirements.

END OF SECTION 23 31 13

SECTION 23 31 19

HVAC CASINGS AND PLENUMS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all casings and plenums as indicated and scheduled on the drawings and in accordance with the Construction Documents.

B. Section includes:

1. Shop-fabricated field-erected casings and plenums.
2. Factory-fabricated sound-rated insulated casings and plenums.
3. Acoustical duct liner board.
4. Sealants, tapes and gaskets.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.

1.3 REFERENCES

A. All casings and plenums shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the State of New York.
   b. Fire Code of the State of New York.
   c. Mechanical Code of the State of New York.
   d. Energy Conservation Construction Code of New York State.
   e. New York City Building Code.
   f. New York City Mechanical Code.
   g. New York City Fire Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
      1). ASHRAE: HVAC Systems and Equipment Handbook.
   b. American Society of Testing and Materials (ASTM)
   c. American Welding Society (AWS)
   d. National Fire Protection Association (NFPA)
      1). NFPA 90A: Standard for the Installation of Air-Conditioning and Ventilating Systems.
      2). NFPA 90B: Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
      3). NFPA 92A: Recommended Practice for Smoke-Control Systems.
   e. North American Insulation Manufacturers Association (NAIMA)
      1). NAIMA AH124: Fibrous Glass Duct Liner Standard.
   f. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA)
      1). ANSI/SMACNA HVAC Duct Construction Standards - Metal and Flexible.
      2). SMACNA Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems.

3). SMACNA HVAC Systems Duct Design.
4). SMACNA HVAC Systems Testing, Adjusting and Balancing.
5). SMACNA HVAC Air Duct Leakage and Testing Manual.
6). SMACNA HVAC Duct Systems Inspection Guide.
7). SMACNA HVAC Duct Cleanliness for New Construction

1.4 SUBMITTALS
A. Submittals shall be furnished in accordance with the requirements of Section 23 00 00.

1.5 WARRANTY
A. Comply with Division 01 - General Requirements and Section 23 00 00 requirements for product warranties.
B. Furnish a one- (1-) year manufacturer's warranty for all casings and plenums, associated accessories and components provided.
C. Furnish a one- (1-) year installation warranty against any and all defects for all casings and plenums, associated accessories and components provided.
D. Warranty period shall initiate upon Final Acceptance by Owner.

1.6 COMMISSIONING
A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Construction Documents.
B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Construction Documents will be revised to reflect the substitution.
C. Adhesives and Sealants
1. Benjamin Foster Company.
2. Centiva.
3. Duro Dyne.
4. Elgen.
5. ITW TACC.
D. Factory-Fabricated Sound-Rated Insulated Casings and Plenums
1. Dynasonics.
2. I.A.C. (Industrial Acoustics Co.).
3. I.N.C. (Industrial Noise Control, Inc.).
4. Kinetics Noise Control, Inc.
5. Vibro-Acoustics.
E. Transverse Duct Connections
1. Ductmate Industries, Inc.
2. Duro Dyne.
3. TDC.
4. TDF.

2.2 GENERAL REQUIREMENTS
A. Casings and plenums shall be designed and constructed utilizing joints and components consistent with the static pressure class, applicable sealing requirements, materials involved, support intervals and other provisions for proper assembly in accordance with the requirements of

Chapter 9 of ANSI/SMACNA HVAC Duct Construction Standards - Metal and Flexible and SMACNA HVAC System Duct Design.

B. All construction standards, figure numbers and details referred to are from the SMACNA HVAC Duct Construction Standards - Metal and Flexible, Third Edition - 2005.

2.3 HANGERS AND SUPPORTS

A. Comply with the requirements of Section 23 05 29.

2.4 SEALANTS, GASKETS AND ADHESIVES

A. Provide sealants, tapes and gaskets as specified and conforming to ANSI/SMACNA HVAC Duct Construction Standards - Metal and Flexible and following the recommendations found in SMACNA HVAC Air Duct Leakage Test Manual for estimated and practical leakage allowances.

B. Sealants and gaskets shall have a maximum flame spread index of 25 and a maximum smoke development index of 50 in accordance with ASTM E84.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Carefully check space requirements with other trades to ensure that all material can be installed in the spaces allotted thereto.

C. Wherever this Contractor's work interconnects with work of other Contractors, this Contractor shall coordinate his work with these Contractors to ensure that all Contractors have the information necessary so that they may properly install all the necessary connections and equipment. Identify all work items (valves, etc.) in an approved manner in order that the Ceiling Contractor may know where to install access doors and panels.

D. The Construction Manager/General Contractor shall provide benchmarks, monuments and other reference points on the job, which shall be available for this Contractor's use.

E. Maintain all existing benchmarks, monuments and other reference points and perform all field engineering required to ensure that work under this section shall conform with grades, elevations and lines required.

3.2 INSTALLATION

A. Prior to installation, verify all required field measurements.

B. Provide all casings or plenums and all auxiliary work of any kind necessary to make the various air conditioning systems, heating and ventilating systems, intake and discharge plenums, etc., complete and ready for satisfactory operation.

C. While the drawings shall be adhered to as closely as possible, the right is reserved to vary the sizes of casings or plenums where necessary to accommodate conditions arising at the building.

D. All casings or plenums shall be built with approved joints and seams, smooth on the inside and with a neat finish on the outside. Joints shall be made with laps in the direction of airflow; flanges shall not project into the air stream. Adequate bracing shall be provided to prevent vibration; additional bracing shall be provided where necessary.

E. Exact dimensions of casings or plenums must await approval of architectural louvers, control dampers, cooling and heating coils, fans, etc. Exact locations shall be in accordance with curtain wall and architectural louvers and shall be submitted for approval; otherwise, any changes directed after installation shall be made without additional cost. For all openings in casings or plenums for connections to architectural louvers, the ductwork must be tightly closed during construction to keep out rubbish.

F. Install all fire dampers, fire/smoke dampers, smoke dampers, manual balancing dampers, backdraft dampers and barometric dampers furnished by this Contractor, as well as control dampers and automatic louver dampers specified and furnished.

G. Dampers in casings and plenums shall be installed with the blades running horizontally.

H. Install dampers square and free from racking. Damper sleeves or frames must not be compressed or stretched into the casing or plenum openings.

I. Provide access doors as specified in Section 23 33 33 - Ducts, Casings and Plenum-Mounted Access Doors to permit inspection, operation and maintenance of all valves, coils, controls, control dampers, fire dampers, airflow-measuring devices, filters, bearings or other apparatus concealed behind casings or plenums.

J. All access doors shall open against the system pressure (i.e., on the suction side of fans, they shall open outward; on the discharge side of fans, they shall open inward).

3.3 ADJUSTING AND BALANCING

A. Refer to Section 23 05 93 - Testing, Adjusting and Balancing for adjusting and balancing the air system. Refer to SMACNA HVAC Systems Testing, Adjusting and Balancing for system balancing requirements.

END OF SECTION 23 31 19

SECTION 23 33 13

DAMPERS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all dampers as indicated and scheduled on the drawings and in accordance with the Construction Documents.

B. Section includes:

1. Volume-control dampers.
2. Fire dampers.
3. Smoke-control dampers.
4. Combination fire/smoke dampers.
5. Control dampers.
6. Backdraft dampers.
7. Automatic control dampers.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.

1.3 REFERENCES

A. All dampers and associated components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the State of New York.
   b. Fire Code of the State of New York.
   c. Mechanical Code of the State of New York.
   d. Energy Conservation Construction Code of New York State.
   e. New York City Building Code.
   f. New York City Mechanical Code.
   g. New York City Fire Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. Air Movement and Control Association International, Inc. (AMCA)
      1). AMCA 500-D: Laboratory Test Methods for Testing Dampers for Ratings.
      2). AMCA 511: Certified Ratings Program for Air Control Devices.
   b. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
      1). ASHRAE: HVAC Systems and Equipment Handbook.
   c. American Society of Testing and Materials (ASTM)
      1).
   d. American Welding Society (AWS)
      1). AWS D1.1/D1.1M: Structural Welding Code - Steel.
      2). AWS D1.2/D1.2M: Structural Welding Code - Aluminum.
      3). AWS D9.1/D9.1M: Sheet Metal Welding Code.
   e. National Fire Protection Association (NFPA)
      1). NFPA 90A: Standard for the Installation of Air-Conditioning and Ventilating Systems.

2). NFPA 90B: Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
3). NFPA 92A: Recommended Practice for Smoke-Control Systems.
4). NFPA 92B: Guide for Smoke Management Systems in Malls, Atria, and Large Spaces.
5). NFPA 101: Life Safety Code.

f. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA)
1). ANSI/SMACNA HVAC Duct Construction Standards - Metal and Flexible.
2). SMACNA Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems.
3). SMACNA HVAC Systems - Duct Design.
4). SMACNA HVAC Systems - Testing, Adjusting and Balancing.
5). SMACNA HVAC Duct Systems Inspection Guide.

g. Underwriters Laboratories, Inc. (UL)
1). UL 33: Standard for Heat Responsive Links for Fire-Protection Service.
2). UL 555: Standard for Fire Dampers.
3). UL 555S: Standard for Smoke Dampers.

1.4 SUBMITTALS
A. Submittals shall be furnished in accordance with the requirements of Section 23 00 00.

1.5 WARRANTY
A. Comply with Division 01 - General Requirements and Section 23 00 00 requirements for product warranties.
B. Furnish a five- (5-) year manufacturer's warranty for all dampers and damper operators.
C. Warranty period shall initiate upon Final Acceptance by Owner.

1.6 COMMISSIONING
A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements as set forth in the Construction Documents.
B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Construction Documents shall be revised to reflect the substitution.
C. Automatic Control Dampers
1. Air Balance, Inc.
2. Arlan.
3. Arrow United Industries.
4. Greenheck.
5. Imperial.
6. Nailor Industries.
7. Pottorff.
8. Ruskin.
9. TAMCO.

D. Backdraft Dampers and Barometric Relief Dampers
   1. Air Balance, Inc.
   2. Arlan.
   3. Arrow United Industries.
   4. Greenheck.
   5. Imperial.
   6. Nailor Industries.
   7. Pottorff.
   8. Ruskin.
   9. TAMCO.

E. Fire Dampers
   1. Air Balance, Inc.
   2. Arlan.
   3. Arrow United Industries.
   4. Greenheck.
   5. Imperial.
   6. Nailor Industries.
   7. Pottorff.
   8. Prefco, Inc.
   9. Ruskin.

F. Smoke Dampers
   1. Air Balance, Inc.
   2. Arlan.
   3. Arrow United Industries.
   4. Greenheck.
   5. Imperial.
   6. Nailor Industries.
   7. Pottorff.
   8. Prefco, Inc.
   9. Ruskin.
   10. TAMCO.

G. Combination Fire/Smoke Dampers
   1. Air Balance, Inc.
   2. Arlan.
   3. Arrow United Industries.
   4. Greenheck.
   5. Imperial.
   6. Nailor Industries.
   7. Pottorff.
   8. Prefco, Inc.
   9. Ruskin.

H. Actuators serving Smoke Dampers and Combination Fire/Smoke Dampers
   1. Belimo.
   2. Honeywell.
   3. Siemens.

2.2 GENERAL REQUIREMENTS

A. Dampers shall be constructed and installed in strict accordance with the following:
   1. Manufacturer’s requirements.
   2. UL 33: Standard for Heat Responsive Links for Fire-Protection Service.
   3. UL 555: Standard for Fire Dampers.
   4. UL 555S: Standard for Smoke Dampers.

5. ANSI/SMACNA HVAC Duct Construction Standards - Metal and Flexible.
6. SMACNA HVAC System Duct Design and the SMACNA Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems.

B. All dampers shall be constructed to withstand the approach velocity developed at maximum design airflow for each ductwork configuration as shown on the Mechanical Drawings. This Contractor shall determine the maximum design airflow through each damper, calculate the air velocity through the damper, and select a damper suitable to withstand the velocity developed without producing excessive noise or vibration. Maximum design airflow calculations shall be included with damper schedule submissions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Dampers shall be installed as detailed on the approved shop drawings. Prior to installation, verify all required field measurements.

B. Examine areas to receive dampers to ensure that there are no conditions that would adversely affect the installation or subsequent operation of dampers. Verify that there is proper clearance for counterweight and blade swings and to service damper actuators.

C. Manual balancing dampers, as shown on the drawings and as required, shall be installed in the various branches of the ductwork to be used in balancing the system. Note that these dampers shall be separate and independent from those specified in Section 23 07 13 - Diffusers, Registers and Grilles to be set behind supply and/or return air grilles. Multi-blade dampers shall be provided in large ducts. Volume dampers shall be provided in all supply, return and exhaust branch ductwork, and where indicated on the drawings.

D. Fire dampers or combination fire/smoke dampers suitable for installation in dynamic systems shall be installed in accordance with manufacturer's UL listing requirements in all ducts piercing fire-rated shafts, walls or floors.

E. Dampers shall be installed with the blades running horizontally.

F. Install dampers square and free from racking. Damper sleeves or frames must not be compressed or stretched into the duct or opening.

G. Fire dampers and combination fire/smoke dampers must be centered in the opening. Where the space between the fire dampers or combination fire/smoke dampers and the opening are greater than 3/4 inch (19 mm), mounting angles must be a minimum 16 gauge and must be installed on both sides.

H. Damper operators furnished by this Contractor shall be coordinated with, and approved for use with, the building automation system and/or building fire alarm system.

I. Duct access doors for inspection and maintenance of fire dampers, smoke dampers, combination fire/smoke dampers and control dampers must be furnished and installed adjacent to the dampers by this Contractor. Access doors at fire dampers, smoke dampers, and combination fire/smoke dampers shall be labeled as required in Section 23 05 53 - Identification for Piping and Equipment.

J. Ceiling and/or wall access doors shall be provided as required for inspection and maintenance of fire dampers, smoke dampers, combination fire/smoke dampers, control dampers and actuators.

K. Protect the interior sections of dampers from dust, dirt, moisture and other foreign materials during installation. Refer to SMACNA Duct Cleanliness for New Construction.

L. .

3.2 ADJUSTING AND BALANCING

A. Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for adjusting and balancing the air system. Refer to SMACNA HVAC Systems Testing, Adjusting and Balancing for system balancing requirements.

END OF SECTION 23 33 13

SECTION 23 33 19

DUCT SILENCERS AND ACOUSTIC TREATMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Provide duct silencers and acoustic treatment as indicated on the Construction Drawings and in accordance with the requirements of the Construction Documents.

B. Section includes:

1. Factory-built rectangular straight duct silencers.
2. Factory-built rectangular elbow duct silencers.
3. Factory-built round duct silencers.
4. Vaneaxial fan cone/diffuser silencers.
5. Sound-insulating panels.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.

1.3 REFERENCES

A. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.

1. Building Code of the State of New York.
2. Fire Code of the State of New York.
3. Mechanical Code of the State of New York.
4. Energy Conservation Construction Code of New York State.
5. New York City Building Code.
6. New York City Mechanical Code.

B. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:

1. Air Movement and Control Association (AMCA).
2. American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
   a. ASHRAE Handbooks - Fundamentals, HVAC Applications and HVAC Systems and Equipment Volumes.
3. American Society of Testing and Materials (ASTM)
   a.
4. National Fire Protection Association (NFPA)
   a. NFPA 90A: Standard for the Installation of Air-Conditioning and Ventilating Systems.
   b. NFPA 90B: Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
   c. NFPA 255: Standard Method of Test of Surface Burning Characteristics of Building Materials.
   d. NFPA 701: Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.
5. American Welding Society (AWS)
   a. AWS D1.1/D1.1M: Structural Welding Code - Steel.
   b. AWS D1.2/D1.2M: Structural Welding Code - Aluminum.
   c. AWS D9.1/D9.1M: Sheet Metal Welding Code.
6. NIST/NVLAP: National Voluntary Laboratory Accreditation Program.

7. North American Insulation Manufacturers Association (NAIMA)
   a. NAIMA AH124: Fibrous Glass Duct Liner Standard.
8. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA).
9. Underwriters Laboratories, Inc. (UL).
   a. UL 181: Factory-Made Air Ducts and Air Connectors.
   b. UL 181A: Closure Systems for Use with Rigid Air Ducts and Air Connectors.
10. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA)
    a. ANSI/SMACNA HVAC Duct Construction Standards - Metal and Flexible.
11. North American Insulation Manufacturers Association (NAIMA)
    a. NAIMA AH124: Fibrous Glass Duct Liner Standard.

1.4 SUBMITTALS

A. Submittals shall be furnished in accordance with the requirements of Section 23 00 00.

1.5 WARRANTY

A. Comply with Division 01 - General Requirements and Section 23 00 00 requirements for product warranties.
B. Furnish a three- (3-) year manufacturer's warranty for all duct silencers and accessories provided.
C. Furnish a one- (1-) year installation warranty against any and all defects for all duct silencers and acoustical systems, associated accessories and components provided.
D. Warranty period shall initiate upon Final Acceptance by Owner.

1.6 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Construction Documents.
B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Construction Documents will be revised to reflect the substitution.
C. Acoustic Lining
   1. Certain Teed Corp.
   2. Johns-Manville.
   3. Knauf.
   4. Owens-Corning.
D. Sound-Insulating Panels
   1. I.A.C. (Industrial Acoustics Co.).
   2. Kinetics Noise Control.
   3. McGill Air Silence LLC.
   4. Pottorff (formerly Dynasonics).
   5. Ruskin Sound Control.
   6. Vibro-Acoustics.
E. Sound Traps
   1. I.A.C. (Industrial Acoustics Co.).
   2. Kinetics Noise Control.

3. McGill Air Silence LLC.
4. Pottorff (formerly Dynasonics).
5. Price Industries.
6. Ruskin Sound Control.
7. Vibro-Acoustics.

2.2 DUCT SILENCERS AND ACOUSTIC TREATMENT - GENERAL REQUIREMENTS

A. All silencers, acoustical panels and assemblies shall have a flame spread and smoke developed rating of less than or equal to 25 and 50 respectively, in accordance with ASTM E84, NFPA 255 and UL-723, and applicable codes.

B. The manufacturer shall review the Contractor's drawings to ensure that the insertion losses and pressure drops for each silencer are based on the actual installed conditions.

C. Silencers shall be constructed of the same material as the attaching ductwork.

2.3 FACTORY-BUILT DUCT SILENCERS

A. Prefabricated duct silencers shall be constructed of all incombustible materials and shall be the standard product of an approved manufacturer.

B. The sound traps shall provide the following net insertion ratings under design airflow velocities as scheduled on the drawings. The ratings shall be determined by the duct to reverberant room test method.

1. Dynamic insertion loss shall be a minimum of:

Dynamic Net Insertion Loss (dB)					
Bands	**Band Width Center Freq. (cps)**	**Sound Trap Types**			
		A	**B**	**C**	**D**
2	125	5	7	12	18
3	250	9	13	16	24
4	500	14	21	28	40
5	1,000	23	29	35	45
6	2,000	19	33	35	46

2. The maximum self-generated noise by the above sound trap types shall not exceed the following sound power levels at face velocities of 2,000 fpm.

Sound Power Level dB re: 10^{-12} Watts			
Bands	**Band Width Center Freq. (cps)**	**Sound Trap Types**	
		AB	**CD**
2	125	51	69
3	250	51	63
4	500	49	64
5	1,000	47	61
6	2,000	50	63

PART 3 - EXECUTION

3.1 INSTALLATION

A. All duct silencers and sound-insulating panels shall be installed in strict accordance with the manufacturers' requirements and in accordance with the requirements of the related sections listed above in Article 1.2 as well as all the requirements in this section.

3.2 CLEANING and protection

A. Comply with Division 01 requirements for cleaning and protection of installed work.

B. Visually inspect duct silencers and sound-insulating panels for dust, dirt, moisture and other contaminants. If dust, dirt, moisture and/or other contaminants are present, reclean and reinspect.

C. Upon completion of the installation, remove all protective materials.

3.3 INSPECTION AND STARTUP

A. A competent factory-authorized service representative shall supervise and inspect the installation of sound-insulating panels.

B. Any defects that develop in the installation shall be corrected by the Contractor at no additional cost to the Contract.

C. Document the results of all testing and inspections.

END OF SECTION 23 33 19

SECTION 23 33 33

DUCTS, CASINGS AND PLENUM-MOUNTED ACCESS DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all access doors as indicated and scheduled on the drawings and in accordance with the Construction Documents.

B. Section includes:

1. Duct-mounted access doors for rectangular ducts.
2. Duct-mounted access doors for round and flat-oval ducts.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.

1.3 REFERENCES

A. Access doors and their components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the State of New York.
   b. Fire Code of the State of New York.
   c. Mechanical Code of the State of New York.
   d. Energy Conservation Construction Code of New York State.
   e. New York City Building Code.
   f. New York City Mechanical Code.
2. Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. American Society of Testing and Materials (ASTM)
   b. American Welding Society (AWS)
   c. National Fire Protection Association (NFPA)
      1). NFPA 90A: Standard for the Installation of Air-Conditioning and Ventilating Systems.
      2). NFPA 90B: Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
      3). NFPA 96: Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
   d. North American Insulation Manufacturers Association (NAIMA)
      1). NAIMA AH124: Fibrous Glass Duct Liner Standard.
   e. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA)
      1). ANSI/SMACNA HVAC Duct Construction Standards - Metal and Flexible.
      2). SMACNA Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems.
      3). SMACNA HVAC Systems Duct Design.
      4). SMACNA HVAC Systems Testing, Adjusting and Balancing.
      5). SMACNA HVAC Air Duct Leakage and Testing Manual.
      6). SMACNA HVAC Duct Systems Inspection Guide.

1.4 SUBMITTALS

A. Prior to beginning fabrication of duct systems and/or plenums, submit the following:

1. Detailed shop drawings for each type of access door for rectangular ducts, round ducts, flat-oval ducts, double-wall ducts, casings and plenums.
2. Manufacturer's approved installation instructions and installation details.

1.5 WARRANTY

A. Comply with Division 01 - General Requirements and Section 23 00 00 requirements for product warranties.
B. Furnish a one- (1-) year manufacturer's warranty for all access doors, ancillary parts and accessories provided.
C. Furnish a one- (1-) year installation warranty against any and all defects for all duct systems, associated accessories and components provided.
D. Warranty period shall initiate upon Final Acceptance by Owner.

1.6 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements as set forth in the Construction Documents.
B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved neither the project specifications nor the Construction Documents will be revised to reflect the substitution.
C. Acceptable Manufacturers
   1. Arlan Damper Corporation.
   2. Ductmate Industries.
   3. Duro Dyne Corporation.
   4. Flexmaster USA, Inc.
   5. Kees, Inc.

2.2 ACCESS DOORS - GENERAL REQUIREMENTS

A. Ducts shall be designed and constructed in accordance with the following:
   1. ANSI/SMACNA HVAC Duct Construction Standards - Metal and Flexible.
   2. SMACNA HVAC System Duct Design.
   3. Manufacturer's requirements (where applicable).
B. Access doors and frames shall be constructed of the same material as the duct, casing and/or plenum and be suitable for the pressure class or rating of the systems where they will be installed.
C. Listed and labeled access door assemblies shall be installed in accordance with the terms of the listing.
D. Access doors in systems having a pressure class of 2 inches (50 mm) or more shall open against the pressure. Outward-opening access doors shall be provided with retaining wires or chains.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Furnish and install access doors and frames as indicated on the drawings and specified herein to permit inspection, operation and maintenance of all valves, controls, fire dampers, fire/smoke dampers, smoke dampers, automatic control dampers, backdraft dampers, filters, humidifiers, smoke detectors, bearings, traps or other apparatus concealed behind the sheet metal work.

B. All access doors and accessories shall be installed in strict accordance with the manufacturers' requirements and in accordance with ANSI/SMACNA HVAC Duct Construction Standards - Metal and Flexible and shall meet the requirements of the following standards that apply:
   1. NFPA 90A: Standard for the Installation of Air-Conditioning and Ventilating Systems.
   2. NFPA 90B: Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
   3. NFPA 96: Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

C. Access doors/cleanout openings in kitchen exhaust ducts shall be provided no less than 20 feet (6 m) on centers and at all changes in direction and within 3 feet of the exhaust fan. They shall be located a minimum of 1-1/2 inches (38 mm) above the bottom and not less than 1 inch below the top of the duct.

3.2 FIELD QUALITY CONTROL

A. Perform all necessary inspections to ensure compliance in accordance with the SMACNA HVAC Duct Systems Inspection Guide.

B. Inspect and replace all damaged latches, hinges and gaskets.

C. Any defects that develop in the installation shall be corrected by the Contractor at no additional cost to the Owner.

D. Document the results of all testing and inspections.

3.3 CLEANING

A. Comply with Division 01 requirements for cleaning and protection of installed work.

B. Visually inspect access doors and components for dust, dirt, moisture and other contaminants. If dust, dirt, moisture and/or other contaminants are present, reclean and reinspect.

C. Upon completion of the installation, remove all protective materials.

END OF SECTION 23 33 33

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SECTION 23 33 43

FLEXIBLE CONNECTORS

PART 1 - GENERAL

1.1 SUMMARY

A. Perform all work necessary to provide and install all flexible connectors required for the complete and proper operation of all systems as indicated herein and on the Construction Documents.

B. Section includes:

1. Flexible connectors at fans.
2. Air distribution flexible connectors.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.

1.3 REFERENCES

A. Flexible connectors and their components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the State of New York.
   b. Fire Code of the State of New York.
   c. Mechanical Code of the State of New York.
   d. Energy Conservation Construction Code of New York State.
   e. New York City Building Code.
   f. New York City Mechanical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. Air Diffusion Council (ADC)
      1). ADC FD 72: Flexible Air Duct Test Code.
      2). Flexible Duct Performance & Installation Standards.
   b. American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
      1). ASHRAE Handbooks - Fundamentals, HVAC Applications and HVAC Systems and Equipment Volumes.
   c. American Society of Testing and Materials (ASTM)
      1). ASTM A653/A653M: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
      2). ASTM C553: Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
   d. National Fire Protection Association (NFPA)
      1). NFPA 90A: Standard for the Installation of Air-Conditioning and Ventilating Systems.
      2). NFPA 90B: Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
      3). NFPA 701: Standard Methods of Fire Tests for Flame Propagation Textiles and Films.

e. American Welding Society (AWS)
   1). AWS D1.1/D1.1M: Structural Welding Code - Steel.
   2). AWS D1.2/D1.2M: Structural Welding Code - Aluminum.
   3). AWS D9.1/D9.1M: Sheet Metal Welding Code.
f. North American Insulation Manufacturers Association (NAIMA)
   1). NAIMA AH124: Fibrous Glass Duct Liner.
g. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA)
   1). ANSI/SMACNA HVAC Duct Construction Standards - Metal and Flexible.
   2). SMACNA Duct Cleanliness for New Construction.
   3). SMACNA HVAC Systems Duct Design.
   4). SMACNA HVAC Air Duct Leakage and Testing Manual.
   5). SMACNA HVAC Duct Systems Inspection Guide.
h. Underwriters Laboratories, Inc. (UL)
   1). UL 181: Factory-Made Air Ducts and Air Connectors.
   2). UL 181B: Closure Systems for Use with Flexible Air Ducts and Air Connectors.

1.4 SUBMITTALS

A. Submittals shall be furnished in accordance with the requirements of Section 23 00 00. .

1.5 WARRANTY

A. Comply with Division 01 - General Requirements and Section 23 00 00 requirements for product warranties.
B. Furnish a one- (1-) year manufacturer's warranty for all flexible connectors and accessories provided.
C. Warranty period shall initiate upon Final Acceptance by Owner.

1.6 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Construction Documents.
B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Construction Documents will be revised to reflect the substitution.
C. Flexible Connectors at Fans and Plenums
   1. Carlisle Hardcast.
   2. Ductmate Industries, Inc.
   3. Duro Dyne.
   4. FanAir Company.
   5. Leader Ventilation.
   6. Ventfabrics.
D. Air Distribution Flexible Connectors
   1. Acosta Sheet Metal Manufacturing, Inc.
   2. C. A. Schroeder Inc. / Casco.

3. Clevaflex, Inc.
4. Flexmaster.
5. Gray Flex Systems, Inc.
6. Hart & Cooley.
7. J.P. Lamborn Co.
8. Quietflex.
9. Wiremold.

2.2 GENERAL REQUIREMENTS

A. Provide flexible connectors of sizes and types as specified and as shown on the drawings. The intention is to prohibit the transfer of vibration from fans, VAV boxes, fan-powered VAV boxes, etc., to the ductwork, plenums, casings, etc.

B. Flexible Connectors at Fans

1. Flexible connections at fans, except as otherwise required by the Authorities Having Jurisdiction and except as otherwise noted below, shall comply with the following:

System Type	Connection Material
Conventional HVAC Systems	18 oz./sq.yd. (610 g/sq.m) vinyl-coated polyester
Generator Radiator Discharge	17 oz./sq.yd. (576 g/sq.m) silicon rubber-coated woven fiberglass

2. The fabric shall be secured to the metal a double hemlock with the fabric shielded on both sides to help prevent tears.
3. Each flexible connection shall be approximately 6 inches (150 mm) long and securely attached and sealed to prevent any leakage at the connection points.
4. Flexible connections shall withstand the operating air pressure without air leakage, and shall not transmit vibration.

C. Air Distribution Flexible Connectors

1. Type 1 flexible connectors shall be made of a PVC-coated metal helix reinforced core with a 1 inch (25 mm) thick, 1 lb. (0.45 kg/cu.m) density fiberglass blanket with a factory-applied foil-faced, scrim-reinforced, Kraft vapor barrier.
   a. 25 inch (6.25 kPa) w.g. pressure rating.
   b. 5,000 fpm (25.4 m/sec.) rated velocity.
   c. -20ºF (-28ºC) to 250ºF (-121ºC) temperature rating.
2. Type 2 flexible connectors shall be made of a nylon fabric core with a 1 inch (25 mm) thick, 1 lb. (0.45 kg/cu.m) density fiberglass blanket with a factory-applied foil-faced, scrim-reinforced, Kraft vapor barrier.
   a. 6 inch (1.5 kPa) w.g. pressure rating.
   b. 5,000 fpm (25.4 m/sec.) rated velocity.
   c. -20ºF (-28ºC) to 250ºF (-121°C) temperature rating.
3. Type 3 flexible connectors shall be made of 18 oz./sq.yd. (610 g/sq.m) vinyl-coated polyester fabric double hemlocked to metal bands.

D. All materials shall be listed and labeled by Underwriters Laboratories, Inc., for a fire hazard classification, as tested under ASTM, NFPA or UL procedures, not to exceed the following:

1. Flame Spread: 25.
2. Fuel Contributed: 50.
3. Smoke Developed: 50.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Furnish and install flexible connectors and all accessories as indicated on the Construction Drawings and specified herein to prohibit the transfer of vibration from fans to ductwork or plenums.

3.2 FIELD QUALITY CONTROL

A. Perform all necessary inspections to ensure compliance with the SMACNA HVAC Duct Systems Inspection Guide.

B. Any defects that develop in the installation shall be corrected by Contractor at no additional cost to the Contract.

C. Document the results of all testing and inspections.

3.3 CLEANING

A. Comply with Division 01 requirements for cleaning and protection of installed work.

B. Visually inspect flexible connectors and all accessories for dust, dirt, moisture and other contaminants. If dust, dirt, moisture and/or other contaminants are present, reclean and reinspect.

END OF SECTION 23 33 43

SECTION 23 34 00

HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all fans as indicated and scheduled on the drawings and in accordance with the Construction Documents.

B. Section includes:

1. Axial fans.
2. Belted vent sets.
3. DWDI centrifugal fans.
4. SWSI centrifugal fans.
5. Plenum fans.
6. Tubular centrifugal fans.
7. Induced-flow high-plume exhaust (cannon) fans.
8. Mixed-flow fans.
9. Propeller fans.
10. Power ventilators.
11. Cabinet fans.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.

1.3 REFERENCES

A. All fans shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the State of New York.
   b. Fire Code of the State of New York.
   c. Mechanical Code of the State of New York.
   d. Energy Conservation Construction Code of New York State.
   e. New York City Building Code.
   f. New York City Mechanical Code.
   g. New York City Fire Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. Air Movement and Control Association International, Inc. (AMCA)
      1). Sound Performance.
   b. American Bearing Manufacturers Association (ABMA)
      1). ABMA 9: Load Ratings and Fatigue Life for Ball Bearings.
      2). ABMA 11: Load Ratings and Fatigue Life for Roller Bearings.
   c. American National Standards Institute (ANSI)
      1). ANSI S2.19: Mechanical Vibration - Balance Quality Requirements of Rigid Rotors - Part 1: Determination of Possible Unbalance, Including Marine Applications.
   d. Occupational Safety and Health Administration (OSHA)
      1). OSHA 1910.212: Machinery and Machine Guarding.
   e. Underwriters Laboratories (UL)

1). UL 705: Standard for Power Ventilators.

1.4 SUBMITTALS

A. Submittals shall be furnished in accordance with the requirements of Section 23 00 00.

1.5 WARRANTY

A. Comply with Division 01 - General Requirements and Section 23 00 00 requirements for product warranties.

B. Furnish a one- (1-) year manufacturer's warranty against manufacturing defects for all systems and components.

C. Furnish a three- (3-) year warranty for motors.

D. Furnish a five- (5-) year warranty for bearings.

E. Warranty period shall initiate upon Final Acceptance by Owner.

1.6 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements as set forth in the Construction Documents.

B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Construction Documents will be revised to reflect the substitution.

C. Prior to consideration of an approval for substitution of any fan manufacturer for the manufacturer scheduled on the drawings, submit the manufacturer's certified performance curves for the main supply, return and exhaust air fans showing the system plot from the scheduled design point down to a cfm equal to 40% of design cfm at approximately 2 inches water static pressure. Certified performance curves shall also indicate the input kilowatts to the motor at design point and 75%, 60%, 50% and 40% of design cfm. This data shall be submitted as a prerequisite to consideration of approval of a substitute fan manufacturer.

D. Vaneaxial Fans

1. Aerovent.
2. American Fan Company.
3. Chicago Blower Corporation.
4. Greenheck.
5. Howden-Buffalo.
6. Loren Cook Company.
7. Strobic Air Corporation.
8. Twin City Fan and Blower.

E. Mixed-Flow Fans

1. Aerovent.
2. Chicago Blower Corporation.
3. Greenheck.
4. Loren Cook Company.
5. Twin City Fan & Blower.

F. Cabinet Fans

1. Carnes Company

2. Greenheck.
3. Loren Cook Company.
4. Penn Barry.
5. Twin City Fan & Blower.

2.2 GENERAL REQUIREMENTS

A. All fans of a particular type shall be the products of one manufacturer.

B. Fans shall be designed and manufactured in accordance with the latest applicable industry standards, applicable codes and the requirements of local authorities.

C. Furnish all fans conforming to the capacity and performance requirements scheduled and with the physical dimensions, direction of rotation, discharge direction and arrangement conforming to the layouts shown on the drawings and complying with the requirements described herein.

D. All fans shall be guaranteed to fulfill the specified requirements. Fans shall not produce excessive noise as compared to units of like size and power when used in conjunction with the specified vibration isolation. Refer to Section 23 05 48.13 - Seismic Controls for HVAC Piping, Ducts and Equipment and Section 23 05 48.16 - Vibration Isolation for HVAC Piping, Ducts and Equipment.

E. Static pressures listed in the fan schedules shall be exclusive of drive losses, or losses due to inlet screens, variable and/or fixed inlet vanes. All motor horsepowers and fan selections shall be sized to deliver the design cfm as scheduled versus the listed static pressure plus the additional static pressure required by the fan manufacturer to compensate for the difference in static pressures between the heating and cooling coils to be provided versus that scheduled, the drive losses per AMCA, inlet screen losses, belt guards and inlet vane losses per published data.

F. All fans shall carry the AMCA performance and construction seal. Fan performance ratings shall be in accordance with the following:
   1. AMCA 210: Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
   2. AMCA 211: Certified Ratings Program - Product Rating Manual for Fan Air Performance.

G. The fan manufacturer shall furnish the published sound power level of fans to define sound power levels (PWL), re: 10^{-12} watts for each of the eight (8) frequencies. Such data shall be based on tests conducted in accordance with the following:
   1. AMCA 300: Reverberant Room Method for Sound Testing of Fans.
   2. AMCA 301: Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
   3. AMCA 311: Certified Ratings Program - Product Rating Manual For Fan Sound Performance

H. Fan housing shall be rigidly built and braced. Where the fan scroll is 19 inches (480 mm) or more in width or where called for in schedule, or shown on plans for scrolls less than 19 inches (480 mm) in width, an access door with frame and gasket shall be provided. All access doors shall be so fabricated that the inner surface is flush with the inside of the scroll. Raised frame doors of the pan type shall be provided on all fans where insulation is required. The doors shall be secured to the frame by hand-grip latches and shall be provided with lift handles. Bolted doors are not acceptable except where specifically noted in schedules.

I. Completed fan assemblies shall be statically and dynamically balanced to meet or exceed Fan Application Category BV-5 in accordance with AMCA 204 - Balance Quality and Vibration Levels for Fans and ANSI S2.19 - Mechanical Vibration - Balance Quality Requirements of Rigid Rotors - Part 1: Determination of Possible Unbalance, Including Marine Applications. Measurements shall be made in three (3) orthogonal planes at the impeller shaft bearings. Where this is not possible, the pick-up shall be mounted at the shortest direct mechanical path between the transducer and the bearing. Transducers shall not be mounted on an unsupported panel, guard or elsewhere where a solid signal path cannot be obtained.

J. Shafts shall be AISI 1040 or 1045 hot-rolled steel, precisely turned, ground, polished and gauged for accuracy. Shafts shall be sized for the first critical speed of at least 1.43 times the maximum speed. Fan shaft shall be solidly constructed of AISI 1040 or 1045 steel. Shafts shall be turned, ground and polished to a minimum 16 micro-inch finish. Shafts shall be sized to run at a minimum

of 120% of the maximum AMCA class speed.

K. Fan bearings shall comply with the following:
1. ABMA 9: Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11: Load Ratings and Fatigue Life for Roller Bearings.
3. Fan bearings shall have an AFBMA L_{50} life of 200,000 hours at maximum horsepower and operating speed.
4. All fans operating against a total pressure of 3-3/4 inch H_2O (0.93 kPa) or greater shall be equipped with heavy-duty, grease-lubricated, self-aligning, double-row, spherical roller bearings with split pillow blocks. Bearings for fans operating against a total pressure of less than 3-3/4 inch H_2O (0.93 kPa) shall be self-aligning, grease-lubricated, spherical, roller type with split pillow blocks. On all Class 1 fans, Arrangement No. 1 and No. 2 heavy-duty ball bearings may be furnished. All bearing casings shall be furnished with self-sealing grease fittings and drain plugs.

2.3 VANEAXIAL FANS

A. In addition to the requirements listed in Article 2.2 - General Requirements, vaneaxial fans shall comply with the following:
1. Fan rotor hub shall be of heat-treated cast aluminum construction, and blades shall be cast of aluminum alloy. Fan blades shall be air-foil shaped for maximum efficiency. A blade angle indicator shall be provided to indicate blade position for various pitch settings. Blade tip clearance to fan housing shall not exceed 0.05 inch (1.25 mm) for 36 inch (90 mm) diameter or smaller fan rotor and 0.10 inch (2.55 mm) for all other sizes.
2. Each blade must be index-marked for various pitch settings.
3. The fan blades on fans scheduled as variable pitch in motion shall be automatically adjustable through a pitch range of sufficient angularity to vary volume and pressure characteristics as required by the design and specification, and shall be capable of stepless control across the complete pitch range while the motor is operating at full speed. The pitch of the blades in the controllable pitch rotor shall be varied by an electric actuator provided by the fan manufacturer. The actuator and its associated positioner shall be mounted external to the fan mounted on the fan casing. The actuator shall be controlled by a signal from a remote controller, furnished and installed by others. Controllable pitch mechanism shall be equipped with a safety stop to prevent blade pitch settings being increased beyond maximum design setting and overloading the motor. Periodic overhaul or routine maintenance shall not require disassembly of the controllable pitch rotor assembly.
4. To avoid the possibility of hysteresis and to ensure a precise blade angle setting for any given signal regardless of the direction of travel, the actuator must be of the double-acting type. A spring-return type actuator shall not be permitted.
5. Vaneaxial fans shall be direct-motor-driven as indicated on the drawings and/or fan schedule as follows:
a. Direct-driven vaneaxial fans shall be Arrangement No. 4 with the motor inside the fan housing and the fan rotor assembly attached directly to the motor shaft.
b. The fan rotor shall be whirl-tested to 125% of maximum operating speed and shall be statically and dynamically balanced on the fan motor shaft to a maximum tolerance, guaranteed in writing, of 1 mil double amplitude at design operating speed. In lieu of a whirl test, manufacturer may provide documented results of an x-ray test.
c. The fan rotor shall be statically and dynamically balanced on the fan motor shaft.
d. Motors shall be totally enclosed air-over, "C" face, flange-mounted, squirrel cage induction, single-speed, single-winding, continuous-duty variable torque, and suitable for operation in either vertical, or horizontal or angular position. Motors shall be rated for 55°C rise over 40°C ambient and shall be capable of operation

at 95°C rise. External copper grease leads for lubrication of motor bearings, and to relieve excess grease pressure, shall be provided by the fan manufacturer. Motors shall be capable of operating at the voltages specified in the schedules.

e. A conduit box shall be mounted on the exterior of the fan casing and the lead wires from the motor conduit box shall be protected from the air stream by being encased in an airtight metal conduit pipe.

f. Inlet bells with radius inlet screens shall be provided for all vaneaxial fans. Bells may be aluminum, fiberglass or galvanized steel.

6. All vaneaxial fans shall be provided with supports for horizontal or vertical mounting, as shown on plans and shown in schedules. Horizontal and vertical fan supports shall be provided by the fan manufacturer and shall be securely bolted or welded to the housing of the fan. Supports shall be braced with angle braces to prevent misalignment and add structural rigidity.

7. Maximum sound power levels for return/exhaust fans are given in the following table. Should units with greater sound power levels be selected, the manufacturer shall be required to provide attenuation treatments in addition to those specified. All fan submittals shall incorporate certified sound power data for review by the Engineer/Acoustic Consultant. All additional attenuation treatments shall be approved by the Engineer/Acoustic Consultant prior to final acceptance.

2.4 CABINET FANS

A. The fan housing shall be minimum 20 gauge galvanized steel and acoustically insulated.

B. Blower and motor assembly shall be mounted to a minimum 14 gauge reinforcing channel and shall be easily removable from the housing. Motor shall be mounted vibration isolators.

C. Unit shall be supplied with integral wiring box and disconnect receptacle shall be standard.

D. Discharge position shall be convertible from right angle to straight through by moving interchangeable panels. The outlet duct collar shall include a reinforced aluminum damper with continuous aluminum hinge rod and brass bushings.

E. Wheel shall be centrifugal forward curved type, constructed of galvanized steel. Wheel shall be balanced in accordance with AMCA Standard 204-05, Balance Quality and Vibration Levels for Fans.

F. Motors shall comply with the requirements of Section 23 05 13 - Common Motor Requirements for HVAC Equipment. They shall be the open dripproof type with permanently lubricated bearings, built-in thermal overload protection and disconnect plug.

G. Where exposed, the inlet shall be furnished with a metal screen. Where mounted above a ceiling, they shall be provided with a white, non-yellowing, high-impact styrene injection molded designer style grill as standard or a powder-painted white steel grille as scheduled on the Contract Documents.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and assemble all fans and accessories shipped loose for field installation in accordance with manufacturer's installation instructions and recommendations.

B. Set fans level and true on resilient isolators as required in Section 23 05 48.13 - Seismic Controls for HVAC Piping, Ducts and Equipment and Section 23 05 48.16 - Vibration Isolation for HVAC Piping, Ducts and Equipment.

C. Connect fans to ductwork using flexible fabric connections in accordance with Section 23 33 43 - Flexible Connectors.

D. Verify that belt drives have been aligned, tension adjusted, and that belt guards are properly installed prior to startup.

3.2 ADJUSTING AND BALANCING

A. Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for adjusting and balancing

the air system. Refer to SMACNA HVAC Systems Testing, Adjusting and Balancing for system balancing requirements.

END OF SECTION 23 34 00

SECTION 23 37 13

DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all ceiling-mounted diffusers, architectural linear slot diffusers, bar grilles, floor-mounted swirl diffusers, floor-mounted VAV swirl diffusers, drum louvers, spot diffusers, single- and double-deflection supply diffusers, return/exhaust grilles and registers and accessories as indicated and scheduled on the drawings and in accordance with the Construction Documents.

B. Section includes:

1. Ceiling-Mounted Supply Diffusers
   a. Cone-type square diffusers.
   b. Plaque-type square diffusers.
   c. Directional-type square diffusers.
   d. Perforated plate diffusers.
   e. Fixed horizontal pattern round diffusers.
   f. Adjustable-pattern round diffusers.
   g. Plaque-type round diffusers.
   h. Plenum slot diffusers.
   i. Self-contained VAV diffusers.
2. Architectural linear slot diffusers and bar grilles.
3. Non-aspirating supply diffusers.
4. Floor-mounted swirl diffusers.
5. Floor-mounted VAV swirl diffusers.
6. Drum louvers.
7. Spot diffusers.
8. Single- and double-deflection supply grilles.
9. Return/exhaust air grilles and registers.
10. Accessories for diffusers, registers and grilles.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.

1.3 REFERENCES

A. Diffusers, registers, grilles and their components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the State of New York.
   b. Fire Code of the State of New York.
   c. Mechanical Code of the State of New York.
   d. Energy Conservation Construction Code of New York State.
   e. New York City Building Code.
   f. New York City Mechanical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

1). ASHRAE: HVAC Systems and Equipment Handbook.
2). ASHRAE 70: Method of Testing the Performance of Air Outlets and Inlets.

b. ASTM International (ASTM)
1). ASTM A568/A568M: Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements.
2). ASTM C1071: Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
3). ASTM C1104/C1104M: Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
4). ASTM 1338: Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
5). ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials.
6). ASTM G21: Standard Practice for Determining Resistance of Synthetic Polymer Materials to Fungi.
7). ASTM G22: Standard Practice for Determining Resistance of Plastics to Bacteria. (Standard was withdrawn in 2001 and no replacement exists. Use ASTM G22 for information purposes only.)

c. National Fire Protection Association (NFPA)
1). NFPA 90A: Standard for the Installation of Air Conditioning and Ventilating Systems.
2). NFPA 90B: Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
3). NFPA 255: Standard Methods of Test of Surface Burning Characteristics of Building Materials.

d. Underwriters Laboratories (UL)
1). UL 94: Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
2). UL 723: Test for Surface Burning Characteristics of Building Materials.
3). UL 2043: Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.

e. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA)
1). SMACNA HVAC Systems Testing, Adjusting, and Balancing.
2). SMACNA HVAC Duct Cleanliness for New Construction.

1.4 SUBMITTALS
A. Submittals shall be furnished in accordance with the requirements of Section 23 00 00.

1.5 WARRANTY
A. Comply with Division 01 - General Requirements and Section 23 00 00 requirements for product warranties.
B. Furnish a one- (1)-year manufacturer's warranty against manufacturing defects for all systems and components.
C. Warranty period shall initiate upon Final Acceptance by Owner.

1.6 COMMISSIONING
A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide

standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements as set forth in the Construction Documents.

B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Construction Documents shall be revised to reflect the substitution.

C. Diffusers, Registers and Grilles
   1. Air Concepts.
   2. Anemostat.
   3. Enviro-Air.
   4. Hart & Cooley.
   5. Krueger.
   6. Nailor Industries.
   7. Price.
   8. Titus.

2.2 GENERAL REQUIREMENTS

A. All diffusers, registers and grilles shall be the products of one (1) manufacturer. Units shall be constructed in accordance with the dimensional constraints indicated on the drawings.

B. All diffusers, registers and grilles shall have the capacities and performance requirements as scheduled and shown on the plans.

C. Each air supply outlet shall have the capacity as noted on the drawings and shall be guaranteed to give the required throw with draft-free diffusion.

D. All diffusers, registers and grilles shall be furnished with a matte enamel finish. Color shall be as selected and approved by the Architect.

2.3 ACOUSTICAL PERFORMANCE

A. It is the intent of this specification that the manufacturer shall furnish units that shall permit attaining sound pressure levels in spaces conforming to NC-35 curves (except as noted hereinbelow) as explained in the 1965 and later issues of the ASHRAE Guide.

B. The terminal devices shall be tested in accordance with ADC Standard 1062-R.3.

Room Type	**NC Level**
Seminar Rooms	NC-30
Conference, Office Areas Administration, Multipurpose Rooms	NC-35
Lobbies, Toilets, Corridors, Open Offices, Laboratories without Hoods with Acoustical Ceilings	NC-40
Pantries	NC-45

C. The maximum permissible sound power levels are as follows:

Octave Band	**Mid-Frequency (cps)**	**Max. PWL re: 10^{-12} Watts**					
		NC-30	**NC-35**	**NC-40**	**NC-45**	**NC-50**	**NC-55**
1	63	61	62	66	68	70	85
2	125	54	56	60	63	66	83
3	250	48	49	54	58	62	74
4	500	43	46	51	56	61	76
5	1,000	38	43	48	53	58	76
6	2,000	38	42	47	52	57	75
7	4,000	36	41	46	51	56	85

Octave Band	Mid-Frequency (cps)	Max. PWL re: 10^{-12} Watts					
		NC-30	NC-35	NC-40	NC-45	NC-50	NC-55
8	8,000	35	42	47	52	57	85

D. The manufacturer shall submit to the Architect's representative guaranteed sound power levels by octave bands. This data shall substantiate that the equipment types and sizes, operating in an installed condition per plans and specifications, conform with the above. Neither the manufacturer nor the specific unit selection shall be approved until such data has been submitted.

E. Should the Owner desire that units as furnished be checked for conformance to the above guarantee, the cost of such testing shall be paid by the Owner. If the units furnished and subsequently tested do not conform to the above guarantee, the cost of the testing and the cost of any corrective measures shall be at no additional expense to the Owner. The testing, if required, shall be performed at the manufacturer's factory and observed by the Engineer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and assemble all diffusers, linear diffusers, grilles, registers and accessories in accordance with manufacturer’s installation instructions and recommendations.

3.2 ADJUSTING AND BALANCING

A. All testing, adjusting and balancing shall be in accordance with the requirements of Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

END OF SECTION 23 37 13

SECTION 23 41 00

HVAC AIR FILTRATION PRODUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all panel air filters, extended surface filters, high-efficiency particulate filters, ultra-low penetration filters, super-ultra-low penetration filters and gas-phase filters as indicated and scheduled on the drawings and in accordance with the Construction Documents.

B. Section includes:

1. Panel air filters.
2. Extended surface filters.
3. High-efficiency particulate filters.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.

1.3 REFERENCES

A. All air filtration products and their components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the State of New York.
   b. Fire Code of the State of New York.
   c. Mechanical Code of the State of New York.
   d. Energy Conservation Construction Code of New York State.
   e. New York City Building Code.
   f. New York City Mechanical Code.
   g. New York City Fire Code.
2. Reference Standards: Provide all products and perform all work in accordance with, but not limited to, the following standards:
   a. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
      1). ASHRAE: HVAC Systems and Equipment Handbook.
   b. American National Standards Institute (ANSI)
      1). ANSI/AHRI 850: Performance Rating of Commercial and Industrial Air Filter Equipment.
      2). ANSI/ASHRAE 52.2: Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
   c. American Society of Mechanical Engineers (ASME)
      1). ASME N510: Testing of Nuclear Air-Treatment Systems.
   d. ASTM International (ASTM)
      1). ASTM D3467: Standard Test Method for Carbon Tetrachloride Activity of Activated Carbon.
      2). ASTM D5160: Standard Guide for Gas-Phase Adsorption Testing of Activated Carbon.
   e. Department of Defense (MIL-STD)
      1). MIL-STD-282: Filter Units, Protective Clothing, Gas-Mask Components and Related Products: Performance Test Methods.

f. Institute of Environmental Sciences and Technology (IEST)
   1). IEST RP-CC001.5 HEPA and ULPA Filters.
g. Underwriters Laboratories, Inc. (UL)
   1). UL 586: Standard for High-Efficiency, Particulate Air Filter Units.
   2). UL 900: Standard for Air Filter Units.

1.4 SUBMITTALS
A. Submittals shall be furnished in accordance with the requirements of Section 23 00 00.

1.5 WARRANTY
A. Comply with Division 01 - General Requirements and Section 23 00 00 requirements for product warranties.
B. Furnish a one- (1)-year manufacturer's warranty against manufacturing defects for all filters.
C. Warranty period shall initiate upon Final Acceptance by Owner.

1.6 COMMISSIONING
A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements as set forth in the Construction Documents.
B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Construction Documents will be revised to reflect the substitution.
C. Particulate Air Filters
   1. American Air Filter.
   2. Camfil Farr.
   3. Flanders.
   4. Viledon.

2.2 GENERAL REQUIREMENTS
A. All filters shall have been tested in accordance with UL 900 and shall bear a UL label.
B. Where required, provide built-up combination frame assemblies to receive prefilters and final filters.
C. Holding frames shall be minimum 16 gauge galvanized steel suitably designed to rigidly support prefilters and final filters, and shall be suitably sealed and caulked to prevent any air or dirt leakage between individual frames, between the filter frames and unit casing or around and between any particular frame at its prefilter or final filter. Frames shall be universal in design, so that various types of filters may be utilized with only a change in the type of retaining clip. There shall be a minimum of four (4) retaining clips with a spring tension of at least 25 lbs installed for each high-efficiency filter.
D. Where the frames exceed 8 ft. 0 in. in height, they shall be furnished with continuous vertical 10 gauge galvanized steel stiffeners every 48 inches as part of the frame assembly.
E. Where specified, provide side-service filter housings with access doors on both sides and filter tracks to accommodate both prefilters and final filters. The filter housing shall be fully gasketed and employ an easily replaceable filter seal to ensure a good seal in the direction of airflow. Leakage shall be guaranteed not to exceed 0.5 inches H_2O (0.5 kPa) at 3.0 inches H_2O (0.75 kPa) pressure differential.

2.3 REPLACEABLE CONSTRUCTION FILTERS

A. During construction, provide prefilters of the throwaway type upstream of the final filters described hereinbelow.

B. Construction filters shall be 2 inches (50 mm) thick, MERV 8 UL Class 2 with a self-supporting media that is a blend of 100% virgin synthetic fibers in a moisture-resistant fiberboard casing with integral pleat stabilizers bonded to the media. Initial resistance shall not exceed 0.33 inches H_2O (0.825 kPa) at a rated flow of 500 ft./min. (25.4 m/sec).

2.4 PERMANENT PREFILTERS

A. Filters shall be 2 inch thick (50 mm), factory-fabricated UL Class 2 pleated prefilters with high-lofted non-woven reinforced cotton and synthetic media bonded to a heavy-gauge metal backing. Media shall have a minimum thickness of 0.15 inches and a media weight of 2.5 oz./sq.yd. Filter efficiency shall not be less than 25-30% with a 5 micron particle efficiency of 95%.

B. Prefilters shall have an initial resistance of not more than: 0.28 inches H2O (0.07 kPa) with a final resistance of 0.9 inches H2O.

2.5 HIGH-EFFICIENCY FINAL FILTERS (RIGID-TYPE)

A. Filters shall be 12 inch (305 mm) deep high-performance factory-fabricated rigid-type filters, pleated, totally rigid and totally disposable type consisting of high-lofted glass microfiber media with a pleated, bonded metal backing and corner stabilizers in a galvanized metal enclosure having either diagonal reinforcement or welded galvanized faceguards.

B. Final resistance may be up to 1.50 inches H_2O (0.375 kPa); initial resistance shall be in accordance with the following:

Efficiency	MERV Rating	Flow Rate	Pressure Drop
90 - 95%	15	2,000 cfm	0.68 inches H_2O (0.17 kPa)
80 - 85 %	13	2,000 cfm	0.50 inches H_2O (0.11 kPa)
60 - 65%	10	2,000 cfm	0.28 inches H_2O (0.073 kPa)
40%	8	2,000 cfm	0.25 inches H_2O (0.063 kPa)

C. Gauges shall be diaphragm-type with 4 inch (100 mm) diameter legible to 0.10 inch (0.0025 kPa) of water pressure with white dial faces, black pointer, and a zero-point adjustment. Each gauge shall be furnished with a filter kit, including mounting plate, static pressure taps, two (2) 5 inch (125 mm) lengths of aluminum tubing, and compression fittings. Gauges for prefilters and rigid- or bag-type final filters shall have a 0 to 2 inch (0 - 0.5 kPa) H2O pressure range. Gauges for HEPA filters shall have a 0 to 5 inch (0 - 1.25 kPa) H2O pressure range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install filter frames according to the manufacturer's written instructions.

B. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.

C. Install filters in position to prevent passage of unfiltered air. Do not operate fan system connected to filter bank until all filters (temporary, prefilter or final filters as specified) are in place.

D. Holding frame joints and spaces between holding frames and filter housing or plenums shall be caulked or sealed against air leakage.

E. Filters shall be gasketed against holding frames.

F. Provide a differential pressure gauge across each group of filters with static-pressure tips upstream and downstream of filters to measure pressure drop through filters. Gauges shall be mounted on the outside of filter housing or filter plenum in an accessible position.

G. Provide one (1) set of temporary construction filters for each system.

H. Prior to balancing and before Final Acceptance by the Owner, replace temporary filters with new prefilters and new final filters.

3.2 CLEANING

A. Upon completion of testing adjusting and balancing, clean filter housings.

B. If, at the time the equipment is being turned over to the Owner, the total air friction is greater than or equal to 0.8 inch (0.2 kPa) H_2O, provide an additional set of new prefilters and new final filters.

3.3 INSPECTION AND STARTUP SERVICE

A. Engage a factory-authorized service representative to inspect, test and adjust field-assembled components, filter and filter-frame installation, and electrical wiring, as well as to assist in field testing. Report results in writing.

END OF SECTION 23 41 00

SECTION 23 64 23.10

AIR-COOLED SCROLL COMPRESSOR CHILLER/HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all air-cooled scroll water chillers as indicated and scheduled on the Construction Drawings and in accordance with the Construction Documents.

B. Section includes:

1. Air-cooled scroll compressor chiller/heaters.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.

1.3 REFERENCES

A. Air-cooled scroll compressor chillers and their components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for the City of New York.
   a. New York City Building Code.
   b. New York City Mechanical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. Air-Conditioning Heating and Refrigeration Institute (AHRI)
      1). AHRI 550/590 Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle.
      2). AHRI 575: Method of Measuring Machinery Sound Within an Equipment Space.
   c. American Gear Manufacturers Association (AGMA)
      1) AGMA 914-BO4: Gear Sound Manual.
   d. American National Standards Institute (ANSI)
      1) ANSI S12.19: Measurement of Occupational Noise Exposure.
      2) ANSI S12.23: Method for the Designation of Sound Power Emitted by Machinery and Equipment.
   e. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
      1) ASHRAE 15: Safety Code for Mechanical Refrigeration.
      2) ASHRAE 34: Designation and Safety Classification of Refrigerants.
      3) ASHRAE 90.1: Energy Standard for Buildings Except Low-Rise Residential Buildings.
   f. American Society of Mechanical Engineers (ASME)
      1) ASME/ANSI BPV-VIII: Division 1 Pressure Vessels.
      2) ASME PTC 25: Pressure Relief Devices.
   g. ASTM International (ASTM)
      1) ASTM E96: Standard Test Method for Water Vapor Transmission Materials.
      2) ASTM F1508: Standard Specification for Angle Style, Pressure Relief Valves for Steam, Gas and Liquid Services.

h. Institute of Electrical and Electronics Engineers (IEEE)
   1) IEEE 85: Test Procedure for Airborne Sound Measurements on Rotating Electric Equipment.
i. National Electrical Manufacturers Association (NEMA)
   1) NEMA ICS-1: Industrial Control and Systems: General Requirements.
   2) NEMA ICS-2: Industrial Control Devices, Controllers and Assembly Standards.
b. National Fire Protection Association (NFPA)
   1). NFPA 70: National Electric Code.
c. Occupational Safety and Health Administration (OSHA)
   1). OSHA CFR 29 Part 1910.95: Occupational Noise Exposure.
j. Tubular Exchanger Manufacturers Association, Inc. (TEMA).
d. Underwriters Laboratories Inc. (UL)
   1) UL 508A: Standard for Industrial Control Panels.
   2) UL 1995: Heating and Cooling Equipment.

1.4 SUBMITTALS

A. Submittals shall be furnished in accordance with the requirements of Section 23 00 00.

1.5 WARRANTY

A. Comply with Division 01 - General Requirements and Section 23 00 00 requirements for product warranties.

B. The manufacturer shall warranty the equipment to meet the performance conditions specified for the period through two (2) years. During the period of the warranty, equipment that discloses defects in design, material or workmanship shall be replaced, including all auxiliary equipment and materials, by the manufacturer at no cost to the Contract.

C. Furnish an alternate price for a manufacturer's extended warranty against manufacturing defects for all systems and components covering all parts and materials associated with the refrigerant compressors for five (5) years.

D. Service
   1. For the duration of the warranty period, provide all required service at no additional cost. Service shall include parts and labor and shall be available through an attended telephone number on a 24-hour-a-day basis with a guaranteed response time as follows:
      a. Telephone contact of qualified technician within fifteen (15) minutes.
      b. Qualified technician on site within four (4) hours.

E. Warranty period shall initiate upon Final Acceptance by Owner.

1.2 GUARANTEE

A. All equipment shall be new, of first class material and of the latest approved design. Workmanship shall be of the best quality, free of any defects that might render the equipment unsuitable or inefficient for the purpose for which it is to be used.

B. The manufacturer shall guarantee his equipment to meet the performance specified for the period of time that is normal industry practice for this type of equipment, but in no case for less than one (1) year from the date of Owner's acceptance subsequent to start-up and performance testing. During the period of the guarantee, equipment that discloses defects in design, material or workmanship shall be replaced, including all auxiliary equipment and materials, by the manufacturer at no cost to the Contract.

C. Although the guarantee shall be enforceable as provided, no requirement of this Contract with respect to guarantees by the manufacturer shall be deemed to be a limitation upon any rights that the Owner would have, either expressed or implied, in the absence of such guarantees, said guarantee being given only for the greater assurance of the Owner.

1.3 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from

the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Construction Documents.

B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Construction Documents will be revised to reflect the substitution.

C. Air-Cooled Scroll Compressor Chillers

1. Aermec.
2. Artic Chill.
3. Multistack
4. Technical Systems (TSI).

1.4 PACKAGED AIR-COOLED CHILLER/HEATERS

A. Furnish, as described in this specification, packaged air-cooled chiller/heaters of the type specified, complete with compressors, air-cooled condensers, refrigerant evaporator (cooler), refrigerant to water heat recovery bundle, free cooling coil, simultaneous heating and cooling heat exchangers, motors, motor controls and starters, steel base, weatherproof enclosures, control panels, hot water and chilled water glycol pumps and all other necessary auxiliary equipment and accessories to satisfy the capacity and performance requirements as scheduled, in accordance with the latest version of ARI Standard 550/590. Only chillers that are listed in the AHRI Certification Program are acceptable.

B. The chiller shall be complete with all required safeties, including high-discharge pressure and temperature, low-suction pressure, low/high motor current, high motor temperature, high-pressure switch, high/low differential oil pressure, high oil temperature, low-suction superheat, critical sensor malfunction, low or high current, phase loss/single-phase power, low voltage and motor winding overload. Safety devices shall be arranged to require manual reset after shutdown. Provide contacts to facilitate an interlocking break-glass station.

C. The assembled chiller shall be completely capable of being serviced and repaired in place without the need for disassembly. This includes compressors, condensers, evaporators and all auxiliary equipment.

D. Refrigerant shall be non-CFC-type R-410a for the vapor compression refrigeration cycle.

1.5 COMPRESSORS

A. Compressors shall be hermetically sealed 15-horsepower (maximum 21.25 FLA at 208 volts) scroll compressors. Each complete with discharge and suction-line service valves with gauge ports, crankcase heater coil, sight glass, rotor locks, anti-slug protection, internal mufflers, three-phase solid-state inherent thermal motor protection, with the entire unit isolated to absorb vibration.

1.6 EVAPORATOR and heat recovery condenser

A. The evaporator and heat recovery condenser shall be compact high-efficiency dual-circuit, brazed plate-to-plate-type heat exchanger with parallel 316 stainless steel plates. The waterside working pressure shall be a minimum of 650 psig (4,481 kPa) and built in accordance with ASME Boiler and Pressure Vessel Code - Section VIII, Division 1 for unfired pressure vessels. Evaporator shall be protected with an electric resistance heat-trace tape and insulated with polyurethane insulation providing freeze protection down to -20ºF (-29ºC) ambient air temperature.

2.2 CONDENSER

A. Each air-cooled condenser shall be furnished complete with low noise, high static type propeller fans (as approved) driven by protected motors with encapsulated windings through multiple ECM drive motors with adjustable motor sheave and belt guard. Each fan shall be resiliently mounted via rubber-in-shear isolators. Aluminum spiral-finned copper tube condensing coils separately circuited for each compressor. Galvanized steel casing suitably protected for outdoor mounting.

B. Each unit shall have automatic head pressure controls for system operation at condenser ambient temperatures above 0°F by modulating refrigerant flow through condenser sections without manual adjustments.

2.3 CONTROLLER

A. Each chiller shall be controlled by a dedicated microprocessor-based controller, supplied by the chiller Materialman. The controller shall be factory-mounted, one for each refrigeration machine. The chiller unit control panel shall monitor and control the entire unit operation including all sensors, actuators, relays and switches for refrigeration, electric, and electronic controls. The microprocessor shall be provided with factory installed battery backup and a separate 120V connection to be supplied by an external UPS system, to provide protection of all configured settings during power failures. The entire control system shall be factory assembled and tested. The control system shall be capable of providing all performance load data to the central BMS.

1.7 ACOUSTICAL REQUIREMENTS

A. Packaged Air-Cooled Modular Chiller Acoustical Performance: The maximum permissible noise levels under design operating conditions, when measured in accordance with ARI Standard 575-73-specified methods and qualifications, shall not exceed 90 dBA.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Air-cooled scroll compressor chillers shall be installed level and true on resilient isolators as required in Section 23 05 48.16 - Vibration Isolation for HVAC Piping, Ducts and Equipment.

3.2 adjusting and balancing

A. All testing, adjusting and balancing shall be in accordance with the requirements of Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

END OF SECTION 23 64.23.10

SECTION 23 74 13

PACKAGED OUTDOOR CENTRAL-STATION AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all packaged outdoor central-station air conditioning units as indicated and scheduled on the Construction Drawings and in accordance with the Construction Documents.

B. Section includes:

1. Packaged outdoor central-station DX air conditioning units.
2. Packaged outdoor central-station chilled water air handling units.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.

1.3 REFERENCES

A. Packaged outdoor central-station air conditioning units and all their components and accessories shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the State of New York.
   b. Fire Code of the State of New York.
   c. Mechanical Code of the State of New York.
   d. Energy Conservation Construction Code of New York State.
   e. New York City Building Code.
   f. New York City Mechanical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. Air-Conditioning, Heating and Refrigeration Institute (AHRI)
      1). AHRI 210: Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment.
      2). AHRI 550: Performance Rating of Water-Chilling Packages Using the Vapor Compression Cycle.
      3). AHRI 575: Method of Measuring Machinery Sound within Equipment Space.
   b. Air Movement and Control Association International Inc. (AMCA)
      1). AMCA 300-08.
   c. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
      1). ASHRAE 37: Methods of Testing for Rating Electrically Driven Unitary Air-Conditioning & Heat Pump Equipment.
      2). ASHRAE 52: Methods of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
   d. American Society of Mechanical Engineers (ASME)
      1). ASME B31.1: Power Piping Standards.
      2). ASME B31.5: Refrigeration Piping and Heat Transfer Components.
      3). ASME B31.9: Building Services Piping.

e. ASTM International (ASTM)
f. Institute of Electrical and Electronics Engineers (IEEE)
1). IEEE 85: Test Procedure for Airborne Noise Measurements on Rotating Electric Machinery.
g. National Fire Protection Association (NFPA)
1). NFPA 70: National Electric Code.
h. Occupational Safety and Health Administration (OSHA)
1). OSHA CFR 29 Part 1910.95: Occupational Noise Exposure.
i. Underwriters Laboratories Inc. (UL)
1). UL 508 - Standard for Industrial Control Equipment.

1.4 SUBMITTALS
A. Submittals shall be furnished in accordance with the requirements of Section 23 00 00.

1.5 WARRANTY
A. Comply with Division 01 - General Requirements and Section 23 00 00 requirements for product warranties.
B. Furnish a three (3)-year manufacturer's warranty against manufacturing defects for all systems and components.
C. Warranty period shall initiate upon Final Acceptance by Owner.

1.6 COMMISSIONING
A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Construction Documents.
B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved neither the project specifications nor the Construction Documents will be revised to reflect the substitution.
C. Packaged Outdoor Central-Station DX Air Conditioning Units
1. Aaon.
2. Governair.
3. Mammoth.
4. McQuay.
5. Miller Picking.
6. Trane.
7. York.
D. Air to air Energy Wheels
1. Hoval.
2. Rotor Source.
3. SEMCO.

2.2 GENERAL REQUIREMENTS
A. All packaged outdoor central-station air conditioning units and unit components shall be the products of one (1) of the manufacturers listed above in Article 2.1 - Acceptable Manufacturers.
B. All components, fans, motors and drives, vibration isolation, air filters, dampers, valves, cooling

and heating coils, piping, insulation, electrical equipment, lighting and wiring, instrumentation and controls, etc., must comply with the requirements of various specification sections listed above in Article 1.2 and shall be the product of one (1) of the acceptable manufacturers listed therein.

C. Provide packaged outdoor central-station air conditioning units of the size, capacity and performance indicated on the Construction Drawings. They shall be completely factory-assembled, -piped, -wired, -tested and -shipped with a single-point power connection ready for final connections and immediate operation after installation. Each such unit shall include within an integral casing a supply fan, return fan, minimum and variable outdoor air dampers, return air dampers, spill air dampers, filters, heating coils, cooling coils, air-cooled condensers and all required standard operating and safety controls, all of which shall comply with the Construction Drawings as well as the schedules and specifications for these particular items as specified.

D. Each unit, comprised of one (1) or more sections, shall be fabricated with a rigid structural steel frame suitably reinforced and braced to permit loading, shipping, unloading, installation on roof, and general handling without damage to, or misalignment of, factory-assembled components under normal handling conditions. Unit sections shall be designed to be bolted together, forming a sealed joint with 1/2 inch (12.5 mm) thick neoprene gasket. Each assembled unit shall be structurally designed to be supported by a concrete pad or roof curb.

E. Units shall not be larger than shown on the drawings and shall be specifically designed for outdoor rooftop application and include a weatherproof housing. They shall be engineered to be shipped fully assembled or in multiple sections ready to be field-assembled and -tested. Full-length perimeter angles located inside the units shall be provided at shipping splits to allow for field-bolting of modular sections. Unit manufacturer shall provide all necessary hardware, gaskets, tape sealer and caulk required to field-join and -seal the modular sections. The mating upper frame of each section shall also be fabricated with a flanged perimeter. The flanged perimeter shall be drilled with assembly clearance holes and be continuously gasketed.

F. The entire unit structure shall be self-supporting, assembled with structural channels and/or square or rectangular structural tubing (minimum 3/16 inch [5 mm] wall thickness) sized and spaced so that, where combined with inner panel and exterior siding, walls withstand 30 pounds (1.43 kPa) per square foot wind load. The roof shall be capable of supporting no less than 30 pounds (1.43 kPa) per square foot of live load, with a deflection not to exceed 1/180 of the span to accommodate maintenance/service personnel. Housings shall be designed to withstand a minimum positive or negative internal air pressure of 6 inches (1.5 kPa) water gauge without any distortion.

G. The structural framing members for the walls and roof shall be on the inside face of the exterior metal siding and shall be arranged to ensure minimum interference on airflow through the unit.

H. The housing shall be completely weatherproof and insulated for an outdoor installation and shall be composed of aluminum or galvanized steel (stainless steel at cooling coils) inner liner, insulation, aluminum or galvanized steel exterior siding, aluminum louvers, aluminum or galvanized steel roof deck and insulated composite diamond plate aluminum or steel floor with steel interior compartments and steel doors. All exterior surfaces shall be phosphatized and finished with an air-dry, water-borne finish. They shall be designed for easy servicing of all operating components from the service compartment or plenums, so that no maintenance or repair operation on components other than the housing proper will have to be performed outdoors. Decals and tags to indicate caution areas and to aid unit service shall be provided. Unit nameplates shall be fixed to the dead-front cover in the main control panel. Electrical wiring diagrams shall be attached to control panels. Installation maintenance bulletins shall be supplied with each unit.

I. The manufacturer's standard cabinet construction shall result in a unit leakage rate that shall not exceed 1% of unit capacity at 1.25 times the operating static pressure.

J. External connections for hot water shall be provided with grooved ends. Casings at DX cooling

coils and heating coils shall be provided with removable panels to facilitate coil removal. Where connections pass through panels, they shall be provided with flexible gaskets and/or grommets around openings.

K. Hinged fully gasketed access doors with flush-mounted, quick-release, single-lever latching mechanisms shall be provided for servicing of filters, return/exhaust air fans, heating coils, evaporator coils, supply air fans and the condensing unit section.

L. Supply and return air duct connections shall be provided with pre-mounted flanged hardware to facilitate installation of external plenums, external ducting and/or dampers.

2.3 PACKAGED OUTDOOR CENTRAL-STATION DX AIR CONDITIONING UNITS

A. Units shall be designed for direct-expansion cooling with hot water coil and shall be shipped with a holding charge of Refrigerant HFC 410a.

B. Condensing Section

1. Compressors shall be heavy-duty, direct-drive hermetic scroll type with centrifugal oil pump, suction and discharge line service valves, crankcase heater, and inherent solid-state thermal overload protection. Each compressor shall have its own completely independent refrigeration circuit, including liquid moisture indicator/sight glass, filter-dryer, manual shutoff valve, and spring-type high-pressure relief valve. Compressors shall be isolated on neoprene-impregnated fiberglass kinetic blocks. Compressor capacity reduction shall be accomplished with cylinder unloading and hot gas bypass.

C. Evaporator Section

1. Coils shall be guaranteed capable of the scheduled performance under the actual job conditions and all coil performance ratings shall be certified by the Air-Conditioning, Heating and Refrigeration Institute (A.H.R.I.).
2. Evaporator coils shall be multi-row type, fabricated from 1/2 inch (12.5 mm) o.d. seamless copper tubing mechanically bonded to rippled and corrugated aluminum fins. Coils shall be factory leak-tested at 300 psig (20.7 bar) under water. The evaporator coil circuitings shall be circuited for a combination row/face split.

D. Heating Coil Section (Hot Water)

1. All water heating coils shall be the product of one (1) of the acceptable manufacturers listed in Section 23 82 16 - Cooling and Heating Coils, and must comply with the requirements therein.

E. Supply and Return Fan Sections

1. All fans shall be the product of one (1) of the acceptable manufacturers listed in Section 23 34 00 - Fans, and must comply with the requirements therein.

F. Filter Sections

1. All filters shall be the product of one (1) of the acceptable manufacturers listed in Section 23 41 00 - Air Filtration Products and must comply with the requirements therein.

G. Outside Air Section

1. All dampers shall be the product of one (1) of the acceptable manufacturers listed in Section 23 33 13 - Dampers and must comply with the requirements therein.
2. The outside and return air sections shall be designed to form a plenum. Outside air arrangement shall be 0-100% outside air with economizer control.
3. Outside air shall be introduced from both sides of the unit through a horizontal louvered intake hood complete with rain lip and bird screen. The unit floor of the outside air section shall be sloped for water drainage. The bottom of the outside air intake shall be not less than 3 feet 0 inches (0.92 mm) above the roof. The return air connection shall be provided in the rear of the unit. The outside and return air dampers shall be sized to handle 100% of the supply air volume and arranged vertically to converge the return and outside air streams in a circular mixing pattern. Low-leak dampers shall be provided. Dampers shall be hollow core, airfoil type, fully gasketed, including stainless steel jamb seals on the side

of the damper assembly. Leakage shall not exceed 1/2% cfm at 1.5 inch (0.373 kPa) static pressure.

4. An exhaust air damper shall be provided and located in the return air section to exhaust air out the back of the unit. Exhaust louvers and a bird screen shall be provided to prevent infiltration. Exhaust dampers shall be lined with urethane gasketing on the contact edges.
5. A 0-100% outside air economizer control shall consist of outside air, return air and exhaust air dampers, adjustable potentiometer, damper motor and an adjustable enthalpy control mounted outside the airstream. The adjustable potentiometer shall control the minimum outside air damper position for fresh air requirements (unit mounted on unit). An enthalpy control shall be provided to sense the dry bulb temperature and relative humidity of the outside air and return air for use in selecting Summer or Winter operation. The damper motors shall be of the modulating spring-return type.

H. Refrigeration Controls: Each compressor circuit shall include a liquid-line solenoid valve, oil pressure switch, high-pressure switch, low-pressure switch, compressor control circuit switch, and pump-down switch. Each refrigeration circuit shall have at least one (1) condenser fan controlled from an ambient thermostat for positive head pressure control. An ambient thermostat shall prevent the refrigeration system from operating below 50°F (10ºC) (adjustable).

I. Controls system shall monitor the operation of the economizer function and shall provide fault detection and diagnostics. System shall alarm when economizer mode is not functioning, when required, based on the unit controls sequence.

J. Temperature Controls: Units shall be provided with discharge air temperature control systems. They shall be microprocessor-based. All temperature control system components shall be completely factory-wired and -tested. The discharge air control system shall be completely factory-installed to control the discharge air temperature from a single sensor. The sensor shall be located at the discharge air opening. The discharge air controller shall have an adjustable temperature setting 40°F - 90°F (4.5°C - 32ºC) and an adjustable throttling range.

1. The discharge air controller shall operate the economizer and mechanical cooling stages and shall alternate circuit unloading between compressors. The economizer cycle shall include enthalpy control of the economizer dampers.
2. For a complete description of temperature controls, refer to Section 23 09 93 - Sequence of Operation for HVAC Controls.

K. All air-to-air energy recovery heat wheels shall be the product of one (1) manufacturer. Units shall be constructed in accordance with dimensional constraints indicated on the drawings.

L. Heat wheels shall have the capacities and performance requirements as scheduled and shown on the plans.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The units shall be installed in a neat and workmanlike manner in strict accordance with the specifications.

3.2 ADJUSTING AND BALANCING

A. All testing, adjusting and balancing shall be in accordance with the requirements of Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

B. Make all necessary adjustments to each unit prior to the being put into service.

3.3 OPERATING AND MAINTENANCE INSTRUCTION

A. Provide all operation and maintenance instructions and manuals for each type of system and/or piece of equipment as indicated and scheduled on the drawings and in accordance with Section 23 01 00 - Operation and Maintenance of HVAC Systems.

B. Operating and maintenance manuals shall be submitted at least 90 days prior to approval of first

unit.

END OF SECTION 23 74 13

SECTION 23 81 23

PACKAGED SELF-CONTAINED COMPUTER ROOM AIR CONDITIONERS (CRAC'S)

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all computer room air conditioners (CRAC's) as indicated and scheduled on the Construction Drawings and in accordance with the Construction Documents.

B. This section includes:

1. Computer room air conditioners (CRAC's) air cooled.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.

1.3 REFERENCES

A. CRAC's and all their components and accessories shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the State of New York.
   b. Fire Code of the State of New York.
   c. Mechanical Code of the State of New York.
   d. Energy Conservation Construction Code of New York State.
   e. New York City Building Code.
   f. New York City Mechanical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. Air-Conditioning, Heating and Refrigeration Institute (AHRI)
      1). AHRI 210: Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment.
      2). AHRI 340: Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
      3). AHRI 410: Forced-Circulation Air-Cooling and Air-Heating Coils.
      4). AHRI 575: Method of Measuring Machinery Sound Within an Equipment Space.
      5). AHRI 1361: Performance Rating of Computer and Data Processing Room Air Conditioners.
   b. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
      1). ASHRAE 37: Methods of Testing for Rating Electrically Driven Unitary Air-Conditioning and Heat Pump Equipment.
      2). ASHRAE 52: Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
      3). ASHRAE 127: Method of Testing for Rating Computer and Data Processing Room Unitary Air Conditioners.
   c. American Society of Mechanical Engineers (ASME)
      1). ASME B31.5: Refrigeration Piping and Heat Transfer Components.
      2). ASME B31.9: Building Services Piping

d. ASTM International (ASTM)
   1). ASTM B68/B68M: Standard Specification for Seamless Copper Tube, Bright Annealed.
   2). ASTM B75/B75M: Standard Specification for Seamless Copper Tube.
   3). ASTM B88/B88M: Standard Specification for Seamless Copper Water Tube
   4). ASTM B280: Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
e. Institute of Electrical and Electronics Engineers (IEEE)
   1). IEEE 85: Test Procedure for Airborne Sound Measurements on Rotating Electric Machinery.
f. National Fire Protection Association (NFPA)
   1). NFPA 70: National Electric Code.
g. Occupational Safety and Health Administration (OSHA)
   1). OSHA CFR 29 Part 1910.95: Occupational Noise Exposure.
h. Underwriters Laboratories Inc. (UL)
   1). UL 508: Standard for Industrial Control Equipment.

1.4 SUBMITTALS
A. Submittals shall be furnished in accordance with the requirements of Section 23 00 00.

1.5 WARRANTY
A. Comply with Division 01 - General Requirements and Section 23 00 00 requirements for product warranties.
B. Furnish a five (5) year manufacturer's warranty against manufacturing defects for all systems and components.
C. Warranty period shall initiate upon Final Acceptance by the Owner.

1.6 COMMISSIONING
A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Construction Documents.
B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Construction Documents shall be revised to reflect the substitution.
C. Air-Cooled CRAC's
   1. Air Flow.
   2. Data-Aire.
   3. Liebert.
   4. Silent-Aire.
   5. Skil-Aire.
   6. Stultz/ATS.

2.2 GENERAL REQUIREMENTS
A. All CRAC's and unit components shall be the products of one (1) of the manufacturers listed

above in Article 2.1 - Acceptable Manufacturers.

B. Provide CRAC systems of the size, capacity and performance indicated on the construction drawings. The units shall be completely pre-piped, pre-wired and ready for final connections.

C. Units shall operate on 208 volt, 3 phase, 60 hertz, and shall be UL-tested and -listed and laboratory-tested in accordance with ASHRAE Standard 37 and ARI Standard 210.

D. Each unit shall be provided with the following additional components:
   1. A smoke detector to shut down the complete system in the event of a fire.
   2. A firestat to shut down the complete system in the event of a fire.
   3. A high-temperature return air alarm and silencing switch.
   4. One (1) solid-state water sensor.
   5. An integral condensate pump factory-installed and -wired.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install CRAC's with a discharge airflow pattern and of capacity and sizes as indicated on the Construction Drawings.

B. Provide a competent factory service representative for final inspection and startup of each CRAC's unit.

C. After the installation of the CRAC's units is complete, perform a thorough inspection of the units in the presence of the Owner's representative, including all controls and electrical and piping connections. Report deficiencies in writing to the Owner's representative.

D. Start up each CRAC's unit in the presence of the Owner's operating personnel and verify the correct operation of all safety devices, operating controls and auxiliary equipment.

3.2 CLEANING AND PROTECTION

A. Comply with Division 01 requirements for cleaning and protection of installed work.

B. Upon completion of the installation, remove all protective materials.

C. Visually inspect the interior and components of all control cabinets for dust, dirt, moisture and other contaminants. If dust, dirt, moisture and/or other contaminants are present, reclean and reinspect.

3.3 ADJUSTING AND BALANCING

A. All testing, adjusting and balancing shall be in accordance with the requirements of Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

B. Make all necessary adjustments prior to the CRAC's being put into service.

END OF SECTION 23 81 23

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SECTION 23 81 26

SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all split-system air conditioning units as indicated and scheduled on the drawings and in accordance with the Construction Documents.

B. Section includes:

1. Outdoor compressor/condensers.
2. Indoor evaporators.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.

1.3 REFERENCES

A. All split-system air conditioning units and associated components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the State of New York.
   b. Fire Code of the State of New York.
   c. Mechanical Code of the State of New York.
   d. Energy Conservation Construction Code of New York State.
   e. New York City Building Code.
   f. New York City Mechanical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. Air-Conditioning, Heating and Refrigeration Institute (AHRI)
      1). AHRI 210: Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment.
      2). AHRI 340: Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
      3). AHRI 410: Forced-Circulation Air-Cooling and Air-Heating Coils.
      4). AHRI 575: Method of Measuring Machinery Sound Within an Equipment Space.
   b. American National Standards Institute (ANSI)
      1). ANSI/AHRI 340/360: Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
      2). ANSI/AHRI/ASHRAE/ISO 13256-1: Water Source Heat Pumps - Testing and Rating for Performance.
   c. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
      1). ASHRAE 37: Methods of Testing for Rating Electrically Driven Unitary Air-Conditioning and Heat Pump Equipment.
      2). ASHRAE 52: Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
      3). ASHRAE 127: Method of Testing for Rating Computer and Data Processing Room Unitary Air Conditioners.

d. American Society of Mechanical Engineers
e. ASTM International
f. American Welding Society
   1). AWS A5.8: Specification for Filler Metals for Brazing and Braze Welding.
g. Manufacturers Standardization Society
   1). MSS SP-73: Brazing Joints for Copper and Copper Alloy Pressure Fittings.
   2). MSS SP-104: Wrought Copper Solder Joint Pressure Fittings.
h. National Fire Protection Association (NFPA)
   1). NFPA 70: National Electric Code.
i. Occupational Safety and Health Administration (OSHA)
   1). OSHA CFR 29 Part 1910.95: Occupational Noise Exposure.
j. Underwriters Laboratories Inc. (UL)
   1). UL 508: Standard for Industrial Control Equipment.

1.4 SUBMITTALS

A. Submittals shall be furnished in accordance with the requirements of Section 23 00 00.

1.5 WARRANTY

A. Comply with Division 01 - General Requirements and Section 23 00 00 requirements for product warranties.
B. Furnish a five (5)-year manufacturer's warranty for all split-system air conditioner equipment.
C. Warranty period shall initiate upon Final Acceptance by Owner.

1.6 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements as set forth in the Construction Documents.
B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Construction Documents shall be revised to reflect the substitution.
   1. Air Flow.
   2. Air Technology Systems.
   3. Canatal (has limited sizes).
   4. Climate Master.
   5. Data Aire.
   6. Enviro-Tec.
   7. Mammoth.
   8. Skil-Aire.
   9. Stultz/ATS.
   10. Water Furnace.

2.2 GENERAL REQUIREMENTS

A. The outdoor units shall be equipped with multiple circuit boards that interface to the controls system and shall perform all functions necessary for operation. Contained within the unit shall be compressor(s), fan, fan motor, piping, electronic modulating linear expansion device and control

circuit board. Each outdoor unit module shall be completely factory-assembled, piped and wired and run-tested at the factory.

B. The indoor unit shall be factory-assembled, wired and run-tested. Contained within the unit shall be all factory wiring, piping, an electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto-restart function, an emergency operation function and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

C. Where indicated on the Contract Drawings, those units to be furnished with electric reheat coils shall have electric resistance heaters sized to offset the sensible cooling capacity in the dehumidification mode and additional humidity due to outdoor air supply to technology areas.

D. R410A refrigerant shall be required for the outdoor unit systems.

E. An interlocking disconnect switch for the indoor/outdoor unit shall be provided for each unit and shall be built in as an integral part of the unit. The disconnect switch shall be completely operable without opening the cabinet and shall have exterior stainless steel trim for appearance.

F. Units shall be UL-listed and laboratory tested in accordance with the requirements of ASHRAE Standard 37 and ARI Standard 210.

G. All equipment and components located outdoors shall comply with wind-resistant construction requirement indicated in Section 23 05 00 - Common Work Results.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All the evaporator sections and condenser sections of each system, all components, piping and all accessories shall be installed in strict accordance with the manufacturer’s requirements.

B.

3.2 ADJUSTING AND BALANCING

A. Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for adjusting and balancing the air system. Refer to SMACNA HVAC Systems Testing, Adjusting and Balancing for system balancing requirements.

END OF SECTION 23 81 26

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SECTION 23 82 16

COOLING AND HEATING AIR COILS (WATER/STEAM)

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all cooling and heating air coils as indicated and scheduled on the Construction Drawings and in accordance with the Construction Documents.

B. Section includes:

1. Cooling coils (water).
2. Heating coils (water).
3. Heat recovery coils.
4. Heating coils (steam).

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.

1.3 REFERENCES

A. Cooling and heating air coils and their components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the State of New York.
   b. Fire Code of the State of New York.
   c. Mechanical Code of the State of New York.
   d. Energy Conservation Construction Code of New York State.
   e. New York City Building Code.
   f. New York City Mechanical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. Air-Conditioning, Heating and Refrigeration Institute (AHRI)
      1). AHRI 410: Forced-Circulation Air-Cooling and Air-Heating Coils.
   b. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
      1). ASHRAE: HVAC Systems and Equipment Handbook.
   c. American National Standards Institute (ANSI).
   d. American Society of Mechanical Engineers (ASME)
      1). ASME: Boiler Pressure Vessel Code Section VIII Rules for Construction of Pressure Vessels.
      2). ASME: Boiler Pressure Vessel Code Section IX Welding and Brazing Qualifications.
   e. ASTM International (ASTM)
      1). ASTM - B903-10: Standard Specification for Seamless Copper Heat Exchanger Tubes with Internal Enhancement.
   f. Heat Transfer Research, Inc. (HTRI)
      1). HTRI Design Manual.

1.4 SUBMITTALS

A. Submittals shall be furnished in accordance with the requirements of Section 23 00 00.

1.5 WARRANTY
- A. Comply with Division 01 - General Requirements and Section 23 00 00 requirements for product warranties.
- B. Furnish a one (1) year manufacturer's warranty against manufacturing defects for all filters.
- C. Warranty period shall initiate upon Final Acceptance by Owner.

1.6 COMMISSIONING
- A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
- A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements as set forth in the Construction Documents.
- B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Contract Documents will be revised to reflect the substitution.
- C. Cooling and Heating Air Coils (Water/Steam)
  1. Aerofin.
  2. Heatcraft.
  3. Marlo.
  4. McQuay.
  5. Temtrol.
  6. Trane.
  7. York.

2.2 GENERAL REQUIREMENTS
- A. All cooling and heating air coils shall be the products of one (1) of the manufacturers listed hereinabove in Article 2.1 - Acceptable Manufacturers.
- B. Furnish all glycol-and-water heating coils shown and scheduled on the Construction Drawings and as described herein, complete with all accessories conforming to the physical dimensions and complying with the capacity and performance requirements as scheduled.

2.3 COOLING AIR COILS (WATER)
- A. All cooling coils shall be continuous tube-type copper tubes, aluminum fins, with non-ferrous headers and 304 stainless steel casings. Tubes shall be seamless copper, 5/8 inch (16 mm) o.d., 0.035 inch (0.9 mm) wall thickness after attachment of fins. Fins shall be flat plate type 0.01 inch (0.25 mm) thick. Supply and return headers must be located on the same side of the coil.
- B. A continuous horizontal stainless steel drip pan shall be provided under each coil section in height and each such drip pan shall be independently drained to a drain header at the bottom, as shown on the drawings. Drip pans shall be stainless steel Type 304.
- C. For all air conditioning supply systems, space only shall be provided for future installation of eliminators. Drain pans shall be sized and constructed so as to be able to accommodate the addition of the eliminators in the future.

2.4 HEATING AIR COILS (WATER) AND HEAT RECOVERY COILS
- A. Coils shall be constructed of heavy-gauge seamless copper tubing, 5/8 inch (16 mm) o.d., 0.025 inch (0.635 mm) wall thickness, with 0.010 inch (0.25 mm) thick aluminum fins. Tube-to-header and tube-to-return bend joints shall be of the brazed type giving permanent pressure-tight joints. The fins on each tube shall be separated from those on adjacent tubes to ensure that each tube

can expand and contract independently without movement with respect to its fins. Coils shall be mounted in suitably flanged galvanized steel casings.

B. The air temperature at any point in a plane 3 inches (75 mm) downstream of the coil shall be within 5% of the average temperature. The air pressure drop across the coil shall remain constant (± 5%) regardless of the orientation of the dampers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The cooling and heating air coils shall be installed in accordance with the requirements of the related sections listed above in Article 1.2 as well as all the requirements in this section.

3.2 ADJUSTING AND BALANCING

A. All testing, adjusting and balancing shall be in accordance with the requirements of Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

END OF SECTION 23 82 16

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SECTION 23 82 39

UNIT HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide and install unit heaters as indicated herein and on the Contract Documents with supplementary items necessary for their proper installation and operation.

B. Section includes:

1. Cabinet unit heaters.
2. Wall and ceiling unit heaters.
3. Electric unit heaters.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 23 00 00.03 – Table of Contents for HVAC for specification sections that apply to all work herein.

1.3 REFERENCES

A. Unit heaters and their components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the State of New York.
   b. Fire Code of the State of New York.
   c. Mechanical Code of the State of New York.
   d. Energy Conservation Construction Code of New York State.
   e. New York City Building Code.
   f. New York City Mechanical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. American Bearing Manufacturing Association (ABMA)
      1). ABMA 4: Tolerance Definitions and Gauging Practices for Ball Bearings and Roller Bearings.
      2). ABMA 9: Load Ratings and Fatigue Life for Ball Bearings.
   b. National Electrical Manufacturers Association (NEMA)
      1). NEMA MG-1: Motors and Generators.
   c. National Fire Protection Association (NFPA).
   d. Underwriters Laboratories, Inc. (UL)
      1). UL 674: Standard for Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.

1.4 SUBMITTALS

A. Submittals shall be furnished in accordance with the requirements of Section 23 00 00.

1.5 WARRANTY

A. Comply with Division 01 and Section 23 00 00 requirements for product warranties.

B. Furnish a two (2)-year manufacturer’s warranty for all unit heaters.

C. Electric heating elements shall be warranted for five (5) years.

D. Warranty period shall initiate upon Final Acceptance by Owner.

1.6 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements as set forth in the Contract Documents.

B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate and must be accompanied by a Letter of Equivalency certifying that the products are equivalent in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Contract Documents will be revised to reflect the substitution.

C. Water Unit Heaters
   1. Airedale North America.
   2. Airtherm.
   3. Daikin McQuay.
   4. Modine.
   5. Rittling.
   6. Sterling.
   7. Trane.

D. Electric Unit Heaters
   1. Berko.
   2. Brash.
   3. Chromalox.
   4. Electromode.
   5. Fostoria.
   6. Indeeco.
   7. QMark.
   8. Trane.

2.2 GENERAL REQUIREMENTS

A. Provide unit heaters of sizes, types and performance ratings as scheduled on the drawings. Heating elements shall be made of non-ferrous construction throughout.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Unit heaters shall be set true on resilient isolators as required in Section 23 05 48.13 - Seismic Controls for HVAC Piping, Ducts and Equipment and Section 23 05 48.16 - Vibration Isolation for HVAC Piping, Ducts and Equipment.

3.2 TESTING, adjusting and balancing

A. All testing adjusting and balancing shall be in accordance with the requirements of Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

END OF SECTION 23 82 39

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 Work Included

A. The work includes, but is not limited to, providing (i.e., furnishing and installing), testing and commissioning the following systems, equipment and services:

1. All work associated with the introduction of electrical services as hereinafter defined under “Consolidated Edison Electric Services” and “Division of Responsibility”.
2. Service switchboards and Con Edison electric metering provisions.
3. Distribution switchboards and panelboards for lighting and power.
4. Feeders and branch circuiting for light, power and control wiring, including connections to all service switchboards, distribution switchboards, transfer switches, panelboards, transformers, motor starter groups, motor control equipment, disconnect devices, outlets, motors and equipment included in the Contract Documents.
5. Fire alarm and detection system.
6. Provide smoke detector elements in the ductwork in cutouts provided under another division. Obtain the necessary approvals for installed detectors. Closely coordinate the installation of all smoke detector elements with the work of the Heating, Ventilating and Air Conditioning Section of the Contract Documents.
7. Lighting equipment, luminaires, lamps, ballasts (if not integral to the fixture), power supplies, etc.
8. Lighting control equipment including, but not limited to, factory preassembled and prewired lighting control cabinets, wall-mounted control stations, contactors, remote control devices and peripheral equipment (if not integral to the system), control interfaces, occupancy sensors, programming, system network wiring, mounting hardware, theatrical connector strips and plug boxes for portable lighting fixtures, etc.
9. Power and raceways for telecommunications, security and audio/visual equipment. (Refer to other Consultants’ drawings for additional information.)
10. A complete electrical grounding system, including a telecommunications signal reference grid.
11. Lightning protection system.
12. Heating cable and monitoring system for freeze protection of all piping.
13. Emergency, standby and optional power systems, light and power system, including automatic transfer switches or installation and testing of the prepurchased emergency, standby and optional power systems, including automatic transfer switches.
14. UPS system, including switchboards, PDC’s, PDU’s, RPP’s and batteries, etc., or installation and testing of the prepurchased UPS, PDC’s, PDU’s, RPP’s and associated switchgear and batteries, etc.
15. Installation and wiring of individual motor controllers and motor control centers, including variable speed/frequency drives furnished by other divisions.
16. Connection of all motors, equipment, interlocks, safety devices and other components as specified herein or as specified in other divisions.
17. All interlock wiring not provided by Divisions 21, 22 and 23, including all 120 volt and 120/208 volt power circuits (coordinate with other sections).
18. Wiring and connection to all conveying systems equipment being furnished or provided under Division 14.
19. Connection of all equipment furnished under other divisions and/or by the Owner.
20. Miscellaneous items as required for complete and functioning systems as specified herein and indicated on the Contract Documents.

21. All excavation and backfill required for the work of this division.
22. Supports, vibration isolation and seismic restraint devices.
23. Electronic submetering system for revenue and NYSGBTC/LEED/NYSERDA requirements.
24. Labor and/or standby assistance in testing and commissioning of all equipment and systems, including modification to existing equipment and/or systems, provided by this and other divisions, including:
    a. Pre-functional tests.
    b. Functional tests.
    c. System tests.
    d. Integrated tests.
25. All time required for the detailed development and review of the Commissioning Documents and process as required by the Construction Manager/General Contractor, Commissioning Authority, Commissioning Agent, Engineer and/or Owner.
26. Participate in and provide labor for all off-hour (nights and/or weekends) testing and/or commissioning of equipment and systems, as required by working conditions, the schedule or the Authorities Having Jurisdiction for all testing/commissioning, including that required to obtain the Temporary Certificate of Occupancy (TCO) and final Certificate of Occupancy (CO).
27. Complete all tests required by the Contract Documents and by all rules, regulations, etc., of all Authorities Having Jurisdiction and prepare, complete and file all forms, tabulations, plans, etc., including Progress and Special Inspections, pertinent thereto with the referenced authorities and accomplish such work with personnel of proper caliber, in particular Professional Engineers, where so required.
28. All testing instruments, as required, for operating, testing and commissioning the various systems.
29. All diesel fuel required for initial fill of the system upon completion of installation, for testing as specified and as required by the Authorities Having Jurisdiction, and to fill the tank upon project completion and prior to Substantial Occupancy.
30. Sleeves for all electrical work, complete with seals and firestop as specified herein and as required by the Authorities Having Jurisdiction.
31. Patching or replacement of all firestop if it is damaged or removed during the installation of the work in this division.
32. All access doors in finished construction.
33. All seismic restraints.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Finished painting except touch-up painting and as otherwise specified herein.
B. Concrete foundations, curbs, pads and blocks for equipment mounting (except as otherwise noted herein), except that anchor bolts and templates shall be furnished to the appropriate Contractor. Drawings of equipment foundations, curbs, pads and blocks (with required reinforcing rods, etc., indicated) shall be furnished for approval.
C. Installation of access doors in finished building construction.
D. Base flashing for all roof equipment and roof penetrations.
E. Cutting and patching.
F. Furnishing of motors, variable speed drives, starters and motor controlling devices.
G. Individual motor controllers that are factory-mounted and integral parts of pieces of equipment, variable speed/frequency drives and integral system controllers.
H. Furnishing, installing and connecting telecommunications conduit, wiring, cables and equipment.
I. Furnishing the lighting fixtures and lighting control systems, as specified under 26 09 23 and 26 51 00 of the specifications.

J. Automatic temperature and humidity control system as specified under Division 23 of the specifications, including furnishing of all motorized valves and control valves, and providing all damper actuators. (Note: All power provisions shall be provided under this section.)

K. Furnishing of any prepurchased equipment specified under other sections of the specifications.

1.3 MOTOR WIRING AND CONTROLS

A. Connect the motor-starting devices for all motors, except where otherwise specifically provided for; furnish all necessary connections between variable speed/frequency drives, starters, motor control devices, controllers and motors, in conduit, and leave motors ready to start. Change connections, if necessary, to secure proper rotation of motors. The power supply leads to the motors from the controllers shall be as required by the manufacturer, with minimum size to be the same size as the feeder.

B. Include the erection and connection of all motor control groups or centers, variable speed/frequency controllers, pushbuttons, relays, controllers, etc. Single starters shall be suitably mounted either on wall or separately on angle iron racks. Unless noted on plans, all motor-starting equipment shall be furnished under other divisions for installation by this division.

C. Motors in outdoor locations shall be provided with weatherproof disconnect switches.

D. Include being responsible for the exact location of the motor controllers or control center and motors as far as wiring is concerned. Ascertain the proper location of the controllers, control groups or groups and motors in each case before installing the circuit work.

E. Perform all the necessary wiring in connection with the motor-starting and remote control equipment. Where control or starting equipment is sent to the job as individual units, they shall be installed, wired up complete and left ready for operation.

F. All motor controllers shall have circuit-protection fusible switches either in combination with the starter or as separate units.

G. Unit heaters shall be furnished under other divisions. Work under this division shall include making all the electrical connections between motors, starters, controllers, aquastats and thermostats, and leaving unit heaters ready to operate.

H. The Division 23 Contractor will provide all wiring in connection with the automatic and safety control of the refrigerating machines. All power wiring to the equipment and all auxiliary equipment shall be provided by this Contractor.

1.4 Vertical transportation

A. Coordinate all work with Division 14.

B. For elevators, escalators and all conveying systems and equipment, provide all power conduit and cables connecting to control panels with sufficient slack in conductors to reach control terminals.

C. Provide all wiring and outlets in Machine Rooms for lighting, relay and signal controls.

D. Provide ground fault receptacles, outlets and lighting fixtures in each elevator shaft and pit.

E. Provide a dedicated branch circuit for each elevator car at every Elevator Machine Room or Control Room with the overcurrent protective device located at the entry/exit door for each of the following, whether indicated on the drawings or not:

1. Car light.
2. Car air conditioning and/or heating source.

F. All feeders and branch circuits serving elevator motors and controllers shall include a code-sized, insulated, green grounding conductor from the motor all the way back to the service. Increase the conduit size as applicable.

G. All lighting in elevator cars/cabs shall be provided with 90 minute battery ballasts, as specified in Section 26 51 00.

H. All fireman service elevator hoistways shall be provided with hoistway lighting, furnished and installed by Division 14.

1.5 PAINTING

A. Painting, except as specified herein or indicated otherwise, shall be done by another division. This division shall cooperate with the other Contractors to determine the size of equipment, sizes and lengths of conduits, etc., to be painted.

B. Equipment furnished under this division shall be factory-finished. If the factory finish is damaged during shipment, storage, installation, etc., it shall be repainted by this division subject to the Engineer's approval. Touch-up painting is acceptable only for minor finish damage.

C. All field-applied architectural coatings shall meet the VOC requirements of the project. For bituminous paints, the maximum allowable VOC content is 34,250 grams/liter, less water, exempt compounds and colorant. For flat topcoats, the maximum allowable VOC content is 50 grams/liter, less water, exempt compounds and colorant. For non-flat topcoats, the maximum allowable VOC content is 150 grams/liter, less water, exempt compounds and colorant.

1.6 SLEEVES

A. For materials passing through roofs, provide roof couplings (Zurn Z-196-3) at a suitable level above the roof to terminate flashings.

B. This Contractor shall be responsible for the timely placement of sleeves and boxouts for all conduit, wiring, cable tray, bus ducts, etc., passing through walls, partitions, beams, floors and roofs while the same are under construction.

C. Penetrations through waterproof membranes shall be accomplished in a manner that maintains their integrity. Submit details of proposed method prior to installation.

D. Field drilling, cutting and/or reinforcing of holes in structural metal deck required for work under this division shall be coordinated through the Construction Manager/General Contractor and approved by the Structural Engineer. All such drilling, cutting and reinforcing costs shall be included as work of this division of the Contract Documents.

E. Sleeves for conduit shall be at least one (1) size larger than the size of conduit it is intended to accommodate, except where Link-Seal casing seals are used in sleeves through walls below grade. Sleeves shall be sized such that the annular space between the sleeve and the conduit will not be less than 1/2 in. or more than 1 in. unless otherwise required by the listed firestop system or governing codes.

F. All conduit passing through concrete or masonry walls above grade shall have at least 18 gauge galvanized steel sleeves and set flush with finished wall.

G. Sleeves set in concrete floor construction shall be at least 16 gauge galvanized steel. All sleeves in floors shall be flush with the underside of slab and extend a minimum of 2 in. above the finished floor, a minimum of 4 in. in Mechanical Rooms, and a minimum of 6 in. in Data Centers and Technology Rooms (±1/2 in.).

H. Sleeves installed in fire-rated construction shall be of suitable length and diameter to accommodate the listed firesafing system used. Where the conduit passes through a sleeve, no point of the conduit shall touch the sleeve and the conduit shall be centered in the sleeve.

I. Except as may be noted on the drawings, sleeves penetrating walls below grade shall be standard weight black steel pipe with 1/4 in. thick steel plate water-seal secured to the sleeve with continuous fillet weld. The water-seal plate shall be located in the middle of the wall and shall be two (2) inches wider all around than the sleeve it encircles. The entire assembly shall be hot-dip galvanized after fabrication. Seal off annular opening between pipe or conduit and sleeve with Link-Seal casing seal as manufactured by Thunderline Corporation, Wayne, Michigan. The sleeve shall be sized to accommodate the Thunderline casing seal. Casing seals shall be Series 300 for sizes 3/4 in. through 4 in. and Series 400 for sizes 5 in. and larger.

J. Provide waterproof-type sleeves, Zurn Z-197, with galvanized Schedule 40 pipe extensions where penetrating membrane-waterproofed floors. Cut, extend and repair membrane.

K. If holes and/or sleeves are not properly installed and cutting and patching becomes necessary, it shall be done at no additional expense to the Owner. The Contractor shall undertake no cutting or patching without first securing the Architect's written approval.

L. Set sleeves as construction progresses and secure in place during pouring of concrete.

M. Where structural steel flooring is used, furnish and locate sleeves, cut holes through deck, reinforce deck and set sleeves. Coordinate the locations of sleeves with work of other trades, including flooring and electrical distribution. Submit drawings showing locations of proposed holes and reinforcing for Architect's and Structural Engineer's approval prior to installation.

N. Do not support conduit or piping by resting clamps or other types of supports on sleeves. Supports must extend beyond sleeve and be supported outboard of sleeve in an approved manner.

O. Coordinate support for all conduit, equipment and structural wall/floor penetrations with the Structural Engineer.

1.7 Fireproofing (Firestoping)

A. Seal all penetrations of fire-rated construction with factory-built devices or with manufactured fill, void or cavity materials classified for use as a through-penetration firestop. All firestop devices and systems shall be installed in compliance with their listing and be approved for such use by the Authority Having Jurisdiction (AHJ).

1. The firestop system used shall maintain the fire resistance rating of the building component that is penetrated.
2. Firestop systems and devices shall comply with ASTM E-814 and (UL 1479) and New York City Building Code for all types of penetration being sealed.
3. Firestop systems shall comply with all applicable F and T ratings.
4. Submittal data for firestop systems shall include copy of the standards, e.g., FHIT, UL Standard, etc., to which they comply.
5. The firestop system or device used shall not require derating the ampacity of electrical distribution or utilities.
6. Excessive shrinkage of the firestop materials that would permit the transmission of smoke or water prior to exposure to a fire condition is unacceptable.
7. Where a mastic is used to seal the surface of the firestop, the mastic shall be non-hardening.
8. All sealants and adhesives used in firestop systems shall meet the VOC requirements of the project.
9. The firestop system used shall accommodate expansion and contraction of the electrical raceway systems and busways without damaging the firestop or reducing its effectiveness as a smoke barrier or water seal.
10. The firestop manufacturer's authorized representatives shall instruct the Contractor's representatives in the proper installation procedure so that the material will be installed in accordance with the UL listing and the manufacturer's recommendations.
11. If any product is proposed to be used in an application that is not in strict compliance with the product's NRTL listing, submit an Engineering Judgement (EJ) to the AHJ for approval for the specific product in the specific application, signed and sealed by a Professional Engineer in the State where the project is located, prior to installation.
    a. The specific approval by the AHJ shall be submitted for record.
    b. The EJ submission shall include documentation supporting compliance with the International Firestop Council (IFC), which includes:
        1). The EJ shall be created and submitted by a Professional Engineer licensed to practice in the State where the project is located (the "Firestopping Engineer"). The Firestopping Engineer shall sign, seal and file all documentation with the AHJ.

2). The EJ shall be based upon a previously tested listed system. The EJ shall include the details, and supporting documentation and calculations, when appropriate, for the applicable UL tested system.
3). The EJ shall be applicable only for this project, and one (1) or more specifically identified location(s) within the project.
4). The EJ shall be based on the assumption that the recommended firestop system would pass UL 1479/2079 for the required rated period of time if tested by a nationally recognized Testing Laboratory.

c. All costs associated with this work, including the cost to hire the Firestopping Engineer, shall be at no additional cost to the Owner.

12. If it complies with these specifications, a firestop sealing component/system as manufactured by one (1) of the following manufacturers will be acceptable:
    a. Tremco fire-resistive joint system using Dymeric sealant and Cerablanket-FS mineral filler.
    b. Specified Technologies, Inc. SpecSeal systems.
    c. 3M Fire Barrier Penetration Sealing Systems (CS-195 + composite sheet, etc.).
    d. GE Pensil Firestop Sealant by General Electric.
    e. International Protective Coatings Corp. Flame-Safe systems.
    f. Thermal Ceramics FireMaster Firestop Fire Protection systems.
    g. Hilti FS 601 systems.
13. Where loose cabling penetrates fire- or smoke-rated walls, partitions, floor slabs, etc., provide sleeves (as described hereinbefore) through the rated construction. All cabling shall be run through these sleeves. Sleeves shall be located as required and shall be filled with a UL-listed, intumescent-type firestop system approved for use in New York City. Quantity of cables, configuration of cables, etc., shall be in accordance with the manufacturer's requirements for the type of rated construction for which the system is to be used. The firestop systems shall be as manufactured by 3M Fire Protection Products, SpecSeal firestop products or as approved.
14. All unused sleeves shall be sealed with firestop devices and systems to maintain the fire rating of the construction penetrated. See Architectural Drawings for locations and ratings of ceilings, floors and walls.

1.8 MISCELLANEOUS STRUCTURAL SUPPORT MEMBERS

A. Provide all miscellaneous steel for support of equipment, conduit systems and lighting systems.
B. Where conduits (including concrete encasements where specified and/or required), etc., are routed horizontally and vertically, the Contractor shall provide and install all necessary miscellaneous structural members to support the loads imposed by the feeders and encasements.
C. Where equipment (transformers, conduit racks, etc.) are supported from slabs or structure, the Contractor shall provide all miscellaneous structural members to support the loads plus a 250 lb. live load.
D. Submit shop drawings for review of all loads imposed (feeders, risers and/or equipment) and support systems to the project Structural Engineer for approval, including details of attachment to the building structure, prior to installation of any support system components.
E. Miscellaneous structural support members shall be hot-dip galvanized.
F. Provide required supports for conduit, piping, etc., and equipment so that loading will not exceed allowable loadings of structure. Submittal of a bid shall be deemed a representation that such bid has included all costs associated with providing such supports and any required modifications to the structural system.
G. If vertical support anchorages are to utilize post-installed anchors, the anchors are to be pre-engineered and meet the cracked concrete requirements of the code.
H. Where supplementary steel is required to support equipment, the supplementary steel shall be designed to provide a maximum deflection of 0.08 inch at the midspan under the supported load.

1.9 ESCUTCHEONS

A. Provide heavy chrome-plated or nickel-plated escutcheons of approved pattern on all conduit passing through walls and ceilings in finished areas. Escutcheons shall be B&C No. 10 or approved equal chrome-plated or nickel-plated steel plates with concealed hinges. Unless finished areas are specifically indicated on the drawings, they are areas that are normally accessible to either the Tenant or the public.

B. Provide sheet metal escutcheons at all penetrations, other than finished areas, where required by code.

1.10 COORDINATION OF WIRING AND OUTLETS

A. Coordinate work so that exact locations may be obtained for all outlets, apparatus, appliances and wiring.

B. The location of all electrical work shown on diagrammatic wiring plans shall be considered as approximate. Before installing electrical work, all pertinent drawings shall be studied and precise information obtained from the architectural schedules, scale drawings, large-scale and full-size details of finished rooms, reviewed shop drawings and from the Architect. It shall be understood that any electrical work may be relocated a distance not exceeding 5 feet from the location shown, if so directed by the Owner. Make any necessary adjustment of the work to fit conditions for recessed fixtures and for outlets, including those occurring in glazed tile, block, wood paneling or other special finish material in order that all boxes may register flush with the initial or intended future finish and shall be centered properly. In centering outlets, make due allowance for overhead piping, ducts, window and door trim, variations in thicknesses of furring, plastering, etc., as erected, regardless of conditions that may be otherwise shown on small-scale drawings. Work incorrectly located shall be properly relocated without expense to the Owner. Locate local switches that are shown near doors at the strike side of the door, unless specifically noted on plans to be beyond the open door.

C. In Mechanical Rooms, electric closets, Elevator Machine Rooms, Pump Rooms, Communications Rooms, etc., the light fixture arrangement shall be adjusted to suit the final coordinated equipment layout. Fixtures shall be mounted approximately 8 feet 0 inches above the finished floor (unless otherwise noted). Layout of proposed fixture locations, including mounting height and support method, shall be submitted for review prior to installation.

1.11 filing requirements

A. Prior to fabrication or commencement of any work hire a New York State Registered Professional Engineer to file the electrical service layout and configuration in accordance with the New York City Buildings Department RCNY 4000-01.

1. The NYS Registered Professional Engineer shall file an initial application with the Department of Buildings indicating all requirements including the dimensioned service layout and service configuration in one-line format (normal and emergency distribution system with a minimum of the first two [2] levels of overcurrent protection) to obtain approval prior to the manufacturing of the switchboards and/or the rough in installation of equipment within the field.

2. Include a short circuit and selective coordination study signed and stamped by a NYS Registered Professional Engineer for the electrical distribution system. Refer to Section 26 05 73 for requirements associated with performing the short circuit and selective coordination analysis.

a. Submit the first two (2) levels of the short circuit and selective coordination analysis to the Department of Buildings demonstrating that the service distribution level and 2nd level downstream overcurrent protective devices are selectively coordinated. The study should also show that the service switchgear short circuit ratings meets or exceeds available fault current at the building’s incoming electrical service.

B. Resubmit filing drawings (by the New York State Registered Professional Engineer) documenting any and all as-built field conditions that vary from the filed documents, for any changes that may

have occurred during the course of construction prior to the Electrical Contractor calling for an electrical inspection.

C. Pay all required filing fees and obtain all plan examination approvals.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 Vertical Transportation

A. Throughout the Construction Phase, as elevators are placed into startup, testing, commissioning and/or service, the source of power may be from a temporary electrical service or from portions of the permanent power system of the building. Since the elevator system can produce a varying amount of regenerative power during these phases of construction, provide the following to prevent power disturbances and/or interruptions:

1. During the shop drawing process, provide a matrix indicating the maximum regenerative energy relative to each individual elevator and each elevator bank (in aggregate) under worst-case operating conditions, including elevator recall and elevator operation under emergency power. Include both final operating conditions as well as all interim scenarios of startup, testing and commissioning.
2. Provide all necessary interim measures to limit the regenerative electrical energy from the elevator system at the utility (temporary electrical service and/or service switchboard[s]) to net zero and thereby prevent adverse effects to any other electrical systems or equipment in the building during the Construction Phase (e.g., resistive load bank[s], modification of drive settings, addition of drive component [e.g., resistors], etc.). Coordinate all such interim measures with the Construction Manager/General Contractor. All damage sustained to any equipment caused by the adverse effects of elevator regenerative power shall be corrected by this Contractor at no cost to the Contract.
3. Confirm that all interim corrective measures are in place prior to the startup of the first elevator.
4. Prior to the removal of the interim measures, confirm with the Construction Manager/General Contractor that sufficient temporary and/or permanent building loads are available and operational to accept the maximum calculated regenerative power such that there will be no adverse effect to any other systems and/or equipment connected to the electric power system (whether temporary or permanent equipment).
5. Coordinate all wok with the Construction Manager/General Contractor and the Division 14 Contractor and vendor.

END OF SECTION 26 05 00

SECTION 26 05 06.03

ELECTRICAL SERVICE
(SECONDARY SERVICE, AS-OF-RIGHT SUB-SIDEWALK VAULTS AND INTERIOR VAULTS)

PART 1 - GENERAL

1.1 Summary

A. Furnish and install all equipment and provide all coordination necessary for the complete Con Edison electric service entrance system, including all conductors, busway, conduit, metering devices, etc., in accordance with EO-2080, from the utility company point of service to the service switch assemblies, in accordance with the requirements of the Contract Documents.

B. Obtain copies of all Con Edison standards and Installation Drawings from Con Edison prior to bid.

C. Section includes:

1. Service.
2. Utility metering.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 REFERENCES

A. All service and service entrance equipment and components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the City of New York.
   b. New York City Electrical Code.
   c. International Building Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. Consolidated Edison Standards.

1.4 WARRANTY

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.5 FIling Requirements

A. Prior to fabrication or commencement of any work, hire a New York State Registered Professional Engineer to file the electrical service layout and configuration in accordance with the New York City Buildings Department RCNY 4000-01. Refer to Section 26 05 00 - Common Works Results for additional requirements.

1.6 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 Interior Service

A. Secondary electrical service for lighting and power shall be furnished by Con Edison and installed by this section via a new spot network consisting of interior vaults, including network transformers, network protectors, collector bus and service stabs.

B. The system service voltage for the building will be 208Y/120 volt, 3 phase, 5 conductor, 4000A 60 hertz.

2.2 Service Arrangement

A. All primary feeders shall be interfaced with Con Edison via concrete splice chambers at property line demarcation.

B.

2.3 UTILITY METERING

A. Current transformers for metering purposes will be furnished by Con Edison for installation by this section in the building service switch assemblies.

B. Each service takeoff shall be metered in a separate barriered section of the metal-enclosed service switch assembly. The arrangement of buses shall be in accordance with Con Edison Specification No. 377, latest revision, for accommodation of the required current transformers. The current transformer cubicle shall be fabricated out of aluminum.

C. The utility meters shall be provided with continuous real-time energy consumption pulsed output for connection to the BATC system. Obtain the equipment, and all required forms, approvals, etc., from the utility and provide to the Owner if required for signature.

D. Ten-point meter pans shall be furnished and installed for the mounting of utility company meters. Demand pans shall be furnished and installed for a cumulative demand meter for one (1) service takeoff with space for one (1) future. See plans for additional individual switchboard metering. Furnish and install all interconnecting wiring and conduit associated with the metering in accordance with the utility company service layout specifications.

E. Provide a telephone communications box, per utility company standards, at each totalizer, with a 3/4 inch empty conduit to the Telephone Service Room, including all communications wiring.

PART 3 - EXECUTION

3.1 Installation

A. Furnish and install the electric service connections from the main service switch assemblies to service interface point. Provide all required interface details including end boxes and bus detailing.

B. Install the current transformers as required by the utility company in the service switch assemblies and all other locations indicated on the drawings.

C. Perform all other work required by the utility company or as shown on the Contract Documents and associated utility company documents to provide a complete and functional electric service.

D. It shall be the responsibility of this section to coordinate all scheduling and construction of related work with the utility company, arrange all tests and inspections with the utility company, and obtain all utility company approvals.

E. The utility company shall serve this building with one (1) takeoff points initial with provisions for one (1) additional future takeoff. Connect to the 3-phase, 4-wire aluminum bus, inside of building at each takeoff point. Install copper bus bars of minimum ampere capacity equal to the service capacity of each takeoff point, or greater if indicated on the Contract Documents, to the incoming bus connection of each service switchboard. Make the connection at the takeoff points. These buses shall be enclosed with a solid bottom in a fabricated aluminum enclosure, fully insulated and braced for 200,000 amperes RMS symmetrical. These buses shall be equipped with snug-fitting firestops of approved non-hydroscopic arc resistance material at the entrance and exit of the current transformer section of each service switch.

F. Coordinate all details of connections with Con Edison. All work shall be performed in accordance with their requirements and standards.

G. All conductors, wires, and busbar shall be copper.

H. Provide (1) 4000A service endbox.

END OF SECTION 26 05 06.03

SECTION 26 05 07

ACCESS DOORS AND COLOR-CODED
IDENTIFICATION IN GENERAL CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish all access doors herein specified and where required. Access doors in general construction will be installed where required and in accordance with the requirements of the Contract Documents.

B. Section includes:

1. Access door construction.
2. Access door sizes and types.
3. Color-coded identification.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 REFERENCES

A. All access doors shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the City of New York.
   b. New York City Electrical Code.

1.4 SUBMITTALS

A. The following submittal data shall be furnished according to the conditions of the Construction Contract, Division 01 and Section 26 00 00 and shall include, but not be limited to:

1. Access doors, including construction, sizes, types, fire ratings and locations superimposed on raceway layout shop drawings, for access to all required junctions, splices, pull points and equipment.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.6 WARRANTY

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.7 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. If they comply with these specifications, access doors manufactured by one (1) of the following manufacturers will be acceptable:

1. JL Industries.
2. Karp Associates, Inc.
3. Milcor Inc.
4. Nystrom, Inc.

2.2 ACCESS DOOR CONSTRUCTION

A. Provide a frame to match the surrounding surface.

B. Provide a recessed-type door as required to accept matching tile, etc.

C. Provide UL-rated doors for fire-rated construction.

D. Provide a flush-type steel-framed panel with concealed hinges.
E. Provide a cam-type locking device.
F. Provide locked access doors located in public corridors and Washrooms complete with master keys.

2.3 ACCESS DOOR SIZES AND TYPES

A. Furnish access doors of proper size for access to concealed equipment. Access doors in general construction shall be installed under another section. Unless otherwise indicated, minimum size shall be 12 in. x 12 in. for hand access and minimum 18 in. x 18 in. for arm access in conformance with the following schedule:
   1. Rated Walls and Vertical Shaft: Inryco/Milcor fire-rated enclosures access door - UL label on door.
   2. Non-Rated Dry Wall Construction: Inryco/Milcor Style DW.
   3. Non-Rated Masonry, Concrete: Inryco/Milcor Style M Standard.
   4. Non-Rated Ceramic Tile: Inryco/Milcor Style M - Stainless.
   5. Non-Rated Plaster Wall: Inryco/Milcor Style K.
   6. Non-Rated Plaster Ceilings: Inryco/Milcor Style AP.

2.4 COLOR-CODED IDENTIFICATION

A. Furnish color-coded buttons or tabs to indicate the location of equipment above removable-type acoustical ceilings where access doors are not required. Provide color-coded dots on access doors to indicate type of service as specified herein.

PART 3 - EXECUTION

3.1 ACCESS DOOR INSTALLATION

A. All access doors shall be installed in accordance with code, the latest industry standards, and per the manufacturer's recommendations where required for equipment needing access concealed by construction.
B. Provide direction in locating and setting of access doors in hung ceilings, furred spaces, walls, etc., to provide access to concealed work items requiring maintenance and/or adjustment. No access door in general construction shall be installed until the location and type have been reviewed and approved by the Architect.
C. Locate and group equipment requiring access doors so that access door locations are aesthetically acceptable. Prepare drawings of junction boxes, pull boxes, splice boxes and equipment locations indicating proposed access door locations for review by the Architect prior to installation of junction boxes, pull boxes, splice boxes, equipment, etc. Coordinate location of equipment with other trades to minimize number of access doors in one area.
D. Provide access doors for maintenance or adjustment purposes for electrical system components including, but not limited to, the following:
   1. Junction boxes.
   2. Pull boxes.
   3. Splice boxes.
   4. Switches and contactors.
   5. Motor controllers.
   6. Other equipment as required.
E. Improperly located or sized access doors shall be corrected prior to Final Review.

3.2 COLOR-CODED IDENTIFICATION

A. Removable ceiling tile and access doors to be marked by small color markings at corner of tile or door in accordance with the following color assignments:
   1. Electrical - Green.
   2. Fire Alarm System - Red.
B. Improperly located or sized color-coding identification shall be corrected prior to Final Review.

3.3 FACTORY TESTING

A. All access doors shall be tested in accordance with the latest applicable industry standards.

END OF SECTION 26 05 07

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SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install all 600 volt electrical conductors as specified herein and as required for proper distribution of power, lighting and receptacle loads throughout the project as indicated on and in accordance with the requirements of the Contract Documents.

B. Section includes:

1. Copper conductors.
2. Conductor sizes.
3. Type AC and MC conductor cable (outside diameter 1 in. and less).
4. Type MC conductor cable (outside diameter greater than 1 in.).
5. MC-PCS cable (lighting power and control signal cable).
6. 2-hour fire-rated MC cable.
7. Type RHH/RHW-2 emergency power cable (EPC).
8. Mineral-insulated (MI) cable.
9. Connectors.
10. Adapters.
11. Reducers.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 REFERENCES

A. All 600 volt electrical conductors and all components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the City of New York.
   b. International Building Code.
   c. National Electrical Code.
   d. New York City Electrical Code.

2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. NEMA WC70: Per NEMA website, “Power Cables Rated 2,000 Volts or Less for the Distribution of Electrical Energy.”
   b. UL Standard 4: Armored Cable.
   c. UL Standard 44: Thermoset-Insulated Wires and Cables.
   d. UL Standard 83: Thermoplastic - Insulated Wires.
   e. UL Standard 486A-B: Wire Connectors.
   f. UL Standard 486C: Splicing Wire Connectors.
   g. UL Standard 486D: Sealed Wire Connector Systems.
   h. UL Standard 486E: Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors.
   i. UL Standard 493: Thermoplastic - Insulated Underground Feeder and Branch Circuit Cables.

j. UL Standard 1479: Fire Tests of Through-Penetration Firestops.
k. UL Standard 1569: Metal-Clad Cables.
l. UL Standard 1581: Electrical Wires, Cables and Flexible Cords.
m. UL Standard 2196: Tests for Fire-Resistive Cables.
n. UL Standard 2225: Cables and Cable Fittings for Use in Hazardous (Classified) Locations.

1.4 DELIVERY, STORAGE AND HANDLING
A. Comply with the requirements of Division 01 and Section 26 00 00.

1.5 WARRANTY
A. Comply with the requirements of Division 01 and Section 26 00 00.

1.6 COMMISSIONING
A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 GENERAL
A. All conductors shall be copper.

2.2 ACCEPTABLE MANUFACTURERS
A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Contract Documents.
B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Contract Documents will be revised to reflect the substitution.
C. If they comply with the Contract Documents, electrical conductors manufactured by one (1) of the following manufacturers will be acceptable:
1. Copper Electrical Conductors, 600 Volts or Less
a. American Insulated Wire.
b. Colonial Wire & Cable Co.
c. General Cable.
d. Encore Wire.
e. Prysmian Group.
f. Republic Wire Inc.
g. Southwire.
h. United Copper Industries.
2. Flat Conductor Cable
a. Belden.
b. Hubbell.
c. Thomas & Betts.
d. Tyco Electronics/AMP.
3. Type AC and MC Conductor Cables, 600 Volts or Less (outside diameter 1 in. and less)
a. AFC/Atkore.
b. Southwire.
4. Type MC Conductor Cables, 600 Volts or Less (outside diameter greater than 1 in.)
a. AFC/Atkore.

b. Southwire.

5. Type MC-PCS Cable, 600 Volts or Less
   a. AFC.
   b. RSCC.
   c. Southwire.
6. 2-Hour Fire-Rated MC Cable
   a. OmniCable/VITALink.
7. Type RHW-2 Emergency Power Cable
   a. Draka/Lifeline.
8. Type MI Cable
   a. Pyrotenax.

D. If they comply with the Contract Documents, wire connectors and lugs manufactured by one (1) of the following manufacturers will be acceptable:
   1. Hubbell/Burndy.
   2. Ideal.
   3. MAC Products.
   4. Thomas & Betts/ABB/Blackburn.
   5. Thomas & Betts/ABB/Homac.
   6. Tyco Electronic.
   7. Union Connector Co.

E. If they comply with the Contract Documents, cable-pulling lubricants manufactured by one (1) of the following manufacturers will be acceptable:
   1. American Polywater Corporation.
   2. Electro-Compound Company.
   3. Ideal Industries.

F. If they comply with the Contract Documents, Type AC, MC and MC-PCS (outside diameter 1 in. and less) steel jacketed cable termination fittings manufactured by one (1) of the following manufacturers will be acceptable:
   1. American Fittings Corporation.
   2. O-Z/Gedney/Emerson - Series C5.
   3. Steel City/Thomas & Betts/ABB - Series XC400.
   4. Thomas & Betts/ABB - No. 253.

G. If they comply with the Contract Documents, Type MC (outside diameter greater than 1 in.) cable termination fittings manufactured by one (1) of the following manufacturers will be acceptable:
   1. American Fittings Corporation.
   2. Arlington.
   3. Bridgeport.
   4. O-Z/Gedney/Emerson.
   5. Steel City/Thomas & Betts/ABB.
   6. Thomas & Betts/ABB.

2.3 Copper Conductors

A. All electrical conductors shall be copper (unless otherwise noted), using an ampacity as described for a 75°C rating for circuits rated greater than 100 amps. Electrical circuits rated equal to or less than 100 amps shall use an ampacity as described for a 60°C rating, unless all components (terminations and device/equipment) are rated for a minimum of 75°C.

B. Conductor Insulation
   1. All copper conductor insulation shall be Type THHN or THHN/THWN, unless otherwise noted.
   2. Field-installed conductors within lighting fixtures, fixture bodies, sections of fixtures unless used as a branch circuit conductor, used as raceways, or within 3 inches of a ballast, shall be Type SFF-2. Where use of SFF-2 is not allowed by the manufacturer or fixture assembly

listing, fixture wiring meeting the temperature rating of the fixture assembly listing shall be provided by the Contractor, in coordination with the manufacturer.

3. All conductors installed vertically for a distance in excess of 35 ft. shall be Type XHHW. (Where XHHW conductors are required for circuits installed with such a vertical run, the conductor shall be continuous, from equipment termination to equipment termination, without a splice.)
4. All conductors installed in conduit that is in contact with earth (e.g., run below a slab on grade; run below a Basement or Cellar Level; or run outside of the building, etc.) shall be Type THWN. Provide a splice transition box at the conduit's point of exit from the building, where required to transition cable type.

C. Fire Rating: Where required by the New York City Building Code, New York City Electrical Code - Articles 695 and 700, NFPA 20 or NFPA 101, a fire-rated system shall be utilized. 2-hour rated RHH/RHW-2, MC cable or MI cable shall be utilized.

2.4 CONDUCTOR SIZES

A. All feeders and branch circuits shall be No. 12 AWG or larger.
B. All feeders and branch circuits shall be sized as indicated on the drawings or as specified herein. Fixture tap conductors shall not be smaller than No. 14 AWG and shall be in lengths not greater than 6 ft. 0 in. or less than 4 ft. 0 in.
C. All wire No. 8 AWG and larger shall be stranded. All conductors in sizes No. 10, No. 12 and No. 14 AWG shall be solid, except Class 1, 2 or 3 wiring, which may be stranded if terminated and spliced as specified hereinafter.

2.5 TYPE AC AND MC CONDUCTOR CABLE (outside diameter 1 in. and less)

A. Type AC and MC conductor cable shall be provided as follows:
   1. Inner Conductor: Soft Annealed Copper.
   2. Inner Conductor Insulation: THHN/THWN-2 or XHHW-2 in True Colors.
   3. Outer Sheath: Lightweight Steel Interlocked Armor
   4. Where utilized within concrete slabs, MC cable shall be provided with PVC jacketing, and conductor insulation shall be rated for wet conditions.
B. Types AC and MC conductor cable may be used in the following applications unless otherwise noted in the Contract Documents:
   1. Conductors connecting receptacle and switch circuits to lighting and power home-run boxes in finished areas may be multi-wire, steel-jacketed, Type AC or MC cable, consisting of one (1), two (2), three (3) or four (4) No. 12 AWG copper THW, THHN or THHN/THWN insulated phase and neutral conductors and one (1) No. 12 AWG insulated ground conductor (for MC cable or hospital-grade AC cable only).
   2. Type AC and MC cables may not be utilized where they will be exposed after completion of construction. .
C. Type AC and MC cable termination fittings (for sizes 1 in. and less) shall be clamp-type, malleable iron locknut-type fittings. Die cast fittings shall not be acceptable.

2.6 TYPE MC CONDUCTOR CABLE (outside diameter greater than 1 in.)

A. Type MC conductor cable shall be provided as follows:
   1. Inner Conductor: Copper
   2. Inner Conductor Insulation: THHN/THWN-2 or XHHW-2 in True Colors
   3. Outer Sheath: Lightweight Aluminum Interlocked Armor
   4. Ground: Green insulated ground conductor
   5. Where run vertically in excess of 35 ft., cable assembly must be "riser-rated". Provide polymeric binder jacket for continuous conductor support.
B. Type MC conductor cable may be used for feeders only where specifically noted on the Contract Documents.

C. Type MC cable termination fittings (greater than 1 in.) shall be steel or zinc die cast type. 90 degree terminations shall not be acceptable. MC cable shall be dressed at a proper angle to allow for straight termination fittings.
   1. Fittings shall be specifically UL-listed for MC cable. Fittings that are only listed for FMC shall not be permitted for use on MC cables.
   2. Listed MC cable fittings shall provide a shoulder that protects conductors from any sharp edges in the armor.

2.7 TYPE MC-PCS CABLE

A. Type MC-PCS cable may be used in the following applications unless otherwise noted in the Contract Documents:
   1. From a central lighting control dimming panel to [a] light fixture[s].
   2. From a wall box dimming control device to [a] light fixture[s].
   3. From light fixture to light fixture on a dimming branch circuit.
   4. Type MC-PCS cable shall be multi-wire, steel-jacketed, Type MC-PCS cable; shall consist of one (1), two (2), or three (3) No. 12 AWG copper THW, THHN or THHN/THWN insulated phase and neutral conductors and one (1) No. 12 AWG insulated ground conductor for power wiring and two (2) 16 AWG copper Type TFN conductors for Class 2 or Class 3 control wiring.
   5. All MC-PCS cable must be manufactured after January 1, 2015, and shall be labeled as MC-PCS.
   6. Type MC-PCS steel-jacketed cable termination fittings shall be clamp-type, malleable iron locknut-type fittings. Die cast fittings shall not be acceptable. There shall be no junction or splice boxes between the lighting control device and lighting fixture load. Combining multiple Type MC-PCS cables in a junction box shall not be permitted.
   7. Yellow stripe identification marks shall printed on the outside of the armor and the print legend shall be applied every 3 feet.

2.8 2-Hour fire-rated mc cable

A. 2-hour fire-rated polymer insulated MC cable shall be provided as follows:
   1. Description: ANSI/NFPA 70, Type MC
   2. Conductor: High-conductivity copper
   3. Insulation Voltage Rating: 600 volts
   4. Cable Temperature Rating: 90°C dry
   5. Termination Temperature Rating: 90°C
   6. Insulation Material: Silicone rubber
   7. Fire Rating: Complete cable system shall have a 2-hour fire rating as listed and classified by Underwriters Laboratories, Inc.

B. 2-hour fire-rated MC cable termination fittings shall be stainless steel glands as recommended by the manufacturer.

C. Where MC cable is utilized as a fire-rated cable assembly, the MC cable assembly and all fittings, connectors, couplings, hangers, supports (including wall and slab assemblies and penetrations), splices, etc., shall comply with the requirements of UL Electrical Circuit Protective System (FHIT), System Number 120 (or as applicable).

D. When used for fire alarm power cabling, 2-hour fire-rated MC cable shall comply with the following:
   1. Conductors shall be solid copper up to size 10 AWG. Stranded copper conductors shall be used for sizes 8 AWG and larger.
   2. All cables shall be provided with dedicated equipment grounding conductor within the assembly. Ground wire shall be labeled "Ground" directly on the insulation at consistent intervals. Wrap ground wire with green electrical tape wherever visible at terminations, etc.

2.9 Type RHW-2 Emergency Power Cable (EPC)

A. In addition to the requirements set forth for 600V cable, RHW-2 emergency power cable (EPC) shall comply with the following:

1. Type RHW-2 EPC shall be a UL 2196-certified, 2-hour fire-rated cable for use in conduit for fire pump and accessory circuits, and emergency feeders.
2. Type RHW-2 EPC and all conduit, fittings, connectors, couplings, hangers, supports (including wall and slab assemblies and penetrations), elbows, splices, etc., shall comply with the requirements of FHIT System Number 25A or 25B. Coordinate with the governing FHIT requirements with the specific field installation.
3. Insulation shall be ICEA S-95-658 Type R-2 silicone.
4. Cable shall be copper stranded for all conductor sizes.
5. Jacket shall be flame-retardant low-smoke, zero-halogen XLPO, meeting or exceeding all smoke, acid gas, halogen content and toxicity requirements of all North American Transit Authority specifications.
6. Cable shall be rated for 90°C and employed at its 75°C ampacity rating.
7. All EPC cable shall be in accordance with the latest edition of the New York City Electrical Code.
8. All EPC cable shall be installed in accordance with all of the manufacturer's requirements and recommendations.
9. Splices are not permitted, but, if required, must be submitted for review. All splices shall be approved for use per the UL listing and shall be within a metal box with an approved cable splice. Box shall be fire-rated with proper 3M (or as approved) Interam E-5 Series Mat (if approved with UL listing). Enclosure shall be certified to a 1-hour UL fire rating. Additionally, all splices must be approved by local the Authority Having Jurisdiction prior to splice.

2.10 MINERAL-INSULATED CABLE (MI)

A. General

1. Mineral-insulated (MI) cable shall have 2-hour fire rating as classified by Underwriters Laboratories, Inc. (UL).
2. MI cable and all fittings, connectors, couplings, hangers, supports (including wall and slab assemblies and penetrations), splices, etc., shall comply with the requirements of FHIT System Number 1850.
3. MI cable shall be used at a 75°C ampacity rating and be rated for 600 volts.
4. All wiring shall be in accordance with the manufacturer's requirements and recommendations.
5. MI cable shall be in compliance with the New York City Electrical Code.

2.11 CONNECTORS

A. Terminals and Lugs

1. Mechanical
   a. All conductors shall be connected with UL-listed, bolted or set-screw type, color-keyed, single conductor, Burndy KA-U mechanical lugs.
   b. Two-bolt mechanical lugs shall be provided for wire connections to switchboard and panelboard busbars/main lugs only. Where required, one-bolt mechanical lugs for use with a UL-listed circuit breaker or switch shall be provided with an anti-turn feature.
2. Compression
   a. Copper
      1). All No. 8 AWG and larger copper conductors shall be connected with high-conductivity, wrought copper, color-keyed concentric compression connectors.
      2). Terminations: Thomas & Betts Series 54200 two-hole long-barrel-type connectors shall be used up to No. 1 AWG and Thomas & Betts 60200 dual-rated two-hole long-barrel-type connectors shall be used for No. 1/0 and larger. Exceptions are as follows:

a). Where equipment or device cannot be provided by the manufacturer to accept two-hole connectors, T&B Series 54100 single-hole connectors with anti-rotation lug or restraint shall be used.

b). Where equipment or devices cannot be provided by the manufacturer to accept either two-hole or single-hole compression connectors, set-screw (mechanical)-type connectors may be submitted. Set-screw connectors for No. 4/0 AWG and larger sizes must be approved in writing by the Engineer, prior to equipment purchase. For a set-screw connector to be considered by the Engineer, the manufacturer shall certify that his equipment will not accommodate the required compression connectors. See Section 26 00 00 for certification requirements.

B. Splices and Taps:
1. Copper-to-copper splices, if allowed, shall be with T&B Series 54800 compression long-barrel-type connectors. All splices shall be insulated with T&B heat-shrink insulation tubing, HF Series, using T&B heat gun.
2. Tapping of copper conductors shall be with T&B Series 54700 compression taps.

C. Mechanical equipment motor terminations shall be made with compression connectors that accommodate the conductor size required and have a hole sized to fit the mechanical equipment motor connection stud. Coordinate the compression connector with the mechanical equipment manufacturer's termination requirements. Field modification to the compression lug or the motor stud will not be permitted.

2.12 ADAPTERS

A. Provide copper adapters (as applicable) for highly stranded flexible cable (locomotive, welding, etc.) connection to circuit breakers, transformers, panels, safety switches, etc. Adapter shall be Greaves PT-FX Series (compression type) with insulating covers, or approved equal.

2.13 REDUCERS

A. Provide copper cable reducers (as applicable) for oversized cable connections to safety switches, panels, circuit breakers, etc., which can only be manufactured with mechanical lugs as defined hereinbefore. Reducer shall be compression type, similar to Greaves PT-R Series, or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Circuit Identification: All circuits shall be identified in accordance with Section 26 05 53.

B. Conductor Pulling: Conductor pulling tensions shall not exceed manufacturer's recommended values. Where necessary, UL-listed lubricants, compatible with the type of insulation involved, may be used to facilitate cable pulling.

3.2 INSTALLATION

A. Splicing and Tapping: Conductors shall not be spliced between the points of origin and termination. If splices are necessary, their use must be approved in writing by the Engineer before installation. Splices, if allowed, and taps shall be made in boxes or gutters.

B. No modifications to any connector or fitting shall be permitted.

C. Vertical Supports: Conductors in vertical raceways shall be supported at intervals as required by code. Provide additional supports as required and as recommended by the cable manufacturer. Supports shall be of the two-piece insulating type and shall be installed in suitable boxes with covers. Insulated supports shall properly secure the conductors and shall have the strength to carry the weight of the conductors attached thereto. Obtain documentation from cable manufacturers stating acceptance of support manufacture type and spacing utilized.

D. Circuits and feeder conductors of different voltage levels or those of same voltage level originating from different switchboards or systems shall be in separate raceways and isolated in pull boxes and junction boxes with suitable metal barriers and independent covers.
   1. At a minimum, the following systems shall be separated or isolated from one another:
      a. Different voltage levels.
      b. Different service switchboards.
      c. Metered and unmetered.
      d. Optional standby/normal.
      e. UPS and non-UPS.
   2. Emergency circuits (NYCEC Article 700) shall be in separate pull boxes, junction boxes or cable support boxes from any and all other systems including, but not limited to, the optional standby system.

E. Where cable sizes exceed that allowed by the equipment for termination, provide additional bus detail, as required, in junction boxes above the equipment for proper installation of oversized conductors.

F. For home runs feeding lighting or receptacle branch circuits, no more than six (6) circuits shall occupy the same raceway. Increase conductor size as required to meet the de-rating requirements of the Electrical Code.

G. Branch circuits feeding a single piece of equipment shall not share a raceway with any other circuits.

H. Type AC, MC, and MC-PCS cable shall not be utilized where it will be exposed after completion of construction.

I. Type AC and MC Conductor Cable
   1. AC and MC cable shall be installed in a neat and workmanlike manner. AC and MC cable shall be installed parallel or perpendicular to building lines and/or walls
   2. AC and MC cable shall not be spliced. Cable shall be ordered in lengths that do not require splicing.
   3. When terminating “riser-rated” MC cable, the binder jacket should be removed flush with the end of the armor prior to installing the cable termination fitting.
   4. Embedded Installation (MC cable only; not permitted for AC cable)
      a. Approval is required by the Structural Engineer for all runs of embedded MC cable. Submit for review.
      b. Where embedded in concrete, MC cable must be provided with a PVC jacketing, and conductor insulation must be rated for use in wet locations.
      c. All PVC-jacketed MC shall be encased in a minimum of 2 in. of concrete.
      d. Where PVC-jacketed MC exits concrete encasement, it shall transition to another method prior to being exposed, or be manufactured such that the portion outside of the slab does not have a PVC jacketing.

J. Type RHW-2 Emergency Power Cable (EPC)
   1. All couplings shall be stainless steel.
   2. All supports, channels, rods, couplings, elbows, etc., shall be subject to the fire rating equivalent to the cable.

K. Mineral-Insulated (MI) Cables
   1. Cable Installation for 2-Hour Fire-Rated Application
      a. Project specifications shall govern the method of installation for any particular application, but must also comply with the manufacturer's specifications.
   2. Exposed or Surface Installations
      a. Cable shall be clipped directly to walls, beams or ceilings using clips or straps available from the manufacturer attached to Kindorf supports with approved tie-backs having a fire rating equal to the cable.

b. Unless otherwise required by local codes or installation requirements, the cable shall be supported at a maximum of every 36 inches or center horizontally and every 72 inches on center vertically to 2-hour rated concrete or steel (building structure) using steel anchors.
c. Exposed runs of cables shall be installed parallel to building lines to present a neat appearance.
d. When subject to potentially damaging abuse, cables shall be protected by metal, channel or cable tray. Where cable tray or metal channel is used, it shall maintain a fire rating equal to the cable.
e. Cable tray, when used to support cable in fire-rated applications, shall be of construction such that the tray system shall function at a temperature up to and including 1,850°F for a period of two (2) hours (no aluminum).

3. Embedded Installation
   a. Cables imbedded in concrete shall be protected by means acceptable to the Engineer against puncture damage from the medium itself or the pouring equipment and have an overall protection of a PVC jacket.
   b. Where cables emerge from the slab, protection against shear damage shall be provided by means of a short metal plate or angle at the point of egress. This protection must extend from 18 inches below finish grade to 8 feet above finish grade.
4. Bending: The cable can be bent to a minimum radius of five times (5X) the cable diameter of the cable up to 250 kcmil and ten times (10X) the cable diameter for 350 kcmil or larger.
5. Pulling
   a. Non-stretch pulling rope should be used with swivels between the cable and the pulling rope.
   b. Use 10 inch sheaves or larger for cables 215/1 through 496/1, 18 inch sheaves or larger for cables 496/1 through 746/1, and 24 inch sheaves or larger for cables 834/1 through 1000/1.
   c. For 350 kmil or larger cables, do not pull over 360 degrees.
6. Single-Conductor Cables
   a. When single-conductor cables are installed, they shall be run in a trifoil configuration with the sheaths of each cable touching the entire length of the run except when entering the enclosure.
   b. Where parallel runs are required, each bundle shall contain a conductor from each phase, plus a neutral if required. Each bundle shall be spaced two (2) cable diameters apart and shall be installed in accordance with code.
   c. When single-conductor cables enter a ferrous metal enclosure, protection must be provided to prevent heating by induction. This may be done by removing a section of the box and replacing it with a brass plate or slotting at least two (2) saw blades wide between holes. Non-ferrous locknuts must be used when using the slotting method.
7. Splicing Cables: When the circuit length exceeds the nominal coil length of a particular reference, two (2) cable-splicing options are available:
   a. Factory-installed fire-rated joints.
   b. Field-installed fire-rated joints installed by a manufacturer's field technician.
8. Lug Connections: When connecting cable to switchboards, panelboards, motor control, circuit breakers, etc., ILSCO lugs approved for solid conductors shall be used as follows:

Conductor Size	ILSCO Catalogue Number
No. 1-250 kcmil	Lo-250
350	CRA-300
500	CRA-400

9. Cable Terminations: Cable must be terminated with an approved termination kit in a manner consistent with manufacturer's installation sheets.
10. Connections to Ferrous Enclosures: Brass plates are to be used when using single-conductor cables carrying currents in excess of 200 amperes. Heating by induction and hysteresis will occur if precautions are not taken.
11. Workmanship: Following the recommendations of the manufacturer will consistently produce satisfactory installations. The Installer shall avail himself of the services of the manufacturer's field technician who will offer the instruction of proper installation techniques.
12. Provide a manufacturer's review of the installation certifying all work is in accordance with the manufacturer's recommendation and the UL listing.

L. 600 Volt Cable Pull Tension
1. All 600 volt or less feeders in excess of 200 feet or requiring more than 180° of bend where conductors are sized 4/0 AWG or larger shall be measured for pulling tension when installing the feeder.
2. The Contractor shall tabulate the reading observed for each feeder section or pull and provide the manufacturer's recommended maximum pull tension for the cable used. The test shall identify each conductor tested, date and time of the test, and manufacturer's recommended values. The test reports shall be submitted to the Engineer for review. Any pull exceeding the maximum allowable tension shall be removed and replaced, and additional tests shall be performed.

3.3 COLOR CODING
A. All branch or distribution circuit conductors No. 8 AWG and smaller shall have continuously color-coded insulation as follows or as required by the local Authorities Having Jurisdiction.
1. 208Y/120 Volt System
a. Phase A - Black.
b. Phase B - Red.
c. Phase C - Blue.
d. Neutral - White.
e. Ground - Green.

B. All conductors larger than No. 8 AWG shall have color-coded tape fifty percent (50%) overlapped for a minimum length of 6 in., installed on conductors at all equipment terminations and where the conductor passes through pull boxes, unless continuous color-coded insulation is utilized.

3.4 FACTORY TESTING
A. All electrical conductors shall be tested in accordance with the latest applicable industry standards and governing code requirements.

3.5 FIELD TESTING
A. Conductor Test (600 Volt)
1. All cables shall be megger tested.
2. Insulation resistance of all conductors shall be tested. Each conductor shall have its insulation resistance tested after the conductor installation is completed and all splices, taps and connections are made, but prior to final connection to points of termination.
3. Conductors that do not meet the test criteria above shall be removed and replaced and the test repeated. The Contractor shall furnish all instruments and personnel required for tests.

END OF SECTION 26 05 19

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SECTION 26 05 20

HEATING CABLE

PART 1 - GENERAL

1.1 Summary

A. Furnish and install all electric heating cable systems specified herein and as required for freeze protection and/or heating of piping, valves, fittings, drains, ice/snow melting, etc., in accordance with the requirements of the Contract Documents.

B. Section includes:

1. Electric heat tracing system for water piping.
2. Floor warming heating cable.

1.2 Related Sections

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 References

A. All heating cable systems and all components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City, New York.
   a. Building Code of the City of New York.
   b. International Building Code.
   c. National Electrical Code.
   d. New York City Electrical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. Underwriters Laboratories.

1.4 Delivery, Storage And Handling

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.5 Warranty

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.6 Commissioning

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Contract Documents.

B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Contract Documents will be revised to reflect the substitution.

C. If they comply with the Contract Documents, electric heating cable systems manufactured by one (1) of the following manufacturers will be acceptable:
   1. Chromalox.
   2. EmerGen Electric.
   3. Nelson.
   4. Raychem.
   5. Thermon.

2.2 Electric Heat Tracing System For Water Piping

A. The heat tracing system shall be designed to maintain the water temperature within the piping to at least 40ºF with an ambient temperature of 0ºF. The piping shall be insulated as specified in other divisions.

B. Heating cables shall be UL-listed electrical heating strips. The electric heat tracing shall be a self-regulating type of parallel-circuit construction consisting of a continuous inner core of self-regulating conductive material between two (2) parallel copper bus wires suitable for operation on 120 or 208 volts, 60 hertz, single-phase power. The heat tracing strips shall be capable of being cut to the desired length in the field.

C. Furnish and install heating cable as required per the pipe schedule located on the drawings to prevent the freeze-up of water piping. Work shall include all required thermostats, boxes and cable.

D. Provide all components for a complete installation including, but not limited to, the following: a power connection kit, splice kit, tee kit, end seal kit, and "Electric Traced" pipe label. Labels shall be installed outside pipe insulation on every separate section of pipe and every 20 feet along long runs of piping.

E. The heater units shall be tested before insulation has been applied. After the pipe insulation has been applied, the heater units shall again be tested.

F. The heat tracing system shall be controlled by an ambient sensing thermostat set at 40ºF located in an approved location. The ambient sensing thermostat shall be used to control contactor coils. Contactors shall be provided as needed for operation of heating cables.

G. All circuit breakers serving heating cable shall be ground fault-interrupter type. Size of each GFCI circuit breaker and exact cable type to be determined by this Contractor, based upon pipe schedules located on the drawings. Provide a dedicated panel and transformer(s) labeled “HT” at appropriate voltage, fed via the closest distribution panel (submit for review). All circuits shall be run to “HT” panel(s). Provide appropriate number of panel sections if additional pole positions are required.

H. Cable Monitoring System
   1. The heater cable monitoring system shall automatically monitor the status of both series and parallel styles of electric pipe heating cables. This system shall monitor continuity and current flow of the heating cables as well as monitor supply voltage to each cable. When used in conjunction with ground fault breakers, it shall serve as an automatic alarm system for any ground fault conditions.
   2. Description of System Components: The entire monitoring system shall be mounted in a NEMA 4 or 4X enclosure that can be wall- or rack-mounted. The unit shall be all solid-state and suitable for use in Division 02 hazardous locations.
      a. The system shall be controlled by a microprocessor-based scanner that systematically interrogates all circuit sensors and compares actual data to its programmed parameters. The scanner shall be complete with power supply and environmentally hardened to allow placement in the operating sections of a plant without added temperature protection. The scanner shall access data from the sensor cards (which monitor individual circuit performance) via a data bus. It shall display output information to a display unit visible through the door of the cabinet. Each scanner shall handle up to twenty-four (24) circuits.

b. Sequence of Operation on the Heater Cable Monitoring Panel
   1). Ambient sensing thermostat to be set at 40°F.
   2). When ambient temperature thermocouple probe is exposed to temperatures lower than 38°F, contactor in thermocouple controller shall close and energize its associated heat tracing breaker panel, turning on all heaters. Controller shall also signal the associated monitor panel to begin scanning heater circuits.
   3). Monitor panel shall continuously scan all heater circuits for voltage, continuity and current. The number of the circuit being scanned shall be displayed on the monitor panel. When a heater circuit is functioning normally, a green "Heater On" light shall be displayed.
   4). If there is no voltage on a heater circuit at the monitor panel, a red light with a "Voltage" legend shall be lit when that heater is scanned. This shall indicate a tripped or open breaker.
   5). If current in a heater falls below the threshold level, a red light with a "Current" legend shall be lit when that heater is scanned. This shall indicate broken wiring from the panel to the heater power connection kit.
   6). If the monitor panel does not detect the continuity monitor at the end of a heater circuit, a red light with a "Continuity" legend will be lit when the heater is scanned.
   7). An alarm condition on any heater monitored by the panel shall trigger a remote alarm via dry contacts to notify building personnel that one (1) or more heater circuits are in alarm condition.

PART 3 - EXECUTION

3.1 Installation
   A. Furnish and install a complete electric heating cable system on all water piping, fittings, drains, valves and valve bonnets located in areas subject to freezing and all required floor areas. Coordinate the cable installation with divisions installing the systems to be heated.
   B. Be responsible for protection of heater unit assembly from damage during the construction period.
   C. All installation and materials furnished shall meet the NYCEC requirements and be Underwriters Laboratories-listed for the application.
   D. Heaters shall be connected to junction boxes using fittings supplied by the heater manufacturer. The contactors, thermostats and control system for the heaters shall be as indicated on the Electrical Drawings.
   E. All heat tracing circuits shall be protected by a GFCI-type circuit breaker.

3.2 Factory Testing
   A. All heating cable systems shall be tested in accordance with the latest applicable industry standards and governing code requirements.

3.3 Field Testing
   A. Test all electric heating cable systems for short circuits, grounds and insulation resistance.
   B. Heating cable shall be megger tested a minimum of two (2) times:
      1. While the cable is still on the reel prior to installation.
      2. At the completion of the installation prior to installation of thermal insulation.
   C. Test all thermostats for proper operation at high and low set points.

END OF SECTION 26 05 20

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SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install all electrical grounding systems as specified herein and as required for the grounding of systems throughout the project as indicated on and in accordance with the requirements of the Contract Documents.

B. Section includes:

1. Grounding conductors.
2. Ground rods.
3. Ground plates.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 REFERENCES

A. All grounding system components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City, New York.
   a. Building Code of the City of New York.
   b. International Building Code.
   c. National Electrical Code.
   d. New York City Electrical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. J-STD-607-A: Commercial Building Grounding and Bonding Requirements for Telecommunications.
   b. UL Standard 467: Grounding and Bonding Equipment.

1.4 DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.5 WARRANTY

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.6 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 GENERAL

A. All equipment and materials provided under this section of the specifications shall be new, UL-listed and bear the UL label.

B. All switchboards, panelboards, transformers, etc., shall be provided with a copper equipment ground bar bolted, brazed or riveted to the associated enclosure or cabinet. Refer to each individual equipment specification section for additional grounding requirements.

C. All receptacles, switches, disconnects, individual motor controllers, etc., shall be provided with a grounding terminal connected to the device frame or enclosure. Refer to each individual equipment specification section for additional grounding requirements.

D. All conduit, cable tray, raceways, junction boxes, pull boxes, equipment, etc., shall be made electrically continuous by means of grounding conductors, bonding jumpers, grounding bushings, couplings, fittings, etc., as required by code and the Authorities Having Jurisdiction.

2.2 GROUNDING CONDUCTORS

A. All grounding electrode conductors shall be bare (buried, underground, exposed indoors or outdoors) or green insulated (in raceways) copper conductors sized as required by code or indicated on the drawings, whichever is larger. Where the Authorities Having Jurisdiction require grounding electrode conductor sizing in excess of that shown on the drawings or specified herein, the larger size conductor shall be installed.

B. All equipment grounding conductors shall be green insulated copper conductors. Where the Authorities Having Jurisdiction require equipment grounding conductor sizing in excess of that shown on the drawings or specified herein, the larger size conductor shall be installed.

C. All bonding conductors shall be flexible copper bonding jumpers sized in accordance with code for grounding electrode conductors.

D. All conductors shall be run in conduit unless otherwise noted. Conduit shall be bonded at each end.

E. Where cable is used for the equipment grounding conductor, all grounding conductors shall be sized in accordance with Article 250 of the NYCEC

2.3 GROUND RODS

A. All ground rods shall be a minimum of 3/4 in. x 10 ft. 0 in. copper-clad steel, unless required to be larger based on code, site conditions or in order to obtain resistance to ground as specified herein.

2.4 GROUND PLATES

A. All ground plates shall be a minimum of 2 ft. x 2 ft. and 0.06 in. thick copper, unless required to be larger based on code, site conditions or in order to obtain resistance to ground as specified herein.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The system neutral shall be grounded at the service entrance. The system neutral on interior wiring shall be kept isolated from grounding systems throughout the building and shall be grounded only to the grounding electrode conductor.

B. Each system of electrically continuous metallic piping and ductwork shall be electrically grounded in accordance with the requirements of the code for bonding as they apply to the bonding of piping systems. Isolated metallic piping and duct systems shall be bonded to the building equipment grounding system.

C. Bonding and grounding conductors shall be sized and connected to various services in accordance with the requirements of the Authorities Having Jurisdiction and the New York City Electric Code, Article 250.

D. Grounding shall be done in accordance with the requirements of, and subject to the approval of, the Architect, Engineer and local inspection authorities. Approved materials, devices and workmanship shall be utilized. All conductor terminations shall be in accordance with Section 26 05 19.

E. All ground conductors, including the grounding electrode conductor, when run independently from its phase conductors (where permissible by code) shall be protected from mechanical injury by rigid conduit, to which the conductor shall be bonded at each end.

F. All ground plates and ground rods shall utilize ground enhancement material to ensure connectivity with earth.

G. Grounding Electrode System

1. All code-qualifying individual grounding electrodes shall be bonded together to form the main grounding electrode system.
2. The grounding electrode conductor shall be bonded together with the incoming domestic water metallic piping system to the building (where galvanized piping is used in direct

contact with the earth) on the inlet side of the main shutoff valve, the metal frame of the building, the concrete-encased steel reinforcing bars in the building footings and a ground ring encircling the building. This bonding shall serve as the grounding electrode system in accordance with the requirements of the code. This Contractor shall only connect one (1) location to the water piping system.

3. The grounding electrode conductor shall be installed in a separate conduit from the point of connection at the grounding electrode system to the system neutral in the service equipment. The grounding electrode conductor shall be insulated stranded copper, sized as required, and shall be without joints or splices over its entire length.
4. A grounding electrode conductor shall be provided, without splice or joints between the service entrance ground reference point and the grounding electrode(s).
5. The grounding electrode conductor shall be connected to the line side of the service switch terminal bar of the identified and/or neutral conductor via the Switchboard Room ground bus assembly where provided.
6. A bonding connection shall be provided from the line side of the terminal bar or neutral bus to the switchboard enclosure or ground bus.
7. The grounding system shall include resistance to ground testing means for all grounding electrodes.
8. All ground rods or plates shall be connected to building steel via exothermic weld.

H. Building Equipment Ground

1. All equipment, non-current-carrying metal parts of permanently mounted electrical equipment, all terminal devices and the conduit system shall be effectively grounded and securely bonded to the reference ground point of its separately derived service ground. The equipment ground path from conduit, equipment and metal enclosures shall be continuous and permanent, and shall have the capacity to safely conduct any fault currents imposed on it with sufficiently low impedance to facilitate the operation of the circuit protective devices.
2. All conduits 2 inches and larger entering Motor Control Centers, service or distribution switchboards, distribution or power panels, transformers, PDU's, uninterruptible power supply equipment and automatic transfer switches shall be provided with grounding bushings connected to the respective equipment ground bus by means of bare copper wire, sized per code.
3. Unless specifically noted otherwise on plans, conduits less than 2 inches, or any conduit entering devices other than those listed above, may be used as the equipment ground conductor if the conduit is attached to the metal enclosure using two (2) locknuts (one [1] inside and one [1] outside the enclosure) or fittings with shoulders that seat firmly against the enclosure and are UL-listed and approved for the purpose.
4. Flexible metal conduit and liquid-tight flexible metal conduit or any form of non-metallic conduit, where permitted by other sections of this specification, shall be provided with a separate copper equipment grounding conductor whether indicated on the drawings or not.
5. Motor frames that are not directly clamped to the supply conduit shall be bonded and grounded to the conduit by means of a suitably sized ground conductor and ground clamp. No soldered connections shall be used in leads.
6. A separate insulated (green) equipment grounding conductor shall be installed in all branch circuits under the following conditions:
    a. Where the branch circuit uses a manufactured wiring system.
    b. All branch circuits used for electronic computer/data processing or telecommunications equipment.
    c. All branch circuits serving loads in hazardous locations.
    d. All branch circuits in outdoor locations.

7. When a separate insulated equipment grounding conductor is provided with a branch circuit, it shall be connected to a ground bus in the panelboard from which it is served.
8. All conduit that penetrates walls, floors and/or ceilings (overhead slab) of technology spaces shall be grounded.

I. Flexible Bonds
1. All expansion joints, points of electrical discontinuity or connections in conduit where firm mechanical bond is not possible shall be bonded with O-Z/Gedney Type BJ or approved equal bonding jumper.
2. A flexible bonding jumper shall be provided around isolating couplings and isolating nipples and shall be similar and approved equal to O-Z/Gedney Type BJ. All mechanical piping requires isolating couplings or isolating nipples when the piping material is changed.

J. Building Ground Riser System
1. Furnish and install in all electric closets a complete grounding system utilizing the building steel as the ground reference point.
2. Furnish at each electric closet a copper detail of sufficient size to accommodate all device connections plus a minimum of three (3) spare positions for future connections (minimum size shall be 18 in. x 4 in. x 1/4 in.).
3. The neutral of each local dry-type transformer shall be bonded to the electric closet ground reference point from the individual transformer external neutral ground lug.
4. The derived neutral of all power conditioning and/or power distribution units shall be bonded to the electric closet ground reference point, and the neutral shall be bonded to the electric closet ground reference point.

K. Emergency Generator System Grounding: The neutral point of the emergency generator system shall be grounded in a manner identical to that previously specified for the service entrance equipment, except that the system will require connection to only one (1) of the grounding electrode means noted above

L. Uninterruptible Power System and Lighting Inverter System Grounding: The uninterruptible power supply (UPS) system and lighting inverter system (LIS) are to be grounded as a separately derived AC system with the input/output switchboard ground bus used as the reference ground point.

3.2 GROUNDING SYSTEM TESTING

A. Upon completion of the electrical system, including all grounding, this Contractor shall test the system for stray currents, ground shorts, etc. These tests shall be performed in a manner acceptable to the Engineer. Approved instruments, apparatus, services and qualified personnel shall be utilized. If stray currents, shorts, etc., are detected, eliminate or correct as required. The test procedure shall be as outlined:
1. Open all main disconnects for the system being tested.
2. Disconnect the system neutral from the service entrance or step-down transformer neutral connection.
3. Connect a DC ohmmeter across the system neutral and equipment ground.
4. An ohmmeter reading in excess of 100 ohms shall indicate that the system neutral and equipment ground are properly isolated.
5. An ohmmeter reading less than 100 ohms shall indicate that the system contains ground shorts (stray currents) at some point along the system neutral.
6. Grounded neutrals may be identified by disconnecting individual neutral conductors from the system one at a time while monitoring the ohmmeter.
7. The systems shall be retested after correction of all ground shorts is complete. Final readings shall be tabulated for review by the Engineer.

B. The maximum resistance to ground from any point in the electrical system shall be 5 ohms.

END OF SECTION 26 05 26

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SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 Summary

A. Furnish and install a complete support system as specified herein and as required for proper distribution, protection and support of all electrical equipment throughout the project as indicated on and in accordance with the requirements of the Contract Documents.

B. Section includes:

1. Conduit hangers and supports.

1.2 Related Sections

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 References

A. All hangers and supports and all components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City, New York.
   a. Building Code of the City of New York.
   b. International Building Code.
   c. National Electrical Code.
   d. New York City Electrical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. ANSI/MSS SP-58: Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation.
   b. ANSI/MSS SP-69: Pipe Hangers and Supports - Selection and Application.
   c. ANSI/MSS 127: Bracing for Piping Systems: Seismic-Wind-Dynamic Design, Selection, and Application.
   d. UL 1565: Positioning Devices.
   e. UL 2239: Hardware for the Support of Conduit, Tubing and Cable.

1.4 Delivery, Storage And Handling

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.5 Warranty

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.6 Commissioning

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Contract Documents.

B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be

inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Contract Documents will be revised to reflect the substitution.

C. If they comply with the Contract Documents, hangers and supports manufactured by one (1) of the following manufacturers will be acceptable:
   1. Haydon.
   2. Thomas & Betts/Kindorf.
   3. Thomas & Betts/Superstrut.
   4. Unistrut.

2.2 General

A. Horizontal conduit runs may be supported by beams, special brackets or adjustable trapeze hangers with each conduit strapped at each support point.

B. Where cable supports, conduits, etc., are routed vertically through shafts, provide and install all necessary miscellaneous structural members to support the loads imposed by the risers.

C. Miscellaneous structural support members installed in Switchboard Rooms, electric closets, central plants, Mechanical Rooms and where exposed to view shall be hot-dip galvanized.

2.3 Conduit Hangers And Supports

A. Provide suitable brackets, stands, piers or other supports for all various components of the electrical system. Also provide suitable supports for all pull boxes, support boxes, etc., securely clamped to steel beams, columns or bearing walls. All details of this work shall be as specified herein or as approved. Refer to the Seismic Controls Section for additional information.

B. All horizontal conduits throughout the building shall be thoroughly and substantially supported with individually approved expansion ring hangers or supported in groups using channels and suitable hangers. Hanger spacing shall be determined by the NYCEC and in no case may hangers be spaced more than 10 feet apart. Special hangers and supports shall be provided where they may be required because of any peculiarities of construction. Additional hangers shall be provided where required by the manufacturer, Structural Engineer or Authority Having Jurisdiction.

C. Perforated extension bar hangers will not be accepted in any part of the work.

D. All vertical conduits shall be substantially supported at floor lines or cable support boxes to carry the weight of the conduit and cable in a satisfactory manner with allowance for expansion and contraction.

E. Where exposed to weather, conduit hangers and supports shall be Robroy Industries Plasti-Bond, or approved equal. Damaged hangers and supports shall be field-coated with Robroy Industries Plasti-Bond Touchup, or approved equal.

F. Hanger rod sizes shall be as recommended by the hanger manufacturer for the service intended.

G. Where embedded in concrete or where plastic coating is not appropriate, hangers, channels, etc., shall be hot-dip galvanized.

PART 3 - EXECUTION

3.1 Installation

A. Prior to installation, obtain approval from the Architect/Structural Engineer for all loads imposed on the structure.

B. Where equipment (transformers, bus ducts, conduit racks, etc.) is supported from structure, provide all miscellaneous structural members to support the load plus a 250 lb. live load.

C. Submit all support systems and methods of restraint for buried and embedded raceways (conduit, manholes, handholes, etc.) to the site Civil/Structural Engineer indicating restraint from movement due to geological forces (e.g., frost heave, water pressure, erosion, etc.).

D. Maintain uniform conduit spacing via bracing or spacers (as required by derating calculations submitted by this section) for all underground or embedded conduit during backfilling.

END OF SECTION 26 05 29

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SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install all conduit, conduit fittings, wall and ceiling outlet boxes, junction boxes, pull boxes, cable support boxes, conduit bodies, elbows, nipples, insulating bushings, grounding bushings and other such items for proper distribution, support, pulling, installation, connection, termination and other such needs of all wire, cable, electrical conductors, luminaires and other equipment throughout the project as required by code, construction constraints, and as indicated on and in accordance with the Contract Documents.

B. Section includes:

1. Conduit.
2. Troughs.
3. Junction and pull boxes.
4. Floor boxes.
5. Ceiling and wall outlet boxes.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 REFERENCES

A. All conduit, outlets, boxes and all components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City, New York.
   a. Building Code of the City of New York.
   b. International Building Code.
   c. National Electrical Code.
   d. New York City Electrical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. ANSI C80.1: Electrical Rigid Steel Conduit.
   b. ANSI C80.3: Steel Electrical Metallic Tubing.
   c. ANSI C80.5: Electrical Rigid Aluminum Conduit.
   d. NEMA TC 2: Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
   e. UL Standard 1: Flexible Metal Conduit.
   f. UL Standard 6: Electrical Rigid Metal Conduit - Steel.
   g. UL Standard 6A: Electrical Rigid Metal Conduit - Aluminum, Red Brass, and Stainless Steel.
   h. UL Standard 50: Enclosures for Electrical Equipment, Non-Environmental Considerations.
   i. UL Standard 50E: Enclosures for Electrical Equipment, Environmental Considerations.
   j. UL Standard 360: Liquid-Tight Flexible Metal Conduit.
   k. UL Standard 514A: Metallic Outlet Boxes.
   l. UL Standard 514B: Conduit, Tubing and Cable Fittings

m. UL Standard 651: Schedule 40 and 80 Type EB and A Rigid PVC Conduit and Fittings.
n. UL Standard 797: Electrical Metallic Tubing - Steel.
o. UL Standard 1242: Electrical Intermediate Metal Conduit - Steel.
p. UL Standard 1684A: Reinforced Thermosetting Resin Conduit and Fittings.

1.4 DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.5 WARRANTY

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.6 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Contract Documents.

B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Contract Documents will be revised to reflect the substitution.

C. If they comply with the Contract Documents, raceways and boxes manufactured by one (1) of the following manufacturers will be acceptable:

1. Rigid Steel and Intermediate Metal Conduit
   a. Allied Tube & Conduit.
   b. American Fittings Corp. (AMFICO)
   c. Republic Conduit.
   d. Triangle.
   e. Western Tube & Conduit Corporation.
   f. Wheatland Tube Company.
2. Rigid Steel and Intermediate Metal Conduit Fittings
   a. AFC.
   b. Allied Tube & Conduit.
   c. American Fittings Corp. (AMFICO)
   d. Bridgeport.
   e. Appleton.
   f. Cooper Crouse-Hinds.
   g. O-Z/Gedney.
   h. Raco/Hubbell.
   i. Steel City/Thomas & Betts.
   j. Wheatland Tube Company.
3. PVC-Coated Rigid Steel Conduit and Fittings
   a. Ocal/Thomas & Betts.
   b. Occidental Coating Company.
   c. Perma-Cote.
   d. Robroy Industries Plasti-Bond Red.
   e. Triangle.

4. Rigid Aluminum Conduit and Couplings
   a. Allied Tube & Conduit.
   b. Republic Conduit.
   c. Wheatland Tube Company.
5. Electrical Metallic Tubing (EMT)
   a. Allied Tube & Conduit/Tyco.
   b. Republic Conduit.
   c. Robroy Industries.
   d. Triangle.
   e. Western Tube & Conduit Corporation.
   f. Wheatland Tube Company.
6. Electrical Metallic Tubing Fittings
   a. AFC.
   b. American Fittings Corp. (AMFICO)
   c. Appleton.
   d. Bridgeport.
   e. Cooper Crouse-Hinds.
   f. O-Z/Gedney.
   g. Raco/Hubbell.
   h. Steel City/Thomas & Betts.
7. RTRC Conduit
   a. FRE.
   b. Champion Fiberglass.
8. Flexible Metal Conduit
   a. AFC.
   b. American Metal Molding.
   c. Anamet Electrical/Anaconda.
   d. Eastern Wire + Conduit.
   e. Electri-Flex Company.
   f. International Metal Hose.
   g. Southwire.
9. Flexible Metal Conduit Fittings
   a. AFC.
   b. American Fittings Corp. (AMFICO)
   c. Appleton.
   d. Bridgeport.
   e. Cooper Crouse-Hinds.
   f. O-Z/Gedney.
   g. Raco/Hubbell.
   h. Steel City/Thomas & Betts.
10. Liquid-Tight Flexible Metal Conduit
    a. AFC.
    b. Anaconda.
    c. Eastern Wire + Conduit.
    d. Electri-Flex Company.
    e. International Metal Hose.
    f. Steel City/Thomas & Betts.
11. Liquid-Tight Flexible Metal Conduit Fittings
    a. AFC.
    b. American Fittings Corp. (AMFICO)
    c. Appleton.

d. Bridgeport.
e. Cooper Crouse-Hinds.
f. O-Z/Gedney.
g. Raco/Hubbell.
h. Steel City/Thomas & Betts.

12. Rigid Polyvinyl Chloride (Type PVC) Conduit and Fittings
    a. Allied Tube & Conduit.
    b. Carlon/Thomas & Betts.
    c. CertainTeed.
    d. FRE.
    e. Triangle.
13. Outlets and Boxes
    a. Appleton.
    b. Cooper Crouse-Hinds.
    c. O-Z/Gedney.
    d. Raco/Hubbell.
    e. Steel City/Thomas & Betts.

2.2 CONDUIT

A. The minimum size conduit that shall be permitted is 3/4 inch.

B. Conduit shall not be embedded in the slabs except specifically where permitted on the drawings. Submit in writing at time of bid any conduit this Contractor intends to run in slab.

C. Non-Flexible Conduit
1. Rigid metal conduit (RMC) or RGS
2. Where exposed to weather, RMC shall be factory PVC-coated RMC. PVC-coated RMC shall be UL listed utilizing UL listed PVC-coated fittings, plastic-coated non-flexible metal conduit and fittings. Exposed threads, damaged coatings, etc., shall be field-coated with manufacturer approved touchup.
3. Aluminum rigid metal conduit
4. Intermediate metal conduit (IMC) shall be as follows:
    a. IMC shall be hot-dipped or electroplated galvanized.
    b. All fittings shall be cast iron or cast iron alloy, galvanized or cadmium-plated.
5. Electrical Metallic Tubing (EMT):
6. Polyvinyl chloride (PVC) conduit shall be as follows:
    a. Any rigid non-metallic conduit (RNC) noted on the project shall be PVC unless indicated otherwise.
    b. Conduit shall be joined with weatherproof solvent, cement and approved pipe couplings. PVC conduit shall be provided with steel insulating grounding bushings as manufactured by Kraloy, Carlon or approved equal.
    c. All PVC shall be Schedule 80 (extra-heavy wall EPC-80).
7. Reinforced Thermosetting Resin Conduit (RTRC) shall be as follows:
    a. RTRC conduit shall be used where conduit is underground, in concrete slabs, where required to be encased in concrete, used for systems operating at over 600 volts, or greater than 4 in. in diameter. Conduit shall be joined with weatherproof solvent, cement and approved pipe couplings. All rigid RTRC shall be extra-heavy wall.
8. Expansion, deflection or combination expansion/deflection fittings shall be manufactured by O-Z/Gedney Company or an equivalent manufactured by Appleton, Crouse-Hinds or Spring City (see Section 26 05 26). Fittings exposed to weather or embedded in concrete slab shall be listed for such use.

D. Flexible Conduit

1. Flexible Metal Conduit (FMC): Flexible metal conduit shall be steel and shall only be used for connections to the following:
   a. Motors.
   b. Transformers.
   c. Control equipment and devices.
   d. Lighting fixtures not connected by non-flexible metal conduit. See Section 26 05 19 for requirements for the use of Type AC and MC conductor cables.
   e. Receptacles: See Section 26 05 19 for requirements for the use of Type AC and MC conductor cables.
   f. Appliances.
   g. Equipment and devices requiring adjustment or removal for maintenance.
   h. Busway switches.
   i. Fan-powered terminal units.
   j. Capacitors.
   k. Equipment and devices subject to movement or vibration.
2. Liquid-Tight Flexible Metal Conduit (LFMC)
   a. Shall be same as flexible metal conduit, with a heavy-duty, inert, watertight outer jacket. Shall be used for all connections to:
      1). Pumps.
      2). Outdoor flexible connections.
      3). Vibrating equipment in wet locations.

2.3 TROUGHS

A. Troughs shall be provided where required.
B. Provide hinged covers and screw closures.
C. Troughs shall be code-gauge steel painted, and fill capacity shall not exceed code.

2.4 JUNCTION AND PULL BOXES

A. Furnish and install junction and pull boxes where required by code and where required to facilitate pulling and supporting conductors, regardless of whether shown on the drawings or not. Pull boxes or junction boxes occurring in finished areas shall have the removable cover plates flush with finished ceiling.
B. 120/208 volt feeders shall not occupy the same box with other feeders unless suitable barriers are provided within boxes to separate these feeders.
C. Emergency feeders, as defined by Article 700 of the NYCEC, shall not occupy the same box with other feeders. Barriers shall not be adequate to separate emergency feeders from other feeders.
D. Emergency feeders, as defined by Article 701 of the NYCEC, shall not occupy the same box with other feeders. Barriers shall not be adequate to separate emergency feeders from other feeders.
E. Emergency feeders, as defined by Article 702 of the NYCEC, shall not occupy the same box with other feeders. Barriers shall not be adequate to separate emergency feeders from other feeders.
F. Feeders originating from different service switchboards shall not occupy the same box unless suitable barriers are provided within boxes to separate these feeders.
G. Unmetered feeders shall not occupy the same boxes with any other service unless suitable barriers are provided within the boxes to separate the services. Separate covers with hardware to facilitate Con Edison seals shall be provided for such box sections.
H. Feeders originating from uninterruptible power supply (UPS) systems shall not occupy the same box with non-UPS feeders unless suitable barriers are provided within boxes to separate these feeders.

2.5 FLOOR BOXES

A. Where indicated on the drawings, furnish and install watertight floor boxes of the type specified on the drawings. Coordinate penetration location and fire rating with the Architect and Structural Engineer prior to installation.
B. Floor boxes shall be metallic. Plastic boxes are not acceptable.

C. Floor boxes shall be UL-listed and scrub-resistant where required.

2.6 CEILING AND WALL OUTLET BOXES

A. All boxes in damp or wet locations, where exposed to the weather, or where surface-mounted shall be aluminum or cadmium-plated cast metal Type FS or FD, as required, with threaded hubs and listed for their use.

B. Boxes shall have only the holes necessary to accommodate the conduit at the points of installation unless otherwise indicated on the drawings. All boxes shall have lugs or ears inside to secure the covers. All unused holes in boxes shall be plugged or capped with appropriate accessories.

C. Outlet boxes for switches and plug receptacles in finished walls shall be of proper design to accommodate the switches, receptacles and conduits required for each location and shall provide ample room for connections.

D. .

PART 3 - EXECUTION

3.1 GENERAL

A. All electric conductors shall be installed in non-flexible or flexible metal conduit, except where Type AC or MC armored or metal-clad cable is specifically permitted by the Contract Documents, where plenum conductor cable is permitted for horizontal branch wiring to individual fire alarm system devices, where surface metal raceway is specifically permitted, and as specified in Section 26 05 19.

3.2 INSTALLATION

A. Rigid Metal Conduit - Steel: All raceways shall be steel RMC, except where other materials may be allowed herein or where specifically called out in other locations of the Contract Documents.
   1. All conduit installed underground or embedded in concrete shall be PVC-coated RMC, PVC or RTRC and shall be incased in a minimum of 2 inches of concrete.
   2. All conduit located outside attached to the building and exposed to weather, including, but not limited to, roof tops, exterior loading docks, etc., shall be RMC, PVC-coated RMC, or IMC

B. Rigid Metal Conduit - Aluminum
   1. At the option of the Contractor, aluminum rigid metal conduit may be used instead of steel RMC except in the following locations, systems or parameters, where another method approved herein must be used:
      a. Underground.
      b. Embedded or encased in concrete.
      c. Exposed to weather.
      d. In wet or damp locations.
      e. Systems operating at over 600 volts, nominal.
      f. Parking areas.
      g. Loading Docks.
      h. Where specifically required elsewhere by the Contract Documents or code.

C. Intermediate Metal Conduit
   1. At the option of the Contractor, intermediate metal conduit may be used instead of steel RMC only in the following locations for systems operating at below 600 volts, nominal.
      a. In wet or damp locations.

D. Electrical Metallic Tubing
   1. At the option of the Contractor, electrical metallic tubing may be used instead of steel RMC except in the following locations, systems or parameters, where another method allowed herein must be used.
      a. Underground.
      b. Embedded or encased in concrete.
      c. Exposed to weather.

d. In wet or damp locations.
e. Systems operating at over 600 volts, nominal.
f. Parking areas.
g. Loading Docks.
h. Exceeding Trade Size 4.
i. Where specifically required elsewhere by the Contract Documents or code.

E. Rigid Non-Metallic Conduit (PVC or RTRC)
1. PVC or RTRC shall only be used instead of steel RMC where specifically indicated on the drawings. PVC or RTRC shall not be allowed in any location, system or parameter except the following, even if indicated elsewhere on the drawings. PVC or RTRC shall only be permitted:
a. Outside the building where not attached to the building structure (i.e., plazas, Ground Floor site lighting, etc.).
b. Underground.
c. Embedded or encased in not less than 2 in. of concrete.
d. Systems operating at over 600 volts, nominal, and in compliance with a, b or c above.
e. Trade Size 4 or larger and in compliance with a, b or c above.
2. For all PVC or RTRC located within the building, provide minimum 2 in. of concrete encasement. Coordinate with project Structural Engineer.
3. Where PVC exits concrete encasement, it shall transition to another raceway method or an enclosure method that provides a minimum of a 1-hour fire barrier. PVC conduit shall not be exposed within a building including any stubs into equipment from underground etc. (i.e. use another raceway method or enclosure method to exit into the equipment)

F. Flexible Metal Conduit: Flexible metal conduit shall only be used where hereinbefore described. FMC shall not be encased in concrete unless listed for the purpose.

G. Liquid-Tight Flexible Metal Conduit: Liquid-tight flexible metal conduit shall only be used where hereinbefore described. FMC shall not be encased in concrete unless listed for the purpose.

3.3 CONDUIT INSTALLATION GUIDELINES

A. Conduit - General
1. All references to “conduit” shall include “tubing” of types allowed herein.
2. Conduit shall not be embedded in any structural slabs, unless specifically noted on the drawings or when permitted by Owner’s acceptance of a Deduct Alternate, if submitted by this section during the Bid Phase.
3. Any and all conduit embedded in concrete or run in earth or underground shall be listed for the purpose.
4. Conduit in finished portions of the building, except in Mechanical and Electrical Equipment Rooms or where otherwise indicated on the drawings, shall be concealed. Concealed conduit shall be run in as direct a manner and with as long a bend as possible. Exposed conduit shall be run parallel to or at right angles with the lines of the building.
5. Each entire conduit system shall be installed complete before any conductors are drawn in. To guard against obstructions and omissions, each run of conduit shall be finished before gypsum board is installed. All conduit shall be swabbed after plaster is finished and dry.
6. Conduit for low-voltage systems shall be provided with pull boxes of approved sizes after two (2) right-angle bends and at intervals not exceeding 100 feet. Boxes shall be in accessible locations approved by the Architect and Engineer.
7. Where conduit enters the building through a concrete foundation wall below grade level, a watertight entrance seal shall be used. The seal shall be Link-Seal or as approved.
8. In areas designated as Class I, Division 02 hazardous areas (e.g., high-pressure Gas Meter Rooms, etc.) rigid metal conduit (or liquid-tight flexible metal conduit for motor

terminations) with approved terminations and fittings shall be used. The Class I, Division 02 hazardous areas shall be as defined by the Authority Having Jurisdiction for the project.

9. The power leads to all motors shall be in conduit. Where motors have conduit terminal boxes, the feeder conduit shall not be connected directly into same. Provide a flexible conduit for final connection to the motor terminal box. Flexible conduit shall be long enough (but in no case less than 36 inches long) and of suitable arrangement to achieve a true flexible connection between motor and rigid conduit. Under no circumstances shall rigid conduit terminate in or be fastened to a motor foundation.

B. Non-Flexible Conduit

1. Conduit installed in the ground shall be PVC-coated RMC and have water-tight joints. All touchups shall be applied in accordance with the manufacturer's recommendations. The entire length of non-flexible metal conduit, including fittings, in contact with the ground to a point 2 in. above the ground (or concrete slab), shall be PVC-coated RMC, subject to the Engineer's approval.

C. Flexible Conduit

1. Continuity of the equipment ground across flexible metal conduit connections shall be maintained for all systems that are over 150 volts to ground. The continuity shall be maintained by installing a grounding conductor sized in accordance with code. The grounding conductor shall be sized per code and be installed inside the flexible conduit and shall be connected on one end of the flexible metal conduit by a suitable binding post and similarly connected on the opposite end with another suitable binding post. All grounding conductors shall be solid copper conductors.
2. Liquid-tight flexible metal conduits shall not be installed in lengths exceeding 6 ft.

3.4 EXPANSION JOINTS

A. Furnish and install expansion, deflection or combination expansion/deflection fittings where non-flexible conduit cross building thermal or seismic expansion joints. Exact fitting type shall be selected based on the available movement at each expansion joint location and coordinated with the Structural Engineer. Refer to Architectural Drawings for expansion joint locations.

B. Where thermal or seismic expansion exceeds the movement allowed by a listed fitting, provide flexible metal conduit (of a type specified hereinbefore) that will allow for the total movement of the expansion joint. The solution shall allow for full movement of the joint without exceeding code-allowed conduit/cable bend radius for the fully compressed condition. Provide supports as required by code for flexible metal conduit. Where there are no structural attachment points spaced closely enough to allow standard supports, provide a framework and Teflon slider pads with vertical support to allow movement of the flexible metal conduit. Provide shop drawings of the fully engineered solution.

3.5 BURIED OR EMBEDDED CONDUIT

A. All conduit that is buried below grade and/or embedded in concrete inside or outside the building shall:

1. Be submitted for review, including thermal derating calculations with appropriate spacing and backfill thermal resistivity (RHO) calculations with supporting documentation of backfill proposed.
2. Maintain uniform conduit spacing (via spacers and bracing) so that required spacing is maintained during backfilling.
3. Be photographed, for the entire length with dimensions to project landmarks in the three (3) dimensions (depth, x and y axes) and submitted for record.

B. All raceways (conduit, manholes, handholes, etc.) that are buried under the building’s lowest slab level(s), or outside the building footprint, shall be submitted for review to the Architect/Structural Engineer/Site Civil Engineer, including methods to restrain conduit/manholes from movement due to underground geological forces (e.g., frost heave, water pressure, erosion, etc.).

3.6 OUTLETS AND BOXES

A. The approval of the Architect shall be obtained for any outlet location in question. Outlets placed without specific approval in locations not suitable to the finished room or area shall be removed and relocated without additional expense to the Owner when so directed by the Architect. This shall include the cutting and patching of work of others as may be necessary. Refer to Section 26 00 00 for additional requirements.

B. All boxes shall be rigidly secured in position to building structure. No box for any conduit system shall be secured to the ceiling suspension system, air conditioning ducts, mechanical piping, cable tray or low-voltage systems and their support systems.

C. Mounting Heights

1. Unless otherwise shown, specified or directed, wall outlet boxes shall be located with their center lines at the following elevations above the finished floor line. Refer to Architectural Drawings for additional details.
   a. Wall switches: 3 ft. 6 in.
   b. Wall receptacles (duplex type): 1 ft. 6 in.
   c. Receptacles above counters (duplex type): Refer to drawings.
   d. Clock hanger outlets: 8 ft. 0 in.
2. Other special outlets shall be installed as shown or specified on the plans, details or in the symbol list on the drawings.

3.7 INSTALLATION GUIDELINES FOR PULL AND SPLICE BOXES

A. General

1. Purpose
   a. Pull boxes shall be used for the following purposes:
      1). Fishing the conduit run.
      2). Installing a pull string or cable.
      3). Pulling the cable to the box and then looping the cable to be pulled into the next length of conduit.
   b. Pull boxes shall not be used for splicing cable.
   c. Splice boxes are intended to be used for splicing, in addition to pulling, cable.
2. Pull or splice boxes shall be readily accessible. Pull or splice boxes shall not be placed in a fixed false ceiling space unless immediately above a suitably marked access panel.
3. A pull or splice box shall be placed in a conduit run where:
   a. the length is over 30 m (100 ft.);
   b. there are more than four (4) 90° bends, or equivalent;
   c. there is a reverse (U-shaped) bend in the run.
4. Pull and splice boxes shall be placed in a straight section of conduit and not used in lieu of a bend. The corresponding conduit ends shall be aligned with each other.
5. Conduit fittings/bodies shall not be used in place of pull or splice boxes unless specifically approved in writing by the Engineer.
6. Pull and splice boxes shall be labeled on the exposed exterior.

3.8 AS-BUILTS

A. Provide As-Built Drawings (1/8 in. = 1 ft. 0 in. scale) at the completion of the work to document the location of all buried conduit, boxes, cable, etc.

1. Drawings shall clearly identify locations, quantities, sizes, etc., for coordination with future construction.
2. Include required photographs described hereinabove.

END OF SECTION 26 05 33

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SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Conduit, ducts, and duct banks.

2. Handholes and boxes.

3. Manholes.

1.3 RELATED WORK

A. Related Sections include the following:

1. Division 01 Section “Construction Waste Management”

1.4 DEFINITION

A. RNC: Rigid nonmetallic conduit.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Duct-bank materials, including separators and miscellaneous components.

2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.

3. Accessories for manholes, handholes, boxes, and other utility structures.

4. Warning tape.

B. Shop Drawings for Precast Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:

1. Duct entry provisions, including locations and duct sizes.

2. Reinforcement details.

3. Frame and cover design and manhole frame support rings.

4. Step details.

5. Grounding details.

6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.

7. Joint details.

C. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.

1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.

2. Drawings shall be signed and sealed by a qualified professional engineer.

D. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858.

1.6 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

1.8 COORDINATION

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Construction Manager.

PART 2 - PRODUCTS

2.1 CONDUIT

A. RNC: NEMA TC 2, Type EPC-40-PVC and Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Manufacturers: Any manufacturer and product approved by Con Edison.

B. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.

2. Warning Tape: Underground-line warning tape specified in Division 16 Section "Electrical Identification."

2.3 PRECAST CONCRETE HANDHOLES AND BOXES

A. Manufacturers: Any manufacturer and product approved by Con Edison.

B. Comply with ASTM C 858 for design and manufacturing processes.

C. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.

1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.

2. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

3. Cover Legend: Molded lettering, As indicated for each service.

4. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.

5. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.

   a. Extension shall provide increased depth of 12 inches.

   b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.

6. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.

   a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.

   b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.

   c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.

7. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

   a. Type and size shall match fittings to duct or conduit to be terminated.

   b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.

8. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.4 PRECAST MANHOLES

A. Manufacturers: Any manufacturer and product approved by Con Edison.

B. Comply with ASTM C 858, with interlocking mating sections, complete with accessories, hardware, and features.

   1. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.

a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.

b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.

c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.

2. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

a. Type and size shall match fittings to duct or conduit to be terminated.

b. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes to facilitate racking of cable.

C. Concrete Knockout Panels: 1-1/2 to 2 inches thick, for future conduit entrance and sleeve for ground rod.

D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.5 ACCESSORIES

A. Manufacturers: Any manufacturer and product approved by Con Edison.

B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.

1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 29 inches.

a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.

2. Cover Legend: Cast in. Selected to suit system.

3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.

C. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.

D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch- diameter eye, and 1-by-4-inch bolt.

E. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch- diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.

1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.

F. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.

1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.

G. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.

H. Cable Rack Assembly: Steel, hot-dip galvanized, except insulators.

1. Stanchions: T-section or channel; 2-1/4-inch nominal size; punched with 14 holes on 1-1/2-inch centers for cable-arm attachment.

2. Arms: 1-1/2 inches wide, lengths ranging from 3 inches with 450-lb minimum capacity to 18 inches with 250-lb minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.

3. Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.

I. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.

1. Stanchions: Nominal 36 inches high by 4 inches wide, with minimum of 9 holes for arm attachment.

2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from 3 inches with 450-lb minimum capacity to 20 inches with 250-lb minimum capacity. Top of arm shall be nominally 4 inches wide, and arm shall have slots along full length for cable ties.

J. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

K. Fixed Manhole Ladders: Arranged for attachment to wall of manhole. Ladder and mounting brackets and braces shall be fabricated from nonconductive, structural-grade, fiberglass-reinforced resin.

2.6 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C 1037.

B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by a independent testing agency.

2. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.

3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT

A. The contractor, subcontractors, and their personnel shall follow the procedures and practices for waste separation, collection and transport as defined in the contractor's "Waste Management Plan" as required by Division 01 Section "Construction Waste Management."

3.2 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Cables Over 600 V: RNC, NEMA Type EPC-80-PVC, in concrete-encased duct bank, unless otherwise indicated.

B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-80-PVC, in direct-buried duct bank, unless otherwise indicated.

C. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-80-PVC, in direct-buried duct bank, unless otherwise indicated.

D. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, installed in direct-buried duct bank, unless otherwise indicated.

3.3 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less, Including Telephone, Communications, and Data Wiring:

1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.

2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.

3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.

4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.

B. Manholes: Precast concrete.

1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.

2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3.4 EARTHWORK

A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Section "Turfs and Grasses".

D. Cut and patch existing pavement in the path of underground ducts and utility structures in accordance with Division 32 Section " Asphalt Paving."

3.5 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations, unless otherwise indicated.

C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.

2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.

3. Grout end bells into structure walls from both sides to provide watertight entrances.

E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition.

F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

G. Pulling Cord: Install 100-lbf- test nylon cord in ducts, including spares.

H. Concrete-Encased Ducts: Support ducts on duct separators.

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.

b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.

3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.

4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.

5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.

6. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.

7. Depth: Install top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.

8. Stub-Ups: Use manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Extend concrete encasement throughout the length of the elbow.

9. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.

    b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.

10. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

I. Direct-Buried Duct Banks:

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.

2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.

3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 Section "Earth Moving" for pipes less than 6 inches in nominal diameter.

4. Install backfill as specified in Division 31 Section "Earth Moving."

5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."

6. Install ducts with a minimum of 3 inches between ducts for like services and 6 inches between power and signal ducts.

7. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated.

8. Set elevation of bottom of duct bank below the frost line.

3.6 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891, unless otherwise indicated.

2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.

3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:

1. Manhole Roof: Install with rooftop at least 15 inches below finished grade.

2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.

3. Install handholes with bottom below the frost line, 42” below grade.

4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.

5. Where indicated, cast handhole cover frame integrally with handhole structure.

C. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

D. Manhole Access: Circular opening in manhole roof; sized to match cover size.

1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.

2. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.

E. Waterproofing: Apply waterproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.

F. Dampproofing: Apply dampproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, dampproof joints and connections and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.

G. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, as required for installation and support of cables and conductors and as indicated.

H. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.

I. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

J. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

3.7 GROUNDING

A. Ground underground ducts and utility structures as per Section 16060 “Grounding and Bonding”.

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.

3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance to the Construction Manager.

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.9 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 26 05 43

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SECTION 26 05 48.16

VIBRATION ISOLATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install all vibration isolation and associated equipment in accordance with code and as indicated on and in accordance with the requirements of the Contract Documents.

B. Section includes:

1. Mounting of generators.
2. Mounting of UPS systems.
3. Electrical connections to vibrating equipment.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 - Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 REFERENCES

A. All vibration isolation devices and all components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City, New York.
   a. Building Code of the City of New York.
   b. National Electrical Code.
   c. New York City Electrical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. ANSI R211.
   b. ACI 318: Building Code Requirements for Structural Concrete.
   c. ANSI/MSS SP-58: Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation.
   d. ANSI/MSS SP-69: Pipe Hangers and Supports - Selection and Application.
   e. ANSI/MSS 127: Bracing for Piping Systems: Seismic-Wind-Dynamic Design, Selection, Application.

1.4 WARRANTY

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.5 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Contract Documents.

B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved,

neither the project specifications nor the Contract Documents will be revised to reflect the substitution.

C. If they comply with the Contract Documents, vibration isolation devices manufactured by one (1) of the following manufacturers will be acceptable:
   1. Mason Industries, Inc.
   2. Vibration Eliminator Co., Inc.
   3. Vibration Mounting and Controls, Inc.

2.2 GENERAL

A. All equipment, conduit, generator(s), UPS system(s), etc., shall be mounted on or suspended from approved foundations and supports, all as specified herein or as required.

B. It shall be understood that the requirements of this section are complementary to requirements delineated elsewhere for seismic restraints of equipment and work.

C. All vibration isolators shall be furnished with zinc electroplated hardware to prevent corrosion and bolt freeze-up and to maintain an attractive appearance. To prevent corrosion, steel or cast iron housing shall be treated by phosphating and painting, while aluminum housing shall be painted.

D. The isolation devices and channel frames shall be products of a single vibration isolation manufacturer. After installation, the isolation manufacturer's representative shall check the various isolators and certify that they have been installed in accordance with the manufacturer's requirements and recommendations.

E. Coordinate manufactured vibration isolation devices with the requirements for seismic restraints as specified in other sections and, if applicable, provide vibration isolation devices with integral seismic restraint features as applicable and in accordance with requirements for seismic restraints. Submit to Seismic Engineer for review and approval.

F. Each isolation device shall have a permanently attached identification tag indicating location and service of the isolation device.

G. The vibration isolation systems shall be guaranteed to have the deflection required by the equipment manufacturer or as specified herein. Mounting systems and components of the isolation mounting shall not be resonant with any of the forcing frequencies of supported equipment or piping. Mounting sizes shall be determined by the mounting manufacturer, and the sizes shall be installed in accordance with the manufacturer's instructions.

H. All mounting systems exposed to weather, encased in concrete or within other corrosive environments shall be protected with factory-applied corrosion resistance.

I. Provide miscellaneous structural support members where required as described in Section 26 05 00.

J. Spring Requirements
   1. Where steel spring isolation systems are provided, the spring diameter not less than 0.8 of the loaded operating height of the spring. Each spring isolator shall be designed and installed so that the ends of the spring remain parallel.
   2. The spring specified minimum deflection from loaded operating height shall be 50% of the rated deflection.
   3. Springs shall be color-coded to allow positive identification after installation. Match color coding to the color code legend provided with the submittals.

K. Elastomer Requirements
   1. Neoprene-in-shear isolation mounting assemblies shall utilize bare neoprene elements with unit-type design molded in oil-resistant neoprene. The neoprene shall be compounded to meet the following:
      a. Not greater than 70 durometer.
      b. Minimum tensile strength of 2,000 psi.
      c. Minimum elongation of 300%.
      d. Maximum compression at 25% of original deflection.

2.3 PRODUCT TYPES

A. Floor-Mounted Isolators

1. Type F-1 Isolators - Neoprene Pads
   a. 3/4 in. minimum thickness, waffled or ribbed neoprene.
   b. Where multiple layers are required to provide the specified deflections, interleave pads with 16 gauge steel shim plates. Size pads for deflection equal to 10 to 15 percent of unloaded height and provide pads of sufficient thickness to achieve the specified deflection. Provide load-distributing top plates if required for uniform loading.
   c. Acceptable Products
      1). Mason Industries - Type Super W
      2). Vibration Mountings and Controls - Type NRC
      3). Vibration Eliminator Co. - Type 400N
   d. For seismic applications, utilize the appropriate seismic restraint accessories (additional grommets and seismic anchors similar to Mason Industries Type HG and Type SAS) subject to review and approval by the structural engineer.
2. Type F-2 Isolators - Neoprene-in-Shear Mounts
   a. Provide double-deflection in-shear isolators with steel bottom plates with pre-drilled bolt holes for attachment to floor or base, a threaded steel insert at the top of the isolator for attaching the equipment, and friction surfaces at both top and bottom. Coat all metal surfaces with neoprene.
   b. Acceptable Products
      1). Mason Industries - Type ND
      2). Vibration Mountings and Controls - Type RD
      3). Vibration Eliminator Co. - Type 368SD
   c. For seismic applications, use the following versions of the acceptable products subject to review and approval of the Structural Engineer.
      1). Mason Industries - Type BR
      2). Vibration Mountings and Controls - Type MB
3. Type F-3 Isolators - Open Springs
   a. Provide isolators of the general characteristics described in Article 2.2, Paragraph L, above, that are freestanding and laterally stable with no housing and that are furnished with level-adjustment bolts for rigid connection to the isolated equipment. Provide with molded neoprene cup or 1/4 inch thick elastomeric friction pad between isolator baseplate and its support. Vary spring size as required for equal deflection under non-uniformly distributed equipment loads.
   b. Acceptable Products
      1). Mason Industries - Type SLFH
      2). Vibration Mountings and Controls - Type AWH
      3). Vibration Eliminator Co. - Type OST
   c. For seismic applications, use the following versions of the acceptable products subject to review and approval of the Structural Engineer.
      1). No seismic version of this product is acceptable, use seismic version of F-4 mount or use the standard type with appropriate Seismic Restraint accessories subject to the Structural Engineer’s review.
4. Type F-4 Isolators - Restrained Springs
   a. Provide built-in adjustable spring restraints for equipment with operating weight greater than weight upon installation to prevent equipment from deflecting (or rising) when the additional weight is applied (or removed in the future). Provide isolators as specified for Type F-3 but with restraint studs and adjustable nuts. Provide 1/2 inch minimum clearance around the restraint studs.

b. Acceptable Products
1). Mason Industries - Type SLR
2). Vibration Mountings and Controls - Type BE
3). Vibration Eliminator Co. - Type KW
c. For seismic applications, use the following versions of the acceptable products subject to review and approval of the Structural Engineer.
1). Mason Industries - Type SSLR
2). Vibration Mountings and Controls - Type MS

B. Wall Mounted Isolators
1. Type W-1 Mount - Captive Neoprene
a. Maximum 70 durometer solid neoprene or neoprene housed in steel casing. Provide threaded insert to receive equipment mounting bolt.
b. Acceptable Products
1). Mason Industries - Types BR, RBA, and RCA
2). Vibration Mountings and Controls - Types MB, RSM

C. Flexible Connections
1. Type FC-1 Connector - Flexible Conduit
a. Provide UL-listed flexible conduit. Provide liquid tight coating and fittings where required under Division 26.
b. Acceptable Products
1). Unjacketed Steel Flexible Metallic Conduit (as specified in Section 260533)
2). Liquid Tight Flexible Steel Conduit (as specified in Section 260533)

D. Isolation Accessories
1. Elastomeric Isolators for Mounting Bolts
a. Provide neoprene grommets, bushings, and washers for all bolts used to secure isolators to floors and housekeeping slabs and for all snubbers. Baseplates for neoprene pads may be rigidly bolted to the floor or housekeeping slab if the bolts secure the baseplates only and do not continue through the neoprene to meet any other rigid material. Do not exceed 40 durometer, Shore A hardness.
b. Acceptable Products
1). Mason Industries - Types HG, HLB and HLW
2). Vibration Mountings and Controls - Type RB
2. Thrust Restraints and Sway Braces
a. Provide spring isolators with the same characteristics and deflection as the isolator springs. Preset thrust restraint isolators in the factory and fine tune in the field to allow for a maximum of 1/4-inch deflection between at-rest and maximum-thrust conditions. Furnish with appropriate brackets to attach to equipment and the structure. Install restraints on centerline of thrust and symmetrically on both sides of the equipment.
b. Acceptable Products
1). Mason Industries - Type WB
2). Vibration Mountings and Controls - Type TRK
3. Seismic Restraints
a. Snubbers for Floor-Mounted Equipment
1). Provide restraints comprising two (2) steel brackets, one (1) bolted to the floor and one (1) to the equipment (or equipment base) separated by a neoprene or rubber bushing.
b. Restraints are to remain inactive during normal operation, with a minimum 1/8 inch gap between the bushing and the upper bracket, subject to the review and approval of the Structural Engineer.

c. Load capacity of the restraint during a seismic event is to be engineered to meet project requirements, and is subject to the review and approval of the Structural Engineer.

d. Each snubbing device or isolator shall be installed and/or adjusted to provide the minimum operating clearance in all directions to permit the operation of the equipment without objectionable noise or vibration to any part of the building structure. The operating clearance for equipment seismic restraints shall not be greater than 1/4 inch.

e. Acceptable Products
   1). Mason Industries - Type Z-1011
   2). Vibration Mountings and Controls - Type SR

4. Cable Restraints and Rod Stiffeners for Suspended Equipment and Conduit
   a. Provide cables, cable brackets, clips, threaded rod stiffeners, and other accessories to meet seismic restraint requirements.
   b. Use cable restraint systems and threaded rod stiffeners provided by the same manufacturer as the vibration isolation hangers, subject to review and approval of the structural engineer. Exact product model numbers to be determined and submitted by the manufacturer's professional Engineer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide all necessary supports and restraints for equipment furnished as specified under this division. All details shall be as submitted and approved by the project Structural Engineer.

B. Provide all hardware required for mounting of systems. Refer to Seismic Section for additional information.

C. Guarantee that the work as installed under this section of the specifications will not result in the transmission of objectionable noise or vibration to any occupied parts of the building, and take full responsibility for any necessary modifications of this equipment, or of the foundations and supports for the same, necessary to secure this result. Replace isolators found to resonate with building structure, at no additional cost to the Owner.

D. The complete vibration isolation installation shall be in accordance with all of the manufacturer's requirements and recommendations. Installation shall be in accordance with engineering calculation coordinated with equipment and vibration isolation manufacturer.

E. During equipment installation, floor-supported spring isolation bases shall be set on 2 inch high spacers between the isolation base and the housekeeping pad. After all connections (conduit, etc.) have been made to the equipment and the system filled (where applicable), the normal operating equipment load shall be removed without change of equipment elevation or transfer of stress to the equipment.

F. Generators
   1. The engine-generator set shall be provided with a structural steel base. The base shall have sufficient rigidity to accept seismically rated spring-type isolators, provided under this division, beneath the entire unit between it and building structural support.
   2. Spring isolators shall be provided in quantities determined by a qualified vibration isolation vendor to permit a minimum static deflection of 2 inches. Mountings shall incorporate a leveling device, vertical limit stops, seismic restraints and a single layer of 3/4 inch Super W type pad. The mountings shall be installed directly under the structural steel base and shall be positioned to accept the weight and weight distribution for uniform mounting deflection. Spring isolators shall be as indicated in the isolation schedule below. The vibration isolators shall not have a surge or natural frequency within $2\sqrt{2}$ of any operating speed of the engines.

3. Isolation Schedule

On-Grade Installation			Above-Grade Installation		
Base	Isolator	Deflection	Base	Isolator	Deflection
B-1	F-4 (Restrained Springs)	2 in.	B-1	F-4 (Restrained Springs)	2 in.

G. Flexible Connections to Vibrating Equipment
1. Provide minimum 36” of Type FC-1 connector listed above.

H. Accessories
1. Provide isolation accessories for all isolated electrical equipment as follows:
a. All bolted connections between equipment and non-isolated structure, or at other locations recommended by the isolation manufacturer, must be made using elastomeric isolators for mounting bolts.
b. Thrust Restraints and Sway Braces
1). When total rotational thrust exceeds 10 percent of the isolated weight, provide resilient horizontal thrust restraints to prevent excessive horizontal movement.
2). When suspended equipment is subjected to wind loads and other lateral forces not due to thrust, provide sway braces meeting the same requirements as thrust restraints.
c. Seismic Restraints
1). Provide seismic restraints commensurate with the seismic zone in which the project is located and as defined within the structural drawings. Seismic restraints may include, but are not limited, to:
a). Seismic versions of curbs and mounts.
b). Snubbers on floor-mounted equipment, for equipment not otherwise supported on seismically-restrained mounts or where such mounts require any supplemental restraint.
c). Rod stiffeners and cable restraints for suspended equipment and conduit.

3.2 FACTORY TESTING
A. All vibration isolation devices and components shall be tested in accordance with the latest applicable industry standards.

3.3 FIELD TESTING
A. Upon completion of the installation and prior to Final Review, the vibration isolation manufacturer's factory-trained technician shall inspect all the various isolators and certify in writing to this section and the Construction Manager/General Contractor that they have been installed properly and are in accordance with the manufacturer's requirements and recommendations. Submit manufacturer’s certification of installation.

END OF SECTION 26 05 48.16

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install all nameplates, warning and safety signage as specified herein and as required for proper identification of circuits and equipment throughout the project, in accordance with code requirements and the Contract Documents.

B. Section includes:

1. Nameplates.
2. Mimic buses.
3. Circuit identification.
4. Branch devices.
5. Arc flash labeling.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 REFERENCES

A. All warning signage and all components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards, including the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City, New York.
   a. Building Code of the City of New York.
   b. National Electrical Code.
   c. New York City Electrical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. IEEE Standard 1584: Guide for Performing Arc Flash Hazard Calculations.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide all warning and safety signage required by code.

B. Electrical equipment shall be identified by means of nameplates screw-fastened to the equipment at the point of electrical feed.

C. Nameplates, mimic buses, labels, etc., shall be colored as follows:

1. Normal Power: Black with white lettering.
2. Emergency Systems (e.g., Lighting, Fire Protection including Fire Pumps, Fire Alarm and Automatic and Manual Transfer Switches, etc.): Red with white lettering.
3. Legally Required Standby Systems (Elevator, Stair/Hoistway Pressurization, etc.): Red with yellow lettering.
4. Optional Standby Systems: Blue with white lettering.
5. Uninterruptible Power Supply Systems: Yellow with black lettering.

D. The Engineer reserves the right to request additional nameplates at the time of review of shop drawings and upon site observations. These shall be furnished at no additional expense to the Owner.

E. Nameplates and tag symbols shall correspond to the identification on the Contract Drawings and on the “Record Drawings.”

2.2 NAMEPLATES

A. Provide nameplates for equipment as noted below.

1. Switchboards, Panelboards and Load Centers

Item	Lettering Size	Example
Designation	1/2 in.	LP-5A
Voltage	1/4 in.	208/120 volt
Amperage	1/4 in.	225 amp
Phase and Number of Conductors	1/4 in.	3Ø, 4W
Size of Neutral (if applicable)	1/4 in.	200% N
Source of Supply	1/4 in.	Source: SS-A#3
Conductor Color Coding	1/8 in.	A-Black, B-Red, C-Blue

2. Overcurrent Protective Devices (Fused Disconnect Switches or Circuit Breakers in Switchboards, Panelboards and Load Centers), Starters, Variable Frequency Drives and Busway Disconnect Switches

Item	Lettering Size	Example
Device	1/4 in.	Disc. Sw.
Voltage	1/4 in.	460 volt
Amperage	1/4 in.	400 amp
Fuse Amperage (if applicable)	1/4 in.	250 amp
Phase and Number of Conductors	1/4 in.	3Ø, 3W
Size of Neutral (if applicable)	1/4 in.	—
Source of Supply	1/4 in.	Source: PP-A#6/8/10
Equipment Served	1/4 in.	Feeds: EF-10
Fuse Type (if applicable)	3/16 in.	Replace only with fuse: LPS-R-250
Circuit Breaker Frame and Trip	3/16 in.	400 AF/350A

3. Automatic or Manual Transfer Switches

Item	Lettering Size	Example
Designation	1/2 in.	ATS-A
Voltage	1/4 in.	460/265 volt
Amperage	1/4 in.	3,000 amp
Phase and Number of Conductors	1/4 in.	3Ø, 4W
Size of Neutral (if applicable)	1/4 in.	100% N
Preferred Source	1/4 in.	Pref. Source: SS-A#7
Alternate Source	1/4 in.	Alt. Source: ESS-A#2
Equipment Served	1/4 in.	Feeds: EDS-A
Conductor Color Coding	1/8 in.	A-Brown, B-Orange, C-Yellow

4. Generators (on Control Panel)

Item	Lettering Size	Example
Designation	1/2 in.	Generator No. 1

Item	Lettering Size	Example
kW/kVA Rating	1/4 in.	1,200 kW/1,500 kVA
Voltage	1/4 in.	480/277 volt
Amperage	1/4 in.	1,805 amp
Phase and Number of Conductors	1/4 in.	3Ø, 4W
Size of Neutral	1/4 in.	100% N
Equipment Served	1/4 in.	Feeds: ESS-A

5. Lighting Relay Panels and Dimming Panels

Item	Lettering Size	Example
Designation	1/2 in.	RP-12A
Source of Supply (If Dedicated Circuit)	1/4 in.	Source: UP-12A#2
Warning	1/4 in.	Warning: This device may be served from multiple sources.

2.3 CIRCUIT IDENTIFICATION

A. All circuits originating from switchboards or panelboards without doors shall be provided with Bakelite plates similar to nameplates hereinbefore described on the cover of the gutter space next to the circuit overcurrent device. The circuit identification shall be as follows:

Item	Lettering Size	Example
Circuit Number	3/16 in.	DP-2#6
Switch or Frame Amperage	3/16 in.	400 amp frame
Fuse or Trip Amperage	3/16 in.	300 amp trip
Equipment Served	3/16 in.	PP-5
Conductor and Conduit Size and Type	3/16 in.	3#350 kcmil Ø, 2#350 kcmil N, 1#4G in 3 in. c.cu

B. Cardholders and directory cards shall be provided for circuit identification in panelboards, lighting relay panels and dimming panels. Cardholder shall be located and permanently attached on the inside of panel door and shall be plastic frame with clear Lexan front. Directory cards shall be typewritten. Circuit descriptions shall include specific floor and unit designations as indicated on floor plans, schedules for all equipment served, and conductor sizes.

C. Circuits and pull wires in empty conduits shall have flameproof tags attached to wiring at points where runs are interrupted at troughs, junction boxes or terminated in panels, boxes, etc., secured with flameproof non-metallic cord. Feeder or branch circuit numbers shall be indicated.

D. Equipment connected to emergency power shall be identified with permanent cemented grey discs affixed to lighting fixture trims and distinctively colored receptacles with emergency engraved cover plates.

E. Multi-outlet Assemblies: Furnish and install an engraved nameplate for all multi-outlet assemblies. Engraving must indicate source(s) of supply.

2.4 BRANCH DEVICES

A. Remote Smoke Detector Lamps and Test Stations: Furnish and install a nameplate for each remote smoke detector lamp and/or test station. Engraving must indicate the location of the device to which the lamp is connected as approved by the Engineer.

B. Switches: Furnish and install an engraved nameplate for each switch controlling loads that are not local to the switch (i.e., exterior lighting, Loading Dock doors, exhaust fans, etc.). Engraving shall be as directed by the Engineer.

C. Fire Warden Stations: Furnish and install a nameplate on each warden station. Engraving must indicate the floor, identification number and location of the station.

D. Freeze Protection
   1. Install decal-type labels on each pipe that is provided with freeze protection.
   2. Labels shall be inscribed “CAUTION – ELECTRIC HEAT TRACING”.
   3. Affix labels to the thermal insulation not more than 20 ft. on center, but not less than once on every length of pipe.

E. Fire Alarm Terminal/Control Cabinets
   1. Furnish and install on each fire alarm terminal/control cabinet an approved nameplate.
   2. Nameplates shall indicate floor, identification number and, where multiple terminal cabinets are installed, a primer designation for each cabinet (e.g., FATC-1A, FATC-1B).
   3. Terminal shall be permanently identified in an approved manner.

F. Luminaires: Where connected to other than 120 volt circuit, provide each fluorescent or high-intensity discharge fixture with the ballast voltage stenciled on the ballast cover in letters not less than 1/2 in. high.

2.5 ARC FLASH LABELING

A. Provide all labeling required by NFPA 70E and in accordance with the arc flash study in Section 26 05 73.

2.6 ADJUSTABLE CIRCUIT BREAKER LABELING

A. Provide nameplate with all adjustable trip settings for each circuit breaker per the final-reviewed short circuit study.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Color-Coded Identification
   1. Furnish color-coded buttons or tabs to indicate the location of equipment located above removable-type acoustical ceilings where access doors are not required. Provide color-coded dots on access doors to indicate type of service as specified herein.
   2. Removable ceiling tile and access doors are to be marked by small color markings at corner of tile or door in accordance with the following color assignments:
      a. Electrical - Green.
      b. Fire Alarm System - Red.
   3. Improperly located or sized color-coding identification shall be corrected prior to Final Review.

END OF SECTION 26 05 53

SECTION 26 05 73

OVERCURRENT PROTECTIVE DEVICE
COORDINATION, SHORT CIRCUIT AND ARC FLASH ANALYSIS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide a complete overcurrent protective device coordination, short circuit and arc flash analysis for the entire power distribution system and perform all field work to ensure a completely selectively coordinated system from the service entrance to the last distribution equipment. Include individual branch circuit devices where required by code.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 REFERENCES

A. The overcurrent protective device coordination, short circuit and arc flash analysis shall be performed in accordance with the latest applicable codes and reference standards, including the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City, New York.
   a. Building Code of the City of New York.
   b. National Electrical Code.
   c. New York City Electrical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. ANSI C37.010: Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
   b. ANSI C37.13: Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
   c. ANSI C37.41: Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
   d. ANSI C57.12.00: Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
   e. IEEE 141: Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
   f. IEEE 241: Recommended Practice for Electric Power Systems in Commercial Buildings
   g. IEEE 242: Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
   h. IEEE 399: Recommended Practice for Industrial and Commercial Power System Analysis
   i. IEEE 495 Gold Book: Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems
   j. IEEE 1015: Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
   k. IEEE 1584: Guide for Performing Arc-Flash Hazard Calculations
   l. NFPA 70E: Standard for Electrical Safety in the Workplace

1.4 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 QUALIFICATIONS

A. The analyses shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies and licensed to practice in the state where the project is located.

B. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.

C. Submit names of at least three (3) equivalent studies performed in the past five (5) years.

D. The analyses shall be performed using an approved software platform which shall be capable of providing overcurrent protective device coordination, short circuit and arc flash analysis.

2.2 ACCEPTABLE VENDORS

A. Being listed herein as an acceptable vendor does not permit the vendor to provide standard services that do not comply with the performance requirements of the Contract Documents.

B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate and must be accompanied by a Letter of Equivalency certifying the vendor's equivalency in all performance characteristics to the vendors listed herein. The proposed substitutions shall be inclusive of all cost implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Contract Documents will be revised to reflect the substitution.

C. If they comply with the Contract Documents, analyses performed by one (1) of the following vendors will be acceptable:

1. Power Analysis Associates.
2. Power Management Concepts.
3. RKV Engineering, P.C.
4. Savin Engineers, P.C.
5. SDM Metro.
6. Skae Power Solutions.
7. Triad CEI.

2.3 GENERAL

A. The scope of overcurrent protective device coordination, short circuit, and arc flash analysis shall include all distribution equipment furnished and/or installed by this division as well as all existing distribution equipment at the facility.

B. This Contractor shall make arrangements to procure the existing overcurrent protective device coordination, short circuit and arc flash analysis and shall update the study under this Contract to reflect all equipment in this scope of work.

C. Submit an integrated short circuit and coordination analysis as described herein for the entire power distribution system to ensure a completely selective coordinated system from the main protective devices to individual branch circuit devices.

D. Incorporate all prepurchased equipment into the overcurrent protective device coordination, short circuit and arc flash analysis.

E. Models shall include all variable frequency drives (VFD's). VFD's specified with "bypass" shall be modeled in "bypass" operation with motor nameplate rating. Include all motors above 25 HP (or cumulative per piece of equipment [e.g., fan wall]) or as recommended by IEEE.

F. The Division 26 Contractor shall furnish all data required by the analyses vendor. The vendor performing the analyses shall furnish to the Contractor a listing of required data immediately after award of the Contract. The Contractor shall expedite collection of the data to ensure completion

of the analyses as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

G. At the completion and approval of the analyses, provide the analyses files to the Owner in PDF format and native electronic formats (e.g., .prj, .dez, etc.) so the Owner can review all aspects of the project and print arc flash labels, one-line diagrams, etc.

2.4 SHORT CIRCUIT ANALYSIS

A. The short circuit study for the power distribution system shall ensure that all equipment provided under this division and equipment provided under other divisions have sufficient withstand capability to allow safe flow of fault currents if the device is not required to interrupt the fault, and sufficient fault-clearing ability to safely operate under a phase-to-ground and three-phase bolted fault condition for fault-clearing devices. Modify or change the protective devices as required to meet the requirements of the analyses.

B. Source contribution shall include all motors and generators including all existing and future planned equipment and configurations.

C. Include fault contribution of existing motors in the analyses. Obtain required existing equipment data via documentation and survey to satisfy the analyses requirements. Obtain all documentation from the CM/GC.

D. Series rating of devices in UL-approved combinations may be permitted where such series rating is noted in the report and approved by the Engineer.

E. The equipment reviewed in this analysis shall include, but not be limited to, the following:
   1. Incoming electrical service (obtain utility contribution).
   2. Generator power system.
   3. Uninterruptable power supply (modeled in bypass).
   4. Switchboards.
   5. Panelboards and distribution boards.
   6. Motor controllers (starters and variable frequency drives).
   7. Automatic transfer switches.
   8. Transformers.
   9. All other equipment that includes overcurrent protective devices.

F. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on applicable code.

G. Transformer nameplate impedances shall be used when test impedances are not available.

H. The report shall include the following:
   1. Summary of Assumptions
      a. Utility impedance data.
      b. Generator impedance data.
   2. One line diagram of the system being evaluated.
   3. Normal, on generator, etc. and any other applicable scenarios shall all be evaluated.
   4. Tabulations of calculated quantities of short circuit.
   5. Other significant data.
   6. Results, conclusions and recommendations.
      a. Protective Device Evaluation
         1). Evaluate proposed equipment and protective devices and compare to short circuit ratings.
         2). Adequacy of equipment bus bars to withstand short-circuit stresses.

2.5 PROTECTIVE DEVICE COODINATION STUDY

A. The protective device coordination study for the power distribution system shall ensure that all equipment provided under this division and equipment provided under other divisions are selectively coordinated. Modify or change the protective devices as required to meet the requirements of the analyses.

B. Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
C. Include on each TCC graph, a complete title and one-line diagram with legend identifying the specific portion of the system covered.
D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
E. Plot the following characteristics on the TCC graphs, where applicable:
   1. Electric utility overcurrent protective device.
   2. Equipment overcurrent relays.
   3. Low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
   4. Low-voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.
   5. Transformer full-load current, magnetizing inrush current and ANSI through-fault protection curves.
   6. Equipment and conductor damage curves, including ground conductor.
   7. Ground fault protective devices, as applicable.
   8. Pertinent motor starting characteristics and motor damage points, where applicable.
   9. Pertinent generator short-circuit decrement curve and generator damage point.
   10. The largest feeder circuit breaker in each motor control center and applicable panelboard.
F. Provide adequate time margins between device characteristics such that selective operation is safely accomplished, while providing proper protection.
G. Provide recommended settings for all devices furnished under this division, comment on settings recommended by other divisions, include all operating schemes including electrical service from utility, standby/emergency power plant, etc., and assume that major motor loads are online.

2.6 ARC FLASH HAZARD ANALYSIS

A. Include an arc flash hazard analysis study adhering to the IEEE 1584 equations that are presented in NFPA 70E Appendix D for the entire power distribution system to ensure safe operating conditions for all equipment provided under this division and devices furnished by the Owner for installation under this division.
B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (e.g., switchboards, switchgear, motor-control centers, panelboards, busway, splitters, etc.) where work could be performed on energized parts.
C. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm2.
D. The short circuit calculations and the corresponding incident energy calculations for multiple system scenarios shall be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations shall be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions.
E. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
   1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
   2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
F. Miscoordination shall be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

G. Arc flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

H. Furnish and install all analysis warning labels and set all protective devices to match the analysis. The analysis shall, at a minimum, indicate:
   1. Minimum arc rating in cal/sq.cm. at a working distance of 18 in. for all 480 volt devices.
   2. Indicate the appropriate flash hazard boundaries.
   3. Indicate the appropriate PPE levels.

I. The arc flash study shall be provided for all operating schemes, including electrical service from utility, standby/emergency power plant, etc., and assume that major motor loads are online.

J. Furnish and install labels for all equipment in accordance with the determined arc flash study, including the energy level present and required personnel protective equipment (PPE).

K. Provide safety training to Owner's employees who have potential to work on live equipment.

PART 3 - EXECUTION

3.1 ANALYSIS REPORT

A. The overcurrent protective device coordination, short circuit, and arc flash analysis shall incorporate the "partial" analyses being conducted as part of the Prepurchase Documents for the UPS system and the generator power system.

3.2 GENERAL

A. Field-adjust settings of all devices furnished under this division and other divisions previously described to recommended settings as per the final coordination study.
   1. Inspect the settings of all devices furnished under other divisions to determine if they have been set to the recommended setting as per the final coordination study.
   2. Make modifications to the proposed equipment as required to accomplish conformance with the short circuit study and protective device coordination studies.

B. Provide a label at each device with all recommended settings, the date set and the name/company of the person who implemented the settings.

C. All devices furnished under this division shall be individually field-tested for proper calibration and operation by an independent testing company retained by this division using a primary injection method for all circuit breakers. Submit field-testing reports for record.

3.3 REPORT SECTIONS

A. Input data shall include, but not be limited to the following for normal, generator, etc. and if applicable, closed transitioning scenarios:
   1. Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper or aluminum).
   2. Transformer input data, including winding connections, secondary neutral-ground connection, primary and secondary voltage ratings, kVA rating, impedance, % taps and phase shift.
   3. Reactor data, including voltage rating, and impedance.
   4. Generation contribution data, (synchronous generators including standby generators, etc. and utility), including short circuit reactance, rated MVA, rated voltage, three-phase and single line to ground contribution (for utility sources) and X/R ratio.
   5. Motor contribution data (induction motors and synchronous motors), including short-circuit reactance, rated horsepower or kVA, rated voltage, and X/R ratio.
   6. Provide the expected short circuit currents at each point in the distribution. Notations where the calculated short circuit current exceeds the rating of the protective device and provide suggested alternative devices to provide sufficient withstand or fault-clearing capacity.

B. Short circuit output data shall include, but not be limited to the following reports:

1. Input Report shall include a section for all input devices of the system for each applicable location:
   a. Device name
   b. Voltage
   c. Contribution to system (amps)
   d. X/R ratio
   e. Impedance seen by overall system
   f. Length of wiring
2. Fault Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information but not limited to for each applicable location:
   a. Voltage
   b. Three-phase amps
   c. Three-phase MVA
   d. Three-phase X/R ratio
   e. Single line to ground amps
   f. Single line to ground MVA
   g. Single line to ground X/R ratio
   h. Momentary amps
   i. Symmetrical amps
   j. Three-phase asymmetrical amps
3. Equipment Evaluation Report shall include but not limited to the following for each applicable location:
   a. Device
   b. Result (pass/fail)
   c. Description of device
   d. Voltage
   e. Interrupting kA
   f. Rating %
   g. Parting time speed cycles
   h. Equivalent impedance
4. All data above shall be analyzed for each operational scenario (e.g., normal operation, on generator, etc.)

C. Recommended Protective Device Settings
1. Phase and Ground Relays
   a. Current transformer ratio
   b. Current setting
   c. Time setting
   d. Instantaneous setting
   e. Recommendations on improved relaying systems, if applicable
2. Circuit breakers:
   a. Adjustable pickups and time delays (long time, short time, ground, etc.)
   b. Adjustable time-current characteristic
   c. Adjustable instantaneous pickup
   d. Recommendations on improved trip systems, if applicable
3. Ground fault protection selective device setting as identified on the contract documents. Nuisance tripping shall be taken into consideration.
   a. Sensor rating
   b. Plug rating
   c. Pickup setting
   d. Delay

D. Incident energy and flash protection boundary calculations.

1. Arcing fault magnitude
2. Protective device clearing time
3. Duration of arc
4. Arc flash boundary
5. Working distance
6. Incident energy
7. Hazard Risk Category
8. Recommendations for arc flash energy reduction

E. One-Line Diagram
1. The one-line diagram shall include the following but not limited to the following:
   a. Utility
      1). Utility company name
      2). Three-phase fault (amps)
      3). Single line to ground fault (amps)
   b. Bus
      1). Three-phase fault (amps)
      2). Single line to ground fault (amps)
      3). Voltage rating
      4). Continuous rating
      5). Short circuit rating
   c. Overcurrent protective device
      1). Type
      2). Frame rating/switch size
      3). Trip setting/fuse size
      4). Settings including, but not limited to:
         a). LTPU
         b). LTD
         c). STPU
         d). STD
         e). Interrupting rating (kA)
   d. Conductors
      1). Type
      2). Quantity per phase
      3). Size
      4). Length
      5). Ampacity
      6). Length
   e. Riser name identification
   f. Transformers
      1). Size
      2). Transformer impedance (%Z)
      3). Primary voltage
      4). Secondary voltage
   g. All motors above 25 HP or as recommended by IEEE
      1). HP rating
      2). Voltage
   h. Automatic Transfer Switch (ATS)
      1). Rating (amps)
      2). Interrupting rating (kA)
   i. Uninterruptible Power Supply (UPS)
      1). Rating

2). Line Voltage
3). Load Voltage
4). Bypass Switch status

j. Generator
1). Rating
2). Voltage
3). Three-phase fault (amps)
4). Single line to ground fault (amps)

k. Relays
1). Identification
2). IEEE Standard Electrical Power System Device Function Numbers, Acronyms, and Contact Designations (IEEE Std.C37.2)

3.4 ARC FLASH LABELS

A. Provide a multi-color 3.5 in. x 5 in. thermal transfer-type label of high-adhesion polyester.

B. All labels shall be based on recommended overcurrent device settings and shall be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.

C. The label shall include the following information, at a minimum:
1. Location designation
2. Nominal voltage
3. Flash protection boundary
4. Hazard risk category/personal protection equipment (PPE) level
5. Incident energy
6. Working distance
7. Report number, revision number and issue date
8. Company location performing the Arch Flash Hazard Analysis study

D. Labels shall be machine-printed, with no field markings.

3.5 OVERCURRENT PROTECTIVE DEVICE SETTING LABELS

A. Provide a multi-color label at each device with all recommended settings, the date set and the name/company of the person who implemented the settings.

END OF SECTION 26 05 73

SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 Summary

A. Furnish and install all lighting control devices, including relay panels, dimmers, switches, etc., as specified herein, as required by code and in accordance with the Contract Documents.

B. Refer to Division 01 for general requirements for the project.

1.2 Related Sections

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 Reference Standards

A. All switches, circuit breakers, lighting control devices and all components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the City of New York.
   b. New York City Electrical Code.
   c. New York City Energy Conservation Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. ANSI/IEC 60529: Degrees of Protection Provided by Enclosures (IP Code).
   b. IEC 60929: AC- and/or DC-Supplied Electronic Control Gear for Tubular Fluorescent Lamps - Performance Requirements.
   c. IEEE - C62.41: IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
   d. UL Standard 20: General-Use Snap Switches.
   e. UL Standard 489: Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.
   f. UL Standard 508: Industrial Control Equipment.
   g. UL Standard 924: Emergency Lighting and Power Equipment.
   h. UL Standard 1008: Transfer Switch Equipment.
   i. UL Standard 1472: Solid-State Dimming Controls.

1.4 Warranty

A. Comply with the requirements of the Contract Documents and Section 26 00 00.

1.5 Commissioning

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Being listed herein as an acceptable manufacturer does not allow the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of these specifications.

B. Any and all substitutions must be included in the Contractor's Base Bid as a voluntary Deduct Alternate in the Contractor's Bid Proposal, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products

listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Project specifications/documents will not be revised to reflect the substitution, should the substitution be approved.

C. If they comply with these specifications, lighting control devices manufactured by one (1) of the following manufacturers will be acceptable:
   1. Architectural Dimming Systems
      a. Crestron.
      b. Electronic Theatre Controls (ETC).
      c. Lightolier.
      Lutron.
   2. Local Controls
      a. Leviton Decora.
      b. Lightolier.
      c. Lutron Nova T.
   3. Network Lighting Control.
      a. Lutron - Quantum.
   4. Occupancy and Vacancy Sensors
      a. Cooper.
      b. Hubbell.
      c. Lightolier.
      d. Lutron.
      e. WattStopper.
   5. Momentary Switches
      a. Hubbell.
      b. WattStopper.
   6. Photo Sensors/Daylight Controls
      a. Cooper.
      b. Hubbell.
      c. Lutron.
      d. PLC Multipoint.
      e. Universal.
      f. WattStopper.
   7. Switching/Relay Systems
      a. Cooper.
      b. Douglas Controls.
      c. General Electric - SWS ProSys.
      d. Lutron.
      e. WattStopper.
   8. Timer Switches
      a. Cooper.
      b. Hubbell.
      c. WattStopper.
   9. Emergency Transfer Relays
      a. Bodine/Philips - GTD20A.
      b. WattStopper - ELCU-200.

2.2 Emergency Lighting Control

A. Fixtures designated on panels as EM shall be connected to the local switch/dimmer under normal conditions. In an emergency condition, the controls shall be bypassed via secondary power supply to each fixture or through a UL-listed relay transfer device. In either condition, all EM-designated

fixtures shall bypass the local controls during emergency conditions, providing full light output. Refer to the Emergency Transfer Relay section.

B. All fixtures as noted on the Contract Documents as emergency and/or with the designation emergency/battery pack ("EM/BP") shall be equipped with an emergency battery ballast to provide illumination during emergency operation for a minimum of at least 90 minutes. Battery ballast shall be integral to the fixture, shall be field-replaceable and shall use a nickel-cadmium source. All battery packs shall have a minimum five (5) year warranty. Fixtures designated shall also be connected to the local switch/dimmer under normal conditions. In an emergency condition, the controls shall be bypassed via secondary power supply to each fixture or through a UL-listed relay transfer device. In either condition, all EM/BP-designated fixtures shall bypass the local controls during emergency conditions, providing full light output.

C. Each fixture outfitted with an emergency battery ballast shall have an integral or remote test switch and charging indicator light (located within the reflector or in an accessible remote location). Provide sufficient wiring where required. Contractor shall provide drawings indicating alternate emergency layout upon substitution of specified manufacturer. See Section 26 51 00 - Interior Lighting for ballast specifications.

2.3 Architectural Dimming System

A. Centralized Control System with Remote Dimmer Panels

1. System Description: The architectural lighting control system shall consist of factory-pretested dimming panels, centralized preset lighting control(s), low-voltage wall stations and/or control interfaces. Additional items shall also be required and are described herein and/or shown on the drawings.
2. Dimming Panel/Racks - Mechanical
   a. Panels shall be UL-listed, CSA-certified, NOM-approved or CE-marked (as appropriate).
   b. Panels shall be wall- or recess-mountable. Enclosure shall be NEMA Type 1 and IP-20. Panel shall be constructed of steel with steel gauge. Contractor shall reinforce wall as required.
   c. Panels shall be of the preassembled or modular variety and components shall be factory-pretested by the manufacturer prior to shipment. The Installing Contractor shall be required to provide line, load and control wiring only. No other wiring by the Installing Contractor shall be required. Rack-to-rack control wiring installation by the Installing Contractor shall be acceptable. In modular systems, the rack shall be designed to allow for easy insertion and removal of all modules without the use of tools. Dimmer supports shall be provided for precise alignment of dimmer modules into power and signal connector blocks.
   d. All input feeds, load and control terminals shall be either front- or rear-accessible without the need to remove dimmer assemblies or other components.
   e. Dimming panels shall be either free-convection or fan-cooled. Air shall flow over the surfaces of the heat-generating components using a combination of convection and fan-assisted airflow. Each rack shall be outfitted with a lockable door that does not impede airflow in any manner. Fans shall be gradually controlled between off and full speed in order to minimize fan noise under all operating conditions. In the event of a rack overtemperature condition, a warning shall be displayed on the rack or on a remote personal computer or control system. If the temperature rises 5°C over the warning threshold, power to control circuits shall be automatically shut off.
3. Dimming Panel/Racks - Electrical
   a. Dimming racks shall be provided in the voltage/phase configuration required by circuiting design documented on the Contract Documents and/or approved by the Electrical Engineer.

b. All dimmers shall be compatible with the lamps controlled.
c. Each dimmer shall be controlled independently or in combination with any other dimmers within the panel or with dimmers from other panels within the system. Each dimmer shall be rated for a minimum of 16A.
d. Panels shall contain branch circuit protection for each dimmer. Branch circuit breakers shall be listed as a molded-case circuit breaker for use on lighting circuits and shall contain a visual trip indicator. Breakers shall be rated at 10,000 AIC for 120V panels.
e. Branch circuit breakers shall be switching duty (SWD) rates so that loads shall be switched off via the breakers. Breakers shall be replaceable without moving or replacing dimmer assemblies or other components of the panel.

4. Dimming Panel/Rack - Emergency Capability
   a. For dimming racks fed with a normal/emergency feeder, the system shall include automatic control circuitry, which brings all circuits to a full-on condition upon the loss of normal power and the subsequent presence of emergency power. The emergency control circuitry shall switch both the intensity signal and the on/off signal of each dimmer connected to an emergency circuit between the local control stations and a full-on constant drive supply.
5. Dimmer Module
   a. Dimmer modules shall be constructed so as to dissipate heat in ambient conditions up to 104°F (40°C). All metal parts shall be properly treated, primed and finished in a fine-texture, scratch-resistant epoxy powder coat.
   b. With the exception of the circuit breaker, the module shall contain no moving parts. Each module shall be labeled with the manufacturer's name, catalog number and rating. All electronic components (current/voltage sensors and indicators) shall be contained in a single field-replaceable housing.
   c. Each dimmer shall consist of one (1) or two (2) single-pole circuit breakers that is/are listed as a molded-case circuit breaker for 100% switching duty on lighting controls. Circuit breakers shall be fully magnetic if dimmer modules are provided with thermal cutout circuitry; otherwise, circuit breakers shall be thermal-magnetic type. Circuit breakers shall be rated for an inrush rating of no less than 20 times normal current.
   d. Modules shall not have any protruding pins subject to physical damage when the module is not installed.
   e. Standard AIC fault current protection shall be 10,000 at 120V.
   f. Dimmer shall be capable of withstanding an inrush current of 50 times the operating current.
   g. A positive air gap switch shall be employed by each dimmer in the panel to ensure that the power to the dimmer's load circuit is completely shut off when an "off" function is selected from the control system.
   h. Under fully loaded operating conditions, all component devices shall operate at a minimum 36ºF (2ºC) safety margin below the component manufacturer's maximum component temperature rating at a 104°F (40°C) ambient room temperature.
   i. Each dimmer shall compensate for incoming line voltage variations such as changes in RMS voltage, frequency shifts, harmonics and line noise. Dimmer shall be capable of maintaining a constant light level with no visible flicker under the following conditions:

      ±2% change in RMS voltage/cycle.
      ±2 Hz change in frequency/second.

1). Dimmer output voltage shall be a minimum 95% of input voltage at maximum intensity setting. Dimmers that do not regulate the dimmer output in real time shall be unacceptable.

2). Each dimmer shall incorporate an electronic soft-start default at initial turn-on that smoothly ramps the lights up to the appropriate levels within 0.5 seconds.

3). Once installed as part of a complete system, the device used to control the power furnished to the loads shall be both designed and tested to withstand surges, without impairment to performance, of 6,000V, 3,000A (equivalent to a near-lightning strike.). Upon request, the manufacturer shall provide a means to demonstrate conformance to this specification using the appropriate surge-generation equipment.

4). Dimmer must be UL-listed for the load it is to control. The module shall be able to accommodate incandescent, magnetic or electronic low-voltage incandescent, fluorescent, neon or cold cathode loads. Coordinate load types and dimmers with load schedule.

5). In the case of low-voltage electronic dimming, the dimmer shall not adversely affect the sound rating of the electronic transformer, nor shall flicker or interaction occur at any point in the dimming range. Coordinate the compatibility of all transformers with the dimmer modules.

6). Dimmers for neon and cold cathode shall have a dimming range of full to 10% without visible flicker. Ensure that low-power-factor transformers are supplied for dimming.

7). Dimmer shall be capable of electronic assignment to any control channel. Upon replacement of a dimmer, only that dimmer shall require replacement and no reprogramming shall be required.

8). Dimmer modules shall limit harmonics, lamp filament hum and radio frequency interference on line and load conductors. Dimmer modules shall provide a rise time of at least 350 microseconds from 10% to 90% of the output waveform at 90 degree conduction angle and full rated dimmer capacity. At no point should current rise faster than 30 mA/msec. Specific applications shall require a 500 or 800 microsecond rise time, and are so noted in the dimmer schedule. The use of various dimmer types shall not reduce rack density.

9). The dimmer module shall be capable of hot-patching cold, incandescent loads up to its full rated capacity without malfunction with the control signal at full on.

10). The dimmer power efficiency shall be at least 97% at full load with a no-load loss of 3V rms for 350 microsecond dimmers.

j. Non-Dim Module

1). All circuits indicated to be switched, but controlled by this control system (non-dim circuits), shall be controlled by a module within the dimmer rack or by a module in an adjacent equipment rack and shall utilize a mechanical, signal-controlled relay, or be a dimmer module programmed to serve as a non-dim.

2). Non-dim modules shall be rated for full circuit switching duty of tungsten, magnetic and electronic transformers and ballasts, and motor loads and shall be interchangeable with any dimmer module.

3). Non-dim output shall be rated for 16A continuous duty for the following load types: resistive (incandescent/tungsten), inductive (magnetic low-voltage [MLV]), electronic low-voltage (ELV), neon/cold cathode, magnetic

and electronic fluorescent lamp ballasts, high-intensity discharge (HID). Motor Loads (1/3 hp at 100 - 277V).

k. Panel Processor

1). Panel processor shall be capable of electronically assigning each circuit to any zone in the dimming system, adjusting high-end trim and low-end trim, determining the load type for each dimmer, determining normal/emergency function of the panel and setting emergency lighting levels.

2). All circuits shall be capable of being operated (dimmed or switched) from the panel processor.

l. Panel processor shall maintain dimmers at current light levels in the event of a control failure. Systems that fail to “off”, “on” or a preset level during a control failure are not acceptable.

m. Panel processor shall react to changes from the control system in no more than 20 milliseconds (update rate of 50 times per second).

B. Control Stations

1. General

a. Remote control stations shall be capable of either programming presets directly at the station (master control stations) or recalling presets that have been programmed at another location (preset select/recall stations) or shall have manual sliders for direct control of lighting zones without programming.

b. Control station faceplates shall be in the color and finish as selected by the Architect. Controls shall be engraved with appropriate zone and/or scene descriptions, furnished to the manufacturer prior to fabrication. Legends on control faceplates are to be engraved to resist removal by cleaning or scratching. Font, type size and color to be selected by the Architect.

c. Control stations shall fasten to a flush-mounted standard back box without visible fasteners. Faceplate shall be held securely with set screws or similar mechanical devices. It shall not be necessary to remove button caps or sliders, or to disassemble the control station for installation.

d. Control stations shall operate at low voltage, powered from a UL-listed Class 2 transformer in the dimmer or control station. All control functions shall be governed by, and all programmed and stored intensity levels (presets) shall be resident in, the dimmer cabinets or network interface (where applicable).

e. Where control stations use electronic memory, they shall incorporate power failure protection such that if power to the dimming panel or control station is disrupted, the lights shall return to the same state when power is restored. Control station with electronic memory shall be able to withstand surges and electrical noise on the power line of 6,000V, 3,000A without loss of memory or impairment to performance. Memory shall be protected without reliance on backup or data-reloading systems.

2. Preset Select (Remote Preset Recall) Stations

a. Pushbutton station(s) shall recall preprogrammed lighting scenes within a room. Quantity of buttons to be coordinated with 1-line diagram(s.)

b. Reselecting a currently active preset shall cause the channels within the room to fade to “off” in a programmable fade time.

c. Station faceplates and pushbuttons shall match those of the master control stations and shall be provided by the same manufacturer. Stations shall be capable of accepting tamperproof covers to match those of the master control station (either key switch or hinged cover).

d. Multi-button wallstation(s) with raise/lower shall be capable of recalling preset light levels for the required number of scenes, each providing LED status feedback, plus “off” and of fine-tuning light levels with master raise/lower.

3. Low-Voltage Control Interface
   a. The low-voltage control interface is to be made of contact closures that accept momentary and maintained contact closures.
   b. The contact closure output device can be configured for maintained or pulsed outputs.

2.4 Local Controls

A. All areas with lighting shall have local controls. Provide local switches for each room and multiple switches in each area (code-minimum) V.O.N. on drawings.
B. Provide wall box dimmers suitable for specific lighting loads in all areas as indicated on drawings. Faceplates are to have screwless covers with finish as per Architect.
C. Wall box control aesthetic configuration shall be consistent with the entire project (e.g., receptacles, data outlets, switches, wall plates, etc.) and shall match type and style required by the Architect (e.g., toggle, paddle type, designer series, etc.).
D. Location of all dimmers and switches to be coordinated with and dimensioned from Architectural Drawings.
E. Dimmers shall provide full-range, smooth and continuously variable control of light intensity.
F. All dimmers shall be designed to minimize the effects of changing line frequency.
G. An actuator, accessible from the front of the unit, with the wall plate attached, shall activate a mechanical air-gap switch disconnecting power from the load during “safety off” condition; no leakage current shall be present at the fixture(s). This front-accessible safety switch (FASS™) shall be separate from the tap switch and raise/lower rocker. All actuators shall be captured internally to the control.
H. Dimmers shall be capable of on/off, raise/lower and mechanical air-gap “safety off” from up to nine (9) additional locations using aesthetically coordinated remotes.
I. Controls shall be capable of operating at the rated capacity; this includes modified capacities for ganging configurations that require the removal of fins. Operation at rated capacity shall be possible across the full ambient temperature range without shortening design lifetime.
J. To ensure a precise color match between all plastic parts, color variation of any gloss part shall not exceed a Delta E of 1 as defined in ASTM E 308-99.
K. Visible parts of dimmers, switches, standard receptacles, cable jacks or any wall plate shall exhibit ultraviolet stability when tested as defined in ASTM D4674-89.
L. Controls shall be tested to withstand voltage surges of up to 4,000V and current surges of up to 200A without damage.
M. Dimmers shall be designed to reduce interference with radio, audio and video equipment.
N. Controls shall incorporate power-failure memory. Should power be interrupted and subsequently returned, the lights or fans will come back on to the same levels set prior to the power interruption. Restoration to some other default level is not acceptable.
O. Controls shall not be susceptible to damage or loss of memory due to static discharge.
P. Controls shall operate in an ambient temperature range of 32°F (0°C) to 104°F (40°C).
Q. 3-way controls shall be wired using conventional 3-way and 4-way wire runs.
R. Multi-location dimmers without neutral shall be capable of operating either 3-way switch location.
S. Wall controls shall fit a decorator wall plate opening with a flush tap switch. Dimmers and remotes shall have a small, raised rocker to the right of the tap switch. Dimmers shall have seven (7) discrete LED’s to the left of the taps witch. Tap switches shall remain flush in both the “on” and “off” state. Wall controls shall have a gloss finish.
T. A single tap of the tap switch shall raise lights from “off” to the preset light level or fade light to “off”. The raise/fade rate shall travel the dimming range in 3 seconds. A rapid double-tap of the

tap switch shall raise lights to full-on in 1.5 seconds. Pressing and holding the tap switch shall activate a delay fade-to-off function. Lights shall fade to off over 10 seconds.

U. The LED's on the left side of the tap switch shall indicate light level when the dimmer is on. When the dimmer is off, the LED's shall glow softly as a night light with the preset level slightly brighter than any of the other LED's.

V. The rocker on dimmers and remotes shall raise and lower the light level; this new light level becomes the preset. The rocker shall be able to raise the lights from "off" to low-end and up, and shall lower the lights to low-end, not to "off".

W. Incandescent Dimmers
1. Provide incandescent dimmers for direct control of up to a full 1,000 watts.
2. Dimmers shall have a high-end of no less than 90% of line voltage.
3. Where 3-way dimming is used, dimmers shall be capable of operating in either 3-way switch location.
4. .

X. Dimmers shall have a high-end of no less than 90% of line voltage.

Y. 0 - 10 Volt Dimmer
1. Provide 0 - 10 volt dimmers for direct control of 0 - 10 volt fluorescent dimming ballasts and 0 - 10 volt LED drivers up to the manufacturer's specified rating.
2. Provide a proper interface device, where required.
3. Dimmers shall be designed to provide full output at high-end.

Z. Remote Dimming Modules for High-Power Loads
1. Where lighting loads exceed the full rated capacity of single dimmers, provide a Maestro incandescent dimmer driving high-power modules. The high-power module and dimmer shall be from the same manufacturer to ensure compatibility.
2. High-power modules shall be remotely mounted.
3. The high-power module shall be rated and UL-listed for control of incandescent, magnetic low-voltage, electronic low-voltage, fluorescent and neon/cold cathode loads in increments of 2,000 watts up to 30,000 watts.

AA. Remotes for Multi-Location Control
1. Remotes shall provide multi-location control and a mechanical air-gap switch. All tap switch and rocker functions shall operate from each remote. Up to nine (9) remotes may be used with a Maestro dimmer.
2. Remotes shall not have any LED's.

2.5 Network Lighting Controls

A. System Description: The network lighting control system shall consist of lighting management panels, factory pretested dimming panels, switching panels, low-voltage wall stations and/or control interfaces all provided by the same manufacturer. Additional items shall also be required and are described herein and/or shown on the drawings.

B. Lighting Management Panel
1. Provide a lighting management panel in a preassembled NEMA-listed enclosure with terminal blocks listed for field wiring.
2. Enable Q-Admin light management software to control and monitor DALI dimming ballast, bus supplies, power panels, dimming panels and shading controls.
   a. The lighting management panel utilizes Ethernet connectivity to Q-Manager.
      1). A dedicated network environment is used to connect Q-Manager with lighting management panels.
3. Integrate control station devices, power panels, shades, preset lighting controls and external inputs into single customizable, multiple fail-safe lighting control systems, operable manually, automatically or through computer control.
4. Contains an astronomical time clock.

5. Solar clock to track the position of the sun to control the shades to limit penetration of direct sunlight.
6. Maintains a backup of the programming in a non-volatile memory capable of lasting more than ten (10) years without power.
7. BACnet Integration License for Lights
   a. Provide the ability to communicate by means of BACnet IP communication from a user-supplied 10BASE-T or 100BASE-T Ethernet network.
   b. Each lighting management panel processor requires a license for BACnet integration.
   c. Basic BACnet Integration License for Lights
      1). The BACnet integrator can command:
         a). Area light output.
         b). Area enable or disable after-hours mode.
         c). Area load shed level.
         d). Area load shed enable/disable.
      2). The BACnet integrator can monitor:
         a). Area on/off status.
         b). Area occupancy status.
         c). Area fault.
         d). Area load shed status.
         e). Area instantaneous energy usage.
8. BACnet Integration License for Shades
   a. Provide ability to communicate by means of BACnet IP communication from a user-supplied 10BASE-T or 100BASE-T Ethernet network.
   b. Each lighting management panel processor requires a license for BACnet integration.
   c. Basic BACnet Integration License for Shades
      1). The BACnet integrator can activate area shade group presets.
      2). The BACnet integrator can monitor area shade group presets.
   d. Shade assignment and grouping shall be self-discoverable with third-party building management software.

C. Light Management System Computer Q-Manager
1. PC/Laptop
   a. Used for occasional programming, monitoring and control of digital network lighting controls.
   b. Computer to be provided by the lighting control system manufacturer.
   c. Computer software preinstalled and tested prior to shipping.
2. Server
   a. Used for 24 hours/day, 7 days/week programming, monitoring, control, graphics and data-logging of digital network lighting controls.
   b. Used to handle Client machine request in multi-computer systems.
   c. Computer to be provided by the lighting control system manufacturer.
   d. Computer software preinstalled and tested prior to shipping.

D. Lighting Management System Software Q-Admin
1. Provide system software license and hardware that is designed, tested, manufactured and warranted by a single manufacturer.
2. Configuration Setup
   a. Used to make system programming and configuration changes.
   b. Windows-based, capable of running on either a central server or a remote Client over TCP/IP connection.
   c. Allow system to:

1). Capture system design.
   a). Geographical layout.
   b). Load schedule zoning.
   c). Shade grouping.
   d). Equipment schedule.
   e). Equipment assignment to lighting management panels.
   f). Daylighting design.
2). Define the configuration for the following in each area:
   a). Lighting scenes.
   b). Shade group presets.
   c). Control station devices.
   d). Interface and integration equipment.
   e). Occupancy/after-hours.
   f). Partitioning.
   g). Daylighting.
   h). Emergency lighting.
   i). Nightlights.
3). Commissioning
   a). Addressing.
   b). Daylighting.

3. Control and Monitor
   a. Basic System View: The Q-Admin system navigation and status reporting is performed using a tree view of the building.
   b. Optional Graphical Floor Plan View: The Q-Admin system navigation and status reporting shall be provided using customized CAD-based drawings of the building. Pan and zoom feature shall allow for easy navigation. Basic system view should always be available.
   c. Control of Lights and Shades
      1). Area lights can be monitored for on/off status.
      2). All lights in an area can be turned on/off or sent to a specific level.
      3). For areas that have been zoned, these areas shall be sent to a predefined lighting scene, and individual zones shall be controlled.
      4). Area lighting scenes can be modified in real time, changing the levels that zones go to when a scene is activated.
      5). Area shades can be monitored for current preset or position.
      6). Area shades can be opened/closed, sent to a preset or sent to a specific position.
   d. Occupancy
      1). Area occupancy can be monitored.
      2). Area occupancy can be disabled to override occupancy control or in case of occupancy sensor problems.
      3). Area occupancy settings, including the level lights turn on when area is occupied, and the level lights turn off when area is unoccupied, can be changed in real time.
   e. Daylighting
      1). Daylighting can be enabled/disabled. This can be used to override the control currently taking place in the space.
      2). Daylight target levels can be changed for each daylit area. This is particularly useful when new departments move into a space.

f. Load Shedding: Load shedding allows the Building Manager to monitor whole-building lighting power usage and apply a load shed reduction to selected areas, thereby reducing a building's power usage.

g. Scheduling: Schedule time of day and astronomic time clock events to automate functions for lights and shades.

h. Reporting allows the Building Manager to gather real-time and historical information about the system as follows:

1). Energy Reports: Show a comparison of cumulative energy used over a period of time for one (1) or more areas.

2). Power Reports: Show power usage trend over a period of time for one (1) or more areas.

3). Activity Report: Shows what activity has taken place over a period of time for one (1) or more areas. Activity includes Occupant activities (i.e., areas going occupied/unoccupied, wall controls being pressed), Building Manager operation (controlling/changing areas using the control and monitor tool) and device failures (keypads, ballasts, etc., not responding).

4). Lamp Failure Report: Shows which areas are currently reporting lamp failures.

i. Diagnostics: Diagnostics allows the Building Manager to check on the status of all equipment in the lighting control system. Devices shall be listed with a reporting status of OK, missing or unknown.

j. Administration

1). Users: Allows new user accounts to be created and existing user accounts to be edited.

2). Publish Graphical Floor Plan: Allows administrative user to publish new graphical floor plan files allowing users to monitor the status of lights, occupancy of areas and daylighting status.

3). Backup Project Database: Allows administrative user to backup the project database. The project database holds all the configuration information for the system, including keypad programming, area scenes, daylighting, occupancy programming, emergency levels, night lights and time clock. The control and monitor tool can be used to adjust some of these settings, and thus it is important to back up the project database prior to changing settings in the design and setup tool.

k. Publish Project Database: Allows the administrative user to send a new project database to the server and download the new configuration to the system. The project database holds all the configuration information for the system, including keypad programming, area scenes, daylighting, occupancy programming, emergency levels, night lights and time clock.

4. Energy Savings Display Software (Green Glance): Provide software from a single manufacturer that can collect and display energy savings from all of the lighting components in the lighting control system.

5. Open-Loop Solar Adaptive Algorithm

a. Primary goals of the shade control system are to:

1). Optimize daylight.

2). Provide manual override capability for Occupants via wall-mounted keypad or simple remote control.

3). Maximize Occupants' connectivity with outdoors by optimizing the view.

4). Provide diffuse daylight and minimize direct sunlight in the space to reduce solar heat gain and maximize Occupants' comfort in the space.

5). Reduce glare.

6). Shades along the same facade shall start, stop and track in unison to maintain a consistent exterior aesthetic.

b. Hardware: Independent operation of solar tracking program through non-windows-based operating system provided in one (1) or more Quantum light management panels.

c. Control Software

1). Control software shall incorporate a solar tracking software that:

a). Calculates the sun's position in the sky relative to the building and then calculates when shade movement is necessary by facade.

b). Calculates the position of the shade to limit direct sunlight penetration to a predetermined limit.

2). Control software shall be controlled using the following inputs for start-up:

a). Building location.

b). Facade orientation.

c). Window dimensions.

d). Solar depth of penetration.

e). Number of shade movements per day.

3). Control software shall require minimal long-term maintenance and service. System shall not require user to make daily changes to programming or overall system functionality, unless desired by the Owner.

d. User Interface

1). PC Graphic User Interface: User interface shall provide access to all adjustable parameters of solar depth of penetration and number of shade movements per day.

2). Manual Override

a). Temporary override of the control program shall be capable through manual keypads.

b). Keypads shall be capable of providing manual control of shades in a particular area.

E. Dimming Panels

1. Refer to Architectural Dimming System Section.

F. Switching/Relay Panels

1. Refer to Switching/Relay System Section.

G. Power Interfaces

1. Provide power interfaces, where required.
2. Electrical
   a. Phase independent of control input.
   b. Dimmer to meet limited short circuit test.
3. Diagnostics and Service: Replacing power interface does not require reprogramming of system or processor.

H. Low-Voltage Wall Stations

1. Preset Wall Stations
   a. Allows control of any devices part of the system.
   b. Electronics: Use RS485 wiring for low-voltage communication.
   c. Functionality
      1). Upon button press, LED's shall immediately illuminate.
      2). LED's shall reflect the true system status. LED's shall remain illuminated if the button press was properly processed, or the LED's turn off if the button press was not processed.
      3). Allow for easy reprogramming without replacing unit.
      4). Replacement of units does not require reprogramming.

d. Color
1). Exact finish to be coordinated with Architect. Provide faceplate samples at the Architect's request.
e. Provide faceplates with concealed mounting hardware.
f. Engrave wall stations in English with appropriate button, zone and scene engraving descriptions.
g. Silkscreened borders, logos and graduations shall use a graphic process that chemically bonds graphics to faceplate, resistant to removal by scratching and cleaning.
h. Software Configuration: Refer to 1-line diagram for configuration/programming of wall stations.
i. Control station device LED's shall support logic that defines when it is illuminated:
1). Scene logic (logic is true when all zones are at defined levels).
2). Room logic (logic is true when at least one [1] zone is on).
3). Pathway (logic is true when at least one [1] zone is on).
4). Last scene (logic is true when spaces are in defined scenes).

I. Low-Voltage Control Interfaces
1. Contact Closure Interface
a. The contact closure input device shall accept both momentary and maintained contact closures.
b. The contact closure output device can be configured for maintained or pulsed outputs.
2. RS232 and Ethernet Interface
a. Provide ability to communicate via Ethernet or RS232 to audio/visual equipment, touchscreens, etc.
b. Provide control of:
1). Lights scene selections.
2). Shade group presets.
3). Fine-tuning of shade preset or light scene levels with raise/lower.
4). Simulate system wall station button presses and releases.
c. Provide status monitoring of:
1). Light scene status.
2). Shade group status.
3). Wall station button presses and releases.
4). Wall station LED's.

J. Occupancy Sensors
1. Refer to Digital Addressable Controls and/or Occupancy Sensor Section.

K. Daylighting Sensors
1. Refer to Digital Addressable Controls and/or Photosensors/Daylight Controls Section.

L. Wiring Device Accessories
1. Refer to Local Controls Section.

2.6 Occupancy And Vacancy Sensors

A. Provide sensors in types, characteristics and electrical ratings for applications indicated that are UL-listed and which comply with other applicable UL standards.

B. Unless noted below or otherwise specifically indicated, provide sensors and their associated equipment for local control of lighting branch circuitry as indicated and in accordance with the following:
1. Sensors shall be utilized to automatically turn off light fixtures when the area is not occupied. Sensors shall have a time delay before turning off that shall be continuously adjustable from 30 seconds to 30 minutes. Sensors shall have a sensitivity adjustment to modify the field of view.

2. Sensors shall operate on 120 volt circuits. Coordinate wattage minimum requirements and loads with the Contract Documents.
3. Sensors shall be suitable for controlling incandescent, quartz halogen, low-voltage, neon, cold cathode, fluorescent and inductive lighting loads without derating.
4. All sensors to be factory-set for a 15-minute time delay and to have sensitivity set at 50% maximum. Field-adjust the time delay and sensitivity settings of each occupancy sensor after installation, but prior to occupancy, based on direction of Lighting Consultant or Owner. Adjustments shall be made in the presence of the Owner's Representative.

C. Configuration
1. Wall-Mounted: Red LED will indicate when unit is being triggered, plus it will glow when off to facilitate location in an unlit room. Wall-mounted area sensors shall utilize passive infrared operation or ultrasonic. The sensor shall emit a beep warning tone before shutting off. Sensor shall be able to be mounted in a single-gang wall box and be gangable with other designer-style electrical devices and faceplates. Sensor shall be provided with a designer-style screwless faceplate, color as selected by the Architect. Where indicated, sensor shall be equipped with a vandal-resistant hard lens. Sensor operation shall be as follows:
   a. Occupancy
      1). Manual switch on with manual switch off.
      2). Manual switch on with automatic off.
      3). Automatic on with automatic off.
   b. Vacancy
      1). Manual switch on with manual switch off
      2). Manual switch on with automatic off
2. Ceiling-Mounted: Ceiling-mounted area sensor shall utilize passive infrared operation. If no Occupant motion occurs within the adjustable time delay period, the lights shall automatically be turned off. The sensor shall have an LED indicator to provide feedback to the power pack when detecting movement and shall have a sensitivity and timing adjustment. All components are to be contained within a 1 inch high by 6 inch long white plastic housing, using four (4) head sensors at fixed angles. Provide three (3) frequency devices for alternate pattern installation. Provide accompanying switchpack with proper head quantity as specified by the manufacturer. Unit shall not detect motion through glass and shall be mounted a minimum of six (6) feet from strong air turbulent devices. Coordinate all installation with the manufacturer's field representative. Sensor operation shall be as follows:
   a. Occupancy: When the sensor detects the presence of an Occupant, the lights will automatically turn on.
   b. Vacancy
      1). Manual switch on with manual switch off. Refer to momentary switch for manual control.
      2). Manual switch on with automatic off. Refer to momentary switch for manual control.
3. Remote Power/Control Module: Where indicated or required, provide a remote power supply that interfaces with the occupancy sensor. Power module shall accept multiple input voltages and shall contain a transformer to provide low-voltage outputs to compatible sensors, and a dry-contact relay (normally open) for switching lighting loads. Control module shall be sized to fit inside a standard 4 in. x 4 in. junction box, and shall be fitted with a 1/2 in. EMT threaded male fitting on the line voltage end such that it may be mounted to the outside of a junction box with the line voltage wiring internal to the box and the low-voltage wiring external. Module shall be rated for switching 20A of ballast load at 120V .

4. Low-Voltage Momentary Switch: Where indicated, provide a single-pole momentary switch. Switch to be provided with faceplate.

D. The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms that are to be provided with sensors. Contractor is responsible for arranging a preinstallation meeting with the manufacturer's factory-authorized representative, at the Owner's facility, to verify placement of sensors and installation criteria. Contractor is responsible for coordination of the appropriate voltage and maximum/minimum load condition as well as coordinating with other work such as painting, raceways, electrical boxes, etc.

E. Locate and aim all sensors in the correct position required for complete and proper volumetric coverage within the range indicated in the manufacturer's recommendations, to the satisfaction of the Owner, Architect and Lighting Designer. Rooms shall have 90% to 100% coverage of the specified area to accommodate all Occupancy habits of single or multiple Occupants at any location within the room(s).

F. Lenses shall be clean and free of dust. Wall box sensors shall be installed only in electrical boxes that are free from building materials, dirt and debris. Ceiling-mounted sensors shall not be installed until completion of plastering, ceiling tile work, painting and general cleanup. Sensors shall be carefully handled to avoid scratching or fingerprinting and shall be, at the time of Owner Acceptance, clean.

G. Be responsible for installing field-of-view templates, as required, to mask the viewing lens to prevent false triggering for auto-on operation if required.

H. Provide, at the Owner's facility, the training necessary to familiarize the Owner's personnel with the operation, use, adjustment and problem-solving diagnosis of the occupancy-sensing devices and systems.

A. All occupancy/vacancy sensors located in areas designated for animal holding shall be passive infrared type and shall be provided with no LOD indicator lights.

2.7 Photosensors/Daylight Controls

A. Photoconductive Sensor

1. The photoelectric device shall be a Class 2, low-voltage, ambient light sensor designed to interface directly with the analog input of the compatible controller. The sensor shall supply an analog signal to the controller system proportional to the light measured. The sensor shall be capable of a fully adjustable response in the range between 0 and 3,000 foot-candles with a ±1% accuracy at 70°F (21°C).
2. The sensor shall be calibrated using voltage/foot-candle calibration curves. The housing shall be constructed from GE CYCOLAC (R) ABS, shall be flame-retardant and meet UL 94 HB standards.
3. Sensor types shall be as follows:
   a. Indoor: Indoor sensors shall have a Fresnel lens, with a 60-degree cone of response. Indoor sensors shall only require a penetration hole in the ceiling of 3/8 in. diameter, and the sensor shall mount to the ceiling using adhesive tape. The indoor sensor range shall be between 6 and 50 FC.
   b. Outdoor: Outdoor models shall have a hood over the aperture to shield the sensor from direct sunlight. The outdoor sensor circuitry shall be completely encased in an optically clear epoxy resin. Outdoor sensors shall mount to a standard threaded 1/2 in. conduit or fit a 1/2 in. knockout. The outdoor sensor shall have two (2) ranges, between 2 and 40 FC or 40 and 500 FC.
   c. Atrium or Skylight: Atrium or skylight sensors shall have a translucent dome with a 180-degree field of view. Atrium or skylight sensors shall mount to standard threaded 1/2 in. conduit or fit a 1/2 in. knockout. Atrium sensor range shall be from 40 to 750 FC. Skylight sensor range shall be between 400 - 3,000 FC.

B. Photodiode Sensor

1. The photoelectric device shall be a Class 2, low-voltage, ambient light sensor designed to interface directly with the analog input of the controller. The sensor shall supply an analog signal to the controller system proportional to the light measured. The sensor shall be capable of a fully adjustable response in the range between 0 and 10,000 foot-candles with a ±1% accuracy at 70°F (21°C).
2. The sensitivity adjustment shall be remote at the compatible controller. The sensor housing shall be constructed from GE CYCOLAC (R) ABS, shall be flame-retardant and meet UL 94 HB standards.
3. Sensor types shall be as follows:
   a. Indoor: Indoor sensors shall have a Fresnel lens, with a 60-degree cone of response. Indoor sensors shall only require a penetration hole in the ceiling of 3/8 in. diameter, and the sensor shall mount to the ceiling using adhesive tape. The indoor sensor range shall be between 0 and 750 FC.
   b. Outdoor: Outdoor sensor models shall have a hood over the aperture to shield the sensor from direct sunlight. The outdoor sensor circuitry shall be completely encased in an optically clear epoxy resin. Outdoor sensors shall mount to a standard threaded 1/2 in. conduit or fit a 1/2 in. knockout. The outdoor sensor shall have two (2) ranges, between 0 and 750 FC or 5 FC and 2,500 FC.
   c. Atrium or Skylight: Atrium or skylight sensors shall have a translucent dome with a 180-degree field of view. Atrium or skylight sensors shall mount to standard threaded 1/2 in. conduit or fit a 1/2 in. knockout. Atrium sensor range shall be from 2 to 4,000 FC. Skylight sensor range shall be between 10 and 10,000 FC.

C. Photodiode Sensors for Daylight Control
1. The photoelectric device shall be a Class 2, low-voltage, ambient light sensor designed to interface directly with the analog input of the energy management system (EMS). The sensor shall supply an analog signal to the EMS proportional to the light measured. The sensor output shall provide for zero- or offset-based signal. The sensor shall be capable of a fully adjustable response in the range between 0 and 10,000 foot-candles with a ±1% accuracy at 70°F (21°C).
2. The sensitivity adjustment shall be at the sensor body and outside of the sensor's viewing angle. The sensor housing shall be constructed from GE CYCOLAC (R) ABS, shall be flame-retardant and meet UL 94 HB standards.
3. Sensor types shall be as follows:
   a. Indoor: Indoor sensors shall have a Fresnel lens, with a 60-degree cone of response. Indoor sensors shall only require a penetration hole in the ceiling of 3/8 in. diameter, and the sensor shall mount to the ceiling using adhesive tape. The indoor sensor range shall be between 0 and 750 FC.
   b. Outdoor: Outdoor sensor models shall have a hood over the aperture to shield the sensor from direct sunlight. The outdoor sensor circuitry shall be completely encased in an optically clear epoxy resin. Outdoor sensors shall mount to a standard threaded 1/2 in. conduit or fit a 1/2 in. knockout. The outdoor sensor range shall be between 0 and 750 FC.
   c. Atrium or Skylight: Atrium or skylight sensors shall have a translucent dome with a 180-degree field of view. Atrium or skylight sensors shall mount to standard threaded 1/2 in. conduit or fit a 1/2 in. knockout. Atrium sensor range shall be from 2 to 2,500 FC. Skylight sensor range shall be between 10 and 7,500 FC.

D. Photosensors for the Control of Dimmable Ballasts
1. The photoelectric device shall be a Class 2, low-voltage, ambient light sensor designed to interface directly via 18 gauge wire to dimming ballast.
2. The sensor shall automatically dim indoor fluorescent lighting in response to the availability of natural daylight, and the dimming rate shall be selectable at either three (3) or eight (8)

seconds. The sensor shall have a range between 0 - 500 foot-candles and be adjustable between 7 and 140 FC. The accuracy shall be ±1% at 70°F (21°C).

3. The illuminance maintained on the task shall be adjustable at the sensor head, outside of the sensor viewing angle, and shall automatically control the lamp output to compensate for lamp lumen depreciation.
4. The sensor shall have a flat Fresnel lens with a 60-degree cone of response. The wire penetration through the ceiling shall be no greater than 3/8 in. diameter, and the sensor shall mount to the ceiling surface via adhesive tape.

2.8 Switching/Relay System

A. General: Provide a lighting control system, utilizing either 12 - 16, 24 - 32 or 48 - 64 relays per panel. Location to be adjacent to or above electrical panel within electrical closet, unless otherwise indicated. The number of relays in each panel shall be determined by the number of circuits to be controlled or relay zones as indicated on the plans. Power supply can be unplugged for maintenance.

1. Provide barrier where 120 volt circuits and normal and emergency circuits are used in the same panel. Positive action, status pilot light relay shall have a maintained contact closure with relay positions dictated by the last signal. Relays shall operate at 50,000 cycles at full load. Relays shall be provided with a 5-pin female connector for ease of maintenance and snap-in-place assembly. Relays to have SPST mechanical latching, split-coil 20 amp tungsten 125 VAC lamp load.
2. Provide, in addition to zones/relays indicated, an additional four (4) spare relay points within the panel and spare relays. Switch operation shall provide manual override of “time-off” sequence only. During programmed hours of “on” operation, switches shall remain inactive, providing no remote control “on” or “off” of the associated relays.

B. Operation: Each panel shall have the following capabilities:

1. System to have the ability to separate each control zone and independently operate the associated relay.
2. Each lighting zone can be independently controlled via local override, phone or central time clock sequencing.
3. Stand-alone systems shall not require the services of an integrator or other software specialist to program the system. No PC or extra device shall be required for setting which relays are controlled by a group switch input. It shall be possible to view and edit which relays are controlled by a switch input by using the indicators and selector buttons integrated into the panel. In addition to the above, stand-alone systems shall permit the following.
    a. Each input shall be capable of controlling any group of relays located throughout the system.
    b. A single group of relays shall be able to be operated by more than one (1) input.
    c. When connected to an input, a pilot light switch shall indicate the state of the relay group. If any relay in the group is on, the switch shall indicate on. Only if all relays in the group are off shall the switch indicate off.
    d. Group inputs shall be able to accept signals from other devices such as time clock, photocells or contact closures from other systems to provide automation of the lighting controls.
    e. Each relay or relay group shall be able to support the flick-warn option. After a flick warning, Occupants shall have five (5) minutes to prevent the local lights from switching off by activating a local switch.
    f. Each relay or relay group shall be able to support the “timeout” or “timed override” option, which allows the Occupant to activate a relay, via a local switch, that will remain on for two (2) hours before producing a flick warning of an impending off.

4. Time Clock: System shall have an 8-line LCD display, EPROM storage, 10-year integral astronomical portable time clock, providing control 365 days per year, with daily and weekly time schedules of on/off events. Overrides of time clock events shall be maintained for a maximum of two (2) hours, followed by a sweep-through of all relay zones. A change in an “on” event shall be prefaced by a flash (blink) warning five (5) minutes prior to turning off lights within a particular zone. Time clock shall have the ability to be overridden via remote low-voltage local switches or phone-activated dial-up control. Provide master/slave control from central time clock (for all floors). Location (floor) of central time clock to be determined. Time clock to operate all logical cards within each panel via low-voltage control wire.

C. Enclosures: Each relay panel shall be preassembled and shall consist of a back box, hinged lockable cover, 120V power supply, and an interior back plane with the required number of relays factory-installed. Panels shall be suitable for surface or flush installation. Panel interior shall have a suitable divider separating Class 1 and Class 2 compartments. Panel enclosure shall be UL-approved.

D. Relays: Relays shall be 2-wire, single-pole full-load relays suitable for controlling all types of lighting loads up to 20A. Load contacts shall be able to sustain 1,500 amp fault currents for up to 20 milliseconds.

E. The relay shall be contained in a molded case containing both low- and high-voltage terminals and shall have a built-in operating level marked on/off for manual switching at the relay panel.

F. Switching the relay shall be accomplished with one (1) signal wire and a common return. The signal wire shall be able to signal on and off and shall also carry status current that indicates if the relay is on or off.

G. Relays for the purpose of switching emergency designated lighting loads shall be UL 924-listed and shall be barriered from relays switching normal lighting loads.

H. Programming: All relay inputs in the panel shall be programmable to any one (1) of eight (8) channels for grouping circuits into zones for manual switch or time schedule overrides. Programming of zones shall be low-voltage wired and with panel-mounted logical control module. Relay inputs and channels shall accept momentary or maintained isolated dry contact closures. Momentary contact switches shall be one of the types listed here.

I. Analog override control switches shall have pilot light status and shall be wired with a single 18 AWG twisted-pair wire harness, from each relay location to each switch. Switch is to be mounted in a 4 in. square box with a one (1)- or two (2)-gang raised cover to accommodate one (1) to four (4) switches under a common plate. Switch wire from panel shall be 18 AWG/3C red, black, white for non-pilot light or 18 AWG/4C red, black, white, yellow for pilot light for each switch. Switch and button color to be gray, ivory or white as specified by Architect.

J. Digital override control switches shall have pilot light status and shall be 18 AWG two (2) twisted-pair black/red, blue/white from panel to each switch location (1, 2, 4 or 8 switch). All switches shall have nameplate capability for either graphic insert style or factory-applied "silkscreen" lettering. Switch covers shall have no exposed screws. Color to be almond, gray, ivory or white as specified by Architect. Switch shall have built-in locator light.

K. Wiring: All relay panels shall be addressable and, where more than one (1) panel is used in the lighting control system, they shall be interconnected with a plenum-type data line, run in 3/4 EMT when within the electrical closet and over hard ceilings. Relay panels that are networked together shall be able to operate as a stand-alone system, or shall be able to be integrated as part of a greater building automation system that addresses functions other than lighting.

L. Functions: Each panel shall be capable of daily and weekly on/off programmed time schedules, switch time delay "on" overrides up to two (2) hours, five (5) minute “flick warn” prior to scheduled "off", astronomical clock with field-adjustment capability, lock-out of switch “off” during specified working hours, EPROM memory of 40 years with no battery backup.

M. Local On/Off Switches: Coordinate switch quantity, load type and voltage with the Contract Documents. Switches to be Decora “paddle” type with finish selected by the Architect. Provide multi-gang faceplates with proper back box size based on manufacturer’s literature. Contractor to be responsible for back box sizing, heat sink removal and proper faceplate sizing. Where devices are indicated within 4 ft. of each other on the same wall, Contractor to consider switches to be within the same faceplate.

N. Exterior Photosensor
   1. Provide a remote outdoor sensor compatible with the relay system time clock.
   2. Exterior sensor head shall be oriented towards the North sky in a location coordinated with the Architect. Sensor shall be aimed to avoid false triggering from adjacent luminaires. Photosensor shall have range of 1 - 10K foot-candles, with ±5% tolerance. Maximum wire length 500 ft. No. 18 AWG, unshielded, non-polarized, to be run in 1/2 in. conduit. Outdoor models shall have a hood over the aperture to shield the sensor from direct sunlight. The outdoor sensor circuitry shall be completely encased in an optically clear epoxy resin. Outdoor sensors shall mount to a standard threaded 1/2 in. conduit or fit a 1/2 in. knockout.

2.9 Digital Timer Switches

A. Switches shall be mounted in the same locations as conventional wall switches (entry doors).

B. Digital timer switch shall automatically turn lights off at a preset time selected by the user. Operation of time switch shall be pushbutton variety. A twist-style timer shall not be acceptable. Pressing the on/off button shall turn lights on for a duration of anywhere from 5 minutes to 12 hours. Lights can be turned off prior to the timeout setting by pressing the on/off button.

C. The time switch can be reset at any time by holding down the on/off button for two (2) seconds. This will restart the timer countdown.

D. Timeout adjustments shall have five (5)-minute increments (up to one [1] hour) and fifteen (15) minute increments (from one [1] hour to twelve [12] hours).

E. All timer switches to be factory-set for a 15-minute time delay.

F. Time-scroll option shall allow user to temporarily override the timeout setting without adjusting the global settings. With time scroll programmed to “UP”, lights can be held on longer than the timeout period. With time scroll programmed to “DN”, lights can be turned off sooner than the timeout period. Pressing the on/off switch for more than four (4) seconds shall cause the timer to scroll in the set direction throughout the possible timeout settings.

G. Digital time switch shall incorporate a flash (flicker) warning of lighting within the space coupled with an audible alarm (beep warning). The visual warning shall flash lights at five (5) minutes and again at one (1) minute prior to timeout. The audible signal shall beep every five (5) seconds at one (1) minute prior to timeout. Both functions (visual and audible) must be incorporated into the timer device.

H. An electroluminescent back-lit LCD in the switch shall show the timer countdown.

I. Timer switch shall be compatible with all electronic fluorescent ballasts and motor loads and shall be UL-listed.

2.10 Emergency Transfer Relays

A. Provide 20 amp emergency transfer relay for the quantity of circuits or zones, as indicated in the Electrical Drawings.

B. The relay device shall comprise of normal voltage-sensing circuitry and transfer relay to automatically bypass lighting controls or/and transfer load circuits from the normal to the emergency power feeds when the normal supply fails.

C. The relay device shall consist of normal voltage-sensing circuitry and transfer relay to automatically transfer load circuits from normal to the emergency power feeds when the normal supply fails.

D. The emergency transfer cabinets shall be designed for use with 120volt, 2-wire feed (line/neutral).

E. Voltage-sensing relays shall cause automatic transfer upon loss of normal power.

F. On restoration of the normal power supply, load circuits shall be transferred to be fed from lighting control automatically or/and from the emergency feeds to the normal supply automatically.

G. An integral test switch shall be provided to simulate normal power source failure for periodic verification of system operation. Access inside the test cabinet shall not be necessary.

PART 3 - EXECUTION

3.1 Installation

A. Receive and store all necessary materials and equipment for installation of the lighting controls. It is the intent of these specifications and plans to include everything required for proper and complete installation and operation of the system, even though every item may not be specifically mentioned. Deliver on a timely basis to other trades any equipment that must be installed during construction.

B. The system shall be installed utilizing complete manufacturer's shop drawings and in accordance with these specifications. Dimmers shall not be used to furnish any temporary light or power for construction activities.

C. Provide accurate as-built drawings to the Owner for correct programming and proper maintenance of the lighting control system. The as-built drawings shall indicate the load controlled by each relay or dimmer and the relay/dimmer panel number.

D. Install control stations only after "wet" work such as plastering has been completed and the area has been cleaned.

E. Mount equipment at locations and heights indicated on approved shop drawings or as directed by the Owner/Architect. Locations indicated on the Electrical Drawings are general and approximate. Clearly verify locations with Architect's plans and elevations prior to installation. Check for adequacy of headroom and clearance with other equipment such as ducts, pipes and openings. Bring any conflicts to the Owner's attention prior to proceeding with the work.

F. Upon completion of the installation and prior to removal of the bypass jumpers, completely test all line-voltage power and low-voltage control wiring for continuity and accuracy of connections. The jumpers shall remain in place until all loads have been fully tested and found to be free of miswires, short circuits or other wiring defects.

G. On completion of the installation, the lighting control equipment shall operate per specifications and be free from defects in condition and finish. Movable parts must operate freely and with uniform friction throughout their range. Prior to inspection, replace any damaged parts.

H. Provide all required relays, transformers, power supplies, wiring, conduit or other necessary or auxiliary devices not specifically listed on the Contract Documents but that are needed to affect the functional requirements of the control systems.

I. Provide ten percent (10%) minimum spare conductors in all conduits and raceways, control cables, and control cable connectors. Spare conductors shall be indicated and labeled on shop drawings and shall be terminated on barrier terminal strips and in connectors and labeled in the same manner as active conductors.

J. Field terminations in these systems shall be made to numbered screw terminals on circuit breakers or switches or on numbered barrier terminal blocks. Wire nuts and crimped connectors are not acceptable.

K. Provide separate grounded conductors (neutrals) for all branch load circuits that include dimmers or dimming systems.

L. Grounded conductors (neutrals) shall be run to all switch locations.

M. All breakers that serve wiring with shared neutrals shall be provided with common trip action.

N. Sensors

1. Provide plans showing sensor locations, devices and control sequences.
2. Review the installation, perform functional tests and document the results and operating and maintenance information prior to receiving final project approval.

3. On completion of installation and after circuitry has been energized, demonstrate capability and compliance with system requirements. Where possible, correct any malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units or relocate devices, if required, and proceed with retesting. Testing and retesting shall be done at no expense to the Owner.

O. Photosensors (Daylight Controls)
1. Prior to commissioning, Contractor shall verify that all photosensors have been properly located, factory-calibrated (proof required) or field-calibrated and set for appropriate set points and threshold light levels. Contractor shall provide documentation of set points, setting and programming for each device.
2. For luminaires that are powered by a separate lighting circuit from non-daylit areas, the Contractor shall demonstrate that only the luminaries in the daylit zone are affected by daylight control. The Contractor shall simulate both bright and dark conditions for the dimming system in order to determine the following:
a. Automatic daylight control system reduces (in a bright condition) and increases (in a dark condition) the amount of light delivered to the space uniformly.
b. In continuous dimming systems, demonstrate that the dimming control system provides reduced flicker operation over the entire operating range. Additionally, in stepped light level control systems, demonstrate that the minimum time delay between steps is three (3) minutes to prevent short cycling and that the automatic daylight control system reduces the amount of light delivered to the space per manufacturer's specifications for power level versus light level.
c. Contractor shall document illuminance measurements in the space, location of measurements and specific device settings, program settings and any other measurements as required.

P. Network Lighting Controls: Provide a dedicated network between the computer and processor panels.

Q. Programming: Program all systems to the satisfaction of the Architect, Engineer and Owner.

3.2 Manufacturer's Service

A. Manufacturer shall assemble and test the dimming system at full load for a minimum of five (5) hours before shipment.

B. Ensure that the factory start-up technician makes any calibrations and adjustments necessary for proper operation of the system.

C. Equipment manufacturer shall provide six (6) bound copies of an operation and maintenance manual to the Owner's Representative. Manual shall contain wiring diagrams, description of all control functions, operation instructions for all applicable components, maintenance and troubleshooting information, parts lists, component specifications, a copy of the warranty and Service Contract (if applicable), and address and phone contacts for service personnel. Also see "Electronic Media Requirements" in Section 26 00 00.

D. Manufacturer shall offer technical support hotline and shall be capable of providing onsite service support within 24 hours anywhere in the continental USA and within 72 hours anywhere in the world, except where special visas are required.

E. Manufacturer shall offer an optional renewable Service Contract on a year-to-year basis that shall include parts and factory labor as well as annual training visits if requested.

F. Systems Integration for Integrated Building Systems: As part of systems integration, all software and associated interface hardware shall be confirmed by both the integrated building system manufacturer and the lighting controls manufacturer to be properly installed and operational.

G. Network Lighting Controls Start-Up and Programming
1. Provide a factory-certified Field Service Engineer to make minimum of three (3) site visits to ensure proper system installation and operation under following parameters.
a. Qualifications for factory-certified Field Service Engineer:

1). Minimum experience of two (2) years' training in the electrical/electronic field.
2). Certified by the equipment manufacturer on the system installed.

3.3 System Start-Up (Commissioning)

A. On completion of the installation, the system shall be commissioned by a factory-trained technician. The commissioning will be performed upon notification that the system installation is complete and that all loads have been tested live for continuity and freedom from defects and that all control wiring has been connected and checked for continuity.

B. Advise the Owner's Representative prior to scheduling start-up so that all persons designated by the Owner and Architect are present for training. Provide both the manufacturer and the Architect/Engineer with ten (10) working days' notice of the scheduled commissioning date.

C. On completion of system commissioning, the factory-trained technician shall demonstrate the operation of the system to the appropriate Owner's Representative. A five (5)-year warranty covering all material and workmanship shall be effective from the date of final system commissioning. Contractor is to secure written acceptance of Owner's Representative on commissioning report.

D. Contractor shall make any necessary adjustments and calibrations necessary prior to Final Inspection by the Owner.

3.4 System Onsite Programming

A. Manufacturer shall provide technical support for one (1) full day of onsite set-up to program scenes and settings. Manufacturer and Contractor shall confirm that system is properly installed, fully operational and commissioned prior to scheduling on-site system programming. Set-up shall be prior to the instruction periods described hereinabove.

B. Manufacturer shall provide technical support for five (5) full day of on-site set-up to program scenes and settings of network controls. Manufacturer and Contractor shall confirm that system is properly installed, fully operational and commissioned prior to scheduling onsite system programming. Set-up shall be prior to the instruction periods described hereinabove.

C. Prior to programming, the Owner/Architect/Lighting Consultant shall provide a "System Operating Narrative" indicating generic description of groupings, zones, operational hours, timed events, light levels and sequencing requirements with other building systems.

3.5 Training

A. A Factory Engineer shall demonstrate the operation and maintenance of all system components to the Owner's Representatives. Factory technician shall schedule, in coordination with the Owner, a training period for the Owner's staff or designated appointees. This training period shall be a minimum of three (3) hours. Training shall encompass the entire scope for the system, including operation, adjustment, maintenance and troubleshooting, until completely understood. Manufacturer shall submit names and period of attendance of those instructed.

B. For Programmable Switching Systems: Provide one (1) full day of onsite start-up and instruction period. Inspection and sign-off to be either one (1) week prior to floor commissioning and Client move-in, or within two (2) weeks of Client occupation of space (to be coordinated with Client).

C. For Network Control Systems: Provide one (1) full day of onsite start-up and instruction period. Inspection and sign-off to be either one (1) week prior to floor commissioning and Client move-in, or within two (2) weeks of Client occupation of space (to be coordinated with Client).

3.6 Factory Testing

A. All standard factory tests shall be performed in accordance with the latest version of NEMA and UL Standards.

3.7 Field Testing

A. Switching/Relay Panels/Network Controls

1. Switching/relay panels shall have automatic and manual operational tests performed following the completion of the installation of the panel and override switches (where included).

2. Simulated programming times (i.e., “on”, “off”) shall be input by the Contractor for the test, and following the completion of the test, the actual “on/off” times as required by the Owner shall be input into the system.

B. Sensors
1. Sensors shall have manual and automatic operational tests performed following the completion of the installation.
2. Sensors shall have their initial settings adjusted by the Contractor according the Owner’s criteria (i.e., sensitivity, time delay, etc.) prior to testing.

C. Wall-mounted dimmers shall be operationally tested.

3.8 Progress Inspections

A. Energy Code Compliance Inspections: Upon major completion of lighting and lighting control installation, Contractor shall alert of readiness for inspection. Contractor to give a minimum one (1) weeks’ notice for inspection to responsible party signing the TR-1 form. During the test, ballast/transformers and lamps for each fixture type shall be accessible, along with sticker of wattage of exit signs.

END OF SECTION 26 09 23

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SECTION 26 22 13

LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install all low-voltage distribution transformers as specified herein and as required for proper transformation of power throughout the project as indicated on and in accordance with the requirements of the Contract Documents.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 REFERENCES

A. All dry-type transformers shall be designed, manufactured, tested and installed in accordance with the latest applicable codes and reference standards, including the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the City of New York.
   b. International Building Code.
   c. National Electrical Code.
   d. New York City Electrical Code.

2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. ANSI C89.2: Dry-Type Transformers for General Applications.
   b. ANSI/IEEE C57.110: Recommended Practice for Establishing Transformer Capability When Supplying Non-Sinusoidal Load Currents.
   c. ANSI/IEEE C57.12.01: General Requirements for Dry-type Distribution and Power Transformers.
   d. ANSI/IEEE C57.12.91: Test Code for Dry-Type Distribution and Power Transformers.
   e. ANSI/NEMA TP 2: Standard Test Method for Measuring Energy Consumption of Distribution Transformers.
   f. DOE 2016: Energy Conservation Standards for Distribution Transformers.
   g. NEMA ST1: Specialty Transformers.
   h. NEMA ST20: Dry-Type Transformers for General Applications.
   i. UL Standard 506: Specialty Transformers.
   j. UL Standard 1561: Dry-Type General Purpose and Power Transformers.

1.4 SUBMITTALS

A. The following submittal data shall be furnished according to the conditions of the Construction Contract, Division 01 and Section 26 00 00, and shall include, but not be limited to:
   1. Dry-type transformers, complete with capacity data, bus data, test, etc.
   2. Shop drawings shall be submitted for review by the Engineer before installation of transformers. These shop drawings shall give construction details and electrical characteristics as well as physical dimensions and weight of transformers. In addition, sufficient information shall be submitted on the vibration isolators for the design to be checked for approval. See Section 26 00 00 for additional requirements.

B. The manufacturer shall submit, with the shop drawings, NEMA TP2 test reports and non-linear load test reports, including the following dry-type transformer electrical characteristics based on actual laboratory tests of typical transformers for each kVA rating and type specified:
   1. Percent impedance.
   2. X/R ratio.
   3. Percent regulation with 80% and 100% power factor load.
   4. Efficiency at 1/6, 1/4, 1/3, 1/2, 3/4 and full load.
   5. No-load (core) losses.
   6. Full-load winding conductor (coil) loss.
   7. Total losses.
   8. Noise level rating.
   9. K-factor rating (where applicable).
   10. Temperature rise.
   11. These reports shall be signed by Factory Test Engineers.

C. The manufacturer shall have performed the following additional tests on units identical to the design type being supplied to this specification. Proof of performance of these tests in the form of test data sheets shall be provided with the shop drawings.
   1. Sound levels.
   2. Temperature rise tests.
   3. Full-load losses.
   4. Regulation.
   5. Impedance.

1.5 DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.6 ALTERNATES

A. Alternate No. 26 22 13-1: State the INCREASE in cost to the Base Bid to provide all transformers with a K-13 rating and 115°C rise insulation class.

B. Alternate No. 26 22 13-2: State the INCREASE in cost to the Base Bid to provide all transformers with an 115°C rise insulation class, in lieu of 150°C.

C. Alternate No. 26 22 13-3: State the INCREASE in cost to the Base Bid to provide all transformers with a 80°C rise insulation class, in lieu of 150°C.

1.7 WARRANTY

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.8 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Contract Documents.

B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Contract Documents will be revised to reflect the substitution.

C. If they comply with the Contract Documents, dry-type transformers manufactured by one (1) of the following manufacturers will be acceptable:

1. ABB.
2. Eaton/Cutler-Hammer.
3. General Electric.
4. Hammond Power Solutions.
5. Jefferson Electric.
6. Olsun.
7. Pioneer Transformers.
8. Powersmiths.
9. Rex.
10. Schneider/Square D.
11. Siemens Industry Inc.
12. Sola/Hevi-Duty.

2.2 RATINGS

A. Dry-type transformers shall be located as shown on the drawings and described in the Contract Documents, and shall have the capacities, current characteristics and ratings indicated.

B. All transformers shall have a minimum K rating of K-4.

C. All transformers shall have a minimum energy efficiency complying with the DOE 2016 regulations.

2.3 GENERAL

A. Dry-type transformers shall have full-capacity taps as indicated herein.

1. Single-Phase
   a. 0.25 to 3.0 kVA, no taps.
   b. 5 to 25 kVA, two (2) 5% taps below normal transformer primary.
   c. 37.5 to 167 kVA, six (6) 2-1/2% taps, two (2) above and four (4) below normal transformer primary.
2. Three-Phase
   a. 3 to 9 kVA, two (2) 5% taps below normal transformer primary.
   b. 15 to 750 kVA, six (6) 2-1/2% taps, two (2) above and four (4) below normal transformer primary.
3. Provide NEMA 3R transformers where required per code and/or as indicated on the drawings.

B. Dry-type transformers shall be suitable for mounting as indicated on the drawings. Insulation for these transformers shall be 150°C rise with temperature class 220°C (or higher) insulation system, at 100% continuous load in a 40°C ambient environment. Transformers shall comply with the temperature rise rating through natural ventilation. No mechanical aids shall be permitted. Winding temperature rise limits applicable to the system temperature classification shall be in accordance with UL Standard 506. Core shall be constructed of cold-rolled, oriented, high-permeability silicon steel formed as a coil or laminated. K-factor-rated transformer core shall be constructed of high-grade, grain-oriented silicon steel with a flux density sufficiently below the saturation point.

C. Windings shall be electrical-grade copper individual windings terminated by electrically welding (heliarc or similar process) to tin-plated or silver-plated bars. Foil windings shall not be acceptable. Transformers shall include a full-length copper electrostatic shield between the primary and secondary windings. Transformers shall be equipped with neutral lugs of sufficient capacity to carry 100% of the secondary nameplate amperage at rated voltage. The neutrals shall be brought up to a lug and bolt inside of the case with the bolt extending outside, so the neutral can be grounded externally. Where panelboards and/or feeders downstream of a transformer are shown with a 200% neutral on the contract drawings, or where transformers are shown as K-13 rated, transformers shall be provided with a 200% rated neutral.

D. Dry-type transformers shall be especially quiet in operation and shall have a certified sound rating in compliance with the table below:

kVA Rating	Maximum Sound Level (dB)
0 - 9	40
10 - 50	45
51 - 150	50
151 - 300	55
301 - 500	60
501 - 700	62
701 - 1,000	64

E. Sound ratings shall be measured per ANSI C89.91. Any transformer that is noisy in the opinion of the Engineer shall be removed and replaced with one of suitable design. Before installation, complete sound data shall be submitted for review by the Engineer.

F. The secondary winding conductors shall be insulated as required to keep hysterisis and eddy current losses at the harmonic frequencies to an absolute minimum. The primary winding conductor shall be of sufficient size to limit the temperature rise to its rated value, even with the circulating 3rd harmonic current.

G. The core flux density shall be well below the saturation point to prevent core saturation caused by the non-linear harmonics, even with a 10% primary overvoltage

H. All transformers shall comply with the minimum efficiencies listed below as tested and rated in accordance with Equipment Class 4 of DOE 2016 and NEMA-TP2 at 35% loading.

Three-Phase	
kVA	**Efficiency**
15	97.89%
30	98.23%
45	98.40%
75	98.60%
112.5	98.74%
150	98.83%
225	98.94%
300	99.02%
500	99.14%
750	99.23%

I. All transformers shall have vibration isolation that isolates the case from the core and the coil assembly. Transformers shall be mounted either on the floor, the wall or suspended from the ceiling as required. Additional vibration isolators shall be provided between trapeze or universal hangers of suspended transformer and its case and between transformer case and floor for floor-mounted units. Use flexible metallic conduit of 24 inch minimum length, with external grounding jumper for final connection to transformer case.

J. Refer to Section 26 05 48.16 - Vibration Isolation for Electrical for additional vibration isolation requirements.

K. Dry-type transformer wiring compartments shall provide adequate space to permit line-and load-side cable terminations in compliance with the requirements listed in Section 26 05 19. Space shall be adequate for connectors as required by these sections. Terminals shall be internally bussed to end wiring chambers that will not exceed conductor insulation temperature needs.

L. Provide isolated air terminal chambers for cable connections on all transformers 500 kVA and larger. Coordinate the quantity of connections with the Contract Documents.

M. Transformers serving sensitive equipment shall be specifically designed for electrical noise isolation protection. These transformers shall provide transverse-mode noise attenuation of 30

dB minimum, and common-mode noise attenuation of 120 dB minimum. Noise isolation shall be achieved by a triple-shield or an ultra-isolating type transformer.

N. The following enclosure requirements shall be in accordance with UL Standard 506:
   1. Ventilation openings.
   2. Corrosion resistance.
   3. Cable bending space.
   4. Grounding provisions.
   5. Surface temperatures.
   6. Wiring compartment temperature rise terminations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all dry-type transformers per the manufacturer's recommendations and as indicated on the drawings.

B. Provide cable supports internal to the transformer, made of insulating materials that comply with the requirements of the manufacturer's listing. Indicate these supports on the shop drawing.

3.2 FACTORY TESTING

A. Transformers furnished by this specification shall be subjected to the following production tests:
   1. Applied potential.
   2. Induced potential.
   3. No-load losses.
   4. Voltage ratio.
   5. Polarity.
   6. Continuity.

B. All standard factory tests shall be performed in accordance with the latest version of NEMA and UL standards.

C. The manufacturer shall provide three (3) certified copies of factory test reports as part of the required submittals.

3.3 FIELD TESTING

A. Fifty percent (50%) load shall be provided on all transformers to confirm the secondary voltage. Secondary taps shall be adjusted as required to provide a minimum of 120/208 volts.
   1. Perform thermographic survey.

B. Transformers shall be tested per all NETA inspections and test procedures.
   1. Visual and Mechanical Inspection
      a. Compare equipment nameplate data with drawings and specifications.
      b. Inspect physical and mechanical condition.
      c. Inspect anchorage, alignment and grounding.
      d. Verify that resilient mounts are free and that any shipping brackets have been removed.
      e. Verify the unit is clean.
      f. Verify that as-left tap connections are as specified.
   2. Electrical Tests
      a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
      b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage in accordance with manufacturer's published data or in the absence of manufacturer's published data, use NETA Table 100.5. Calculate polarization index.
      c. Perform turns-ratio tests at all tap positions.
      d. Verify correct secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

C. Phase rotation shall be demonstrated as part of the operational checkout at the site.

END OF SECTION 26 22 13

SECTION 26 24 13

SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install all free-standing, dead-front-type 600 volt service and distribution switchboards utilizing individually mounted circuit protection devices, including surge protection devices (SPD's) as required for the distribution of lighting and power throughout the building in accordance with the requirements of the code and per the Contract Documents.

B. Section includes:

1. Distribution switchboards.
2. Service switchboards.
3. Ground fault protection system.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 REFERENCES

A. Switchboards and all components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards, including the following as modified to conform to Bureau of Electric Control Advisory Board requirements:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City, New York.
   a. Building Code of the City of New York.
   b. National Electrical Code.
   c. New York City Electrical Code.

2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. NEMA PB 2: Deadfront Distribution Switchboards.
   b. UL Standard 891: Switchboards.
   c. UL Standard 977: Fused Power - Circuit Devices.

1.4 DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.5 WARRANTY

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.6 FILING REQUIREMENTS

A. Prior to fabrication or commencement of any work, hire a New York State Registered Professional Engineer to file the electrical service layout and configuration in accordance with the New York City Buildings Department RCNY 4000-01. Refer to Section 26 05 00 - Common Works Results for additional requirements.

1.7 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Contract Documents.

B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Contract Documents will be revised to reflect the substitution.

C. If they comply with the Contract Documents, service switch assemblies and distribution switchboards manufactured by one (1) of the following will be acceptable:
   1. All City Switchboard.
   2. American Switchboard.
   3. Atlas Switchboard Co.
   4. East Coast Panelboard Inc.
   5. Electric Switchboard Co.
   6. Electro-Tech Co.
   7. Lincoln Electric Co.
   8. Mac Products.

D. If they comply with the Contract Documents, overcurrent protection devices manufactured by one (1) of the following will be acceptable:
   1. Boltswitch.
   2. Eaton/Cutler-Hammer.
   3. Federal Pioneer.
   4. General Electric.
   5. Pringle.
   6. Siemens Industry Inc.
   7. Square D.

2.2 RATINGS

A. Switchboards shall be of fixed-mounted, indoor switchboard construction, arranged for 208Y/120 volt, 3 phase, 4 conductor, full-neutral and 25% ground bus, or as indicated on the drawings, and assembled complete with spares, spaces and circuit protection devices with capacities as indicated on the drawings.

B. Switchboards and their overcurrent protection devices shall be listed, and have a minimum short circuit interrupting rating/withstand rating of 200,000 amperes rms symmetrical at 208 volts.

2.3 CONSTRUCTION

A. The indoor enclosure shall meet the applicable requirements of the New York City Electric Code, Advisory Board, Bureau of Electrical Control and NEMA.

B. Each section shall be provided with adequate lifting means, and shall be capable of being rolled or moved into installation position and bolted to the housekeeping pad. Individual shipping sections shall be designed for bolting together at the installation site. All necessary hardware required for bolting, including steel channels with shims for leveling as well as main bus splices, shall be supplied with the switchboard sections.

C. All switchboards shall be rear-accessible unless shown against an obstruction on the drawings that would prohibit rear access.

D. Adequate conduit space shall be provided in the rear compartments if rear-accessible, or side gutters if not rear-accessible, to satisfy the current ratings of the individual devices and feeder sizes within a vertical section. All cable terminations shall be made with two-bolt-hole concentric

compression-type lugs, which shall be supplied with the switchboard section and approved by the Engineer.

E. Provide switchboard and circuit identification in accordance with Section 26 05 53.

2.4 DISTRIBUTION SWITCHBOARDS

A. Switchboard assemblies shall be arranged in accordance with the details and schedules shown on the drawings. Each assembly shall consist of a completely metal-enclosed, self-supporting metal structure of the required number of formed and welded vertical panel sections, protection devices in one (1) integrated structure. All fastening between vertical panel sections shall be bolted, not welded. All screwed-on front covers shall be flanged on all four sides and shall be not less than code-gauge steel. The top, side and rear enclosing sheet steel shall be removable, not less than code-gauge, and shall be furnished with openings for proper natural ventilation.

B. Protection devices shall be individually mounted where 800 amps and larger.

C. Bolted or welded frames and insulating blocks shall be provided to support and brace all main horizontal buses for the stresses due to the maximum available short circuit current from the electrical system, but not less than 200,000 amperes rms symmetrical.

D. All main horizontal buses and bus connections between main bus and feeder protection devices shall consist of copper of sufficient size to limit temperature rise to 65°C over an average air temperature outside the enclosure of 40°C, but not less than one (1) square inch per 1,000 amperes; bus density shall be decreased as required to meet the requirements of the NYCEC. All bus connections shall be silver-plated, after fabrication, and bolted and taped. Provide Belleville washers on all bolted joints, torqued to manufacturer's requirements.

E. A full-capacity (minimum) copper neutral bus shall be provided, or larger where indicated. Provide separate ground bus 1/4 inch x 3 inches in each switchboard assembly.

F. Bus bars shall be adequately braced to withstand resulting mechanical forces exerted during short circuit conditions when subjected to short circuit currents but no less than 200,000 amperes rms symmetrical.

G. Approved barriers shall be placed between adjacent sections of the switchboard, and all openings in the barriers for bus bars shall be closed with snug-fitting, approved non-hygroscopic arc-resisting material. Provide isolation barriers and approved non-hygroscopic firestops at main buses, between each means of circuit protection and each means of circuit protection and its respective outgoing section, effectively isolating each distribution means of circuit protection.

H. Provide isolation barriers between the main bus section and the cable termination area. Provide barriers so that all bus connections can be made accessible for thermoscanning without removal of entire barrier.

I. Provide non-metallic cable supports to allow the cables to be shaped and supported.

J. All buses shall be assembled so as to maintain the minimum UL electrical clearances without the use of insulating material. Load studs shall be equipped with load extension buses, terminating in copper-bodied solderless concentric compression-type, 2 bolt-hole long-barrel lugs in the rear cable compartment. Bus extensions shall be silver-plated where the lugs are attached.

K. Meter readouts shall be mounted at a maximum height of 66 inches and a minimum of 48 inches above the finished floor.

L. If indicated on drawings, or as required, metal pull box (crown box) of the same depth as the switchboard shall be constructed to the required height (minimum of three [3] feet) and mounted atop each switchboard assembly. Pull box is to be so designed that top, sides and end panels are all screw-removable. Insulated cable supports shall be provided. The bottom of pull box shall be enclosed by metal completely separating cables in the pull box from switchboard sections. All cables entering the pull box at the bottom from the switchboard shall be sealed using an O-Z Type GRK with Type BB insulated bushings of the size and number of holes as required for cables specified. Each section of the crown box of each switchboard shall be barriered to maintain separation of feeders.

M. All sheet and structural steel parts shall be rustproofed prior to painting and finished with a light gray paint, ANSI 61, over all steel surfaces on both the interior and exterior faces.

N. Rear doors shall be not more than 36 inches in width with three-point locking hatches.

2.5 SERVICE SWITCHBOARDS

A. Service switchboard assemblies shall be arranged in accordance with code requirements and as hereinbefore described for distribution switchboards, except where in conflict with the requirements described hereinbelow.

B. Metal-enclosed main service switch assemblies shall consist of incoming service termination, overcurrent protective devices, fuses, etc., metering the current transformer section and outgoing sections. Each service switch shall be enclosed in a self-supporting metal cubicle. Provide isolation barriers and approved non-hygroscopic firestops at main buses entering and leaving the current transformer section and between each service switch and its respective outgoing section.

C. Where main service switch sections are contiguous with associated distribution switchboards, provide a fire barrier comprised of 3/4 inch non-hygroscopic fiberboard between metal end closures of service switch and distribution switchboard assembly. All bus openings in the barrier shall be closed with snug-fitting, approved non-hygroscopic arc-resisting material. A 1 foot minimum separation shall be provided between the service switch and distribution section.

D. Main bus and section buses shall be provided in each switchboard section and shall be copper with either silver or tin plating at all joints. All main bus shall be either welded or bolted to section bus and bolted where main bus extends to adjacent shipping sections. Bolted joints shall consist of silver- or tin-plated splice plates and high tensile strength steel bolts with nuts and Belleville washers tightened to the proper torque requirements as dictated by the Belleville washers and UL requirements.

E. Bus bars shall be sized to maintain UL temperature rises for each particular section of bus when operating in an ambient room temperature of 40ºC, but not less than 1 square inch per 700 amperes (copper).

F. Bus bars shall be adequately braced to withstand resulting mechanical forces exerted during short circuit conditions when subjected to short circuit currents but no less than 200,000 amperes rms symmetrical.

G. All buses shall be assembled so as to maintain the minimum UL electrical clearances without the use of insulating material. Load studs shall be equipped with load extension buses, terminating in copper-bodied solderless concentric compression-type 2 bolt-hole long-barrel lugs in the rear cable compartment of each structure. Bus extensions shall be silver- or tin-plated where outgoing lugs are attached. The rear cable or bus duct section shall be barriered from the main bus section using non-hygroscopic material. Provide barriers in sections so that all bus connections can be made accessible for thermoscanning without removal of the entire barrier. Provide non-metallic cable supports to allow the cables to be shaped and supported.

H. A continuous 1/4 inch x 4 inch copper ground bus, readily accessible upon removal of rear panels, shall be run through and connected to all component parts of the switchboard structure. Provide for connection of 500 kCMIL copper ground connection.

I. A full-capacity neutral bus, fully insulated from the frame, shall be provided with a suitable disconnect link. Provide a separate ground bus in each service switch and distribution switchboard assembly.

J. Provide floor steel channels with shims for level mounting of assemblies on floor.

K. Provide a utility metering compartment in accordance with all requirements of the local utility company (Con Edison).

L. For each service switch, provide an ammeter in accordance with Section 26 27 13 - Electricity Metering.

M. For each service switchboard, provide a voltmeter in accordance with Section 26 27 13 - Electricity Metering.

N. Hinged rear doors shall be not more than 36-inch-wide door panels with 3-point locking latches.

O. All sheet and structural steel parts shall be rustproofed prior to painting, finished with a light gray paint, ANSI 61, on the interior and exterior over all steel surfaces.

P. Each service switchboard shall be provided with surge protection devices (SPD's) in accordance with Section 26 43 00.

Q. All freestanding service switches shall be provided as required by code and in accordance with the service switchboard section.

R. Provide space within service switchboard assemblies for all future equipment (utility meters, service switches, etc.).

S. Service Switchboard and Distribution

Switchboard Assembly Circuit Protection Devices

1. All overcurrent protection devices shall be UL-listed.
2. All service overcurrent protection devices for all separately derived systems including, but not limited to, utility service, transformer secondary, generators, power conversion equipment, etc., shall be rated for one hundred percent (100%) of their continuous ampere rating and shall comply with all New York City Electrical Code Requirements.
3. On all service disconnect devices and on distribution disconnect devices indicated on the Contract Drawings, provide a ground fault monitoring system. Each ground fault detection system shall consist of a current monitor, zero-sequence current transformer relay coil and fault indication on the face of the switchboard either on the device cubicle in alarm or centrally located on the switchboard metering compartment if proper identification is provided.
4. All service switches for all separately derived systems (except for fire pumps), 1,000 amps or greater shall be provided with ground fault protection.
5. For Switches 1,200 Amps and Larger: Provide two (2) pairs of isolated Form C contacts rated 10 amperes, 125 volts from each ground fault sensor for remote alarm-sensing under other sections. Extend Form C contacts to terminal strips in a separate control compartment in each switchboard.
6. For Switches 1,200 Amps and Larger: Provide two (2) pairs of isolated Form C contacts rated 10 amperes, 125 volts for each switch for remote status indication provided under other sections. Extend Form C contacts to terminal strips in a separate control compartment in the service switchboard.
7. Provide two (2) pairs of isolated Form C contacts rated 10 amperes, 125 volts from each distribution device for remote status indication provided under other sections. Extend Form C contacts to terminal strips in a separate control compartment in the switchboard.
8. Switches
   a. All switch devices rated 1,200 amps and higher shall be high-pressure contact switches. All switch devices rated below 1,200 amps shall be high-pressure contact switches or quick-make/quick-break-type switches.
   b. Pressure switches shall be 600 volt high-pressure contact load break type, 3-pole ampere rating as indicated on drawing schedules, equipped with current-limiting fuses of the silver sand type. Each switch shall be provided with an electrical-operated mechanism for remote tripping. The tripping mechanism shall be provided with terminals to allow remote trip operation if desired and shall contain the necessary relays to provide automatic tripping upon the loss of a phase. All switch contacts, fuse terminals, line and load terminals shall be silver-plated. Switch mechanisms shall provide sliding contact pressure at jaws during opening or closing operation of switch and positive bolted contact pressure when switch is in the closed position. Any arcing during opening of switch shall occur at the auxiliary contacts. Arcing shall not occur on any part of the main jaw and switchblade contact areas. Switch bases shall be in two (2) sections to provide maximum air movement and heat dissipation around fuses. Switches shall be

dead-front and externally operated, enclosed in properly designed ventilated enclosures. An access door shall be provided with wired glass insert for visual inspection of the switch without opening the door. The external operating mechanism shall be provided with positive mechanical lock when switch is in the closed position. Access door to fuses shall be arranged for opening only when switch operating handle is in the "off" position.

c. All service disconnect devices shall be provided with blown-fuse detection indication and single-phasing protection. Blown-fuse indicator lights shall be mounted on the switchboard face adjacent to each switch and Form C NO/NC dry contacts rated 10 amperes, 125 volts, shall be left in a low-voltage wiring compartment for connection under other sections for remote alarm.

d. Fusible switches shall be stationary quick-make/quick-break (QMQB) type. All QMQB switches shall be individually mounted, dead-front, 3-pole, fused, equipped with current-limiting fuses. All switch contacts, fuse terminals, and line and load terminals shall be silver-plated. Pressure switch mechanism shall provide sliding contact pressure at jaws during opening or closing operation of switch and positive bolted contact pressure when switch is in the closed position. Any arcing during opening of switch shall occur at the auxiliary contacts. Arcing shall not occur on any part of the main jaw and switchblade contact areas. Switches shall be dead-front and externally operable, enclosed in a properly designed, naturally ventilated enclosure. The external operating mechanism shall be provided with positive mechanical lock when switch is in the closed position.

9. Circuit Breakers

a. Circuit breakers shall be drawout insulated-case type for all circuit breakers, complete with solid-state overcurrent and trip devices and electric operators. All circuit breakers, in their enclosures, shall be UL-listed for application at 100% of designated frame ratings (ANSI C37.13, C37.16, C37.17 and C37.50, UL-1066, CSA C22.2). Each circuit breaker faceplate shall have visual indicators to indicate contacts' "open" and "closed" positions, with a local "charge" pushbutton and an LCD display unit. An individual trip target shall be visible from the face of the device. Local control buttons shall be provided for breaker operation. Provide adjustable solid-state (digital) tripping devices for each circuit breaker, each having a complete range of tripping functions and characteristics built into its solid-state module. In addition, each circuit breaker shall be equipped with a Modbus open-protocol communication port. Complete system coordination shall be provided by inclusion of following time/current curve shaping adjustments:
   1). Ampere setting.
   2). Long-time pickup.
   3). Long-time delay.
   4). Short-time pickup.
   5). Short-time delay.
   6). Instantaneous pickup.
   7). Instantaneous delay.
   8). Ground fault trip.

b. Changes in settings shall be made by adjustment at the circuit breaker trip module or by interchangeable switching plugs for precise settings. All settings shall be sealable. This manufacturer shall submit recommended settings for all switchboard protection devices to achieve a completely selective coordinated system from the main protection device (normal and emergency service disconnect devices), through and including the critical load device (branch devices

on subfed critical distribution panelboards). Submit for approval final time current curve indicating selectivity. Circuit breakers shall be rated at 200,000 rms symmetrical amperes. All circuit breakers shall be individually field-tested (primary induction testing) for proper calibration and operation by an independent testing company retained by this manufacturer, before site acceptance testing. The independent testing company shall submit a written report of the test after all corrections and adjustments have been made.

c. All trip units shall have integral meter readings, including 3-phase amps.

d. Provide one (1) test kit for testing all frame sizes. The test kit shall contain all required appurtenances including, but not limited to, harnesses, ground fault defeat modules, etc.

e. Where circuit breakers are utilized, provide an integral breaker lifting device, mounted on a self-contained track, supported from the front section of the assembly, for the switchboard lineup. The lifting device shall not interfere with any incoming power or control cable. The hoist shall be capable of being moved the full length of the switchboard assembly without binding when supporting the largest-frame-size circuit breaker included in the switchboard. The hoist, with the aid of a lifting yoke, shall be capable of lifting from the floor or from the withdrawn breaker cradle the largest-frame-size circuit breaker included in the switchboard. The lifting mechanism shall be designed for easy hand operation, and shall be so designed that the load will not move up or down when the lift is left unattended with the load in midair. Suitable stops shall be provided at the ends of the lifting device track to prevent its running off the track.

2.6 GROUND FAULT PROTECTION SYSTEM

A. Where required by code, provide a ground fault protection (GFP) system for all main service disconnect devices and distribution switches rated 1,000 amps and above. Each GFP system shall consist of a current monitor, zero-sequence current transformer relay coil and fault indication. All alarms will be displayed on a digital display panel (LED type). The GFP system shall be mounted on the face of the switchboard on the device cubicle in alarm.

1. Ground fault protection shall be provided where indicated on the drawings and on all main service disconnect devices rated 1,000 amps or larger (except fire pumps).

2. The ground fault protection shall consist of the following:

a. Current Monitor: Zero-sequence current transformer enclosing all current-carrying conductors, including the neutral conductor, if used, of the circuit being protected.

b. Ground Fault Sensor: Senses the output of the current monitor. Should the sensor detect a ground current in excess of the pickup setting for a duration exceeding the time delay, the sensor shall shunt-trip the appropriate device. The sensor shall have an adjustable pickup of 100 to 1,200 amperes and an adjustable time delay from 0 to 60 seconds.

c. Test Panels: Provide each ground fault sensor with a test panel that shall completely test the ground fault system. The test panel shall indicate that a ground fault was sensed or test the system with or without tripping the feeder switch or breaker. The test panel shall be installed in the front of the switchboard adjacent to the device being protected.

d. Shunt-Trip: Each device or switch with ground fault protection shall be provided with a shunt-trip that shall automatically open the device when signaled by the sensor.

e. Provide a fuse-protected central power transformer from the switchboard line side for the ground fault systems. Ground fault and shunt-trip device shall be capable of operation at 55% of rated voltage.

3. Settings: The electrical trade shall set each ground fault sensor pickup setting at 25% of the rating of overcurrent device with a 6-cycle time delay unless specifically indicated otherwise in the accepted short circuit and coordination study.
4. Integral, self-powered ground fault protection with mechanical ground fault indicator, test function, current sensors, and adjustable pickup and delay with inverse and constant time characteristics. The system shall be field-adjustable with pickup settings from 100 amps to 1,200 amps and trip signal time from 0.1 seconds to 0.5 seconds. The ground fault system shall be self-powered and shall only require external control power for test purposes. The ground fault relay shall have an internal memory circuit that sums intermittent arcing ground faults until the summed ground fault current reaches the trip setting and opens the switch.
5. The ground fault system components shall be mounted and wired onto the circuit protection device during switch assembly, and be factory-tested by the manufacturer to ensure system compatibility.
6. A ground fault protection monitor and test panel shall be provided as an integral part of the switch. The panel shall be visible from the front of the switchboard and shall be equipped with control power indicating light, ground fault trip indicating target, target reset and means of testing the GFP relay and trip circuit, with and without tripping the switch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The assembled service and distribution switchboard structures shall be securely anchored to continuous 1-1/2 in. x 6 in. channels the full length of the switchboard, which shall be embedded in the concrete equipment pad. Bolt studs shall be at least 3/8 in. in diameter and located not more than 30 in. apart center-to-center for switchboard mounting. The mounting channels shall be continuous one-piece structural channels mounted along the front and rear for each continuous switchboard lineup, leveled and embedded in the concrete equipment pads. The channel and bolt studs shall be furnished and installed by this Contractor.

B. A minimum of three (3) spare fuses or current limiters of each type and size used in conjunction with circuit protection devices for the switchboards shall be furnished and delivered to the Owner upon issuance of a Certificate of Substantial Completion.

3.2 FACTORY TESTING

A. All switchboards shall be fully assembled and factory-tested for full functionality at the manufacturer's factory prior to shipment as specified herein:
   1. The switchboard manufacturer shall provide a ground fault monitoring system test for verification of the trip function and alarming of the ground fault sensors at the factory location. The manufacturer shall pass predetermined values of current through the relay sensors and confirm resultant required relay operation. This test shall include a polarity verification of the interconnection of the ground sensor circuits.

3.3 FIELD TESTING

A. After construction work is complete and prior to energizing of the switchboard, the ground fault monitoring system shall be field-tested and reset to the manufacturer's recommended setting for both current and time.

B. Service Switchboards, Distribution Switchboards and Panelboards (in excess of 800 amperes)
   1. Switchboards shall be megger tested.
   2. Switches shall be operated to confirm proper mechanical operation.
   3. Test the accuracy of all meters under varying load conditions with hand-held true rms reading multimeters.

4. Ground fault trip/sensing systems shall be tested to verify their settings and proper activation, including current transformer wiring and orientation. Polarity verification of the interconnection of the ground sensor circuits shall be performed.
5. Primary and secondary injection testing shall be performed on all breakers.

END OF SECTION 26 24 13

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SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install all panelboards as specified herein and as required for proper control and distribution for power, lighting and receptacle loads throughout the project as indicated on and in accordance with the requirements of the Contract Documents.

B. Section includes:

1. Distribution and power panelboards.
2. Lighting and utility panelboards.
3. Ground fault circuit interrupters.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 REFERENCES

A. All panelboards and all components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards, including the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City, New York.
   a. Building Code of the City of New York.
   b. National Electrical Code.
   c. New York City Electrical Code.

2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. NEMA FU 1: Low-Voltage Cartridge Fuses.
   b. NEMA KS 1: Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
   c. NEMA PB 1: Panelboards.
   d. NEMA PB 1.1: General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
   e. UL Standard 67: Safety for Panelboards.
   f. UL Standard 489: Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
   g. UL Standard 943: Ground Fault Circuit Interrupters.

1.4 SUBMITTALS

A. The following submittal data shall be furnished according to the conditions of the Construction Contract, Division 01 and Section 26 00 00 and shall include, but not be limited to:

1. Panelboards, complete with physical dimensions, materials, bus dimensions and capacity data, circuit schedule, connector details, nameplate data, voltage, current and short circuit ratings, factory test reports, installation details, location of neutral and ground buses, etc.

1.5 DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.6 WARRANTY

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.7 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Contract Documents.

B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Contract Documents will be revised to reflect the substitution.

C. If they comply with the Contract Documents, panelboards manufactured by one (1) of the following will be acceptable:

1. American Switchboard.
2. All City Switchboard.
3. Atlas Switchboard.
4. East Coast Panelboard Inc.
5. Electric Switchboard.
6. Electrotech.
7. Lincoln Electric Co.
8. Mac Products.

2.2 RATINGS

A. Panelboards shall be of indoor (NEMA 1) or outdoor (NEMA 3R) construction. All panelboards exposed to outdoor conditions shall be NEMA 3R unless otherwise noted.

B. Panelboards shall be arranged for the voltage and current capacity ratings indicated on the Contract Documents, and assembled complete with spares, spaces and circuit protection devices.

C. Panelboards shall have a short circuit interrupting rating that exceeds the available rms symmetrical fault current values per the coordination study as provided in Section 26 05 73. All devices, including branch devices, shall be fully rated.

D. Where panelboards are indicated on riser diagrams with no corresponding schedule, provide voltage and current rating based on the upstream overcurrent protection device, with a main circuit breaker and distribution devices (fuse or circuit breakers) based on downstream distribution or 42 poles (as applicable).

2.3 GENERAL

A. Enclosure Construction

1. Panelboard cabinets shall be formed from code-gauge galvanized steel with master-keyed flush door locks. Cabinet fronts shall be finished with two (2) coats of ANSI 61 gray enamel over a rust-inhibiting primer coat, or protected by an electro-deposition or powder coat paint process.
2. All unused spaces shall be provided with blank-off plates.
3. The indoor enclosure shall meet the applicable requirements of UL for NEMA 1-type construction. Wet location enclosures shall meet the applicable requirements of UL for NEMA 3R-type construction.
4. Panelboards shall be identified in accordance with Section 26 05 53.
5. Cardholders and directory cards shall be provided in accordance with Section 26 05 53. Circuit arrangement shall correspond to the arrangement indicated on the panel schedules

on the drawings. Alternate phases shall be used in consecutive circuit numbering. If arrangement of circuits is modified to achieve load balance on the phases, panel schedules and "as-built" drawings shall be modified accordingly.

6. Cabinets shall be of sufficient size to allow a gutter space of at least 4 inches on all sides around lighting and utility panels, and 6 inches for power and distribution panelboards. Conduit entry points shall be coordinated so that additional gutter space is allowed for proper cable terminations at mains to avoid short radius bends on cable. Where gutter taps, multiple lugging provisions, installation of metering current transformers or increased feeder size provisions are required, gutter spaces shall be increased accordingly.

B. Bus Construction

1. Panel bus shall be arranged to accommodate copper-bodied compression connectors at the main lug, main overcurrent device and feed-through lug connections for No. 6 AWG or larger copper conductors. See Section 26 05 19 for conductor and connector specifications. Attach these lugs to the panel bus with two (2) bolts per lug or one (1) bolt with anti-turn device. Use of rough-edged washers will not be acceptable as an anti-turn device. Bolts shall be captive or shall be studs to facilitate reinstallation of the lugs with the wire attached.
2. Bus bars shall be designed, supported and braced for a minimum short circuit equal to the short circuit interrupting rating of the panelboard as described hereinbefore.
3. Bus bars shall be sized to limit the temperature rise within the panelboard to 50°C over a 40°C ambient temperature. Bus bars shall be 98% conductivity round-edge copper with bolted joint connections. Bolted joint connections shall be readily accessible for inspection and proper maintenance.
4. Ground Bus: Ground bus in each panelboard section, with a minimum of one (1) termination point per pole and additional termination points where additional equipment grounding conductors are required on the drawings or elsewhere.
5. Neutral Bus (where required): Neutral bus in each section panelboard section, fully rated unless otherwise noted, with a minimum of one (1) termination point per pole and additional termination points where additional conductors are required on the drawings or elsewhere.
6. For equipment directly connected to the secondary side of a K-13 rated or higher transformer, provide two hundred percent (200%) rated, solid neutral with terminations for 200% rated conductors or double conductors where 1/0 and larger.
7. Isolated Ground Bus (where required): Isolated ground bus in each panelboard section mounted on insulating bushings, with a minimum of one (1) termination point per pole and additional termination points where additional equipment grounding conductors are required on the drawings or elsewhere.
8. Bolted joint connection surfaces for copper bus shall be silver-plated.
9. All two-section panelboards shall be connected with conductors of a capacity equal to or greater than the panelboard main bus amperage capacity. Conductor connections shall be as specified hereinbefore.

C. All spares and spaces shall be fully bussed, including bus straps for sizes indicated on drawings.

D. UPS-Backed and Critical Panelboards: Provide SPD protection as specified in Section 26 43 00.

E. Certain panels shall be equipped with integral mechanically held contactors or remote mounted multiple relays for remote control of sections or circuits. Adequate panel space shall be coordinated to accommodate these devices and their wiring.

2.4 DISTRIBUTION AND POWER PANELBOARDS

A. 208Y/120 volt, 3-phase, 4-conductor or 3-phase, 3-conductor as indicated on the drawings. Panelboards shall conform to standards and bear the label of Underwriters Laboratories, Inc., and shall be of dead-front construction. Cabinets and fronts shall be constructed as specified hereinbefore and shall be provided with hinged door-in-door-type doors.

B. Panelboards shall be assembled complete with bolted-in devices, spares and spaces.

C. Overcurrent and Disconnecting Devices
1. Multi-pole switches and breakers shall operate all poles with a single action.
2. Multi-pole breakers shall have common trip action.
3. Fusible Switch Assemblies: NEMA KS 1 quick-make/quick-break, load interrupter enclosed knife switch with externally operable handle. Furnish interlock to prevent opening front cover with switch in ON position. Handle lockable in ON or OFF position. Fuse Clips: Rejection type, designed to accommodate NEMA FU 1, Class R, J or L fuses.
4. Molded-Case Circuit Breakers: UL 489 circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL-listed as Type HACR for air conditioning equipment branch circuits.
5. Molded-Case Circuit Breakers with Current Limiters: NEMA AB 1 circuit breakers with replaceable current-limiting elements, in addition to an integral thermal and instantaneous magnetic trip in each pole.
6. Current-Limiting Molded-Case Circuit Breakers: UL 489 circuit breakers with an integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current-limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size NEMA FU 1, Class RK-5 fuse.
7. Where EPO or Ansul systems are used, breakers or switches shall be provided with a shunt trip.
8. Devices serving hydraulic elevators shall have additional contacts indicating position and shall be wired to the controller.

2.5 LIGHTING AND UTILITY PANELBOARDS

A. 208Y/120 volt, 3-phase, 4-conductor service. All panelboards shall conform with the standards and bear the label of the Underwriters Laboratories.

B. The panelboards shall be assembled complete with molded-case bolted-in circuit breakers, spares and spaces as indicated on the drawings.

C. Certain panels shall be provided in a split-bus arrangement with the indicated quantity of multi-pole circuit breakers or fusible switches provided in Section One. All devices in Section One shall feed transformers or mechanical equipment or act as the main for the branch devices of Section Two. The ampacity of Section One shall be equal to or exceed the ampacity of the distribution device feeding the panel, but in no case be less than 200 amperes. Provide main lugs only on both sections as specified and include either bus or cable connections to subfeed the second section for the protection device provided in Section One.

D. Where two (2) or more section panelboards are indicated, each section shall be provided with a main circuit breaker.

E. Overcurrent and Disconnecting Devices
1. Multi-pole breakers shall be interchangeable with single-pole breakers, operate all poles with a single action, and have common trip action.
2. Molded-Case Circuit Breakers: UL 489 bolt-on-type thermal magnetic trip circuit breakers, operate all poles with a single action, and have common trip action with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HID for lighting other than fluorescent or incandescent, Type D for LED lighting, Type HACR for air conditioning equipment circuits, Class A ground fault circuit interrupter breakers as indicated on drawings. Do not use tandem circuit breakers.
3. Current-Limiting Molded-Case Circuit Breakers: UL 489 circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current-limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size NEMA FU 1, Class RK-5 fuse.
4. EPO or Ansul system: Breakers shall be provided with a shunt trip.

5. Where no schedule is provided, 42 poles shall be assumed.
6. Devices serving hydraulic elevators shall have additional contacts indicating position and shall be wired to the controller.

2.6 GROUND FAULT INTERRUPTERS

A. Class A ground fault circuit interrupter branch circuit breakers shall be provided for all exterior receptacles, window washing receptacles, pipe trace circuits and slab heating circuits, in addition to what is indicated on the drawings. Circuit breakers shall be circuit-interrupting, and will operate manually for normal switching functions and automatically under overload, short circuit, and 0.005 amp line-to-ground fault conditions in accordance with UL Standard 943. The operation mechanism shall be entirely trip-free, so that contact cannot be held close against an abnormal overcurrent, short circuit or ground fault condition. The device shall be bolt-on type with molded- or insulated-case construction and shall be interchangeable with standard breakers utilized in the panelboard.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Panelboards shall be installed per code, manufacturer's recommendations and as indicated on the drawings. Where panelboards are shown or required to be free-standing, provide and install angle iron rack suitably braced.
B. All panelboards in wet locations shall comply with the requirements of the code.
C. Where panelboards are mounted on gypsum board partitions, the mounting screws shall pass through the gypsum board and be securely attached to the partition studs or framework. At the Subcontractor's option, the mounting screws may pass through the gypsum board and be securely attached to 6 in. square, 18 gauge galvanized metal backplates that are attached to the gypsum board with an approved non-flammable adhesive. Toggle bolts installed in gypsum board partitions will not be acceptable.
D. Three (3) spare fuses of each type and size used in conjunction with circuit protection devices for the distribution and power panelboards shall be furnished and delivered to the Owner upon issuance of a Certificate of Substantial Completion.
E. Set all settings on circuit breakers per the reviewed short circuit coordination study.
F. All branch circuits shall be provided with dedicated neutrals whether noted on drawings or not. Where shared neutrals are specifically allowed on the drawings, breaker shall be provided with common trip action.

3.2 EXISTING WORK

A. Survey the existing space closets, and panelboards to verify the suitability of the installation design indicated. Include any and all modifications of existing conditions necessary to comply with the design intent at time of bid. Additional work shall be highlighted in the bid proposal. This assessment shall include evaluating the availability of branch circuits to accommodate the circuiting on the design drawings. Rerouting of circuits to alternate panels within the same closet shall be included in the bid proposal.
B. Circuit numbers shown on drawings are for reference only. Actual circuits to be determined at Shop Drawing Phase.
C. Verify the availability of existing circuit breakers after demolition in order to meet the intent of the new work. Report any discrepancies prior to commencement of work.
D. Disconnect and remove abandoned panelboards.
E. Maintain access to existing panelboards and load centers remaining active and requiring access. Modify installation or provide access panels where required.
F. Clean and repair existing panelboards and load centers to remain or to be reinstalled.

3.3 FACTORY TESTING

A. All standard factory tests shall be performed in accordance with the latest version of NEMA and UL standards.

3.4 FIELD TESTING

A. Following the installation of branch circuitry, phase currents shall be verified to ensure the balance of loads. Branch circuitry shall be reconnected to achieve a maximum imbalance of 10%. Relabel pull boxes, loads, etc., as required.

END OF SECTION 26 24 16

SECTION 26 27 13

ELECTRICITY SUBMETERING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install complete electricity submetering systems, including local meters, current transformers, voltage source, system monitoring and all associated wiring for revenue metering of all Tenants, metering for the “measurement and verification” LEED credit, and power quality metering for fully functioning systems as indicated on and in accordance with the Contract Documents.

B. Section includes:

1. Billing submeters.
2. LEED M&V meters.
3. Power quality meters.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 REFERENCES

A. The electricity submetering system shall be designed, manufactured, tested and installed in accordance with the latest applicable codes and reference standards, including the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City, New York.
   a. Building Code of the City of New York.
   b. National Electrical Code.
   c. New York City Electrical Code.
   d. New York State Public Service Commission and Electric Submetering Regulations, 16 NYCRR Part 96.
2. Reference Standards
   a. ANSI C12.20, 0.5 and 0.2 accuracy classes.
   b. Con Edison standards.
   c. FCC Part 15, Subpart B, Class A.
   d. IEC 61010-1.
   e. IEEE C37 90.1: Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
   f. UL 61010B-1: Electrical Measuring and Test Equipment; Part 1: General Requirements.
   g. ANSI/IEEE C57.13: Standard Requirements for Instrument Transformers.

1.4 DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.5 WARRANTY

A. Comply with the requirements of the Division 01 and Section 26 00 00.

1.6 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Contract Documents.

B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Contract Documents will be revised to reflect the substitution.

C. If they comply with the Contract Documents, billing and LEED M&V metering systems manufactured by one (1) of the following manufacturers will be acceptable:
   1. ASCO.
   2. Dranetz.
   3. E-Mon.
   4. Eaton.
   5. Electro Industries/GaugeTech.
   6. General Electric.
   7. Ion/Schneider.
   8. Leviton.
   9. Quad Logic.
   10. SATEC.
   11. Siemens Industries, Inc.

D. If they comply with the Contract Documents, power quality metering systems manufactured by one (1) of the following manufacturers will be acceptable:
   1. ASCO.
   2. Dranetz.
   3. Eaton.
   4. Electro Industries/GaugeTech.
   5. General Electric.
   6. Ion/Schneider.
   7. SATEC.
   8. Siemens Industries, Inc.

2.2 GENERAL

A. The instruments shall be factory-calibrated using instruments certified to have been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology (NIST) and calibration certificates must be furnished with the meters.

B. Construction
   1. Separate, lockable, painted steel NEMA 1 enclosure or located within a switchboard or panelboard, including manufacturer-recommended fusing, fuse block, CT shorting block and internal wiring color, coded as per the NEC. Provide a NEMA 3R enclosure where located in unconditioned space.
   2. Unit shall be rated for the available short circuit at the point in the electrical distribution where connected.
   3. The meter's surge withstand shall conform to IEEE C37.90.1.
   4. Revenue-grade with a utility-grade test pulse allowing power providers to verify and confirm that the meter is performing to its rated accuracy.

5. 0.5% Accuracy: Meters and CT's shall be calibrated to achieve the required accuracy. Accuracy shall be stated for a given burden, which the combination of the meter and current transformers shall not exceed.
6. The meter shall have a phasor diagram that clearly indicates wiring configuration.
7. The meter shall be user programmable to support any PT or CT ratio. DIP switches or other fixed ratios shall not be acceptable.
8. All inputs and outputs shall be galvanically isolated 2,500 volts AC.
9. The meter shall take a sample from at least every cycle.

C. Current Transformers
1. Split-core or solid-core.
2. Revenue-grade.
3. CT rating shall match the voltage and current rating of the service being metered.
4. Provide shorting blocks for CT shorting when the meter is removed.

D. Power Supply: Provide all required accessories to power each meter, including any transformers, circuit breakers, fuses, taps, etc., such that the meter can operate at any required input voltage.

2.3 BILLING SUBMETERS

A. All billing submetering data shall reside on a metering network. The metering network will consist of the submetering network.

B. Real-time parameters to meter and display:
1. kW.
2. kVA.
3. kVAR.
4. Power factor.
5. Voltage line-to-line.
6. Voltage line-to-neutral for each phase.
7. Amperage per phase.
8. Maximum/minimum values for kW, kVA and kVAR.

C. Parameters to meter, display and record:
1. kWh.
2. kVAh.
3. kVARh.
4. kW peak per 15-minute demand per billing month and lifetime.
5. kW peak per half-hour demand per billing month.
6. Power factor at peak half-hour demand per billing month.
7. kVAR at peak half-hour demand per billing month.
8. Maximum/minimum values for all displayed parameters.

D. Data Recording
1. Astronomical calendar that accommodates for daylight saving time and leap years. Daylight saving time enable/disable shall be user-selectable. Exact dates of the beginning and end of daylight saving time shall be programmable.
2. Time and date of all peak values shall be recorded.
3. Non-volatile, whereby recorded data and programmable settings will be stored for at least 10 years without a battery replacement.
4. Battery-backed; rechargeable.
5. The meter shall be capable of implementing password protection.
6. The meter shall have an inerasable system of events/anti-tampering log to record the following occurrences with a time stamp:
   a. Limit resets.
   b. Password requests.
   c. System start-up.
   d. Energy resets.

e. Log resets.
f. Log reads.
g. Programmable setting changes.

7. Provide an incremental counter that records the number of times the enclosure was opened with time and date.
8. Each loss of meter power shall be recorded with time and date.
9. The meter's internal clock shall be programmable to be synchronized via 60 Hz line frequency or via an NTP server.
10. Coincident demand shall be calculated and displayed at the server for any group of meters.

E. Display
1. Digital.
2. 7-digit; six (6) to the left of the decimal point and one (1) to the right.
3. Units displayed shall be scalable (e.g., milli-, kilo-, mega-, etc.).
4. Display shall allow programming of the meter.
5. Provide a test pushbutton to test the display.
6. Pushbutton to cycle through parameters.

F. Communications Protocol
1. Native BACnet/IP: Where BACnet/IP is not native, provide a gateway for each meter for conversion to BACnet/IP, subject to approval by Engineer.
2. BACnet MS/TP (RS-485).
3. Pulsed output.
4. Modbus TCP/IP.
5. Modbus RTU (RS-485).

G. Limit Alarms
1. The meter shall provide limit alarm and control capability.
2. Limits for each measured parameter shall be user-programmable.
3. The meter shall allow up to sixteen (16) limits per parameter.
4. Limits shall be based on a percent of full-scale settings.
5. Manual relay control shall be available through software.
6. The meter shall have a log for limit alarms. The log shall provide the magnitude, duration and time stamp of an event. The log shall be capable of recording up to 2,000 events.

H. Submetering Network System
1. The system shall include all equipment and software to allow central and commercial billing of Tenants from either an onsite or offsite location.
2. Provide an isolated billing submetering system, including riser cabling, server, billing software and all required appurtenances.
3. Backbone wiring shall be fiberoptic, Cat 6 or RS-485, and comply with the manufacturer's requirements and distance limitations. Provide all required wiring and interfaces at each meter. Provide all cable, conduit, etc.
4. All wiring methods, including power taps, shall meet code and manufacturer voltage drop limits.
5. Provide a system server that meets the latest minimum hardware and software requirements as follows:
a. Manufacturer: Dell or approved equal.
b. Processor: Dual 2.4 GHz CPU.
c. Storage: 2 x 500 GB Raid 0 Array.
d. RAM: 12 GB.
e. Software: Microsoft Server (latest version), SQL Server, Office (latest version) and IE (latest version).
6. Billing meters shall also be used as LEED M&V meters and shall be connected to the BATC system. Provide additional output(s) as required.

7. Provide capability of monitoring multiple buildings in a campus or multiple buildings in different geographic regions for one (1) Owner.

I. Meter Software
1. Windows-based.
2. Real-time polling, programming and graphical data analysis.
3. Automatically download meter log data at scheduled intervals and convert it into the format required by the billing software.
4. Synchronize meters with server time clock at regular intervals.
5. All functions shall be capable of being performed over a network or serial connection.

J. Billing Software
1. Programmable to output bills based on time-of-use schedules at different billing rates for different times of day, weekends and holidays, and shall mimic local utility (Con Edison) reading schedules.
2. Automated energy reporting, cost analysis and usage billing.
3. Allow bills to include usage information on other commodities, including water, steam and gas.
4. Allow set-up of multiple customers, multiple locations (facilities) for each customer, and multiple meters and commodities measured for each location. The application shall let the user create customized rate structures for any commodity at a location. The user shall be able to create rates for:
   a. Peak and off-peak hours.
   b. Up to two (2) seasons.
   c. Weekends and weekdays.
   d. Customizable holidays using a perpetual calendar that only needs to be set up once, after which the software will update the dates for the holidays.
5. The user shall be able to add fixed charges and tax percentages that will be automatically added to the total commodity usage on the customer bill.
6. Work with meter log databases from metering software and be compatible with third-party applications that supply usage data.
7. Support usage update rates of 15-minute intervals.
8. Customizable usage reports and trending graphs. The user shall be able to save, print, copy and export to a file the usage reports and trending graphs.
   a. Usage reports shall be customizable by selecting customer, commodity, and month to view; by choosing to generate the summary format (with the meter's data shown on one [1] page), or full format (meter's data is shown on multiple pages); by choosing to display total usage and interval data on the same graph or on separate graphs; and by choosing to display peak-demand or total-usage data. The usage report shall show total and interval data for the month, for the week, and for the peak day for each of the meters.
   b. Trending graphs shall be customizable by selecting either usage commodities and date range for a meter, or by selecting to view usage for a day, month or year for one (1) commodity from a meter. The second option shall also allow the user to compare the usage to another date or to another meter.
9. Flag any errors in the imported usage data and allow the user to correct those errors. Any modified data shall be marked as such on bills generated from the data.
10. Automatically generate usage bills. The application shall also support manual bill generation through the user interface. Bill generation shall be customizable by selecting to generate bills for:
    a. Individual customers.
    b. All customers.
    c. Individual locations.

d. All customer locations.

11. Both usage and cost based on rate structure shall be totalized on the bill for all meters at a location. The user shall be able to subtract a meter from a location and assign it to another location for billing purposes.
12. Function in either a client/server structure (database stored on server and Client computers having access to the data) or a stand-alone mode (database and application stored on the same computer). Installation of both structures shall be easily accomplished through the same installation program.
13. Simple and constructed so that it can be used by any skill level.
14. Graphical user interface with easy-to-use and clearly labeled screens.
15. Provide a website link from the user interface to an online manual. The manual shall explain thoroughly, in a straightforward manner, the steps needed to use all of the application features.

2.4 LEED M&V METERS

A. All LEED M&V meter data shall reside on a metering network. The metering network will consist of submetering network.

B. Real-time parameters to meter and display:
1. kW.
2. kVA.
3. kVAR.
4. Power factor.
5. Voltage line-to-line.
6. Voltage line-to-neutral for each phase.
7. Amperage per phase.
8. Maximum/minimum values for kW, kVA and kVAR.

C. Parameters to meter, display and record:
1. kWh.
2. kVAh.
3. kVARh.
4. kW peak per 15-minute demand per billing month and lifetime.
5. kW peak per half-hour demand per billing month.
6. Power factor at peak half-hour demand per billing month.
7. kVAR at peak half-hour demand per billing month.
8. Maximum/minimum values for all displayed parameters.

D. Data Recording
1. Astronomical calendar that accommodates for daylight saving time and leap years. Daylight saving time enable/disable shall be user-selectable. Exact dates of the beginning and end of daylight saving time shall be programmable.
2. Time and date of all peak values shall be recorded.
3. Non-volatile, whereby recorded data and programmable settings will be stored for at least 10 years without a battery replacement.
4. Battery-backed; rechargeable.
5. The meter shall be capable of implementing password protection.
6. The meter shall have an inerasable system of events/anti-tampering log to record the following occurrences with a time stamp:
a. Limit resets.
b. Password requests.
c. System start-up.
d. Energy resets.
e. Log resets.
f. Log reads.

g. Programmable setting changes.

7. Provide an incremental counter that records the number of times the enclosure was opened with time and date.
8. Each loss of meter power shall be recorded with time and date.
9. The meter's internal clock shall be programmable to be synchronized via 60 hz line frequency or via an NTP server.
10. Time-of-use schedules shall include the ability to program different billing rates for different times of day and shall mimic local utility (Con Edison) reading schedules.
11. Coincident demand shall be calculated and displayed at the server for any group of meters.

E. Display
1. Digital.
2. 7-digit; six (6) to the left of the decimal point and one (1) to the right.
3. Units displayed shall be scalable (e.g., milli-, kilo-, mega-, etc.).
4. Display shall allow programming of the meter.
5. Provide a test pushbutton to test the display.
6. Pushbutton to cycle through parameters.

F. Communications Protocol
1. Native BACnet/IP: Where BACnet/IP is not native, provide a gateway for each meter for conversion to BACnet/IP, subject to approval by Engineer.
2. BACnet MS/TP (RS-485).
3. Pulsed output.
4. Modbus TCP/IP.
5. Modbus RTU (RS-485).

G. Limit Alarms
1. The meter shall provide limit alarm and control capability.
2. Limits for each measured parameter shall be user-programmable.
3. The meter shall allow up to sixteen (16) limits per parameter.
4. Limits shall be based on percent of full-scale settings.
5. Manual relay control shall be available through software.
6. The meter shall have a log for limit alarms. The log shall provide the magnitude, duration and time stamp of an event. The log shall be capable of recording up to 2,000 events.

H. System
1. All LEED M&V meters shall be wired to the BATC system. Provide all cable, conduit, etc., for connection to a local BATC data-gathering panel.
2. Provide all required wiring and interfaces at each meter.
3. All wiring methods, including power taps, shall meet code and manufacturer voltage drop limits.
4. Provide all programming, etc., including standby and assistance to the BATC Contractor.

2.5 POWER QUALITY METERS

A. All power quality meter data shall reside on a metering network. The metering network will consist of the submetering network.

B. Real-time parameters to meter and display:
1. kW.
2. kVA.
3. kVAR.
4. Power factor.
5. Voltage line-to-line.
6. Voltage line-to-neutral for each phase.
7. Amperage per phase.
8. Amperage average of all three (3) phases.
9. Neutral current.

10. % voltage imbalance.
11. % current imbalance.
12. Frequency.
13. Maximum/minimum values for all displayed parameters.

C. Parameters to meter, display and record:
1. kWh.
2. kVAh.
3. kVARh.
4. kW peak per 15 minute demand per billing month and lifetime.
5. kW peak per half-hour demand per billing month.
6. Power factor at peak half-hour demand per billing month.
7. kVAR at peak half-hour demand per billing month.
8. Coincident demand.
9. Maximum/minimum values for all displayed parameters.

D. Data Recording
1. Astronomical calendar that accommodates for daylight saving time and leap years. Daylight saving time enable/disable shall be user-selectable. Exact dates of the beginning and end of daylight saving time shall be programmable.
2. Time and date of all peak values shall be recorded.
3. Non-volatile, whereby recorded data and programmable settings will be stored for at least 10 years without a battery replacement.
4. Battery-backed; rechargeable.
5. The meter shall be capable of implementing password protection.
6. The meter shall have an inerasable system of events/anti-tampering log to record the following occurrences with a time stamp:
    a. Limit resets.
    b. Password requests.
    c. System start-up.
    d. Energy resets.
    e. Log resets.
    f. Log reads.
    g. Programmable setting changes.
7. Provide an incremental counter that records the number of times the enclosure was opened with time and date.
8. Each loss of meter power shall be recorded with time and date.
9. The meter’s internal clock shall be programmable to be synchronized via 60 hz line frequency or via an NTP server.
10. Time-of-use schedules shall include the ability to program different billing rates for different times of day and shall mimic local utility (Con Edison) reading schedules.
11. Coincident demand shall be calculated and displayed at the server for any group of meters.
12. Harmonic distortion for each voltage and current input, provided as individual harmonic magnitudes up to the 15th harmonic and as total odd, total even and total overall harmonic distortion; all readings given as a percentage of fundamental.
13. K-factor calculations of the first 15 harmonics for all current inputs.

E. Waveform Capture
1. Power factor.
2. Voltage line-to-line.
3. Voltage line-to-neutral for each phase.
4. Amperage per phase.
5. Frequency.

6. The meter shall be capable of recording 512 samples per cycle for a voltage sag or swell, or a current fault event.
7. The meter shall provide pre- and post-event recording capability.
8. The meter shall allow up to 150 events to be recorded.
9. The meter shall have a programmable sampling rate for the waveform recorder.
10. The meter shall store waveform data in a first-in, first-out circular buffer to ensure that data is always being recorded.

F. Display
1. Digital.
2. LCD display.
3. 9-digit; six (6) to the left of the decimal point and three (3) to the right.
4. Units displayed shall be scalable (e.g., milli-, kilo-, mega-, etc.).
5. Display shall allow programming of the meter.
6. Pushbutton to cycle through parameters.

G. Communications Protocol
1. Native BACnet/IP: Where BACnet/IP is not native, provide a gateway for each meter for conversion to BACnet/IP, subject to approval by Engineer.
2. BACnet MS/TP (RS-485).
3. Pulsed output.
4. Modbus TCP/IP.
5. Modbus RTU (RS-485).

H. Limit Alarms
1. The meter shall provide limit alarm and control capability.
2. Limits for each measured parameter shall be user-programmable.
3. The meter shall allow up to sixteen (16) limits per parameter.
4. Limits shall be based on percent of full-scale settings.
5. Manual relay control shall be available through software.
6. The meter shall have a log for limit alarms. The log shall provide the magnitude, duration and time stamp of an event. The log shall be capable of recording up to 2,000 events.

I. Power quality meters shall also be used as billing meters and LEED M&V meters where required and shall be connected to the billing system and BATC system. Provide additional outputs as required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide all wiring between the CT's and meter.

B. Provide all wiring between each meter and the metering network. Coordinate the connection type with the metering network.

C. All wiring shall be installed in conduit. Power and communication wiring shall be in separate conduit.

D. Maximum pulling tensions as specified by the manufacturer shall not be exceeded during installation. Post-installation residual cable tension shall be within the cable manufacturer's specifications.

E. All cabling and associated components shall be installed in accordance with the manufacturer's instructions, requirements and recommendations. Minimum cable and unjacketed fiber bend radii as specified by the cable manufacturer shall be maintained.

F. Terminate all fiber strands and/or Cat 6 wiring at each end.

G. All power supply and communications wiring connections must be performed in accordance with the guidelines set out in the product documentation and local Building Codes.

3.2 FACTORY TESTING

A. All standard factory tests shall be performed in accordance with the latest version of NEMA and UL standards and submitted to Engineer for review.

3.3 FIELD TESTING

A. Provide functional testing, including verification that all meters are operating properly and that the server system reads and records data utilizing a measured load on each meter. Provide a 1 kW load if building load is not available. Testing shall verify the following functions and parameters:
   1. Accuracy.
   2. Communication to billing server and BATC system.
   3. Billing software. A sample bill shall be generated and printed.
   4. Incremental counter.
   5. Limit alarms.
   6. Coincident demand.

3.4 PROGRAMMING

A. Provide all programming of the system as required to set up initial occupancy per the Owner's instruction.
B. Provide telephone support as required.
C. Create all custom reports as required by the Owner.
D. Provide the ability to expand the system based on additional buildings.
E. Set up all alerts as required by the Owner.

END OF SECTION 26 27 13

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 Summary

A. Furnish and install all wiring devices as specified herein and as required for complete and operational systems throughout the project as indicated on and in accordance with the requirements of the Contract Documents.

B. Section includes:

1. Line voltage switches.
2. Plug receptacles.
3. Flush wall plates.
4. Exposed, exterior, surface-mounted moist-location cover plates.
5. Floor boxes and cover plates.

1.2 Related Sections

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 References

A. All wiring devices and all components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City, New York.
   a. Building Code of the City of New York.
   b. National Electrical Code.
   c. New York City Electrical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. NEMA WD 1: General Color Requirements for Wiring Devices.
   b. NEMA WD 6: Wiring Devices - Dimensional Requirements.
   c. UL 20: General-Use Snap Switches.
   d. UL 498: Attachment Plugs and Receptacles.
   e. UL 514D: Cover plates for Flush-Mounted Wiring Devices.
   f. UL 894: Switches for Use in Hazardous (Classified) Locations.
   g. UL 943: Ground-Fault Circuit-Interrupters.

1.4 Delivery, Storage And Handling

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.5 Warranty

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.6 Commissioning

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Contract Documents.

B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Contract Documents will be revised to reflect the substitution.

C. If they comply with the Contract Documents, wiring devices manufactured by one (1) of the following manufacturers will be acceptable:

1. Line Voltage Switches, Plug Receptacles, Wall Plates and Cover Plates
   a. Arrow-Hart/Cooper.
   b. Bryant.
   c. Hubbell.
   d. Leviton.
   e. Lutron.
   f. Pass & Seymour/Legrand.
   g. Russellstoll/Thomas & Betts.
2. Weatherproof "While-in-Use" Covers
   a. Carlon.
   b. Pass & Seymour/Legrand.
   c. Taymac.
   d. Thomas & Betts.
3. Floor Boxes and Covers
   a. FSR.
   b. Hubbell.
   c. Thomas & Betts.
   d. Wiremold/Legrand.

2.2 General

A. The color of all wiring devices, wall plates and cover plates constructed of plastic shall be black for general utility service, red for emergency service, and of colors as designated by the Architect for all finished areas.

B. The finish of all metallic wall plates and cover plates shall be as designated by the Architect.

2.3 Line Voltage Switches

A. Indoor line voltage switches, unless otherwise specified on the drawings, shall be flush-mounted, heavy-duty AC quiet-type rocker handle switches, similar and approved equal to the following Pass & Seymour/Legrand catalog numbers:

1. Load of 20 amps or less, single-pole, 120/277 volts: Pass & Seymour/Legrand 2621 Decorator Series.
2. Load of 20 amps or less, three-way, 120/277 volts: Pass & Seymour/Legrand 2623 Decorator Series.
3. Load of 20 amps or less, four-way, 120/277 volts: Pass & Seymour/Legrand 2624 Decorator Series.

B. Where ganged with wall dimmers, line voltage switches shall be linear slide switch type, one-pole, 120/277 volt Lutron Model No. NT-1PS, or three-way, 120/277 volt Lutron Model No. NT-3PS, or as indicated on the drawings.

C. Where located in damp locations, exposed to the weather, or surface-mounted, line voltage, surface-mounted heavy-duty AC quiet-type toggle switches, unless otherwise specified on the drawings, shall be similar and approved equal to the following Pass & Seymour/Legrand catalog numbers:

1. Load of 20 amps or less, single-pole, 120/277 volts: Pass & Seymour/Legrand 20AC1.
2. Load of 20 amps or less, three-way, 120/277 volts: Pass & Seymour/Legrand 20AC3.

3. Load of 20 amps or less, four-way, 120/277 volts: Pass & Seymour/Legrand 20AC4.

D. Outdoor, loading dock and parking garage switches shall be surface- or recessed-mounted in enclosures (with clear cover) suitable for wet locations similar to Carlon, Taymac, or approved equal.

2.4 Plug Receptacles

A. Unless otherwise noted, all receptacles shall be 20 amp.

B. Where installed in locations accessible to the public, indoor plug receptacles, unless otherwise specified on the drawings, shall be flush-mounted and similar and approved equal to the following catalog numbers:
1. 15 amp, 125 volts, duplex: Pass & Seymour/Legrand 26242.
2. 20 amps, 125 volts, duplex: Pass & Seymour/Legrand 26342.
3. 20 amps, 125 volts, single: Pass & Seymour/Legrand 26361.
4. 20 amps, 125 volts, duplex with ground fault circuit interrupter: Pass & Seymour/ Legrand 2091-S.
5. 20 amps, 125 volts, plug load controllable duplex: Pass & Seymour/Legrand TR26352CD.
6. 20 amps, 125 volts, duplex with two (2) USB ports: Pass & Seymour/Legrand TR5362USB.
7. Special outlet numbers shall be as noted on the drawings.

C. Where installed in spaces only accessible to building maintenance personnel, indoor surface-mounted plug receptacles, unless otherwise specified on the drawings, shall be similar and approved equal to the following Pass & Seymour/Legrand catalog numbers:
1. 20 amps, 125 volts, duplex: Pass & Seymour/Legrand 5352.
2. 20 amps, 125 volts, single: Pass & Seymour/Legrand 5351.
3. 20 amps, 125 volts, duplex with ground fault interrupter: Pass & Seymour/ Legrand 2091-S.
4. Special outlet numbers shall be as noted on the drawings.

D. Outdoor, wet location, damp location, Loading Dock and/or Parking Garage plug receptacles, unless otherwise specified on the drawings, shall be 125 volts, 20 amps, surface- or recessed-mounted in enclosures (with clear cover in spaces accessible only to maintenance crews and solid cover where in public view), UL listed weather-resistant and labeled “WR”. Grade or Ground Level outdoor receptacles shall be lockable. Cover and receptacle shall be similar and approved equal to the following catalog numbers:
1. While in use cover: Thomas & Betts 2CKU.
2. 20 amps, 125 volts, duplex: Hubbell HBL5262WR.

E. All receptacles installed in the following areas shall be UL listed as tamper-resistant and labelled “TR”:
1. Dwelling units.
2. Business office, corridors

F. Receptacle shall be similar and approved equal to the following catalog number:
1. 15 amps, 125 volts, duplex: Hubbell DR15TR.
2. 15 amps, 125 volts, duplex with ground fault circuit interrupter: Hubbell GFR5262TR.

2.5 Flush Wall Plates

A. Provide matching plastic wall plates for all back-of-house indoor wiring devices (MER’s, EMR’s, electrical closets, etc.), including multiple-gang common wall plates where required. The color of all wall plate covers shall be as selected by the Architect.

B. Provide architectural metal finish wall plates (stainless steel, bronze, brass, etc.) for all other wall plates. Coordinate with the Architect.

C. All wall plates in Mechanical/Electrical Rooms and closets shall have an engraved plate indicating circuit designation.

2.6 Exposed, Exterior, Surface-Mounted Moist-Location Cover Plates

A. Coverplates for surface-mounted boxes shall be of the galvanized type for interior use and cast metal type with gaskets and covers for moist locations and exterior use and shall be designed to fit the boxes on which they are installed.

B. All exterior wall plates, wall plates in plenums, wall plates in the Parking Garage, and wall plates for all devices (receptacles and switches) indicated with a “WP” shall be weatherproof “while-in-use”.

C. All “WP” cover plates for exterior receptacles around the site at grade level shall be lockable when no plug is inserted.

2.7 Floor Boxes And Cover Plates

A. Provide flush, gasketed, architectural metal finish (brass, bronze, aluminum, etc., as selected by the Architect) cover plates for all flush floor devices in public areas similar to Carlon, Thomas & Betts, etc.

B. Floor boxes shall be metallic and suitable for the application (embedded in concrete, etc.).

C. All receptacles in flush floor boxes shall be GFCI type with scrub-resistant covers.

PART 3 - EXECUTION

3.1 Installation

A. Where there is more than one (1) flush switch, receptacle and/or dimmer in the same location, they shall be set in gangs under one (1) common wall plate. Dimmer cooling fins shall not be removed.

B. Switches and/or dimmers shall be installed in boxes in a uniform position so that the same direction will open and close the circuits throughout the project.

C. Switches in general shall be installed directly adjacent to the entrance door on the lock side, or on the wall directly past the full open position of the door, or as detailed.

D. All wiring devices shall be installed plumb and aligned in the same plane of the wall, floor or ceiling on which they are mounted.

E. Provide barriers between adjacent switches and/or dimmers where the voltage between conductors exceeds 300 volts.

F. Provide separate grounded conductors (neutrals) for all branch load circuits that include dimmers or dimming systems.

G. Furnish and install line voltage switches where indicated on the drawings for the control of certain circuits.

H. Furnish and install plug receptacles where indicated on the drawings.

I. All receptacles in elevator pits, Elevator Machine Rooms, on the exterior of the building, outdoors, outdoor air plenums, Loading Dock areas, Locker Rooms, Toilet Rooms and janitor’s closets shall be GFCI type.

3.2 Factory Testing

A. All wiring devices shall be tested in accordance with the latest applicable industry standards.

3.3 Field Testing

A. Receptacles shall be tested for polarity.

B. Light switches shall be operationally tested.

C. Window washing distribution shall be tested to ensure proper voltage at the roof-mounted outlets. Provide full motor load equivalent to the manufacturer’s window washing rig motor(s) and verify that the output voltage at the outlet is at the manufacturer’s recommended voltage level.

END OF SECTION 26 27 26

SECTION 26 28 13

FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install all fuses as specified herein and as required for electrical distribution throughout the project as indicated on and in accordance with code requirements and the Contract Documents.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 REFERENCES

A. All fuses and all components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards, including the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City, New York.
   a. Building Code of the City of New York.
   b. National Electrical Code.
   c. New York City Electrical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. NEMA FU 1: Low Voltage Cartridge Fuses.
   b. UL 248: Low-Voltage Fuses.
   c. UL 4248: Fuse Holders.

1.4 UNIT PRICES

A. This Contractor shall state in its proposal unit prices in accordance with the following schedule and the requirements of Section 26 00 00.

1. Furnish and install fuses of the size and type utilized on the project. Provide a complete list indicating size, type and installed cost.

1.5 WARRANTY

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.6 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Contract Documents.

B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Contract Documents will be revised to reflect the substitution.

C. If they comply with the Contract Documents, fuses manufactured by one (1) of the following

manufacturers will be acceptable:
1. Cooper/Bussmann.
2. Mersen/Farraz-Shawmut.

2.2 RATINGS

A. Fuses: All fuses shall be suitable for use at 208 volts, or at other voltages as indicated on the drawings and selected to reduce the available fault current to a value less than the withstand rating of the equipment served and less than the interrupting capacity of the circuit protection device.

2.3 FUSES

A. All fuses shall be of the same manufacturer and shall be installed under this section in all equipment furnished and/or installed under any section of the specifications and motor controllers using rejection-type fuse clips.

B. Fused circuits rated 601 amperes and larger shall be Class L fuses protected by time delay current-limiting fuses listed by Underwriters Laboratories to interrupt 200,000 amperes, unless noted otherwise on drawings. These fuses must hold 5 times the rated current for a minimum of 4 seconds and clear 20 times the rated current in 0.015 second or less.

C. Fused motor circuits serving individual or groups of motors shall be Class RK-5, protected by dual-element current-limiting fuses listed by Underwriters Laboratories to interrupt 200,000 amperes. These fuses must hold 5 times the rated current for a minimum of 10 seconds.

D. Lighting, utility and distribution feeders shall be protected by Class RK-1 dual-element, current-limiting, fast-acting fuses listed by Underwriters Laboratories to interrupt 200,000 amperes. These fuses must hold 5 times the rated current for a minimum of 1 second. Where series rating with downstream circuit breakers is required, the fuses noted in this paragraph may be Class J dual-element time-delay, listed by UL to interrupt 200,000 amperes. Fuses must hold 5 times rated load for 10 seconds.

E. Current-limiting fuses with suitable operating characteristics shall be installed in series with individual or groups of circuit breakers when the available fault current exceeds the rating of the breaker and the combination of the fuse and the circuit breakers is UL-rated for series operation.

F. Spare Fuses: Upon acceptance of the electrical distribution system, provide the Owner with spare fuses and multiple racks to hold same as follows:
1. In each major Switchboard Room, provide three (3) fuses of each type used in the room.
2. In each major Electrical Room, provide three (3) fuses of each type used for motor circuit and distribution on the floor with associated racks.

G. Submit selective coordination fuse curves as required by code and as necessary for comparative analysis of the Coordination Study as described in Section 26 05 73.

H. The fuse manufacturer shall provide fuse characteristic curves of peak demand let-through current versus short circuit current in symmetrical rms amperes for each fuse size installed on this project. These characteristic curves shall be submitted as shop drawings for the Engineer's review. See Section 26 00 00 for requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. No fuse shall be installed or purchased until the coordination study has determined the exact fusing requirements.

B. This Contractor shall install all fuses per the manufacturer’s recommendations and as indicated on the drawings.

C. Replace any fuse with new, where the fuse has opened or been otherwise compromised as a result of construction activities, start-up, testing, commissioning, etc.

D. Provide fuse reducers as required to accommodate fuse sizes if required. Fuse reducers shall be by Bussman or Eaton.

3.2 FACTORY TESTING

A. All standard factory tests shall be performed in accordance with the latest version of NEMA

standards, including NEMA FU-1 and UL standards.

END OF SECTION 26 28 13

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SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install all fused and non-fused switches and/or enclosed circuit breakers as specified herein, as required by code and as indicated on and in accordance with the Contract Documents.

B. Section includes:

1. Enclosed switches.
2. Enclosed circuit breakers.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 REFERENCES

A. All enclosed switches, circuit breakers and all components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards, including the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City, New York.
   a. Building Code of the City of New York.
   b. National Electrical Code.
   c. New York City Electrical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. NEMA KS 1: Enclosed and Miscellaneous Distribution Equipment Switches (600 volt maximum).
   b. UL 50: Enclosures for Electrical Equipment, Non-Emergency Considerations.
   c. UL 98: Enclosed and Dead-Front Switches.
   d. UL 489/NEMA AB 1: Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
   e. UL 512: Fuse Holders.
   f. UL 869A: Reference Standard for Service Equipment.

1.4 DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.5 WARRANTY

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.6 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of these specifications.

B. If they comply with the Contract Documents, enclosed switches and circuit breakers manufactured by one (1) of the following manufacturers will be acceptable:

1. ABB.

2. Eaton/Cutler-Hammer.
3. General Electric.
4. Schneider/Square D.
5. Siemens Industry Inc.

2.2 GENERAL

A. All enclosed switches and circuit breakers shall be Type HD (heavy duty) and shall be suitable for use 208 volts, or at other voltages as indicated on the drawings. Switches protecting motor feeders shall be horsepower-rated.

B. Devices serving hydraulic elevators shall have additional contacts to indicate position and shall be wired to the elevator controller.

2.3 ENCLOSED SWITCHES

A. All enclosed switches shall have manufacturers' permanent nameplates mounted on the cover that indicate the switch type and ratings.

B. All enclosed switches shall have defeatable door interlocks that prevent the door from opening when the operating handle is in the "ON" position.

C. All enclosed switches shall have provisions for padlocking in the "OFF" position.

D. All enclosed switches exposed to the weather or to water damage shall be NEMA Type 3R with approved conduit hubs installed on top of these switches, unless a more stringent rating is shown on the drawings. NEMA Type 12 enclosures shall be used in all plenum areas.

E. Disconnect switches shall be fused where required for overcurrent protection and unfused where disconnecting means only is required.

F. Where current-limiting fuses are specified, rejection-type fuse clips shall be provided to prevent installation of non-current-limiting-type fuses.

G. Non-fused switches shall not be provided with fuse clips.

H. Switches shall be rated where required for motor circuits. Where fused switches are specified, they shall be provided with fuse clips and shall be UL-listed in combination with fuses for the short circuit duty required.

I. See Section 26 05 19 for termination requirements and space in the enclosure.

2.4 ENCLOSED CIRCUIT BREAKERS

A. Circuit breakers shall be molded-case type.

B. All circuit breakers shall be UL-listed for application at 100% of designated frame ratings.

C. Complete system coordination shall be provided by inclusion of the following time/current curve shaping adjustments:
   1. Ampere setting.
   2. Long-time delay.
   3. Short-time pickup.
   4. Short-time delay.
   5. Instantaneous pickup.

D. Changes in setting shall be made by adjustment at the circuit breaker trip module or by interchangeable switching plugs for precise settings. All settings shall be sealable.

E. All circuit breakers shall be provided with two (2) sets of Form A and B contacts, wired to a terminal strip in the enclosure for remote breaker status.

F. Provide one (1) test kit for testing all frame sizes. The test kit shall contain all required appurtenances including, but not limited to, harnesses, ground fault defeat modules, etc.

G. Circuit breakers shall have short circuit rating as required in the coordination study. Provide fusing as part of the assembly, if required to obtain a short circuit rating.

H. See Section 26 05 19 for termination requirements and space in the enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. This Contractor shall install all enclosed switches per the manufacturer's recommendations and as indicated on the Contract Documents.

B. A disconnect means shall be provided at each appliance and motor, and at other equipment where required by code, in addition to that equipment indicated on the Contract Documents.

C. The use of lockout pushbuttons in control circuits of motors shall not be permitted in lieu of the above-specified disconnect means.

D.

E. Enclosed circuit breakers shall be provided where indicated and may be used in lieu of enclosed switches, where appropriate, with Engineer's approval.

3.2 FACTORY TESTING

A. All standard factory tests shall be performed in accordance with the latest version of NEMA and UL standards.

3.3 FIELD TESTING

A. Switches and enclosed circuit breakers shall be operationally tested.

END OF SECTION 26 28 16

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SECTION 26 32 13.13

DIESEL ENGINE-DRIVEN GENERATOR SET[S]

PART 1 - GENERAL

1.1 Summary

A. Furnish and install a complete prime rated diesel engine-generator set[s], including all associated automatic controls, monitoring, load banks, output distribution, fuel oil belly tank, acoustic enclosure and appurtenances for a complete, operational system as specified herein and required for backup of emergency and optional standby systems throughout the project, as indicated on and in accordance with the requirements of the Contract Documents.

B. Section includes:

1. System operation.
2. Diesel engine-generator set[s].
3. Generator.
4. Cooling system.
5. Sound-attenuating enclosure.
6. Local indicator control panel (LICP).
7. Distribution overcurrent protection devices.
8. Remote annunciation.
9. Load bank.

1.2 Related Sections

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 References

A. The diesel engine-driven generator set[s] and all components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards, including the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City, New York.
   a. Building Code of the City of New York.
   b. National Electrical Code.
   c. New York City Electrical Code.
   d. NFPA 101: Life Safety Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. ANSI.
   b. EGSA: Electrical Generating Systems Association.
   c. IEEE 446: Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications.
   d. IEEE 493: Design of Reliable Industrial and Commercial Power Systems.
   e. NEMA MG 1: Motors and Generators.
   f. NEMA MG 2: Safety Standard and Guide for Selection, Installation, and Use of Electric Motors and Generators.
   g. NFPA 110: Standard for Emergency and Standby Power Systems.
   h. UL 489: Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

i. UL 1236: Battery Chargers for Charging Engine-Starter Batteries.
j. UL 2200: Stationary Engine-Generator Assemblies.

1.4 Bid Proposal

A. The following submittal data shall be furnished according to the conditions of the Construction Contract, Division 01 and Section 26 00 00 and shall include, but not be limited to:
1. Technical proposal, including specification and description of all components, equipment and operation, including manufacturers of all major components and equipment.
2. Completed technical data bid analysis and rating forms (see Appendices).
3. Set of drawings indicating system's configuration and dimensioned physical layout within allocated space. This shall include all output, control and distribution equipment.
4. Provide a detailed schedule with key milestones identified (e.g., shop drawing submission dates, approval dates required, completion of fabrication, factory testing, etc.) to achieve the rigging date.
5. PE-stamped calculations by a qualified New York-registered Engineer showing compliance with seismic forces per code.
6. Qualifications.
7. Alternate physical layout, where appropriate.
8. Shipping method and crating description, including method and extent of equipment protection during shipping as well as onsite after rigging.
9. Details of rigging and diesel-generator subassembly.
10. Details of mounting requirements.
11. Warranty statements.
12. Factory acceptance test procedure.
13. Site acceptance test procedure.

B. None of the technical data required with the technical bid proposal shall be construed as submittals, nor will they fulfill the contractual obligation for submission of shop drawings or submittals as stated in the Contract Documents.

C. Provide the following information on service and maintenance:
1. Locations of factory-authorized service capability, number of full-time factory-trained personnel at each location, and specific experience on diesel engine-generators, including skill levels.
2. Location and response time of local service organization providing primary service to the facility. The response time shall be considered the interval between the initial request and the time that the representative arrives on the site. The maximum acceptable response time is two (2) hours. Include a listing of spare parts that are stocked at the local service location.
3. Escalation procedures if problems fail to be resolved.
4. Recommended preventive maintenance tasks and intervals.
5. Price list of a complete list of spare parts, with notation of recommended spare parts that the Owner should maintain onsite for the entire DEG system (including circuit breakers) to ensure minimum downtime for repair. If any of these parts has a limited shelf life, it shall be identified. Include price list for additional recommended spare parts.

D. Compliance with all commitments made by this section including, but not limited to, submissions, scheduling, fabrication, delivery, testing, etc., including all component elements required by these Contract Documents, including those outsourced, is the sole responsibility of this section.

1.5 Delivery, Storage, and Handling

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.6 Warranty

A. All equipment shall be new, of first class material and of latest approved design. Workmanship shall be of the best quality, free from any defects that might render the equipment unsuitable or inefficient for the purpose for which it is to be used.

B. The manufacturer shall warranty his equipment to meet the performance conditions specified for the period of time that is normal industry practice for this type of equipment, but in no case for less than from the completion of commissioning until two (2) years thereafter. If the standard warranty period is longer, state this in the technical proposal.

C. Two-hour response field service assistance shall be available on a 24 hour/day, 7 day/week basis from each manufacturer or his authorized representative in the New York area.

D. Comply with the requirements of Division 01 and Section 26 00 00.

1.7 Spare Parts

A. Provide a complete list of spare parts for all equipment being provided as part of this section (i.e., including circuit breakers) with notation of all recommended spare parts to be kept onsite for repair and replacement during the first 600 hours of operation including, but not limited to, the following: air filters, oil filters, fuel filters, spare bulbs, spare jacket water heater element, antifreeze inhibitor, inhibitor test kit, oil sample kit, etc., special tools required for repair and replacement, and a storage cabinet to house the above.

1.8 Filing Requirements

A. Prior to fabrication or commencement of any work, hire a New York State Registered Professional Engineer to file the electrical service layout and configuration in accordance with the New York City Buildings Department RCNY 4000-01. Refer to Section 26 05 00 - Common Works Results for additional requirements.

PART 2 - PRODUCTS

2.1 General

A. Furnish and install a complete, diesel engine-driven generator set[s] and power distribution and control system for operation as a stand-alone plan with one (1) 400 kW/500 kVA, 80% p.f. diesel engine-generator in an acoustic enclosure with belly-mounted fuel oil tank and radiator-mounted 400 kW load bank, EPA Tier 2 rated, for backup of emergency and optional standby loads.

B. The generator system shall be equipped with all necessary operating accessories, such as AC generator, radiator fan, dual-fuel pumps, dual water pumps, dual starting systems, local and remote control equipment, and dual safety devices. The control system shall be capable of sensing the loss of the normal source through the automatic transfer switches, which shall initiate the start of the engine-generator set within 10 seconds of the start signal.

C. The fuel delivery system external to the generator set[s] will be provided under another division.

D. Furnish and install exhaust silencers, scrubbers/silencers and flexible connections to the exhaust manifolds as well as the exhaust piping from the silencers, including elbows, wall flanges and supports.

E. The engine-generator[s] shall be capable of operation with low-sulfur fuel.

2.2 Acceptable Manufacturers

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Contract Documents.

B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Contract Documents will be revised to reflect the substitution.

C. If it complies with the Contract Documents, diesel engine-driven generator set[s] manufactured by one (1) of the following manufacturers will be acceptable:

1. Caterpillar.
2. Cummins/Onan.

3. Detroit Diesel.
4. Kohler.
5. Mitsubishi.

D. If they comply with the Contract Documents, resistive load banks manufactured by one (1) of the following manufacturers will be acceptable:
1. Avtron.
2. Loadtec.
3. Professional Power Products Inc.
4. Simplex.

E. If they comply with the Contract Documents, acoustic enclosures manufactured by one (1) of the following manufacturers will be acceptable:
1. International Supply Company.
2. Professional Power Products, Inc.
3. Robinson.

2.3 System Operation

A. Automatic Mode
1. When the system control switch is placed in the “auto” position, the loss of normal utility service, as sensed at any of the automatic transfer switches, shall cause the diesel engine-generator set to start.
2. The failure of the generator shall transfer all loads to an “off” emergency position by returning the switch to the neutral position of the transfer switch. The system shall recognize whether any Priority One transfer switches are connected to emergency and shall not cause the automatic load shed of the lowest-priority transfer switches if the generator fails and the Priority One transfer switches are not connected to emergency.
3. Automatic transfer switches that have been shed due to engine failure or prohibited from transferring to the emergency position due to the failure of the diesel engine-generator set to start may be manually added or returned to the system by operation of the override switch for each automatic transfer switch, including Priority One.
4. Upon restoration of the normal source within acceptable limits at the automatic transfer switches, loads shall be retransferred to the utility manually. After the expiration of an adjustable engine cooldown time delay (0 - 30 minutes) provided as part of the generator control system, the diesel engine-generator may be manually shut down (return to normal service via manual control). All controls shall automatically reset for the next operation, and the priority selector system shall be deactivated, with all bypassed priorities returned to their original priority position.

B. Test Mode
1. When the generator is online, the load bank circuit breaker shall be permitted to close from the LICP. The control switch shall be a momentary control switch.
2. In this mode of operation, additional loads other than the load bank may be selectively added to the generator by activating the bypass mode of the priority selector switch associated with the desired transfer switch. . In this mode of operation, the load bank is assumed to be the Priority One load in lieu of the building emergency loads.
3. Returning the system control switch to the “auto” position shall cause all loads then connected to the generator to retransfer to the normal source using the return-to-normal time delay on the automatic transfer switches to sequence the return. The load bank circuit breaker is to be considered the Priority One transfer switch in this mode and shall open.
4. Loss of the normal source of supply while operating the system in this mode shall cause the load bank circuit breaker to open and place the automatic transfer switch priority system in the automatic mode, while maintaining the running status of the generator.

C. Activation of any “stop” or “lockout” command from the system described herein shall cause, in addition to electrically shutting down the diesel engine-generator, the normally closed fuel oil supply solenoid valve to close.

D. The diesel engine-generator shall contain a generator-mounted local indicator and control panel. This panel shall contain a switch labeled “automatic-run-stop”. From this position, it shall be possible to control the diesel engine-generator (except when the “emergency stop” pushbutton has been activated).

E. Placing the system selector switch in any position other than the “auto” or “run” position shall cause a red light, located in the LICP, to flash at 1 second intervals, and remote signal to be transmitted to the building management system, indicating an abnormal condition. A Form C isolated contact rated 10A, 125V shall be provided for this purpose, to be extended under other divisions.

2.4 Diesel Engine-Generator Set[s]

A. The diesel engine-generator shall be capable of developing sufficient horsepower to deliver the specified kW at eighty percent (80%) power factor when equipped with all necessary operating accessories, including engine-mounted radiator and load bank, auxiliary pumping equipment, and fuel oil pump, and when operating under the following conditions:

B. The diesel engine shall be a full-compression ignition engine, four-stroke cycle, water-cooled solid-injection, suitable for operation with No. 2 diesel oil. The engine speed shall not exceed 1,800 rpm at normal full-load operation.

C.

D. Provide for the engine stainless steel flexible exhaust fitting and supercritical (hospital)-type Maxim, Nelson (Donaldson) or Burgess-Manning silencer (minimum 65 dBA at a distance of 5 feet 0 inches beyond the attenuated muffler discharge pipe in fully installed position; selection is responsibility of manufacturers). Provide exhaust outlet pipe and insulation within an acoustic enclosure.

E. The engine shall be started by means of dual separate 24 volt DC automatic starting systems. There shall be dual engine-starting motors, each capable of starting the engine should the other one fail. Each starting motor shall be of the heavy-duty type and shall automatically disconnect upon engine start-up.

1. The automatic starting control shall be actuated by contacts in the automatic transfer switches.
2. Provide a manual switch to select the “lead” battery system.
3. Provide nickel-cadmium batteries as manufactured by NiFe, Inc., Alcad or approved equal, complete with steel rack, necessary cable and connectors, all in conformance with the engine manufacturer's requirements. Batteries shall provide a minimum of 240 seconds of continuous crank in an ambient from 0ºF to 120ºF.
4. For maintenance of batteries at 90 - 100% of full charge, a temperature-sensitive automatic two-rate type battery charger, Lamarche, NiFe, Simms, or as approved, shall be provided for the engine's starting battery system. Provide two (2) sets of Form C contacts rated 10 amperes at 120 volts for remote indication of the charger’s low DC voltage and AC power failure alarms. The alarm initiation shall have an adjustable time delay to compensate for loss of normal power. Provide circuit for charger from a local panel.
5. Provide all interconnecting conductors as required and recommended. All prewiring on each machine that is furnished and installed by the engine-generator manufacturer shall be installed in a suitable raceway system, consisting of properly organized junction boxes, flexible metal and/or SealTite conduit raceways, termination boxes with terminal blocks with wiring identifications and all additional appurtenances, fasteners, hardware, etc., needed to achieve a neat and orderly arrangement of all branch circuit components formed into a consistent pattern.

F. Provide a battery monitor for all battery strings, including each diesel generator battery and each switchboard control battery. Monitor shall be as manufactured by CEL-CHK or Power Alert. Provide all wiring for a complete system.

G. The engine shall be equipped with sensors that will shut down the engine and prealarm sensors indicating the approach to specified settings, all as listed hereinafter.

H. Provide a crankcase explosion relief valve or vented crankcase for each engine.

I. The engine-generator set shall be provided with a structural steel base. The base shall have sufficient rigidity to accept seismically rated spring-type isolators, provided under this division, beneath the entire unit between it and building structural support. Spring isolators shall be provided as per Section 26 05 48.16 of the specifications.

J. The line side of the circuit breakers shall be bussed to a common input bus, which shall be constructed of copper with either silver or tin plating at all joints. Bus bars and the enclosure shall be sized to meet the requirements of UL 891 and shall be braced to withstand resulting mechanical forces exerted during short circuit currents, but no less than 100,000 amperes rms symmetrical.

K. Adequate conduit space shall be provided in the rear compartment of the compartments to satisfy the current ratings of the individual devices and the input from the generator.

2.5 Generator

A. The generator shall be a four-lead machine of required kW rating as hereinbefore specified, 0.8 p.f., 3 phase, 4 wire, with grounded neutral, 60 hertz, 277/480 volt, 1,800 rpm, with Class H synthetic non-hygroscopic fungus-resistant insulation.

Cooling System

B. The cooling system shall consist of a vertically mounted radiator, fan, engine-driven water circulating pump and all accessories pertaining thereto. The system shall have sufficient capacity for cooling the engine under full-load conditions at an ambient temperature of 120°F. Provide permanent-type antifreeze for -25°F protection. The radiator fan shall be capable of overcoming 1.0 inch of water column static pressure external to the unit, including its radiator.

2.6 Local Indicator Control Panel (LICP)

A. A local indicator and control panel (LICP) mounted on the generator shall be provided at the diesel engine-generator set, suitably isolated from vibration, and shall be provided with an isolated control section and a power circuit breaker section. The LICP shall contain all necessary equipment required for isolation, control and annunciation of the unit including, but not limited to, the following:

1. All alarms, indications, shutdowns, etc., required by NFPA 110 for emergency power supply.
2. Elapsed time indicator (up to 99,999.9 hours, non-resettable), to indicate the time that the diesel engine-generator has run, whether or not it has been online.
3. Engine local control switch with Automatic/Run/Stop positions.
4. Circuit breaker open/close switches for the load and load bank overcurrent devices.
5. Engine pre-alarm/shutdown annunciator panel with audible alarm and silence switch.
6. Mushroom-type lockout switch.

2.7 Distribution Overcurrent Protective Devices

A. Output overcurrent devices shall comply with all local codes. Switch and fuse shall be provided as required for all loads including fire pumps, fire alarm, load bank, etc., and the local control panel shall be enclosed in NEMA 12 enclosures for the diesel engine-generator set. All devices shall be in separate enclosures.

B. Provide one (1) load bank overcurrent circuit breaker device suitable for use in LICP panel. These devices shall have a minimum of four (4) Form C contacts, in the breaker cubicles, wired to terminal blocks for remote monitor status.

C. Output fused disconnect switch, capable of being locked in the open position, shall be provided for the fire alarm system. Disconnect shall be painted red and permanently identified as a fire alarm circuit with a means of interrupting the unfused grounding and all ungrounded conductors.

D. The line side of the circuit breakers shall be bussed to a common input bus, which shall be constructed of copper with either silver or tin plating at all joints. Bolted joints shall consist of silver- or tin-plated copper splice plates and high tensile strength steel bolts, with nuts and Belleville washers tightened to the proper torque. Bus bars and the enclosure shall be sized to meet the requirements of UL 891 and shall be braced to withstand resulting mechanical forces exerted during short circuit currents, but no less than 100,000 amperes rms symmetrical.

E. Load bank and distribution circuit breakers shall be drawout type, electrically and manually operated, 100% rated for continuous duty. Generator output circuit breakers shall be insulated case with a minimum interrupting rating of the available short circuit current from the engine-generator.

F. Each circuit breaker shall be equipped with a 24 volt DC operating mechanism (with a DC-to-DC converter) for trip and 120 volt AC (via system UPS provided under this section) operating mechanism for remote closing and charge.

G. Provide solid-state tripping devices for each distribution circuit breaker, each having a complete range of tripping functions and characteristics built into its solid-state module. Module shall be true RMS sensing. Complete system coordination shall be provided by inclusion of the following time/current curve shaping adjustments:
   1. Ampere setting.
   2. Long-time pickup.
   3. Long-time delay.
   4. Short-time pickup.
   5. Short-time delay.
   6. Instantaneous pickup.
   7. Ground fault.

H. Visual indicators shall be provided to indicate tripping mode, i.e., overload, short circuit or ground fault. All circuit breakers shall be equipped with test points for in-service function testing. Provide one (1) test kit for testing of all frame sizes.

I. Furnish and install a ground detection system for each distribution overcurrent device. The ground detection system shall be the type that monitors the outgoing ground fault current and shall consist of a ground sensor, which surrounds all three (3) or four (4) outgoing conductors, and a relay to operate an alarm indication on the face of the breaker with remote contacts for monitoring. The ground sensor shall have adjustable current pickup settings and adjustable time settings.

J. Furnish and install an electrical interlock system between the engine-generator load bank circuit breaker and its respective engine output circuit breaker to prohibit simultaneous closure of more than one (1) device with the command to close provided at the LICP.

2.8 Remote Annunciation

A. In addition to indications previously specified in this section, provide one (1) set of Form C contacts rated 125 volt, 10 ampere wired to rear compartment labeled terminal strips in their respective enclosures for extension and remote annunciation by this Contractor:
   1. Automatic transfer switch (ATS) status (provide six [6] points for each ATS: connected to normal, connected to emergency, normal source available, emergency source available, ATS in load shed, ATS in load shed bypass, plus two [2] points for those ATS's with bypass functions: bypass-to-normal and bypass-to-emergency).
   2. Ground fault alarm for each generator service distribution device.
   3. Diesel engine-generator status (provide generator available, generator running, generator stop, controls not in auto).
   4. Open/closed indication for each generator output overcurrent protective device.
   5. Engine-generator summary failure alarm (one [1] per generator).

B. Provide a remote annunciator, located in the Building Engineer's Office.

PART 3 - EXECUTION

3.1 Installation

A. Install generator(s) where shown on drawings. Provide all wiring, power wiring, remote monitoring wiring and control wiring to systems and ATS's, etc. Provide all rigging, coordination, etc., in accordance with manufacturer's guidelines.

B. Installation of the emergency power system shall be in full accordance and under the technical supervision of qualified technicians provided by the manufacturer.

C. The manufacturer shall furnish a minimum of fifteen (15) working days of technical supervision onsite for the purpose of overseeing the installation and to conduct and assist the Owner with the site acceptance test. Participation by the manufacturer shall include providing a final check of all wiring, terminations, connections, and start-up, interpretation and analysis of site acceptance test results, adjustments, if required, of controls, etc., all to the satisfaction of the Owner.

D. The DEG manufacturer shall furnish a minimum of ten (10) working days of technical supervision onsite for the purpose of assisting the Owner with commissioning critical systems and the integration of the EPS with these systems. The man-hours provided in this paragraph are in addition to any other requirements previously specified.

3.2 Factory Acceptance Testing

A. The diesel engine-generator set[s] shall be tested at the factory to demonstrate compliance with the specifications. Tests may be witnessed by the Owner and/or his representative. (Submit a detailed chronological test plan with the shop drawings.) A certified copy of this performance test shall be submitted before shipment to the job siteSite Acceptance Test

3.3 Site Acceptance Test

A. The complete generator system shall be tested as hereinafter described under the supervision of a capable Service Engineers provided by the diesel engine-generator manufacturer and the control system manufacturer. (Submit a detailed chronological test plan with the shop drawings.) Prior to any testing, verify that the plant is complete and ready for testing and that all instrumentation required is connected and ready for start-up and test. Tests shall be witnessed by the Owner and/or his representatives. Provide necessary lube oil and fuel oil, as well as testing and recording equipment to obtain full-load conditions, including the required temporary load banks, full load without use of radiator-mounted unit load banks and temporary cable connections to generator output switchboard. Testing shall be repeated at no additional cost to the Owner if required for total components and system acceptance.

B. Perform a final integrated system ("pull-the-plug") test to demonstrate the system as a whole, including safeties, etc., to the satisfaction of the Owner/Engineer. This test shall not be conducted as an extension of the site acceptance test, but rather as a separate test after Substantial Completion of all other work associated with this project. (Submit a detailed chronological test plan with the shop drawings.)

1. Operate all other features of the control system including, but not limited to: load demand control, main bus overload protection, etc.
2. This test shall utilize actual building loads and fifteen (15) temporary portable 100 kW load banks (furnished by this section) to be distributed throughout the facility and temporarily connected to the electrical power distribution system.

C. Provide complete, chronological, detailed factory, onsite and pull-the-plug test procedures for approval with the shop drawings.

D. A minimum of ten (10) working days' notice shall be provided to the Owner, Architect and Engineer, in writing, before all factory, onsite and pull-the-plug testing.

END OF SECTION 26 32 13.13

SECTION 26 33 23.13

STATION BATTERY SYSTEM

PART 1 - GENERAL

1.1 Summary

A. Furnish a complete station battery system, as indicated on the drawings and/or specifications, as required to provide control and metering power for the referenced electrical switchgear.

B. Refer to Division 01 for all general requirements for the project.

1.2 Related Sections

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 Reference Standards

A. All work shall be in full accordance with the requirements of all local and governmental departments and agencies having jurisdiction over these matters, as well as with any requirements of the NFPA, UL and other applicable codes and standards.

B. Equipment and materials shall be new, of heavy-duty industrial construction, listed to the requirements of the applicable Underwriters Laboratories standards by a nationally recognized testing agency, and manufactured in accordance with OSHA, NEMA, ANSI and IEEE.

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City, New York.
   a. Building Code of the City of New York.
   b. International Building Code.
   c. National Electrical Code.
   d. New York City Electrical Code.

2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. American National Standards Institute (ANSI)
      1). UL V0 - 2B LOI: Wall Thickness, Flame-Retardant Polypropylene Container and Cover.
   b. Institute of Electric and Electronic Engineers (IEEE)
      1). IEEE 1188: Recommended Practice for Maintenance, Testing and Replacement of Valve-Regulated Lead-Acid Batteries for Generating Stations and Substations.
   c. National Electrical Manufacturers Association (NEMA)
      1). NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).
   d. Underwriters Laboratories, Inc. (UL)
      1). UL 50 - Enclosures for Electrical Equipment.

1.4 Quality Assurance

A. In addition to the requirements of Section 26 00 00 - General Requirements for Electrical meet all requirements of this section.

B. All equipment and material to be furnished and installed on this project shall be UL- or ETL-listed, in accordance with the requirements of the NYC Electrical Advisory Board, and suitable for its intended use on this project.

C. Manufacturer shall have at least fifteen (15) years' experience in manufacturing station battery systems.

D. All components of types and sizes required shall have been satisfactorily used for purposes similar to those intended herein for not less than three (3) years.

E. Batteries and battery chargers of types and sizes required shall have been in satisfactory use for purposes similar to those intended herein for not less than three (3) years.

1.5 Submittals

A. In case of question, the Owner and/or Specifying Engineer shall be the final judge as to the requirement for shop drawings for specific areas of work.

B. In addition to the requirements of Section 26 00 00 - General Requirements for Electrical, the shop drawings shall include, but not be limited to, the following:

1. Manufacturer's literature of all major components including, but not limited to, the following:
   a. DC panelboards and overcurrent protective devices.
   b. Batteries
   c. Battery chargers.
   d. Battery racks and/or enclosures/cabinets.
   e. Factory- or field-mounted terminal blocks, relays or switches.
   f. Seismic anchoring details.
   g. List of special tools required for operation and maintenance of all equipment.
2. Test Reports
   a. Submit factory tests and field tests forms for approval prior to implementation of the tests.
   b. Submit certified test reports as specified in this section.
   c. Submit seismic certification.

1.6 Operation and Maintenance Manuals

A. In addition to the requirements of Section 26 00 00 - General Requirements for Electrical }, the maintenance documentation, including manuals, shall include descriptive material that will enable the Owner and/or his representation (operations team) to maintain the supplied equipment at the component level. The documentation shall provide guidelines for isolating the cause of malfunctions and for the removal, repair and replacement of all devices.

1.7 Warranty

A. Comply with the requirements of the Contract Documents and Section 26 00 00 - General Requirements for Electrical.

B. The system batteries shall be guaranteed to meet the performance criteria specified on a pro rata basis as hereinafter specified for the full twenty (20)-year life of the battery.

C. The battery guarantee shall be unconditional for the first year, starting from the date of the site acceptance test defined in this specification, and shall be pro rata for the next nineteen (19) years. “Unconditional guarantee” shall mean that any battery or cell that is required to be corrected or replaced due to defects in design, material or workmanship shall be the full responsibility of the battery manufacturer. The cost of replacement shall include new batteries, shipping, removal, installation, disposal and recycling of defective batteries, including documentation to certify that the disposal is in accordance with all local AHJ, provincial, federal and national DOT and EPA regulations.

D. Battery pro rata warranty for the last nineteen (19) years shall be based upon a formula for credit equal to fifty percent (50%) of the current list price multiplied by the months remaining until the expiration of the warranty divided by 228. The system batteries shall be guaranteed to meet the performance criteria specified on a pro rata basis as hereinafter specified for the full twenty (20)-year life of the battery.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Contract Documents.

B. All requests for substitutions must be included in the Contractor's Base Bid, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Project specifications/documents shall not be revised to reflect the substitution, should the substitution be approved.

C. If they comply with these specifications, batteries and racks manufactured by one (1) of the following will be acceptable:
   1. Alcad.
   2. C&D Technologies, Inc.
   3. EnerSys Inc.
   4. Johnson Controls, Inc.

D. If it complies with these specifications, a battery charger manufactured by one (1) of the following will be acceptable:
   1. La Marche Manufacturing Co.
   2. Nife.
   3. Simms Electronics.
   4. or as approved.

2.2 Station Battery

A. General
   1. Provide a complete DC station battery system, including dual batteries, battery charger, battery isolation device and output distribution. A DC overvoltage protection circuit shall be provided to protect the system from overvoltage, and the battery isolation device shall automatically open if the device sees an overload or end voltage below 1.75.
   2. Provide batteries, racks and battery charger(s) in accordance with the requirements of these specifications.
   3. Batteries and battery chargers and associated equipment shall be for indoor use. Quantity, rating, sizes and locations shall be as shown on the Contract Drawings.
   4. No polyvinylchloride (PVC) insulation or materials shall be utilized in the construction or wiring of the equipment.
   5. The station battery shall be sized to power all loads in the referencing Contract Documents.

B. Batteries
   1. The battery shall be constructed of identically sized cells, of the same construction, connected in series, lead-acid type, conforming to IEEE Standard 1187.
   2. Each battery shall provide a minimum of eight (8) hours of standby operation of all switchgear and remote mimic/control, plus the simultaneous operation of all powered circuit breakers for trip and spring recharge. Manufacturer shall provide calculation to verify sizing of battery.
   3. The nominal rated DC voltage of the battery, the number of cells and both the ampere-hour capacity at the eight-hour rate and amperes at the one-minute rate of discharge to 1.75 volts per cell shall be as shown on the Contract Drawings.
   4. The individual independent storage batteries shall use lead-acid technology valve-regulated, new, freshly formed to 100% of capacity at the factory, with a specific gravity of 1.30. The storage batteries shall be designed for high-rate, short-term discharges. The battery cells shall be designed for a normal float voltage of 2.25 to 2.30 volts per cell, with an equalize voltage of 2.35 volts per cell.
   5. The batteries shall be warrantied for a twenty (20)-year service life.
   6. The cell jar shall be formed from flame-retardant ABS. Where more than one (1) cell per jar is required to meet the specified criteria, the vendor shall note the deviation in his bid proposal. The cell jar shall provide ample space within the container to allow positive plate growth without developing internal stress in the container or cover.

7. The individual storage batteries shall be provided with all required lead-plated flat copper intercell connectors, crimp-type terminal lugs and inter-tier connectors. All bolts, washers and nuts shall be Grade 316 stainless steel and all posts and intercell connectors shall be provided with insulated covers having a limiting oxygen index (LOI) of 28 over their entire length. All connecting cables shall be supported to relieve all strain on the cell posts. The battery manufacturer shall supply mechanical support assemblies for this purpose.
8. Batteries shall be suitable for operation in an ambient temperature between 66°F and 86°F.
9. The battery shall be complete with the following accessories:
   a. Flame arrestors.
   b. Pressure-sensitive cell number labels.
   c. Inter-tier, inter-rack and inter-cell connectors and cables. Inter-cell connectors shall be lead-plated copper. Across-aisle inter-rack connectors and cables shall be included.
   d. Lead-plated terminal plates and compression-crimp-type, solderless lugs for cable connections.
   e. Stainless steel bolt connectors.
   f. Portable hydrometer with wall mount holder.
   g. Thermometer.
   h. Cell lifting device.

C. Battery Rack
1. The cells that make up the stationary valve-regulated (sealed) lead-acid battery shall be mounted on a seismic rack or group of racks. Provide a rack configuration that coordinates with the available space.
2. Battery racks shall be constructed of steel rails, frames and braces. Rail insulation shall be provided with 0.06-inch-thick plastic channels on the rails. The battery cells rest on the plastic channels. The entire rack shall be painted at the factory with two (2) coats of acid-resisting enamel paint. Paint color shall be ANSI 61 conforming to ANSI Z55.1.
3. The area under the rack shall be provided with a containment dam and absorption system to prevent the spread of spilled acid.
4. Provide suitable non-conductive removable shields over all DC terminals to protect operators from incidental contact while facilitating routine battery maintenance.

D. Battery Charger
1. For maintenance of batteries at 90 - 100% of full charge, a temperature-sensitive automatic two-rate-type battery charger shall be provided for each battery. The automatic charger shall be capable of charging the batteries, and the charger shall be capable of recycling automatically to high rate after a discharge. The charger shall be complete with DC ammeter, voltmeter, individual float and equalize adjustments, on-off switch, DC fuse and charging indicator light, and shall be suitable for operation on a 120 or 208 volt circuit. Provide two (2) sets of Form C contacts rated 10 amperes at 120 volts for remote indication of the charger's low DC voltage and AC power failure alarms. One (1) set of contacts shall be used to annunciate alarm conditions at the system control and annunciation panel and one (1) set of contacts shall be left for use by the BMS. The alarm initiation shall have an adjustable time delay to compensate for loss of normal power.
2. Each battery charger, when more than one (1) is operating in parallel, shall be capable of supplying the connected DC load and maintaining line voltage even with the battery disconnected.
3. All battery chargers shall be identical.
4. The battery charger shall consist of four (4) major sections that work together to produce stable, regulated, filtered output as follows:

a. Power input transformer to supply AC voltage of the proper magnitude and capacity to the rectifier section and to supply various other voltages used by the control unit and accessories.
b. Silicon-controlled rectifier (SCR) consists mainly of voltage-regulating SCR and power rectifier diodes to rectify AC voltage to DC and to control voltage's magnitude so that the charge output is regulated at all times.
c. Control unit to control the SCR in response to the charging requirements of the battery load and to monitor and maintain the output voltage of the battery charger.
d. Filter section to smooth the rectifier output and to remove the charging ripple at the battery terminals.

5. The charger shall be designed for use in a 40°F ambient temperature without exceeding the allowable temperature rating of any of the components, including their class of insulation. All components shall be rated for continuous duty at the worst possible charging condition for that particular component. All sensitive devices shall be protected for:
   a. All self-generated transients.
   b. Normal external applied transients.
   c. Turning the charger on or off at any charging rate with the battery disconnected.
   d. Disconnecting the battery while charging at any charge rate.
6. Float Adjustment Range: -11.5% to +7.7% of the nominal voltage shown on the Contract Drawings.
7. Equalize Adjustment Range: -4.6% to +15.4% of the nominal voltage shown on the Contract Drawings.
8. The DC output voltage shall be regulated to ± 5% from no load to full load with the AC line variations of ± 10% voltage and ± 5% frequency.
9. The current shall be limited so that it does not exceed 140% of rated current.
10. The efficiency shall be at least 90% at full load at rated AC voltage.

E. Cabinets
1. The cabinet shall be of NEMA 1 construction, fabricated from at least 11 gauge steel. Where installed in Standby Generator Rooms, the enclosure shall be minimum NEMA 2.
2. Large floor-mounted units shall be suitably braced and reinforced to form a rigid structure, or have a 3/16 inch angle iron framework suitably constructed so as to rigidly contain the unit.
3. The sheet metal wrap covering the structure shall be at least 11 gauge steel.
4. Equipment in the cabinet shall be arranged so that required access to all circuit breakers, meters, relays, switches, etc., shall be from the front.
5. Internal components and connections shall be easily accessible and/or removable through a hinged front door that opens approximately 180 degrees for easy serviceability. Absolutely no access from the back or sides of the cabinet is to be required.
6. The cabinet shall be furnished completely wired and ready for installation. Provision shall be made for the incoming and outgoing cables that will enter the side of the cabinet. Wiring shall be color-coded, SIS-high temperature, flame-retardant, cross-linked polyethylene-insulated wire. Test point identification and circuit symbol labeling of internal components shall be provided.
7. The cabinet shall be so designed as to provide adequate ventilation. All air inlet or discharge louvers or grilles shall be provided with replaceable filters, supported by a metallic frame. The external surface temperature of the cabinet shall not rise above 110°F for an ambient temperature of 85°F. Top of the cabinet is to be provided with a dust cover.
8. Operating controls, meters and pilot lights shall be identified with black laminated plastic nameplates. On the front of the cabinet, provide a nameplate indicating the input voltage and phase.

9. The battery charger and all internal equipment shall not be installed in an atmosphere containing industrial fumes, non-metallic dust and excessive moisture. Therefore, all accessory parts, protective coats of paint, seals, etc., to be used in or on this equipment shall be selected so as to eliminate the harmful effects resulting from excessive dampness and a corrosive atmosphere.
10. All surfaces shall be thoroughly cleaned, treated with an approved rust inhibitor and then painted with two (2) coats of acid-resisting enamel paint in compliance with ANSI 61 and ANSI Z55.1. The underside of all equipment not readily accessible for repainting shall be painted with three (3) coats of bituminous paint.
11. Output from the battery isolation device shall be fed through a fused cutout panel with independent devices in both systems for each service entrance switchgear arrangement. Ampacity of the individual fusing shall be determined by the switchgear vendor to allow for proper operation plus twenty-five percent (25%) spare capacity.

F. Accessories
1. The battery charger shall be equipped with the following:
   a. AC power "on" front panel, indicating light.
   b. AC input circuit breaker, front panel-mounted.
   c. DC output circuit breaker, front panel-mounted.
   d. AC and DC surge suppressers, metal-oxide varistor (MOV) type.
   e. DC output ammeter 0- to FLA +25% scale, unless otherwise shown on the Contract Drawings and DC output voltmeter (0 - 150 VDC scale unless otherwise shown on Contract Drawings), front panel-mounted, 3-1/2 inch case, 2% accuracy.
   f. Auto-equalize timer, Zero to 72-hour, with front panel indicating lights.
   g. Float and equalize adjustment potentiometers, front panel-mounted and lockable.
   h. Current, limit adjustment potentiometer, internally mounted, with easily accessible adjustment.
   i. DC output blocking diode to prevent battery from discharging back through the filter and rectifier when charger is off due to AC power failure or charger malfunction.
   j. DC output protection diode to prevent damage to battery charger and battery due to reversed polarity connections.
   k. DC ground detection with front panel indicating lights and ground test and lamp test switch.
   l. Filtered battery eliminator battery chargers shall operate as DC power supplies without the battery connected. Filtered battery eliminators will reduce the output ripple voltage to 100 millivolts rms or less.
   m. Input lightning arrestors to provide additional input protection against lightning-induced transients.
   n. Alarm relays with front panel indicating lights for the following alarm conditions:
      1). AC power failure.
      2). DC ground detection.
      3). High DC voltage.
      4). Low DC voltage.
      5). Charger failure.
      6). DC current limit.
      7). Battery discharging.
   o. Common alarm which provides an alarm indication via relay contacts when any one of the alarm circuits being monitored goes into its alarm state. A Form C double-pole, double-throw (DPDT) contact shall be provided for connection to a remote alarm system.

p. Provide separate alarm contacts for positive ground and negative ground for connection to a remote alarm system.

q. DC zero-center ammeter for battery load monitoring to indicate the direction and amount of the battery current. Indication on the meter is to the right of the center when the charger is charging the battery and to the left when the battery discharging or furnishing current to the load.

2.3 DC Distribution

A. Each station battery shall be furnished with a DC distribution center to provide individual overcurrent protection and electrical disconnects for each DC branch circuit required by the loads.

B. All DC feeds to each control cubicle, including EGCC and MEPSCC, shall be individual dedicated runs.

C. When all DC-powered equipment is located in a single switchgear lineup, a single fused DC feed from each station battery may feed an internal DC distribution system that includes internally segregated, fused DC feeds for each control cubicle.

2.4 Spare Parts

A. Provide a minimum of ten (10) spare lamps for all types provided.

B. Provide a minimum of ten (10) spare control fuses for all sizes provided.

C. Provide a list of recommended additional spare parts.

PART 3 - EXECUTION

3.1 Installation

A. The charger, racks, batteries and distribution system shall be installed by the Electrical Subcontractor.

3.2 Factory Testing

A. The batteries shall be inspected and tested at the factory to demonstrate 95% capacity. Tests shall be factory-certified and sent to the Engineer prior to placing the battery in service.

3.3 Field Testing

A. Tests: After the completion of the installation, batteries shall undergo a full-discharge test in accordance with IEEE 1188.

3.4 Commissioning

A. The building systems on this project shall be formally commissioned by a Commissioning Agent engaged directly by the Owner. The commissioning process and methods employed shall enable the building to meet the design criteria and ensure proper operation of all equipment per the Contract Documents.

B. The Contractor and/or manufacturer shall be responsible for participating in the commissioning of their respective equipment and systems, and shall assist with the work carried on by the commissioning team and the Commissioning Agent. The responsible Contractor shall perform all field verification inspections and functional tests as developed by the Commissioning Agent and shall make good any defects that do not comply with the Contract Documents.

END OF SECTION 26 33 23.13

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SECTION 26 33 53.13

EMERGENCY LIGHTING INVERTER SYSTEM

PART 1 - GENERAL

1.1 Summary

A. Furnish and install a complete, fully operational central emergency lighting inverter system as specified herein for proper backup of lighting systems throughout the project, as indicated on the drawings and in accordance with the requirements of the Contract Documents.

1.2 Related Sections

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 Reference Standards

A. The central emergency inverter system and all components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City, New York.
   a. Building Code of the City of New York.
   b. National Electrical Code.
   c. New York City Electrical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. ANSI C62.41.
   b. ANSI C62.42.45 (Cat. A and B).
   c. FCC Class A.
   d. MEA: Materials and Equipment Acceptance.
   e. NFPA 101: Life Safety Code.
   f. OSHA.
   g. UL 1778: Standard for Uninterruptible Power Systems.
   h. UL 924: Standard for Emergency Lighting and Power Equipment.

1.4 Warranty

A. Comply with the requirements of the Contract Documents and Section 26 00 00.

1.5 Commissioning

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Being listed herein as an acceptable manufacturer does not allow the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of these specifications.

B. Any and all substitutions must be included in the Contractor's Base Bid, as a voluntary Deduct Alternate in the Contractor's Bid Proposal, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Project specifications/documents will not be revised to reflect the substitution, should the substitution be approved.

C. If it complies with these specifications, an inverter system manufactured by one (1) of the following vendors shall be acceptable:
   1. AtLite/Cooper.
   2. Chloride/Philips.
   3. Crucial Power Products.
   4. Emergi-Lite/Thomas & Betts.
   5. Hubbell/Dual-Lite.
   6. Liebert/Emerson.
   7. MGE/Schneider.
   8. Myers Power Products, Inc.
   9. OnLine Power, Inc.

2.2 Central Inverter System

A. General: Central emergency inverter system shall provide a reliable source of power, and shall operate during a utility line deficiency without any interruptions of power supplied to the load. The system shall be capable of powering any combination of electronic, power factor-corrected, fluorescent, incandescent or HID lighting and any other critical voltage or frequency-sensitive electronic loads. The system shall operate from 0 - 100% loading and be rated to deliver its full kVA rating, at unity power factor, for a minimum of 90 minutes. Upon return of the normal AC utility line power, the system shall recharge the batteries within 24 hours without any interruption of power supplied to the load. Runtime shall be for a period of 1-1/2 hours upon interruption, brownout or failure of the monitored AC utility line

B. Operation: Operation shall be fully automatic.
   1. During normal operation, the charger maintains the battery bank at full capacity. The system shall also include an RS232 serial port for remote communications.
   2. The system shall allow connection of both “normally on” and "normally off” (optional) loads. Connected loads shall be carried via the transfer circuit by the utility during normal operation, or by the system inverter during utility failures, without interruption.
   3. The system shall be designed to maintain the normal operation and performance integrity of all connected loads, including voltage- and frequency-sensitive equipment, by providing true no-break, digitally generated sinusoidal output. Refer to plans for type and location of loads served by the system.

C. System Diagnostics: The system’s user interface display (UID) shall include an array of five (5) LED lights, a 2-line 40-character LCD display, and a keypad to control and monitor the system.

D. Alarms: The system shall have thirty (30) audible and visual alarms with automatic logging of the twenty-five (25) most recent events. The system’s alarm acknowledgement feature shall enable the user to silence only the current audible alarm(s) without silencing other alarms, or clearing the alarming condition until the fault has been addressed. Provide Form C contacts for connection to BATC system for the following alarms:
   1. On battery.
   2. Low battery.

E. Manual Testing: The system shall incorporate a manual test function and three (3) automatic test modes.

F. Battery Charger: The charger shall be software-controlled, temperature-compensated, three-step float-type charger, with equalizer. The charger shall charge the batteries continuously during normal standby condition. Recharge time shall not exceed 24 hours.

G. Batteries: The batteries will provide sufficient power to maintain the output voltage of the inverter for a period of 1.5 hours. The batteries shall be valve-regulated (VRLA) maintenance-free, sealed lead calcium supplied in cabinets, with pocket plate construction and a 20-year design life expectancy at 77°F (25°C).

H. Output Circuit Breakers: A maximum of twenty (20) positions (twelve [12] unsupervised single-pole and eight [8] supervised single-pole circuit breakers) shall be possible, or bulk supervised

breaker for feed of a subpanel. Each critical output circuit breaker shall be equipped with a trip alarm circuit. Provide 120V breakers (using one [1] position each) in a quantity as indicated on the Electrical Drawings.

I. Environmental: Unit shall have an operating range of 32°F to 102°F in an environment with maximum 90% relative humidity, non-condensing.

PART 3 - EXECUTION

3.1 Installation

A. Batteries shall be installed on the system's energized charging circuit within 90 days of date of shipment to maintain the validity of the warranty.

B. The system shall be installed in accordance with all appropriate manufacturer's installation instructions and in compliance with all appropriate codes.

C. Provide a factory service representative to perform the initial start-up of the system.

D. Manufacturer shall provide drawings and manuals supplied with each system.

E. At the request of the Owner, maintenance and service programs shall be made available by the supplier, to ensure long-term reliability of the system. .

3.2 Factory Testing

A. All standard factory tests shall be performed in accordance with the latest version of NEMA and UL standards.

3.3 Field Testing

A. The inverter system shall be operationally tested.

B. The maintenance bypass procedure shall be followed and tested.

C. All alarms shall be initiated and verified.

D. A battery rundown shall be performed in accordance with IEEE standards.

E. Input power shall be disconnected and a waveform capture performed on the output utilizing a graphing meter.

END OF SECTION 26 33 53.13

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SECTION 26 36 23

AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1 Summary

A. Furnish and install all automatic transfer switches, with all control and monitoring wiring including, but not limited to, generator start wiring, load shed, remote monitoring, etc., for control of normal, emergency, legally required standby and optional standby loads throughout the project, as required by code and as indicated on and in accordance with the requirements of the Contract Documents.

B. Control wiring shall be included between the generator, the output switchboard and automatic transfer switches. All interconnecting conduit and cable shall be provided under this section for power, control, monitoring and interlocking functions as required to render a complete and fully operational system. Include all lugs, connectors and terminations required but not specifically indicated on the generator, switchboard and automatic transfer switch shop drawings.

C. Section includes:

1. Bypass and isolating automatic transfer switches.
2. Control panel.

1.2 Related Sections

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 References

A. All automatic transfer switches and all components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City, New York.
   a. Building Code of the City of New York.
   b. National Electrical Code.
   c. New York City Electrical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. UL 1008: Standard for Automatic Transfer Switches.
   b. NFPA 101: Life Safety Code.
   c. NFPA 110: Standard for Emergency and Standby Power Systems.

1.4 Quality Assurance

A. All equipment and material to be furnished and installed on this project shall be UL- or ETL-listed, in accordance with the requirements of the NYC Electrical Advisory Board, and suitable for its intended use on this project.

B. Manufacturer shall have at least 15 years' experience in manufacturing automatic transfer switches.

C. All components of types and sizes required shall have been satisfactorily used for purposes similar to those intended herein for not less than three (3) years.

D. All control relays, solid-state voltage monitors and transfer switch assemblies shall be the product of a single manufacturer regularly engaged in the design, development and production of automatic transfer switches. Manufacturer shall provide service and spare parts 24 hours/day, 7 days/week, which shall be available at a local level.

1.5 Operation and Maintenance Manuals
- A. In addition to the requirements of Section 26 00 00 - General Requirements for Electrical, the maintenance documentation, including manuals, shall include descriptive material that will enable the Owner and/or his representation (operations team) to maintain supplied equipment at the component level. The documentation shall provide guidelines for isolating the cause of malfunctions and for the removal, repair and replacement of all devices.

1.6 Delivery, Storage, and Handling
- A. Comply with the requirements of Division 01 and Section 26 00 00.

1.7 Warranty
- A. Comply with the requirements of Division 01 and Section 26 00 00.
- B. The manufacturer shall warranty his equipment to meet the performance conditions specified for the period of time which is normal industry practice for this type of equipment, but in no case for less than two (2) years from the date of Owner's final system acceptance. If the base price includes a warranty period of a longer duration, state this period in the base price.
- C. During the period of the warranty, equipment that fails due to defects in design, material or workmanship shall be replaced, including all parts and labor for all auxiliary equipment and materials, by the manufacturer at no cost to the Owner.

1.8 Filing Requirements
- A. Prior to fabrication or commencement of any work, hire a New York State Registered Professional Engineer to file the electrical service layout and configuration in accordance with the New York City Buildings Department RCNY 4000-01. Refer to Section 26 05 00 - Common Works Results for additional requirements.

1.9 Commissioning
- A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers
- A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Contract Documents.
- B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Contract Documents will be revised to reflect the substitution.
- C. If they comply with the Contract Documents, automatic transfer switches manufactured by one (1) of the following manufacturers will be acceptable:
  1. ASCO/Emerson.
  2. Russelectric Inc.

2.2 General
- A. The transfer switch, complete with timers, relays and accessories, shall be listed by Underwriters Laboratories in their Electrical Construction Materials Catalogue under Standard UL 1008 (automatic transfer switches) and approved for use on emergency systems outlined in NFPA 110.
- B. Automatic transfer switches shall be provided and rated as shown on drawings and schedules. Each transfer switch shall be capable of switching all classes of load and shall be rated for continuous duty when installed in a non-ventilated enclosure in accordance with Underwriters Laboratories Standard UL 1008.

C. The transfer switch shall be rated to close on and withstand the available RMS symmetrical short circuit current of 200 kaic unless otherwise scheduled on the drawings. The switch mechanism shall be listed to the UL 1008 standard for 1.5- and 3-cycle ratings. Series rating with upstream protective devices will not be accepted without written consent of the Engineer.

D. Each switch shall have two (2) positions (normal, emergency) or three (3) positions (normal, neutral, emergency) and shall be double-throw. The switch shall be electrically operated and mechanically held, with the operating mechanism energized only during the time of transfer. All main contacts shall be silver alloy, wiping action type, protected by separate arcing contacts and blowout coils. Contacts shall be of a design specifically intended for automatic transfer switch service and shall not be circuit breaker contact assemblies.

E. Adequate conduit space shall be provided in each automatic transfer switch to satisfy the cabling design. All cable terminations shall be made with two-bolt hole, long-barrel, copper-bodied, concentric compression-type lugs, which shall be supplied with the automatic transfer switch. Automatic transfer switch enclosures and buses shall be enlarged to accommodate lugs at no additional cost, if required.

F. Switches serving 3-phase, 4-wire loads shall be provided with overlapping neutral transfer contacts that shall be overlapped only during transfer operation and remain so overlapped until the main contacts close to the source being transferred to. Overlap time shall not exceed 100 ms. Four-pole switches may be substituted for overlapping neutral.

G. Switches serving large motor loads shall be provided with in-phase monitors or neutral position with time delay to prevent excessive currents during transfer of these loads.

H. Automatic transfer switches serving elevators (either directly or indirectly):

1. Automatic transfer switches serving elevators shall be interlocked with other transfer switches that serve non-regenerative loads, so that in the event an elevator automatic transfer switch transfers to emergency, its interlocked automatic transfer switch shall also automatically transfer to emergency, regardless of the availability of the normal source. The selection of which automatic transfer switches will be interlocked shall be determined at the time of occupancy by the Owner.
2. Transfer switches serving elevators shall also include the following contacts and wiring to a junction box in the Elevator Machine Room for connection to elevator controllers under another division:
   a. Form C contacts changing state as a function of an adjustable 0 - 60 second time delay relay energized on return of normal power, which will be indicative of a “pending return to normal condition”, to allow for any in-transit elevator to be brought to rest in a controlled manner.
   b. Form C contacts for each elevator controller in each of the elevator banks to communicate: loss of normal power, emergency available, connected to emergency, normal available and connected to normal conditions to the elevator controllers.
   c. Automatic transfer switches serving elevators shall be provided with two (2) spare sets of Form C contacts (in addition to those described herein and those required to perform the specified functions).
3. Provide all control and annunciation wiring, conduit, etc., for interconnection of this system to the vertical transportation system. Provide a shop drawing, coordinated with both the Vertical Transportation Contractor and ATS manufacturer indicating all control and annunciation wiring.

2.3 Bypass and Isolating Automatic Transfer Switches

A. Bypass and isolating switches shall be provided to permit the bypass and isolation of selected transfer switches for periodic maintenance and inspection without interruption of service.

B. The isolating switch shall render the automatic transfer switch, as well as its control circuitry, electrically dead. The isolating switch shall be positively interlocked with the bypass switch,

requiring operation of the bypass switch to either the bypass-to-normal or bypass-to-alternate before the isolating switch contacts may be opened. It shall also ensure that the isolating switch is closed before the bypass switch has been opened, except for loss of the source to which the load is bypassed. In the event of a loss of the source to which the load is bypassed, a quick-make/quick-break load interrupter shall allow the disconnection of the load to allow transferring of the bypass switch to the surviving source. Upon transfer, the quick-make/quick-break switch will be manually closed. This mode shall not require the closing of the isolating switch. The automatic transfer switch shall be mechanically interlocked with the bypass switch to positively prevent the connection of the normal and emergency source to the load simultaneously.

C. The bypass and isolating switch shall have the same withstand rating as the automatic transfer switch.

2.4 Controls

A. Each automatic transfer switch shall be equipped with a microprocessor-based control panel. The control panel shall perform the operational and display functions of the transfer switch.

B. Each automatic transfer switches shall include an LCD display screen with touchpad function and display menus for access to programming functions, alarm history, and status conditions.

C. The control panel shall be opto-isolated from electrical noise.

D. The system controller shall provide for the retransfer to a dead normal source for load shedding upon the loss of sufficient generating capacity and bypass to emergency under test conditions.

E. Provide a built-in diagnostic display that includes the capturing of historical data, such as the number of transfers and time on emergency power source, for ease of troubleshooting.

F. The ATS shall include an adjustable retransfer to normal time delay adjustable in 1-minute increments, from 0 to 30 minutes maximum. Following a sensed loss of the utility source and a subsequent transfer to emergency, this delay timer shall prevent an automatic retransfer to a restored normal source until the countdown is expired or is bypassed by a manual command.

G. Control circuitry shall provide for the retransfer to a dead normal source or neutral position for load shedding upon loss of sufficient generating capacity and bypass to emergency under test condition. The controls shall include the necessary auxiliary contacts to give indication of transfer switch position and source availability. The controls shall also include a pilot contact to close and initiate the start of the emergency system and open to stop the system. In addition, these controls shall include a voltage-sensing relay to sense the availability of emergency power prior to allowing transfer, to ensure its acceptability.

H. Provide terminals for connection to the generator control system to permit automatic shedding and restoration of loads on the emergency or standby power plant and indication of source availability and switch position. Automatic load shedding shall be achieved by transferring back to a de-energized normal source or to a dead neutral position upon signal from the generator control panel.

I. A full duplex RS485 redundant supervised interface shall be installed in each ATS to enable serial communication. The serial communications shall be capable of a direct-connect or a multi-drop configured network. This shall allow for the seamless integration of existing and/or new communication to transfer switches.

J. Control Switches

1. Each transfer switch shall include a test switch to simulate normal power failure.
2. The ATS shall include a retransfer to normal delay bypass momentary switch which bypasses the retransfer to normal time delay function. The ATS shall immediately retransfer when all other interlocks are satisfied (in-phase monitor, etc.).

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L. All automatic transfer switches shall be provided with metering at the load terminals of the switch. Digital power meters shall be provided for measurement of the following:

1. Voltage on each phase line-to-line, for both the normal and emergency sources.
2. Output current of each phase.
3. Output kilowatts/kilovolt-amperes of the load bus.

4. Output frequency.

2.5 Submetering

A. Provide electrical submetering, including CT's, for the load side of each ATS with power metering display as follows. Coordinate all CT's and connections.
   1. Current, per phase and neutral.
   2. Current unbalance.
   3. Voltage, phase-to-phase and phase-to-neutral.
   4. Voltage unbalance.
   5. Real power, per phase and 3-phase total.
   6. Reactive power, per phase and 3-phase total.
   7. Apparent power, per phase and 3-phase total.
   8. Power factor, 3-phase total and per phase.
   9. Frequency.

2.6 Remote Interfaces

A. BATC
   1. Provide Form C contacts wired to a terminal block for the following alarms:
      a. Normal available.
      b. Connected to Normal.
      c. Emergency available.
      d. Connected to Emergency.
      e. Load shed.
      f. Neutral position (three-position switches only).
      g. Four (4) spare auxiliary contacts.
   2. Bypass isolation switches shall include the following, in addition to the above:
      a. Bypass to Normal.
      b. Bypass to Emergency.

PART 3 - EXECUTION

3.1 Installation

A. Installation of the automatic transfer system shall be in full accordance and under the technical supervision of qualified technicians provided by the manufacturer as part of this section. Meet with field service technicians to review installation instructions, handling and wiring of the equipment.

B. The automatic transfer switch system shall be installed in accordance with the equipment manufacturer's written instructions and recommendations to ensure that the system complies with the specifications and serves the intended purpose.

3.2 Control Wiring

A. Install all control and monitoring wiring including, but not limited to, generator start wiring, load shed, remote monitoring, etc., for control of normal, emergency, legally required standby and optional standby loads throughout the project, and as required by code, all in accordance with the requirements of the Contract Documents. Add 20% spare control wires from point-to-point (minimum of one [1] extra set of each cable).

B. In addition to the control wiring indicated above and by the vendor, provide the following control wiring:
   1. 2 #12-3/4 inch conduit from auxiliary contact (closed when switch is in emergency position) on transfer switch to each Elevator Machine Room that is served via the associated ATS. Terminate as and where required by the elevator vendor.
   2. 2 #12-3/4 inch conduit from auxiliary contact (closed before switch returns to normal power) on transfer switch serving elevators to each Elevator Machine Room that is served via the associated ATS. Terminate as and where required by the elevator vendor. Coordinate exact time delay setting required with elevator vendor.

3. 2 #12-3/4 inch conduit from auxiliary contact (closed before switch transfers to the emergency position) on transfer switch serving elevators to each Elevator Machine Room that is served via the associated ATS. Terminate as and where required by the elevator vendor.
4. 4 #12-3/4 inch conduit, two (2) from the engine start contact and two (2) from the load shed contact, on transfer switch to respective emergency generator control panel.
5. 4 #12-3/4 inch conduit, two (2) from the engine start contact and two (2) from load shed contact on transfer switch, to respective fire alarm control panel.
6. Wiring in conduit as required (per the manufacturer) from transfer switch to all remote annunciator panels and engine control panels for transfer switch control/annunciation.

3.3 Factory Testing

A. All standard factory tests on all ATS's shall be performed at the same time, in accordance with the latest version of NEMA, NETA and UL standards. Advise the Owner four (4) weeks prior to the scheduled factory test in order to allow the Owner to attend and witness the test.
B. The manufacturer shall provide three (3) certified copies of factory test reports as part of the required submittals.

3.4 Field Testing

A. The onsite acceptance test shall verify that all components are currently installed and interconnected. Exercise each automatic transfer switch, including its drawout mechanism (where provided).
B. Test each ATS on its backup source individually and with all ATS's and backup sources collectively.
C. Test all ATS's and all backup sources at the completion of the project by conducting a full-scale pull-the-plug test in the building.

END OF SECTION 26 36 23

SECTION 26 41 13

LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 Summary

A. Furnish and install a lightning protection system in accordance with the requirements of the Contract Documents, including all air terminals, roof conductors, down conductors, fastener connections, performance recording equipment and grounding. The system shall be designed to qualify for the maximum insurance rate reduction allowed for lightning protection for this type of construction.

B. The lightning protection system shall respond dynamically to the appearance of a lightning down leader and shall be designed to trigger in relation to the optimum predetermined conditions for upward leader inception. The triggering conditions must dynamically adjust to reflect the down leader intensity, building height above ground and other factors that affect the electric field intensification above the air terminal. The lightning protection systems shall be a CLT (controlled leader trigger) system. No ESE's (early streamer emitters) shall be used or substituted.

C. The lightning protection system shall employ an air terminal of the type designed to minimize corona emissions and optimize streamer inception when optimum predetermined conditions are met.

1.2 Related Sections

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 Reference Standards

A. The lightning protection system and all components shall be designed, manufactured and tested in accordance with the latest applicable industry standards and codes, including the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City, New York.
   a. Building Code of the City of New York.
   b. National Electrical Code.
   c. New York City Electrical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. FM: Factory Mutual.
   b. NFPA 780: Standard for the Installation of Lightning Protection Systems.
   c. UL Standard 96A: Installation Requirements for Lightning Protection Systems.
   d. UL Standard 96: Lightning Protection Components.

1.4 Submittals

A. The following submittal data shall be furnished and include, but not be limited to:

1. Lightning protection system, including all system components, wiring diagrams, devices, parts, installation and mounting details, UL certifications, etc.
2. Copy of the Owner's lightning protection Certificate of Compliance.
3. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by the manufacturer. Include instructions for storage, handling, protection, examination, preparation and installation.

1.5 Warranty

A. Comply with the requirements of the Contract Documents and Section 26 00 00.

1.6 Quality Assurance

A. Qualifications

1. Lightning protection system materials shall consist of standard products of a regularly engaged in-production lightning protection system and shall be the manufacturer's latest approved design.
2. Installer of the lightning protection systems shall be listed as an approved installer. All other installers shall receive approval, in writing, from the manufacturer.

B. Regulatory Requirements: Lightning protection system shall comply with the CLT (controlled leader triggering) system as stated in Reference Information Section of this specification. No ESE's (early streamer emitters) shall be used or substituted.

C. Certifications: Furnish Owner with a lightning protection Certificate of Compliance from the manufacturer providing proof that the lightning protection system was installed according to the manufacturer's design and installation instructions.

1.7 Sequencing

A. Coordinate installation of lightning protection system with installation of other building systems and components, including supporting structures and building materials, metal bodies requiring bonding to lightning protection system components, exterior and interior building finishes, and building roofing.

1.8 Commissioning

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. This Contractor shall engage the services of an accredited Underwriters Laboratories, Inc., Contractor, or an LPI-registered installer qualified to furnish and install the system described herein and to procure the Underwriters Laboratories, Inc. Master Label demonstrating that the system fulfills the requirements of the State Insurance Commission governing the allowance of the aforementioned insurance rate reduction. Submit copy of UL Master Label or LPI certification label to the Engineer and the Owner upon system completion.

B. ERICO, Inc., the DYNASPHERE enhanced air terminal, or approved equal.

2.2 Components

A. UL 96: Air terminals, main conductor(s).

B. Air Terminal

1. The protective zone provided by the air termination shall be such that it becomes the preferred strike point for all discharges exceeding a peak amplitude return strike current of X kA according to the statistical Level Y. The design shall take account of upward leader competing projections on the structure.

Strike Current (X)	Levels of Protection (Y)	Exceedance Probability
2.9 kA	Protection Level I - Very High	99%
5.4 kA	Protection Level II - High	97%
10.1 kA	Protection Level III - Medium	91%
15.7 kA	Protection Level IV - Low	84%

C. Down Conductor

1. The down conductor shall consist of a polyethylene tubing, combined copper stranded and wound tape conductor, triple semi-conductive/insulation/semi-conductive layer, outer copper conductor, conductive compound sheath, all concentrically arranged.
2. The main copper conductor shall be made of electrical-grade copper, with a minimum cross-sectional equivalent to 1/0 AWG.
3. Only approval from the manufacturer can allow the substitution of bare copper cable in place of the insulated high-voltage cable.
   a. .

b. Bonding of all conductive material within six (6) feet of the conductor shall be accomplished via a secondary conductor no smaller than #6 copper.
c. Conductors shall be installed so that all wire runs shall always have a horizontal or downward path, free of “U” or “V” pockets, with the exception that an 8 inch maximum rise or a rise of 3 inches maximum from every 12 inches of conductor length shall be permitted in a main conductor run.
d. Each CLT terminal shall have two (2) paths to ground from the base plate of the mast, with the exception of an elevated mast that may have a single conductor run for a maximum of sixteen (16) feet before two (2) down conductors shall be initiated.
e. The Electrical Contractor shall furnish and install all necessary PVC or fiberglass conduits (1 in.) for concealed down conductors.

D. Performance-Recording Equipment
1. Each protection system shall be supplied with a lightning event counter. The lightning event counter shall have an electronic register that activates one (1) count for every discharge where the peak current exceeds 1,500A. The test wave shape shall be the 8/20 us standard as defined by ANSI C62.41.
2. The lightning event counter shall be installed per the manufacturer’s instructions in a readily accessible manner so that readings can be taken at regular intervals. It shall be positioned such that its operating temperature is within the range -14°F to +122°F.

E. Grounding
1. The grounding system reading shall not exceed 10 ohms static impedance except with prior approval by the site Engineer or manufacturer of the lightning protection system.
2. Grounding shall be affected by copper wire or tape buried below the frost line (or to approximately 2 ft. deep in non-freezing locations) or by deep-driven UL-listed copper-bonded steel core ground rods of at least 10 mil copper thickness.
3. Bonding of the grounding system to metallic parts of the building, the structural reinforcing steel of the building and to arriving services is required. The resistance should be measured and the 10-ohm requirements achieved before such bonding is affected.
4. Electrically conductive ground-enhancing materials shall be used to achieve low ground resistance, provided that the materials are mixed and strictly in accordance with the manufacturer’s instructions.
5. Only approval from the manufacturer can allow deviation from the specified grounding system, depending on existing grounding systems and/or soil conditions.

2.3 TVSS
A. Provide transient voltage surge suppressors in each service switchboard and all incoming services (e.g., tel/com, electrical, etc.) as required for UL Master Label.

PART 3 - EXECUTION

3.1 Installation
A. Cable conductors shall be concealed at all locations throughout the building. Cable conductors in parapets shall be coordinated with the window wall installation. Conductors shall be aluminum No. 1/0, 28 strand, No. 14 gauge.
B. Connection of supports, clamps, devices and other appurtenances to rust-protected metal structures exposed to the weather shall be made using rust-protected devices and shall be installed in a manner to preserve the rust protection of the structure.
C. Where the building is not a steel structure, provide down conductors in conduit as required for the required number of columns. Conduit may be rigid non-metallic conduit or IMC. Conduit shall be concealed in the building structure. If IMC is used, down conductors must be bonded to the IMC at the top and bottom.

D. At the base of the required number of columns, copper cable shall be exothermically welded to the steel and coursed down to grounding locations, exothermically welded to 3/4 inch diameter x 10 foot long copper-clad steel ground rods or ground plates and counterpoise ground loop. See Section 26 05 26 for additional information.
E. Metals of conductance at any point within 6 feet of the lightning conductor system shall be securely bonded and made a part thereof, and materials for these interconnections shall be equivalent in quality to the main conductor and fittings.
F. Cable conductors shall interconnect all air terminals offering a two-way path to the ground electrodes.
G. On large roof areas, points shall be mounted on cross runs at intervals of 50 feet on center and interconnected by conductor cable so that no area larger than 50 feet x 150 feet remains unprotected.
H. From the closed loops, an aluminum ground cable shall be coursed through the roof in pitch pockets at intervals not to exceed 60 feet on center and connected to run as down conductors in PVC conduit to ground counterpoise location below Cellar slab. Where this method is not practical, the conductor shall run continuously concealed within the building construction to grounding locations. Verify the electrical continuity of the steel and, if necessary, provide full-size cable jumpers to ensure this condition.
I. Furnish and install a ground counterpoise consisting of a 500 MCM bare copper ground conductor run in a complete loop under the Cellar slab around the building perimeter. Connect to MSGB ground bus in Service Switchboard Room with two (2) 500 MCM ground conductors from each side of loop. Provide ground rods on ground counterpoise at each corner of building and maximum 60 ft. on center or as per UL Master Label Standard/NFPA 780. Counterpoise shall have ground resistance not to exceed 5 ohms to ground.
J. All ground rods and/or plates shall utilize bitmus clay packing to ensure connectivity with earth.
K. Each down conductor shall terminate at a ground terminal dedicated to the lightning protection system and be installed below the frost line.
L. Grounding media in or on the structure shall be interconnected to provide a common ground potential. This shall include, but is not limited to, lightning protection, electric service, telephone, antenna system grounds and underground metallic piping systems.
M. Provide air terminals on all mechanical and rooftop equipment, including fans, generator enclosures, etc., as required. Refer to drawings of other trades for additional information.

3.2 Field Testing
A. The lightning protection system shall be tested and certified in accordance with the Master Label requirements of NFPA.

3.3 Closeout Submittals
A. Project Record Documents: Record active location of lightning protection system components.
B. Operation and Maintenance Data: Include manufacturer's recommended operating instructions, maintenance procedures and preventative maintenance instructions.

3.4 Installation
A. Install lightning protection in accordance with the manufacturer's design and installation instructions.
B. All work installed in accessible locations shall be properly guarded and protected.
C. All materials shall be installed in a neat and workmanlike manner.

3.5 Corrosion Protection
A. When using bare copper cable, do not combine materials that can form an electrolytic couple that will accelerate the corrosion in the presence of moisture, unless moisture is permanently excluded from the junction of such materials.

3.6 Field Quality Control
A. Apply for inspection from the manufacturer to obtain a Certificate of Compliance and submit to the Owner.

B. Test the grounding system to ensure continuity prior to backfilling or paving. Check that resistance to earth does not exceed 25 ohms, measured by Fall-of-Potential method.

C. Installer of the lightning protection systems shall be listed as an approved installer. Contact factory for an approved installer in your area. All other installers shall receive approval, in writing, from the manufacturer.

END OF SECTION 26 41 13

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SECTION 26 43 00

SURGE PROTECTIVE DEVICE SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install a complete surge protective device (SPD) system with multiple levels to protect the electrical distribution against high-energy transient voltages, including surge current diversion, high-frequency attenuation and line voltage stabilization in accordance with ANSI/IEEE Categories A, B, and C and UL 1449 Third Edition throughout the project, as indicated on and in accordance with the requirements of the Contract Documents.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.3 REFERENCES

A. The SPD system and all components shall be designed, manufactured, tested and installed in accordance with the latest applicable codes and reference standards, including the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City, New York.
   a. Building Code of the City of New York.
   b. National Electrical Code.
   c. New York City Electrical Code.

2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. ANSI/IEEE C62-41.1: IEEE Guide on the Surge Environment in Low-Voltage (1,000V and less) AC Power Circuits.
   b. ANSI/IEEE C62-41.2: IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1,000V and less) AC Power Circuits.
   c. ANSI/IEEE C62-45: IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1,000V and less) AC Power Circuits.
   d. UL Standard 1283: Standard for Electromagnetic Interference Filters.
   e. UL Standard 1449, 3rd Edition: Standard for Surge Protective Devices.
   f. NFPA 780: Standard for the Installation of Lightning Protection Systems.
   g. UL Standard 96A: Standard for Installation Requirements for Lightning Protection Systems.

1.4 DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.5 WARRANTY

A. Comply with the requirements of Division 01 and Section 26 00 00.

B. Minimum ten (10) year warranty.

1.6 COMMISSIONING

A. Provide all testing and commissioning as required. Obtain all commissioning requirements from the Commissioning Provider/Owner/Agent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Contract Documents.

B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Contract Documents will be revised to reflect the substitution.

C. If they comply with the Contract Documents, surge protective devices manufactured by one (1) of the following manufacturers will be acceptable:
   1. Advanced Protection Technologies (APT).
   2. Eaton Innovative Technology.
   3. Emerson Network Power.
   4. General Electric.
   5. Siemens.
   6. Surge Suppression Inc. (SSI).
   7. Thomas & Betts/Current Technology.

2.2 GENERAL

A. Provide SPD protection at each piece of electrical and IT service entrance equipment.

B. Each SPD shall be manufactured and installed in accordance with UL 1449, 3rd Edition, UL 1283, and NYCEC Article 285: Surge Protective Devices 1 kV or Less.

C. Short circuit current rating of each SPD shall be clearly marked and shall not be below the available fault current at the point of installation as determined by the short circuit coordination study. Fuse ratings shall not be considered in lieu of demonstrated withstand testing of SPD.

D. SPD shall not require external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal overtemperature controls.

E. The system shall be suitable for 120/208 volt, 3-phase, 4-wire operation. The operating frequency range of the SPD shall be between 47 and 63 hertz.

F. Each SPD's single surge rating shall be based on the ampacity of the protected equipment in accordance with the chart below:

Equipment Ampacity Rating	Surge Current Rating Per Mode	Surge Current Rating Per Phase
≤ 225 amps	50,000 amps	100,000 amps
≤ 800 amps	75,000 amps	150,000 amps
≤ 4,000 amps	150,000 amps	300,000 amps
> 4,000 amps	200,000 amps	400,000 amps

G. Minimum voltage protection ratings shall be as follows:

Voltage	L-L	L-N	L-G	N-G
208Y/120V	700V	700V	700V	700V

H. Maximum continuous operating voltage for L-N, L-G, and N-G modes of protection shall be as follows:

System Voltage	Allowable System Voltage Fluctuation (%)	MCOV
208Y/120V	± 125%	150V

I. SPD manufacturers shall provide third-party single-surge test reports validating the surge rating of the products being submitted. Surge ratings based on the mathematical sum of components used in the construction of the SPD will not be accepted.

J. SPD protection shall be provided in all modes. Wye-configured systems shall provide line-to-neutral, line-to-ground and neutral-to-ground protection. Delta-configured systems shall provide line-to-line protection in ungrounded systems and line-to-line and line-to-ground protection in grounded systems. All modes are to be provided with directly connected protection elements.

K. Wall-mounted SPD's installed on the line side of service disconnects shall be Type 1. Wall-mounted SPD's installed downstream of the service shall be Type 1 or Type 2. Factory-installed integrally mounted SPD's shall be Type 1 or Type 4 intended for Type 1 or Type 2 applications.

L. Devices installed on service equipment shall have a nominal discharge current rating of 20 kA.

M. Suppression components shall be heavy-duty large-block MOV's.

2.3 LOCAL INDICATIONS

A. SPD's shall be equipped with the following monitoring capabilities:

1. LED indication lamps per phase indicating that the SPD has reached end of life and should be replaced.
2. Local audible alarm and alarm silence switch.
3. Transient surge counter to totalize transient surges in normal and common modes. The counter shall be provided with a non-volatile memory or integral battery with a ten (10)-year minimum life span to retain data in the event of a power failure.
4. N-G bond indication.

2.4 REMOTE INTERFACES

A. Form C contact for a summary alarm to the site remote monitoring system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Each device shall be wall-mounted in an enclosure in accordance with the following:

1. NEMA 4 or 12, dependent upon the installation location. If the device is protecting a switchboard, switchgear or panelboard, at the Contractor's option, the device may be mounted within the enclosure with appropriate code-required clearances and per all manufacturer recommendations. It is the Contractor's responsibility to address any spatial issues that may arise regarding room layouts from installing the SPD within the panel enclosure.
2. Mounted as close as practicably possible to the equipment protected.
3. A fully surge-rated fused disconnect with wiring terminations suitable for copper conductors sized to each specific application. The disconnect shall be configured to allow safe testing and maintenance without affecting the load.
4. Service entrance SPD ground shall be bonded to the service entrance ground.
5. Before energizing, ensure that the service and separately derived system neutral-to-ground bonding jumpers are properly connected.
6. Provide all wiring, conduit, disconnect and overcurrent protection as required to complete the installation in accordance with code and manufacturer's guidelines.

B. SPD units shall be provided for each service switchboard, distribution board and all other locations required by the Contract Documents.

3.2 FACTORY TESTING

A. All SPD equipment shall be tested in accordance with the latest applicable industry standards and governing code requirements.

3.3 FIELD TESTING

A. Verify the proper operation of all SPD's using the manufacturer's approved diagnostic test kit. Verify 0.5 ohms maximum ground continuity to all units.

B. Check tightness of all accessible mechanical and electrical connections to ensure they are torqued to the minimum acceptable manufacturer's recommendations.

C. Panels requiring SPD's shall be checked for proper grounding, fastening and alignment.

END OF SECTION 26 43 00

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 Summary

A. Furnish and install all lighting fixtures of the type indicated by letter and number at each specified location throughout the project as indicated on and in accordance with the requirements of the Contract Documents.

B. Section includes:

1. Luminaires.
2. Light-emitting diode (LED) fixtures.
3. Transformers.
4. Lamps.
5. Light-emitting diodes (LED).
6. Finishes.
7. Reflectors.
8. Stems.
9. Lenses, louvers and diffusers.

1.1 Related Sections

C. Refer to Divisions 01, 14, 21, 22, 23, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

D. Refer to Section 26 00 00.03 – Table of Contents for Electrical for specification sections that apply to all work herein.

1.2 References

A. All lighting fixtures, and all components shall be designed, manufactured, tested and installed in accordance with the latest applicable codes and reference standards, including the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City and New York State.
   a. Building Code of the City of New York.
   b. New York City Electrical Code.
   c. New York City Energy Conservation Code.

2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. ANSI/ANSLG C78.81: American National Standard for Electric Lamps - Double-Capped Fluorescent Lamps - Dimensional and Electrical Characteristics.
   b. ANSI C78: American National Standards for Metal Halide Lamps.
   c. ANSI C78.375: American National Standard for Fluorescent Lamps - Guide for Electrical Measurements.
   d. ANSI C81.61: American National Standards for Electric Lamp Bases.
   e. ANSI C82.2: American National Standard for Lamp Ballasts - Method of Measurement of Fluorescent Lamp Ballasts.
   f. ANSI C82.4: American National Standard for Ballasts for High-Intensity Discharge and Low-Pressure (LPS) Lamps (Multiple-Supply Type).
   g. ANSI C82.11: American National Standard for High-Frequency Fluorescent Lamp Ballasts.
   h. EISA: Energy Independence and Security Act.
   i. EPA TCLP: Toxicity Characteristic Leaching Procedure and Characteristic Wastes (D-Codes).

j. IEEE C62.41: IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
k. UL Standard 844: Standard for Luminaires for Use in Hazardous (Classified) Locations.
l. UL Standard 935: Standard for Fluorescent Lamp Ballasts.
m. UL Standard 1029: Standard for High-Intensity-Discharge Lamp Ballasts.
n. UL Standard 1574: Standard for Track Lighting Systems.
o. UL Standard 1598: Standard for Safety of Luminaires.
p. UL Standard 1838: Standard for Low-Voltage Landscape Lighting Systems.
q. UL Standard 2108: Standard for Low-Voltage Lighting Systems.
r. UL Standard 8750: Standard for Light-Emitting Diode (LED) Equipment for Use in Lighting Products.

1.3 Submittals

A. The following submittal data shall be furnished according to the conditions of the Construction Contract, Division 01 and Section 26 00 00 and shall include, but not be limited to:

1. Shop drawings must clearly indicate the Contract Drawing number of fixture details used as reference in the development of the shop drawings and the names of the job, Architect and Lighting Designer. Provide all full-scale shop drawings in reproducible form. Fixture cuts are to be provided in legible reproduction or original. No fax materials will be reviewed.
2. Submit dimensioned drawings of lighting fixtures. Submit fixture shop drawings assembled in order of luminaire type designation with proposed fixture and accessories clearly indicated on each sheet. Shop drawings must be submitted for review before fabrication. Fabrication details may vary slightly from those shown on drawings, provided that those changes do not adversely affect ease of installation, durability, performance, or appearance of the fixture.
3. Shop drawings shall not vary from the general arrangement and detail shown on drawings, unless the change suits a condition on the actual premises. Changes must be shown clearly on drawings to be submitted for approval.
4. Catalog cuts lacking sufficient detail to indicate compliance with Contract Documents will not be acceptable.
5. Shop drawings of lighting fixtures must be submitted within sixty (60) days after Award of Contract.
6. Pre-approved specification status does not and shall not exempt the identified manufacturers from full and complete compliance with all criteria identified either in the specifications or as attributed to “prime specification” equipment with regard to photometric performance, brightness control, size, finishes, etc. Consideration, acceptance or rejection of any proposed submittal at any time shall rest solely upon the joint evaluation of the Engineer and the Architect for those areas within the project scope.
7. All fixtures, after the initial approval process, that are submitted as substitutes, or have been disapproved or approved with comments pending, shall be resubmitted within a two-week period after Contractor receipt of the initial submission. If said comments have not been complied with, Contractor shall resubmit original specified manufacturer.
8. Where indicated on the fixture schedule and Contract Drawings, supply complete photometric data for the fixture, including optical performance as measured by an independent testing laboratory, according to methods of the Illuminating Engineering Society of North America:
   a. Coefficients of utilization.
   b. Visual comfort probability:
      1). 80% ceiling.
      2). 50% walls.
      3). 20% floor.

c. Zonal lumens stated numerically in 10-degree increments.
d. Luminance table with data presented numerically, showing maximum luminance of the fixture at the shielding angles. Readings should be taken both crosswise and lengthwise in the case of fluorescent fixtures or fixtures with asymmetric distribution.
e. Candela distribution data, presented graphically and numerically in no more than 5-degree increments (5, 10, 15, etc.). Data developed for up and down quadrants normal, parallel and at 22.5 and 167.5 degrees to the fixture axis if light output is asymmetric.
f. Provide fixture-operating efficiencies.
g. Provide spacing criteria.

9. Provide photometric data from an independent testing laboratory for any fixtures offered as substitutes for a specified fixture.
10. For all area luminaires, provide isocandela charts and coefficients of utilization.
11. For each type of fixture, supplying lighting manufacturers shall provide a maintenance manual listing: any tools required, types of cleaners to be used, replacement part listing and final “as-built” shop drawing.
12. Lamps, complete with base or pin configuration, lumen rating, life expectancy, color temperature, starting characteristics, etc.
13. Provide lamp cut sheet, including mercury content, for each lamp type.
14. Submit catalog number/cut sheet for all lamps for every fixture type.
15. Submit catalog number/cut sheet for all transformers, ballasts, and/or power source for every fixture type.

1.4 Samples

A. Samples, if requested, must be complete with lamps, with a 6-foot power cord and 120 volt operation, as needed for proper evaluation/examination. The complete sample must be an actual working unit.
B. All samples shall be shipped prepaid to the Architect or Engineer, or as otherwise noted.
C. None of the samples received are returnable, nor shall they be included in the quantities listed for the project.
D. Provide new samples or modifications to samples for onsite mock-ups.
E. Submit color finish samples for approval by the Architect as requested by the Architect.

1.5 Extra Materials (Spares)

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing the contents unless noted differently in the fixture cut sheets.
1. Lamps: Ten (10) lamps for every one hundred (100) (ten percent [10%]) of each type and rating installed. Furnish at least one (1) of each type.
2. Plastic Diffusers and Lenses: Five (5) for every one hundred (100) (five percent [5%]) of each type installed. Furnish at least one (1) of each type.
3. Ballasts/Drivers: Five (5) for every one hundred (100) (five percent [5%]) of each type and rating installed. Furnish at least one (1) of each type.
4. Globes and Guards: Five (5) for every one hundred (100) (five percent [5%]) of each type installed. Furnish at least one (1) of each type.
5. Parabolic Louvers and Reflector Cones: Five (5) for every one hundred (100) (five percent [5%]) of each type installed. Furnish at least one (1) of each type.
6. Custom Luminaires: If not otherwise clarified in Part 4 of this specification, provide five percent (5%) spare diffusers or lenses (glass, acrylic, fabric panels, or any specialty material) for custom luminaires. If requested, provide complete fixture as attic stock, in quantities as specified by the Owner.
7. LED Modules/Boards: One (1) for every 50 of the same fixture type, from the same

batch/production run as the installed product. Provide a minimum of one (1) per fixture type.

8. Non-Field-Serviceable Fixtures: If a specified luminaire has a return-to-factory warranty only, provide two percent (2%) spare fixtures as attic stock. Furnish at least one (1) of each type.

1.6 Mock-Ups

A. The specific design requirements of certain building conditions will mandate the necessity of full-scale onsite mock-ups prior to final authorization (release) to fabricate. The Contractor shall include, as part of his bid, provision for complete mock-ups of the following conditions:
   1. Type and quantity of fixtures, to be determined by the Architect.
   2. Participants at mock-up (Architect, Lighting Consultant, Owner's representative) shall be given a minimum of one (1) weeks' notice prior to attendance.

B. Mock-ups are intended as evaluation tools and should not be construed as part of the permanent installation. Contractor shall provide drawings outlining the scope of the mock-up for approval before proceeding with any aspect of procurement or fabrication.

1.7 Delivery, Storage And Handling

A. Comply with the requirements of Division 01 and Section 26 00 00.

1.8 Warranty

A. Comply with the requirements of Division 01 and Section 26 00 00.

B. During the warranty period, the Contractor shall guarantee the following in a form satisfactory to the Owner:
   1. The fixtures shall operate without malfunction.
   2. All lamps shall be warranted for their full rated life (see "Lamps").
   3. All ballasts shall carry a minimum five (5)-year warranty for electronic, three (3) year warranty for magnetic or hybrid (see "Ballasts").
   4. All lighting fixtures (unless noted otherwise) and accessories shall carry a minimum one (1)-year warranty.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Contract Documents.

B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Contract Documents will be revised to reflect the substitution.

C. If they comply with the Contract Documents, lighting fixture manufactured by one (1) of the manufacturers listed in Part 4 with the appropriate fixture type will be acceptable.

D. If they comply with the Contract Documents, lighting fixture accessory equipment manufactured by one (1) of the following manufacturers will be acceptable:
   1. LED Drivers
      a. Advance/Philips.
      b. General Electric.
      c. Lutron.
      d. Osram/Sylvania.
   2. Incandescent Emergency Remote Batteries
      a. Bodine (Eli-250-SD).

b. EmergiLite.
c. Iota.

3. Lamps
   a. Agilent (LED's only).
   b. Cree (LED's only).
   c. General Electric.
   d. Lumileds (LED's only).
   e. Nichia (LED's only).
   f. Osram/Sylvania.
   g. Phillips.
4. Low-Voltage Emergency Remote Batteries
   a. Atlite (LVR).
   b. Bodine.
   c. Encore.
5. Low-Voltage Transformers (Remote)
   a. Q-Tran.

2.2 Luminaires

A. A UL listing shall be provided for each fixture type and labels shall be affixed to each fixture in a position concealing it from normal view. All equipment shall be listed and approved for use in New York City.

B. Lighting fixtures shall be of rigid construction, dimensionally stable, and shall be assembled with secure fastenings. Ferrous parts shall be protected from corrosion by plating or shall be finished with high-reflectance enamel with non-yellowing binder and a high pigment-to-binder ratio, with matte finish. Ferrous parts shall be prepared for finish by an industry-standard finishing process (see "Finishes").

C. Provide each fixture with lamps as indicated in the lighting fixture schedule. Where or if lamp types, wattages or distributions are not indicated, contact the Architect for clarification.

D. Hinged door closure frames shall operate smoothly without binding. Fabricate frames to allow lamp installation/removal without tools. Hinge mechanisms shall be so designed as to preclude accidental falling of hinged door closure frames during relamping operations and while secured in operating position.

E. Recessed lighting fixtures and lighting track systems shall be suspended from structural members or ceiling structure members of minimum 1-1/2 inch channels, by standard bar hangers or other approved means. Fixture locations shall be coordinated with ceiling patterns. Refer to architectural reflected ceiling plan for exact location of fixtures and architectural room finish schedule for ceiling construction details and mounting heights. Provide structural steel as required to properly support the fixtures.

F. Fixture wiring shall be suitable for the temperature rating of the fixture; wiring through fluorescent channels shall be done with Type SFF2 wire. Where a junction box is required to change from branch circuit to fixture wiring, use approved feed through pre-wired fixture wiring and install a separate junction box. The junction box shall be fully accessible after installation of covering materials. Where flexible conduit or portable cord is used, a grounding jumper shall be installed; all fixtures shall be grounded. Housings shall be so constructed that all electrical components are easily accessible and replaceable without removing fixtures from their mountings, or disassembly of adjacent construction.

G. All recessed, pendant and surface-mounted lighting fixtures, unless otherwise noted or directed, shall be UL-listed for through-wiring and shall be furnished complete with all required integral wiring and all required flexible conditions, pigtails and related accessories necessary for suitable operation and installation.

H. All recessed fixtures that are to be installed in insulated ceilings shall be provided with UL-listed thermocouple protection.

I. All materials, accessories and other related fixture parts shall be new and free of defects that in any manner may impair their character, appearance, strength, durability and function, and be effectively protected from any damage or injury from the time of fabrication to the time of delivery and until Final Acceptance of the work by the Owner.

J. Enclosures: Fabricate fixture enclosures with a minimum No. 20 gauge (0.0359 inch) thick cold rolled sheet steel. Enclosures may be constructed of other metals, provided that they are equivalent in mechanical strength, durability, compliance with local codes and acceptable for the purpose.

K. Sheet Metal Work: All sheet metal work shall be free from tool marks and dents, and shall have accurate angles bent as sharp as compatible with the gauges of the required metal. All intersections and joints shall be formed true and be of adequate strength and structural rigidity to prevent any distortion after assembly.

L. Castings: All aluminum, iron or composite castings shall be exact replicas of the approved patterns and shall be free of sand pits, blemishes, scales and rust, and shall be smoothly finished. Tolerance shall be provided for any shrinkage of the metal castings in order that the finished castings will accurately fit in their designated locations.

M. Mounting Frames and Rings: If the ceiling system requires it, each recessed and semi-recessed fixture shall be furnished with a mounting frame or ring compatible with the ceiling in which they are to be installed. The frames and rings shall be one piece or constructed with electrically welded butt joints and of sufficient size and strength to sustain the weight of the fixture.

N. Yokes, brackets and supplementary supporting members needed to mount lighting fixtures to carrier channels, suitable ceiling members or other structure shall be furnished and installed by the Contractor.

O. For steel and aluminum fixtures, all screws, bolts, nuts and other fastening and latching hardware shall be cadmium- (or equivalent) plated. For stainless steel fixtures, all hardware shall be stainless steel. For bronze fixtures, all hardware shall be stainless steel or bronze.

P. Welding shall be in accordance with recommendations of the American Welding Society and shall be done with electrodes and/or methods recommended by the manufacturers of the metals being welded. Welds shall be continuous, except where spot welding is specifically permitted. Welds exposed to view shall be ground flush and dressed smooth. All welds on or behind surfaces that will be exposed to view shall be done so that finished surfaces will be free of imperfections such as pits, runs, splatters, cracks, warping, dimpling, depressions or other forms of distortion or discoloration. All welded surfaces shall be free of weld splatter and welding oxides.

Q. Extruded aluminum frame and trim shall be rigid and manufactured from quality aluminum without blemish or warpage in the installed product. Miter cuts shall be accurate. Joints shall be flush and without burrs. Cuts shall maintain alignment with the light fixture located in its final position.

R. All extruded aluminum fixtures shall be fabricated of 6063 alloy (min. wall thickness 0.110 in.) and in all cases shall be provided with heavy-gauge internal alignment brackets in order to ensure clean, level and continuous appearance after installation. Unless otherwise noted, all end plates shall be continuously welded, filled and ground so as to present a clean, seamless and monolithic appearance. Exposed fasteners on end plates shall be absolutely prohibited. Overlap detail end plates shall not be acceptable.

S. Lampholders shall be suitable to operate the specified lamp as called for within each fixture type. Sockets shall be positioned such that the lamp is optically centered with respect to fixture operating efficiency and control of glare. Lampholders shall be compliant with the requirements of ANSI.

T. All fluorescent fixtures shall be equipped with a guarded disconnecting means between ballast and lamp.

U. Exit Signs: Exit signs are to have a power draw of no more than 5 watts per face. All exit signs are to be provided with a sticker or certificate showing power draw allowance.

V. Exit Sign Letter Height: Exit sign letters are to be 8 in. high in Group A and Group R-1 U.O.N. All other exit signs are to be 6 in. Refer to Architectural Code Compliance Drawings and Egress

Drawings for occupancy classifications and paths of egress.

W. Exit Sign Letter Height: Exit sign letters are to be 6 in. high U.O.N. Refer to Architectural Code Compliance Drawings or Egress Drawings for paths of egress.

X. Maximum Wattage Restriction Sticker: All light fixtures that contain a ballast, transformer or power supply source that is capable of supplying a greater wattage than the specified lamp shall contain a sticker stating that the maximum installed wattage is that of the specified lamp.

2.3 Light-Emitting Diode (LED) Fixtures

A. All power supplies to the fixtures, whether line voltage or low voltage shall also be UL-listed. One (1) manufacturer shall supply both the LED fixture and its driver to ensure compatibility.

B. For wet and damp locations, LED-based fixtures shall be sealed, rated and tested for appropriate environmental conditions, without the need for any additional housing or enclosure. LED fixture housing shall be designed to properly transfer heat from the LED board to the outside environment, given an ambient temperature range of -20°F to 120°F. Circuit boards shall require onboard thermocouples/thyristors that measure circuit board temperature, enabling the fixture to de-energize in the event of overheating.

C. LED fixtures shall be operated at constant and carefully regulated current levels. LED's shall not be overdriven beyond their specified nominal voltage and current.

D. All hardwired connections to LED fixtures shall be reverse-polarity protected and provide high-voltage protection in the event that connections are reversed or shorted during the installation process.

E. Power supplies provided with LED fixtures shall have outputs with current-limiting protection, miswiring protection and power factor correction. Power supplies shall be UL-listed for Class 2 wiring. All power supplies shall provide for knockouts for conduit connections or clamp-style connections for low-voltage wiring.

F. In the case of dimmed LED's, dimming shall be accomplished by means of high-speed digital, noise-shaping, pulse-width modulation (PWM) technology. Drivers shall not overdrive LED's beyond manufacturer's recommendations, and shall provide uniform, smooth, full-range dimming to one percent (1%). LED's shall maintain consistent brightness (and color, if applicable) throughout the dimming range. Drivers shall allow for manual fine-tuning, assuring that LED's remain consistent in appearance when controlled by different drivers.

G. Digital LED systems shall use integral and differential 14-bit or greater, non-linear scaling techniques for high-resolution output. An LED color changing system shall be capable of at least 8-bit control of red, green and blue LED's to produce 16.7 million colors or more.

H. LED fixtures that are digitally controlled shall have all products associated with their control (power supplies, wiring harnesses, power/data cables, optical isolators/repeaters, interfaces, etc.) provided by one (1) manufacturer. Control software shall likewise be provided by the same manufacturer. Software shall be Windows-based, and compatible with an Owner-supplied PC meeting the software manufacturer's minimum requirements.

I. Digital LED systems shall have a selectable means of external control via a data network. Each LED node or module (depending on the configuration) shall have the ability to be set to a unique digital address, accessible by manufacturer-supplied software.

J. The manufacturer shall have at least five (5) years' experience in designing and supporting digital LED systems and shall be capable of providing a list of at least ten (10) installations using software-based control and scheduling.

2.4 Transformers

A. Provide remote step-down transformers where required and properly wire to fixtures to ensure that voltage drop does not exceed five percent (5%), regardless of transformer's location. Circuiting shown on drawings is line voltage only. Provide transformers and secondary conductors as required.

B. All remote step-down transformers shall be mounted in approved NEMA-type enclosures and only located in areas deemed to be readily accessible by maintenance personnel.

C. Remote transformers shall be of the toroidal choke variety, shall be suitable for use with dimmers rated for magnetic low-voltage load, and shall operate at 96% efficiency.

D. Remote transformer housing shall be code-gauge welded steel and shall be suitable for indoor use.

2.5 Lamps

A. The Contractor shall provide all lamps as called out in the lighting fixture schedule or specifications and, upon request, shall provide a schedule of lamps that are being proposed for use on the project.

B. All linear fluorescent, compact fluorescent and high-intensity discharge lamps shall be in compliance with EPA Toxicity Characteristic Leaching Procedure and Characteristic Wastes (TCLP).

C. Total lamp mercury value shall not exceed 80 pg/lumen-hour for the total lamps on the project.

2.6 Light-Emitting Diodes (LED)

A. Unless otherwise indicated, all LED's shall be batch-sorted for color and brightness consistency and shall be manufactured by a reputable LED manufacturer. Substitution of LED's by other manufacturers shall be equal in all respects of initial and maintained lumen output, lamp life, color consistency and compatibility with specified equipment. LED's shall be warm white, color consistent to 3,200 degree Kelvin scale.

B. LED lumen output shall be in accordance with the specifications and shall not depreciate more than twenty percent (20%) after 10,000 hours of operation.

C. Fixture manufacturers wishing to supply LED's in their products other than those listed above must verify that the LED manufacturer has been fabricating LED's for a minimum of five (5) years. Substitutions shall be submitted in the form of both manufacturer's printed data and corresponding samples for review.

D. Provide operating sample of each type of LED fixture as listed in the lighting fixture specification appendix.

2.7 Finishes

A. Painted surfaces shall be synthetic enamel with acrylic, alkyd, epoxy, polyester or polyurethane base, light-stabilized, baked on at 350°F minimum, and catalytically or photochemically polymerized after application.

B. White Finishes: Minimum eighty-five percent (85%) reflectance (semi-gloss).

C. Selection: Unless otherwise noted, external fixture finishes shall be as selected by the Architect.

D. Undercoat: Except for stainless steel, all ferrous metal surfaces shall be given a five-stage phosphate treatment or other acceptable base bonding treatment before final painting and after fabrication.

E. Unpainted non-reflecting surfaces shall be satin-finished and coated with a baked-on clear lacquer to preserve the finish. Where aluminum surfaces are treated with an anodic process, the clear lacquer coating may be omitted.

F. Unpainted Aluminum Surfaces: Finish interior aluminum trims with an anodized coating of not less than 7 mg per square inch of a color and surface finish as selected by the Architect. Finish exterior aluminum and aluminum trims with an anodized coating of not less than 35 mg per square inch of a color and surface finish as selected by the Architect.

2.8 Reflectors

A. Reflectors, cones or baffles shall be absolutely free of spinning lines, stains, ripples or any marks or indentations caused by riveting to other assembly techniques. No rivets, springs or other hardware shall be visible after installation.

B. Downlight reflectors shall provide minimum 45 degree lamp and lamp image cutoff, unless otherwise specified.

C. Cone flanges shall be formed as an integral part of the cone and shall have identical color and finish as the cone, except as shown. The flange's major surface shall be perpendicular to the cone axis.

D. The reflecting surface of the cone or reflector shall be tested for proper sealing. Test per ASTM B136-63T. If any stain is visible, the specimen shall not be considered to have been properly sealed. Reflector cones shall be free of manufactured defects. The reflector inner surface shall be free of water spotting and shall maintain a reflectivity ratio of not less than ninety-five percent (95%) satin specular finish, ninety percent (90%) for all “white” finished internal reflectors.

E. All Alzak parabolic cones shall be guaranteed by the manufacturer against discoloration for a minimum of ten (10) years, and in the event of premature discoloration, shall be replaced by the manufacturer (including both materials and the cost of labor) at no cost to the Owner.

F. Where modification of standard fixtures is specified, fixtures shall be modified as required with lamp sockets positioned to provide the desired photometric performance.

G. Where or if a “specular black Alzak finish” is specified, high-gloss baked black enamel applied to the reflector shall be considered as an acceptable alternate.

H. Specular and semi-specular clear Alzak reflector cones and parabolic louvers specified with the use of compact fluorescent lamps or triphosphor fluorescent shall be provided with clear non-iridescent coating.

2.9 Stems

A. Each stem shall have a brass or steel swivel and hang straight, or be provided with other self-aligning device or design/construction, where required.

B. Stems shall be made of woven aircraft cable with a minimum 18 in. field adjustability.

C. Wherever a fixture or its hanger canopy is applied to a surface-mounted outlet box, a finishing ring shall be utilized to conceal the box. Maximum canopy depth shall be 1/8 in. See fixture details/specifications for canopy design.

D. All power feeds shall be via ST rated cord with a silver polyester mesh jacket.

E. Cables shall, at the completion of installation and all other work, be free of clamp marks, scratches and all other visual imperfections.

F. Unless otherwise indicated, cables shall be provided in order to adequately mount and level each fixture run with proper structural support per manufacturer's recommendations.

G. Pendant Fixtures: Install pendant lighting fixtures plumb and at a height from the floor as specified on the drawings. In cases where conditions make this impractical, refer to the Architect for direction. Use ball aligners and canopies on pendant fixtures, unless otherwise noted.

H. Pendants shall be equally spaced along every fixture run. If field conditions or fixture construction does not allow for this condition, immediately notify the Architect.

2.10 Lenses, Louvers, And Diffusers

A. Lenses/Louvers: All lenses, diffusers and shielding media shall be properly and securely mounted within fixture assemblies. Lay-i- type lenses and louvers shall not be acceptable. All shielding materials shall be tightly fitted with no loose panels or parts and shall show no visible leaks of unintentional or unscheduled light.

B. Lenses (Plastic)

1. Unless otherwise indicated or otherwise authorized, all plastic shielding, lenses and diffusers shall be white opal clear one hundred percent (100%) UV-stabilized virgin acrylic or, in special cases, high-impact polycarbonate (Lexan). Use of polycarbonate lenses shall be restricted to those areas outlined in the NYCEC. Use of polystyrene components is absolutely prohibited.

2. Plastic for lenses and diffusers shall be formed of colorless one hundred percent (100%) virgin acrylic as manufactured by Rohm & Haas, DuPont or preapproved equal. The quality of the raw material must meet American Society of Testing Materials (ASTM) standards, as tested by an independent test laboratory. Acrylic plastic lenses and diffusers shall be properly cast, molded or extruded as specified and shall remain free of any dimensional instability, discoloration, embrittlement or loss of light transmittance for at least fifteen (15) years.

C. Lenses (Glass)

1. Unless otherwise indicated or authorized, all-glass shielding, diffusers or lenses shall be clear tempered borosilicate glass. Soda lime glass material shall not be acceptable. Submit samples of glass elements upon request.
2. Glass used for lenses, refractors and diffusers in incandescent and tungsten halogen lighting fixtures shall be tempered for high impact and heat resistance; the glass shall be crystal clear in quality with a transmittance of not less than ninety-two percent (92%). For exterior fixtures, use tempered borosilicate glass, Corning No. 774-0 or equal.
3. Where optical lenses are used, they shall be free of spherical or chromatic aberrations and other imperfections that may hinder the functional performance of the lenses.
4. Mechanical: All lenses, louvers or other light-diffusing elements shall be removable but positively held so that hinging or other normal motion will not cause them to drop out.

PART 3 - EXECUTION

3.1 Installation

A. Furnish and install lighting fixtures as noted on the drawings. Fixtures shall be completely wired and lamps installed, and shall be in perfect operating condition at the time of completion.

B. Setting and Securing: Set lighting fixtures plumb, square and level with the ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved shop drawings.

C. Mounting: Mounting heights specified or indicated are to the bottom of the fixture for suspended and ceiling-mounted fixtures and to the center of the fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before installation is commenced and, where applicable, after coordinating with the type, style and pattern of the ceiling system being installed.

D. Coordination: The Installing Contractor shall coordinate with other trades as necessary to properly interface the installation of lighting fixtures with other work. All fixture lengths, whether straight or curvilinear, shall be fabricated based upon the fixture manufacturer's or Contractor's field-verified dimensions only. Contractor shall coordinate conduit entry locations with the fixture manufacturer.

E. Grounding: Ground non-current-carrying parts of electrical equipment. Where the copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

F. Installation of lighting fixtures shall be in strict accordance with the intent of the Contract Drawings and approved shop drawings.

G. Fixture Locations: Do not scale Electrical Drawings for exact location of the lighting fixtures. In general, the architectural reflected ceiling plans indicate the proper locations of lighting fixtures.

H. Coves: Where indicated, all uplight or wallwash coves utilizing fluorescent equipment shall be installed so as to produce a continuous and unbroken band of light free of visual imperfections, socket shadows, light gaps, etc., from end to end of cove. The inability to provide this appearance shall be brought immediately to the Architect's attention prior to installation.

I. Provide hangers, rods, mounting brackets, supports, frames, earthquake clips and other equipment normally required for the proper, safe and distortion-free installation in the various surfaces in which they appear. Determine surface types from the Architectural Drawings.

J. Instructions: Each lighting fixture shall be packaged with complete illustration and instructions showing how to install. Install lighting fixtures in strict conformance with manufacturer's recommendations and instructions.

K. Rigidly align continuous rows of lighting fixtures for true aligned appearance.

L. Mechanical Rooms: Lighting fixture locations in Mechanical and Electrical Equipment Rooms are approximate. Coordinate mounting height and location of lighting fixtures to clear mechanical, electrical and plumbing equipment and to illuminate adequately meters, gauges and equipment.

M. Support all lighting fixtures independently of ductwork or piping.

N. Splices in internal wiring shall be made with approved insulated wire nut-type mechanical

connectors, suitable for the temperature and voltage conditions to which they are subjected.

O. All wire utilized for connections to or between individual lamp sockets and lamp auxiliaries (i.e., wires that do not constitute through-circuit wiring) shall be suitable for temperature, current, and voltage conditions to which they are subjected.

P. Install reflector cones, baffles, aperture plates and light-controlling elements for air handling fixtures and decorative elements after completion of ceiling tiles, painting and general cleanup.

Q. Replace blemished, damaged or unsatisfactory fixtures as directed by the Owner.

R. Provide information/description to the Construction Manager/General Contractor to coordinate architectural existing ceiling pendent locations with description for existing J-box/canopy conditions.

S. Protection: Protect installed fixtures from damage during the remainder of the construction period.

T. Tests: Upon completion of installation of lighting fixtures and after building circuits have been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

3.2 Aiming And Adjustment

A. All adjustable lighting units shall be aimed, focused, locked, etc., by the Contractor under the supervision of the Architect or Engineer. The Architect or Engineer shall indicate the number of crews (foreman and apprentice) required. All aiming and adjusting shall be carried out after the entire installation is complete. All ladders, scaffolds, mechanized lifts, etc., required shall be furnished by the Contractor at the direction of the Architect or Engineer. As aiming and adjusting is completed, locking set screw, bolts and nuts shall be tightened securely.

B. Night Work: Where possible, units shall be focused during the normal working day. However, where daylight interferes with visual acuity, aiming shall be accomplished at night.

3.3 Erection Of Poles

A. Set reinforcement for anchor bolts, nuts, and washers according to anchor-bolt templates furnished by pole manufacturer. For concrete finish, trowel and rub smooth.

B. Install poles as follows:

1. Use web fabric slings (not chain or cable) to raise and set poles.
2. Mount the pole to the foundation with leveling nuts, and tighten top nuts to the torque level recommended by the pole manufacturer.
3. Secure poles level, plumb and square.
4. Grout the void between pole base and foundation. Use non-shrink or expanding concrete grout firmly packed to fill space.
5. Use a short piece of 1/2 inch (13 mm) diameter pipe to make a drain hole through the grout. Arrange to drain condensation from interior of pole.

C. Ground metal poles/support structures as follows:

1. Install grounding electrode for each pole.
2. Non-Metallic Poles: Ground metallic components of pole accessories and foundations.
3. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

D. Corrosion Prevention

1. Aluminum: Do not use in contact with earth or concrete. When in direct contact with dissimilar metal, protect aluminum by insulating fittings or treatment.
2. Steel Conduits: In concrete foundations, wrap conduit with 0.010 inch (0.254 mm) thick pipe-wrapping plastic tape applied with a fifty percent (50%) overlap.

3.4 Cleanup

A. Clean: Clean lighting fixtures of dirt and debris on completion of installation, with materials and by methods recommended by the manufacturer.

B. Final Acceptance: At the time of Final Acceptance by the Owner, all broken parts shall have been replaced and all lamps shall be operative.

3.5 Factory Testing

A. All standard factory tests shall be performed in accordance with the latest version of NEMA and UL standards.

3.6 Field Testing

A. Lighting Fixtures: Lighting fixtures shall be operationally tested.

B. Lighting Battery Ballasts/Inverters: Battery ballasts/inverters shall have an operational test performed following installation.

C. Refer to Section 26 08 00 for additional testing requirements for lighting fixtures.

3.7 Progress Inspections

A. Public Assembly Emergency Lighting: Upon completion of lighting, lighting control and emergency power system and Substantial Completion of architectural elements, including walls, ceilings, floors, and furniture systems, Contractor shall alert of readiness for testing. Contractor shall give a minimum one (1) week notice of emergency lighting testing to responsible party signing the TR-1 form.

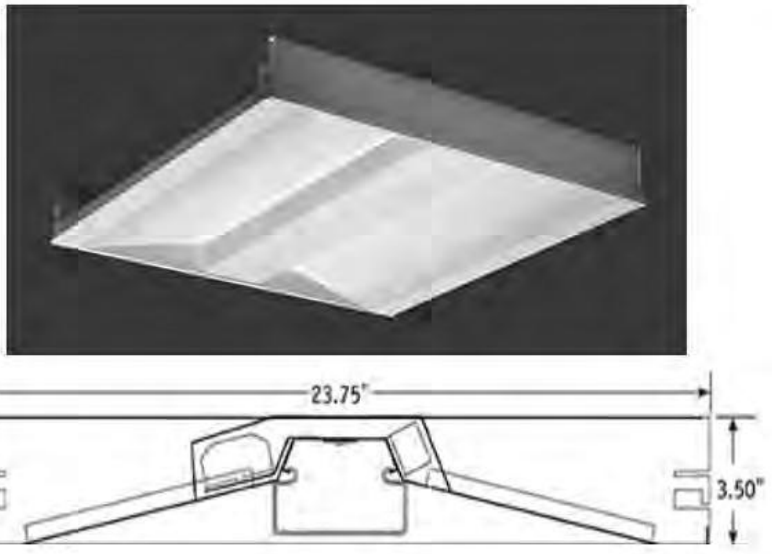
B. Energy Code Compliance Inspections: Upon Substantial Completion of lighting and lighting control installation, Contractor shall alert readiness for inspection. Contractor shall give a minimum one (1) week notice for inspection to responsible party signing TR-1 form. During test, ballast/transformers and lamps for each fixture type shall be accessible along with sticker of wattage of exit signs.

PART 4 - LUMINAIRE CUT SHEETS

4.1 FIXTURE TYPE FF

FIXTURE TYPE:	**"FF"**
DESCRIPTION:	Recessed 2x2 lensed LED fixture. Cold-rolled steel housing shall be 3.5" deep, with white powder coat finish . Square diffuser shall be made of high transmission acrylic material with linear ribbing. Integral driver shall be electronic and dimmable to 1% with 0-10V dimming controls.
MANUFACTURER:	**MERCURY 'LR305': LR305-22G-3400-35K-1%-UNI**
ALTERNATE MANUFACTURER:	National, Metalux, or Axis
LAMPS:	32W; 3400 lumen; 80+ CRI; 3500K LED
CONTROL GEAR:	Electronic and dimmable (0-10V).
LOCATION:	General
COMMENTS:	Contractor shall verify that fixture is compatible with specified ceiling system. Coordinate voltage with electrical drawings.

GRAPHIC

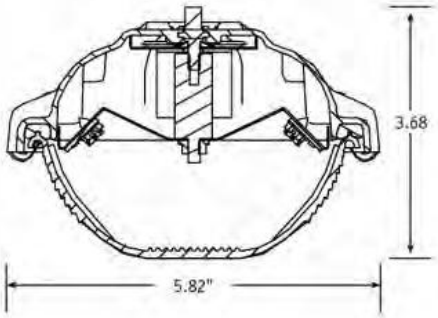


TYPE FF

4.2 FIXTURE TYPE FG

FIXTURE TYPE:	**"FG"**
DESCRIPTION:	Pendant-mounted linear lensed fixture. Fixture to be nominally 6" wide x 4" deep x 4' long. Fixture to have injection molded clear acrylic lens with multiple linear and cross prism pattern to provide batwing distribution. Fixture to be UL listed for wet location.. Provide with tamperproof latches for toolless access.
MANUFACTURER:	**MERCURY 'L701-GL': L701-GL-4-4800-35K-PIM-1%-UNI-TP**
ALTERNATE MANUFACTURER:	Lamar, National, or Zumtobel
LAMPS:	48W; 4800 lumen; 80+ CRI; 3500K LED
CONTROL GEAR:	Electronic and dimmable to 1% (0-10V)
LOCATION:	Parking Garage
COMMENTS:	Align bottom of fixture with lowest ceiling device, element and/or equipment.

GRAPHIC

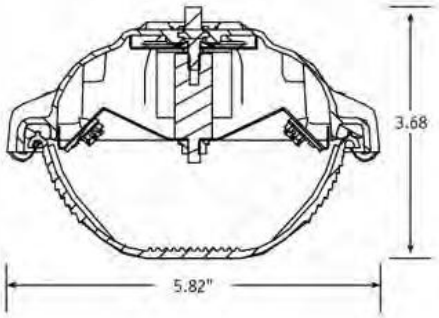


TYPE FG

4.3 FIXTURE TYPE FG1

FIXTURE TYPE:	**"FG1"**
DESCRIPTION:	Pendant-mounted linear lensed fixture. Fixture to be nominally 6" wide x 4" deep x 4' long. Fixture to have injection molded clear acrylic lens with multiple linear and cross prism pattern to provide batwing distribution. Fixture to be UL listed for wet location.. Provide with tamperproof latches for toolless access.
MANUFACTURER:	**MERCURY 'L701-GL': L701-GL-4-8000-35K-PIM-1%-UNI-TP**
ALTERNATE MANUFACTURER:	Lamar, National, or Zumtobel
LAMPS:	84W; 8000 lumen; 80+ CRI; 3500K LED
CONTROL GEAR:	Electronic and dimmable to 1% (0-10V)
LOCATION:	Parking Garage Entrance
COMMENTS:	Align bottom of fixture with lowest ceiling device, element and/or equipment.

GRAPHIC

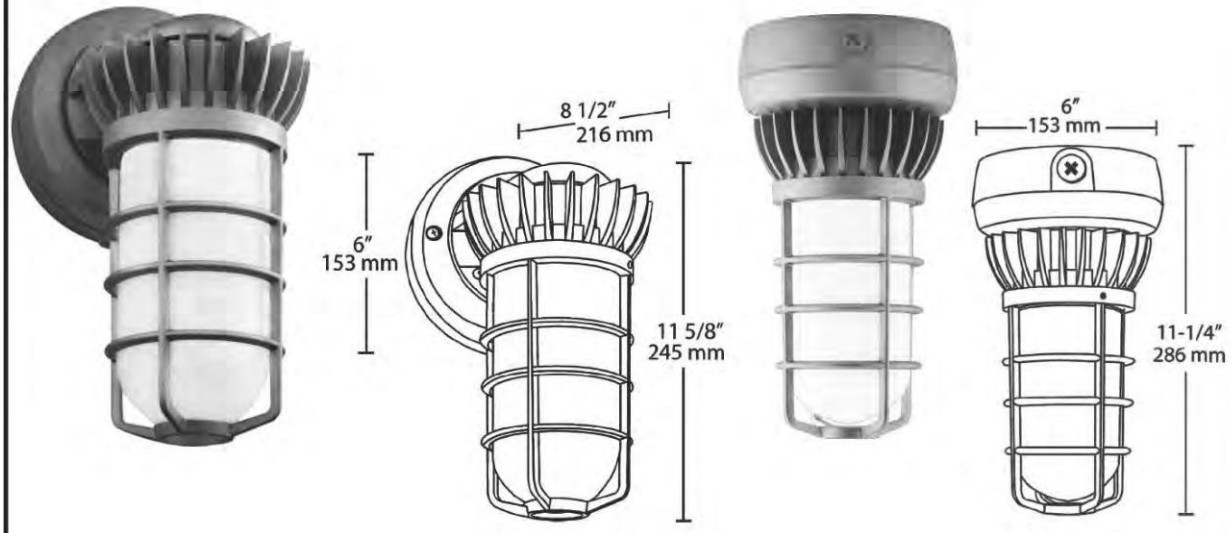


TYPE FG1

4.4 FIXTURE TYPE FJ

FIXTURE TYPE:	**"FJ"**
DESCRIPTION:	Surface, wall, or pendant mounted LED jelly jar fixture. Fixture to be nominally 12" in length X 8-1/2" in diameter. Fixture to have a cast aluminum grill and fittings with a frosted glass globe. Fixture finish to be brushed aluminum and to be coordinated with architect. Driver to be suitable a minimum starting temperature of 0 degree F. Fixture to be suitable for wet location.
MANUFACTURER:	**RAB: VXLED-VXBRLED-26YDG**
ALTERNATE MANUFACTURER:	Stonco, Hubbell, Exceline, or Guth.
LAMPS:	26W white LED module; 3000 K, 81+ CRI, 1400 lumens
CONTROL GEAR:	Electronic
LOCATION:	General.
COMMENTS:	Provide 10% spares in electrical/mechanical rooms using this fixture type. Coordinate exact mounting with field conditions.

GRAPHIC



TYPE FJ

4.5 FIXTURE TYPE FJ1

FIXTURE TYPE:	**"FJ1"**
DESCRIPTION:	Similar in all aspects to type 'FJ' except in mounting. Fixture to be mounted on mechanical equipment. Coordinate exact mounting with HVAC equipment.
MANUFACTURER:	**RAB: VXLED-VXBRLED-26YDG**
ALTERNATE MANUFACTURER:	Stonco or Hubbell
LAMPS:	26W white LED module; 3000 K, 81+ CRI, 1400 lumens
CONTROL GEAR:	Electronic
LOCATION:	General.
COMMENTS:	Coordinate exact mounting with field conditions.

GRAPHIC

TYPE FJ1

4.6 FIXTURE TYPE FJ2

FIXTURE TYPE:	**"FJ2"**
DESCRIPTION:	Similar in all aspects to type 'FJ' except fixture to have blue globe.
MANUFACTURER:	**RAB: VXLED-VXBRLED-26YDG-BLUE GLOBE**
ALTERNATE MANUFACTURER:	Stonco or Hubbell
LAMPS:	26W white LED module; 3000 K, 81+ CRI, 1400 lumens
CONTROL GEAR:	Electronic
LOCATION:	General.
COMMENTS:	Coordinate exact mounting with field conditions.

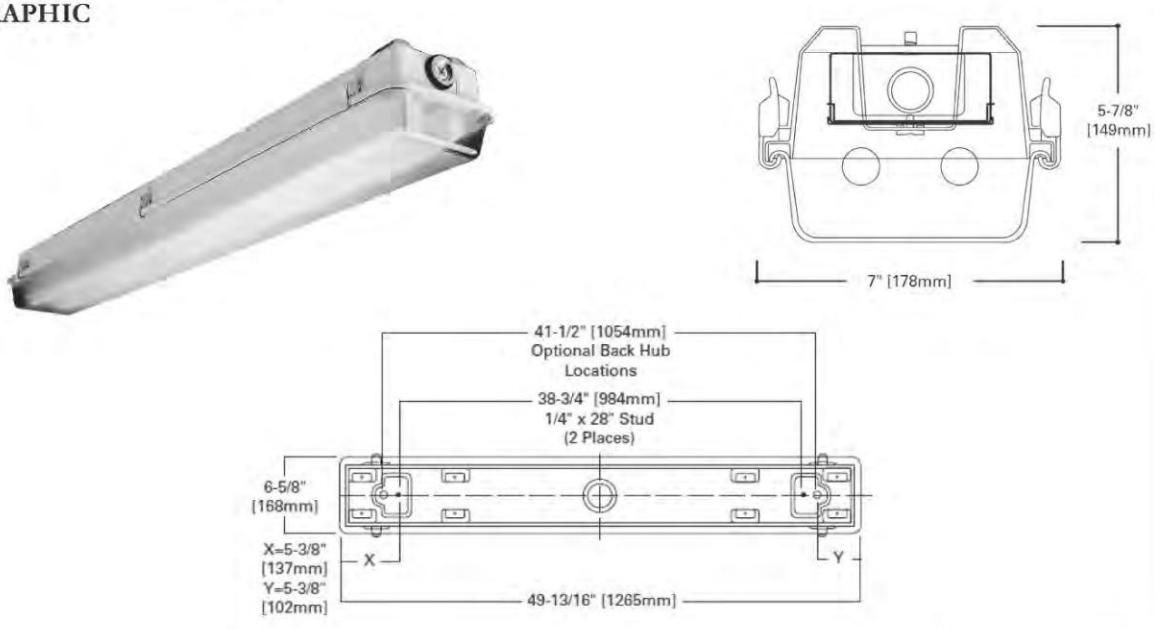
GRAPHIC

TYPE FJ2

4.7 FIXTURE TYPE FK

FIXTURE TYPE:	**"FK"**
DESCRIPTION:	Surface or pendant mounted, enclosed and gasketed LED industrial fixture. Fixture to be nominally 5-7/8" deep X 7" wide X 4' long. Fixture to be gasketed. and suitable for wet location. Lens to be internal prismatic with a medium distribution. Fixture to contain an integral driver suitable for dual 120/277 V operation. Provide a 10 watt (1050 minimum lumen) integral emergency battery driver for all locations with BP designation on electrical drawings.
MANUFACTURER:	**METALUX: 4VT2-LD4-4-DR-UNV-L835-WL**
ALTERNATE MANUFACTURER:	Mercury, Legion, National, or Lamar.
LAMPS:	38W LED module; 3500K, 85+ CRI, 4000 lm output.
CONTROL GEAR:	Electronic driver.
LOCATION:	Mechanical/Electrical Rooms; Storage.
COMMENTS:	Provide 10% spares in electrical/mechanical rooms using this fixture type. Coordinate exact mounting with field conditions.

GRAPHIC

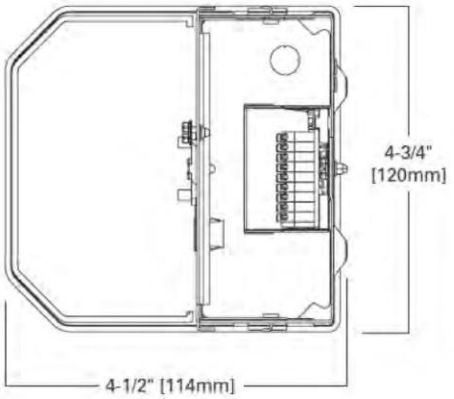


TYPE FK

4.8 FIXTURE TYPE FS

FIXTURE TYPE:	**"FS"**
DESCRIPTION:	Surface mounted LED lensed wraparound fixture. Fixture to be nominally 4-1/2" deep X 4-3/4" high X 4' long. Housing shall be die formed cold rolled steel. Lens te made of smooth opal white acrylic. Coordinate exact mounting condition and location with architect and contractor. Provide a 14 watt (1315 minimum lumen) integral emergency battery driver for all locations with BP designation on electrical drawings.
MANUFACTURER:	**METALUX: 4-BCLED-LD4-48HL-F-UNV-L835**
ALTERNATE MANUFACTURER:	Mercury, Legion, National, or Lamar.
LAMPS:	58W, 4800 Lumens, 85CRI, 3500 K.
CONTROL GEAR:	Electronic driver
LOCATION:	Stairwells
COMMENTS:	

GRAPHIC



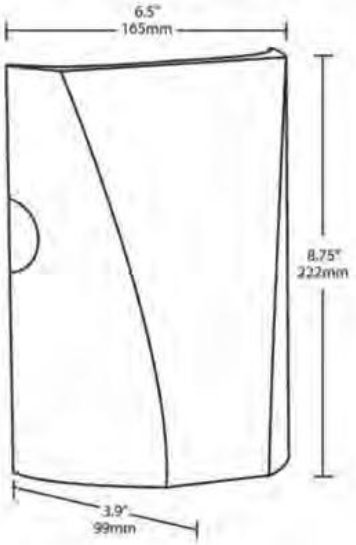
Fixture shall be mounted at 9'-0" A.F.F.

TYPE
FS

4.9 FIXTURE TYPE X1

FIXTURE TYPE:	**"X1"**
DESCRIPTION:	Surface mounted LED fixture with directed light. Die-cast aluminum housing shall be 6" wide x 9" high x 4" deep. Housing shall be supplied with mounting bracket for direct mounting over a j-box. Internal reflector shall be specular thermoplastic. Fixture shall have clear tempered glass lens and shall be fully gasketed. Coordinate exact finish with the architect. Fixture shall be IP66 rated.
MANUFACTURER:	**RAB 'SLIM' - SLIM26Y-D10**
ALTERNATE MANUFACTURER:	We-ef, Design Plan, Erco
LAMPS:	26W; 3500 Lumen; min. 70 CRI; 3000K LEDs
CONTROL GEAR:	Electronic and dimmable (0-10V)
LOCATION:	Exterior Egress Stairs
COMMENTS:	Fixture to be mounted above egress door.

GRAPHIC

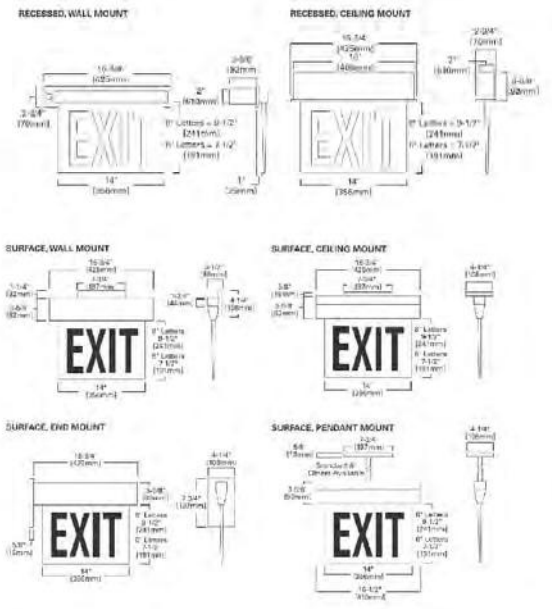


TYPE
X1

4.10 FIXTURE TYPE EX6

FIXTURE TYPE:	**EX6**
DESCRIPTION:	Recessed wall or ceiling, surface wall, ceiling or end mount or pendant mounted, single or double faced, edge-lit exit sign. Sign to use LED lamps and contain integral battery pack. Letters to be "red," 6" high with arrows as indicted on drawings. Panel to be clear acrylic, edge-lit with white backing. Finish to be coordinated with architect. Exact location and mounting conditions to be coordinated with architect and contractor.
MANUFACTURER:	**ATLITE: S-C/W/SCM/SEM/SBM/SPM-1/2-6-RC/RM-PA-XX**
ALTERNATE MANUFACTURER:	Encore, Chloride, or Sure-Lites
LAMPS:	LED
CONTROL GEAR:	Electronic driver; Integral battery.
LOCATION:	General
COMMENTS:	Exit sign shall not exceed 5 watts per face. Provide for non-public assembly spaces. Refer to life safety drawings.

GRAPHIC

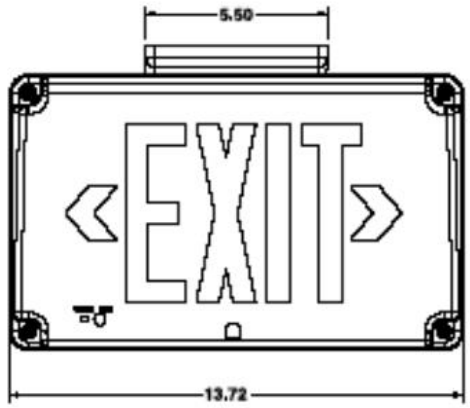


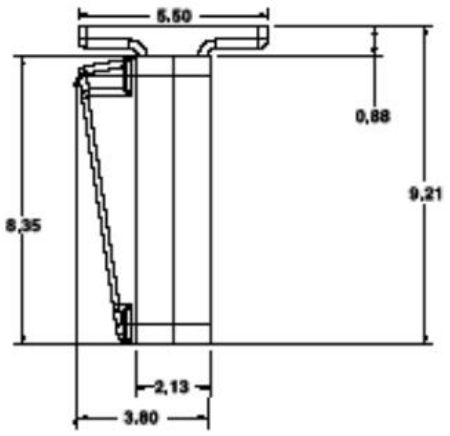
TYPE
EX6

4.11 FIXTURE TYPE EX-W

FIXTURE TYPE:	**EX-W**
DESCRIPTION:	Wall or ceiling mounted, single/double faced wet location exit sign, using LED lamps. Letters to be red, 6" high, with arrows as indicated on drawings. Panel to be injection molded clear polycarbonate. Housing finish to be coordinated with architect. Exact location to be coordinated with architect and contractor. Exit sign to contain battery pack.
MANUFACTURER:	**ATLITE: UXN-6-D-R-1/U-NEMA 4X**
ALTERNATE MANUFACTURER:	Encore, Chloride, or Sure-Lites
LAMPS:	LED
CONTROL GEAR:	Electronic driver; Integral battery.
LOCATION:	General
COMMENTS:	Exit sign shall not exceed 5 watts per face. Refer to life safety drawings for exact location.

GRAPHIC





TYPE
EX-W

END OF SECTION 26 51 00

SECTION 26 56 00

EXTERIOR LIGHTING

PART 1- SUMARY

1. SCOPE

A. Lighting fixtures using solid-state LED technology serving the exterior of the parking garage and community center

2. WARRANTY AND MAINTENANCE SERVICE

A. LED Arrays: 10 Years from date of Beneficial Occupancy

B. LED Drivers: 10 Years from date of Beneficial Occupancy

C. Full Maintenance Service Warranty Service: 2 Years

3. DEFINITIONS

A. CCT: Correlated color temperature

B. CRI: Color-rendering index.

C. IP: International Protection or Ingress Protection Rating.

D. LED: Light-emitting diode.

E. LER: Luminaire efficacy rating.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting fixture, including lamp, reflector, and housing.

4. SYSTEM

A. Operation System:
   1. Automatic operation of standard white light exterior luminaries via photo eye sensors: NEC & NYCEC
   2. Programmed dynamic control system

B. Auxiliary Operations:

   1. Certain fixtures require battery-powered emergency automatic backup service for evacuation in the event of power loss: NEC & NYCEC

C. All Fixture housing mounted within 8’ of the floor or ground shall be sufficiently tamper proof

PART 2- PRODUCTS:

1. LUMENAIRES

A. Fixture designation(s): A, B, D, E, F, & L

B. May Apply to additional fixtures as design developments proceed

C. Catalog numbers indicated in the Luminaire Schedule are a design series reference and do not necessarily represent the exact catalog number, size, voltage, wattage, type of light bar, driver, finish trim, ceiling type, mounting hardware or special requirements as specified or as required by the particular installations. Provide complete luminaire to correspond with the features, accessories, number of LED’s, wattage and/or size specified in the text description of each luminaire type. Additional features, accessories and options specified shall be included.

D. Provide all frames, supplementary support structures, hangers, spacers, stems, aligner canopies, auxiliary junction boxes and other hardware as required for a complete and proper installation. Recessed luminaries shall have frames that are compatible with the ceiling systems.

E. Luminaire voltage shall match the voltage of the circuit serving same.

F. Comply with UL 1598.

G. Luminaries provided shall have means for disconnection from power source during service, as required in NEC Article 410.

H. Lenses, Covers, Diffusers and Globes:

a. Acrylic Lighting Diffusers: 100% virgin acrylic plastic. UV stabilized high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

1) Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

2) Lenses shall have uniform brightness throughout the entire visible area without LED pixelation.

b. Glass Globes: Annealed crystal glass unless otherwise indicated.

I. Adjustable luminaries shall have positive locking devices to fix aiming angle. Luminaries shall be capable of being serviced without adjusting aiming angle.

J. Factory-Applied Labels: Comply with UL 1598. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when light bars are in place.

K. Luminaries shall be free of light leaks while providing sufficient ventilation of LED’s and drivers to provide the required photometric performance.

L. Luminaries shall hold LED arrays securely against normal vibration and maintenance handling.

M. Comply with IES LM-79-08 Approved Method for measuring lumen maintenance of LED light sources.

N. Comply with IES LM-80-08 Approved Method for electrical and photometric measurement of SSL product.

O. Comply with In-Situ testing for more reliable results.

P. LED's shall be Restriction of Hazardous Substances Directive (RoHS) compliant.

Q. All luminaries and drivers shall operate within the temperature limits of their design and as specified by UL in the applications and mounting conditions specified.

R. LED arrays shall be sealed, high performance, long life type; minimum 70% rated output at 50,000 hours. (L70)

S. LED luminaries shall deliver a minimum of 80 lumens per watt.

1. LED's shall be "Bin No. 1" quality.

T. The LED light source shall be fully dimmable with use of compatible dimmers switch designated for low voltage loads.

U. LED color temperatures: 4000k or as noted, +/- 275K.

V. Luminaries shall have internal thermal protection.

W. Luminaries shall not draw power in the off state. Luminaries with integral occupancy, motion, photo-controls, or individually addressable luminaries with external control and intelligence are exempt from this requirement. The power draw for such luminaries shall not exceed 0.5 watts when in the off state.

X. Color spatial uniformity shall be within .004 of CIE 1976 diagram.

Y. Color maintenance over rated life shall be within .007 of CIE 1976.

Z. Indoor luminaries shall have a minimum CRI of 85.

AA. Luminaire manufacturers shall adhere to device manufacturer guidelines, certification programs, and test procedures for thermal management

BB. LED package(s)/module(s)/array(s) used in qualified luminaries shall deliver a minimum 70% of initial lumens, when installed in-situ, for a minimum of 50,000 hours.

CC. Luminaries shall be fully accessible from below ceiling plane for changing drivers, power supplies and arrays.

2. SPECIALTY COLOR CONTROLLED LUMENAIRES

A. Fixture designation(s): I, J, & K

B. May Apply to additional fixtures as design developments proceed

C. Catalog numbers indicated in the Luminaire Schedule are a design series reference and do not necessarily represent the exact catalog number, size, voltage, wattage, type of light bar, driver, finish trim, ceiling type, mounting hardware or special requirements as specified or as required by the particular installations. Provide complete luminaire to correspond with the features, accessories, number of LED's, wattage and/or size specified in the text description of each luminaire type. Additional features, accessories and options specified shall be included.

D. Provide all frames, supplementary support structures, hangers, spacers, stems, aligner canopies, auxiliary junction boxes and other hardware as required for a complete and proper installation. Recessed luminaries shall have frames that are compatible with the ceiling systems.

E. Luminaire voltage shall match the voltage of the circuit serving same.

F. Comply with UL 1598.

G. Luminaries provided shall have means for disconnection from power source during service, as required in NEC Article 410.

H. Lenses, Covers, Diffusers and Globes:

   a. Acrylic Lighting Diffusers: 100% virgin acrylic plastic. UV stabilized high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

      1) Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

      2) Lenses shall have uniform brightness throughout the entire visible area without LED pixelation.

   b. Glass Globes: Annealed crystal glass unless otherwise indicated.

I. Adjustable luminaries shall have positive locking devices to fix aiming angle. Luminaries shall be capable of being serviced without adjusting aiming angle.

J. Factory-Applied Labels: Comply with UL 1598. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when light bars are in place.

K. Luminaries shall be free of light leaks while providing sufficient ventilation of LED's and drivers to provide the required photometric performance.

L. Luminaries shall hold LED arrays securely against normal vibration and maintenance handling.

M. Comply with IES LM-79-08 Approved Method for measuring lumen maintenance of LED light sources.

N. Comply with IES LM-80-08 Approved Method for electrical and photometric measurement of SSL product.

O. Comply with In-Situ testing for more reliable results.

P. LED's shall be Restriction of Hazardous Substances Directive (RoHS) compliant.

Q. All luminaries and drivers shall operate within the temperature limits of their design and as specified by UL in the applications and mounting conditions specified.

R. LED arrays shall be sealed, high performance, long life type; minimum 70% rated output at 50,000 hours. (L70)

S. LED luminaries shall deliver a minimum of 80 lumens per watt.

1. LED's shall be "Bin No. 1" quality.

T. The LED light source shall be fully controllable with use of DMX or E.131 protocols.

U. Luminaries shall have internal thermal protection.

V. The power draw shall not exceed 0.5 watts when in the off state.

W. Color spatial uniformity shall be within .004 of CIE 1976 diagram.

X. Color maintenance over rated life shall be within .007 of CIE 1976.

Y. Luminaire manufacturers shall adhere to device manufacturer guidelines, certification programs, and test procedures for thermal management

Z. LED package(s)/module(s)/array(s) used in qualified luminaries shall deliver a minimum 70% of initial lumens, when installed in-situ, for a minimum of 50,000 hours.

AA. Luminaries shall be fully accessible from below ceiling plane for changing drivers, power supplies and arrays.

2. POWER SUPPLIES AND DRIVERS

A. Drivers shall be solid state and accept 120 through 277 VAC at 60 Hz input.

B. Power Factor: 0.90 or higher

C. Maximum driver case temperature not to exceed driver manufacturer recommended in situ operation.

D. Output operating frequency: 60Hz.

E. Interference: EMI and RFI compliant with FCC 47 CFR Part 15.

F. Total Harmonic Distortion Rating: 20% Maximum.

G. Meet electrical and thermal conditions as described in LM-80 Section 5.0.

H. Fully dimmable, 0 – 10 VDC standard.

I. Secondary Current: Confirm secondary current specified by individual luminaire manufacturers.

J. Compatibility of dimming switches: Certified by manufacturer for use with individually specified luminaire and individually specified control components.

3. DYNAMIC LIGHTING CONTROL SYSTEM

A. General

1. Control System manufacturer to provide hardware and software to control the various components of the facility technical systems (lighting and video), and report on the operational condition of all system components, as per the specifications below.

2. The lighting controller shall be a microprocessor based lighting system designed specifically as a multi-purpose lighting and show playback controller for entertainment and architectural applications. A personal computer running emulation software shall not be acceptable.

3. The controller shall be an integrated device that combines DMX-based lighting playback with architectural control features, scripting capability, various I/O ports for system integration and web-based programming and operation.

4. The controller shall store all of its programming data in non-volatile flash memory, including built-in flash memory and/or a removable flash memory card and can be transferred to/from a remote personal computer via Ethernet.

5. The controller shall be able to begin playback automatically when power is applied without requiring any external input.

6. The controller shall have an internal real-time clock and calendar that operates from an internal lithium battery even in the absence of external power and be able to trigger shows and other events based on time of day, sunrise, sunset, day of week, day of year and/or a combination of these events.

7. The controller shall be capable of synchronizing its operation with and/or remotely controlling other controllers of the same kind across an Ethernet network.

8. The controller shall support standard entertainment grade lighting playback models including direct channel control, fixture level control, groups, channel parking, scaling, disabling, offsets, transparency, tracking and overrides, which can be used to create sub-masters and grandmaster control, partitioning, zones and other control setups.

9. The controller shall have the ability to operate as a lighting backup device with automatic DMX takeover in the case of loss of external DMX input signal.

B. Data

1. DMX

a. Control System shall be able to output twenty (20) universes of USITT DMX512 over streaming ACN E1.31 to control lighting equipment and media servers.

b. Control system shall be able to exchange status and override commands between the Controller and BIM controls (by others).

2. RDM

a. Control System shall be able to initiate device discovery, Send GET and SET commands, and receive RDM response messages from lighting fixtures via RDM compliant streaming ACN E1.31 gateways, including:

1. Fixture errors

2. Operation hours

3. Resetting lamp hours counter

4. Discovery of new fixtures (when fixtures are swapped out for maintenance)

5. Setting fixture DMX addresses

3. TCP

a. Control system shall be capable of exchanging pre-defined UPD messages for the purpose of communication

4.Functionality

A. Scheduling

1. General: Control system shall be capable of initiating all cues, sequences, and timed events as per a scheduler that incorporates the functionality of an astronomical clock such that any event can be set to occur at any specified time as an offset in relation to sunset or sunrise, or at any clock time, on any given day.

B. Daily Schedule

1. Lights Beginning of Day (BOD) sequences shall be executed at a pre-determined offset to the astrological sunset that day. This offset shall be selectable by the commissioning programmer.

2. Lights End of Day (EOD) sequences shall be executed at a time selected by Engineering users. End user shall be able to pre-program five (5) EOD sequence times to correspond with between 5 and 10, (exact number TBD) Seasons of park operations. (see 4.B.1.c)

C. Manual Override

1. Control system shall provide the means to manually override the scheduled EOD sequence in case of emergency via the engineering touch screen (see User Interface, below).

2. Control system shall provide the means to manually override the scheduled EOD sequence via a DMX command from Park Wide control.

D. Automatic Response to Error Condition

1. Control system shall have the ability to parse incoming RDM errors and execute a response sequence. (example: An error message is received that a particular light in not striking. The controller parses the message and strikes a backup fixture to take its place.)

E. Onsite Interactivity

1. Control System shall receive inputs from sensors attached to the local network and generate real time synchronous responses.

2. Control System shall be capable of parsing data received from external online sources and trigger appropriate lighting states based on preset ranges of the data.

F. Error Reporting & Logging

1. Control system shall be able to issue on-screen warnings and error messages for the operations crew and engineering, and generate error logs for review by engineering when any reportable system malfunctions may exist, including but not limited to:

a. Lighting fixture not responding

b. Lighting fixture lamp failure

c. Fixture over-temp error

d. Scroller error

e. Lighting fixture lamp hours over 90% of duty cycle as set by the commissioning programmer.

f. Lighting fixture lamp hours over 100% of duty cycle as set by the commissioning programmer

G. Lighting Fixture Maintenance Routine

1. Control system shall be capable of automatically discovering new lighting fixtures swapped out for maintenance, associating their RDM ID's to the correct control channel, and setting their DMX start addresses, via the Engineering Touchscreen as described below in section IV, B, 1, b.

H. User Interface

1. Operations Screen

a. Control system user interface shall include one (1) customizable LCD display, capable of displaying the following four (4) screen states:

1) System Off -- text displays the BOD and EOD sequence times for the day.

2) System On w/ no errors -- text displays the EOD sequence time for that day.

3) System On w/errors -- Background screen flashing w/ text displays error summary message and EOD sequence time for that day.

4) Critical Error - Screen red, White text displays "CRITICAL" and auto EOD sequence time for that day.

b. Operations touch screen shall be located in the maintenance control center, or other operator location TBD.

2. Engineering Touchscreen

a. Control system user interface shall include 1 touch screen, with a diagonal measurement of approximately seventeen (17) inches.

b. Main Navigation Screen shall include three (3) tabs.

c. Tab one (1) shall display an interactive facility map image divided into zones, with the following functionality. Reportable malfunctions in any zone cause that zone to change from green to red. Touching a zone reveals the zone drill-down where the following is displayed:

1) Current reportable malfunctions in that zone

2) All Clear text when no malfunctions are reported

3) Current Day's BOD and EOD sequence times

4) Schedule (table view) of all lighting fixtures in zone with the following information and selectable options displayed for each fixture:

a) Fixture Status (lamp on/off),

b) Operation Lamp Hours,

c) button to Reset Lamp Hours,

d) toggle Test button to strike and dowse the fixture's lamp, and

e) Discover/Address New Fixture button to address new fixture and associate its RDM ID to that fixture's channel number when a fixture is swapped out for maintenance.

d. Tab two (2) shall include a programming interface with the following functionality:

1) Allow engineering to update between 5 and 10 (exact number TBD) season start dates and EOD sequence times

2) Allow engineering to manually override the current day's EOD sequence time, to avoid a “lights out “condition in case of an emergency.

e. Tab three (3) shall provide the means for engineering to view and print error logs for the attraction, for a selected day or week, sorted by zone.

f. Tab four (4) shall include heartbeat health data from 3rd party connected servers and any manual override button control for the system.

g. Engineering touchscreen shall be located in the EER for the facility

PART 3- EXECUTION: For further development after Award of project.

END OF SECTION 26 51 00

SECTION 27 03 00

COMMUNICATIONS FIBEROPTIC CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install all fiberoptic cable as specified herein and as required for proper distribution of all wire, cable and electrical conductors throughout the project as indicated on the drawings and in accordance with the Contract Documents.

B. Section includes:

1. Laser-optimized multi-mode fiberoptic cable (LOMMF).
2. Single-mode fiberoptic cable.
3. Fiberoptic terminations.
4. Fiberoptic connector types.
5. Fiberoptic testing.

1.2 RELATED DOCUMENTS

A. Refer to Divisions 01, 14, 21, 23, 22, 26 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 27 00 00.03 – Table of Contents for Communications for specification sections that apply to all work herein.

1.3 REFERENCES

A. All fiberoptic cable, connectors, mounting devices and all components shall be designed, manufactured and tested in accordance with the latest applicable codes and reference standards including, but not limited to, the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City.
   a. Building Code of the City of New York.
   b. International Building Code.
   c. National Electrical Code.
   d. New York City Electrical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   e. TIA Telecommunications Building Wiring Standards
   f. BICSI Telecommunications Distribution Methods Manual

1.4 SUBMITTALS

A. The following submittal data shall be furnished according to the conditions of the Construction Contract, Division 01 and Section 27 00 00 and shall include, but not be limited to:

1. LOMMF cable.
2. Single-mode fiber cable.
3. Fiberoptic housing.
4. Fiberoptic terminations.
5. Fiberoptic connectors.

1.5 WARRANTY

A. Comply with the requirements of the Contract Documents and Section 27 05 00.

PART 2 - PRODUCTS

2.1 UNAUTHORIZED MATERIALS

A. Materials and products required for work of this section shall not contain asbestos, polychlorinated biphenyl's (PCB's) or other hazardous materials identified by the Owner.

2.2 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide

standard manufactured equipment that does not comply with the performance and/or physical-characteristic requirements of the Construction Documents.

B. All substitutions must be identified in the Base Bid as a voluntary Deduct Alternate, and must be accompanied by a Letter of Equivalency certifying the product's equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Should the substitution be approved, neither the project specifications nor the Construction Documents will be revised to reflect the substitution.

C. If they comply with these specifications, fiber and fittings manufactured by one (1) of the following manufacturers will be acceptable:
   1. Belden.
   2. CommScope.
   3. Corning Cable Systems.
   4. Leviton/Berk-Tek.
   5. Panduit/General.

2.3 LASER-OPTIMIZED MULTI-MODE FIBEROPTIC CABLE

A. Provide plenum and/or riser rated fiber, LOMMF, fiber cable with integral strength member and individually jacketed OM4 50/125 µm strands (OM4).

B. All fibers in the cable must be usable and meet required specifications.

C. Each optical fiber shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical and environmental requirements of this specification.

D. Each optical fiber shall consist of a doped silica core surrounded by a concentric glass cladding. The fiber shall be a matched clad design.

E. Each optical fiber shall be proof-tested by the fiber manufacturer at a minimum of 100 kpsi (0.7 GN/m^2).

F. The fiber shall be coated with a dual-layer acrylate protective coating. The coating shall be in physical contact with the cladding surface.

G. The attenuation specification shall be a maximum value for each cabled fiber at 23 $\pm$ 5°C on the original shipping reel.

H. All fiber shall support 500 meter link lengths for 10 Gb/s applications

I. All fiber shall support 150 meter link lengths for 40 Gb/s applications

J. All fiber shall support 150 meter link lengths for 100 Gb/s applications

K. Minimum cabled effective modal bandwidth (EMB) determined by restricted mode launch (RML) measurement method (FOTP-204): 4,700 MHz•km at 850 nm.

L. Minimum OFL Bandwidth: 3,500/500 MHz•km at 850/1,300 nm.

M. Attenuation Uniformity: There shall be no point discontinuities greater than 0.2 dB at either 850 nm or 1,300 nm.

N. Attenuation at the Water Peak: The attenuation coefficient at 1,380 nm shall not exceed the attenuation coefficient at 1300 nm by more than 3.0 dB/km.

O. Macrobend Attenuation: The attenuation due to 100 turns of fiber around a 75 ± 2 mm diameter mandrel shall not exceed 0.5 dB at 850 nm or 1,300 nm

P. Where armored fiber cabling is utilized, Contractor shall provide an armored fiber grounding kit to the ground cable jacket at both ends.

2.4 SINGLE-MODE OPTICAL FIBER

A. Provide plenum and/or riser rated fiber, single-mode fiber cable with integral strength member and individually jacketed OS2 strands.

B. All fibers in the cable must be usable and meet required specifications.

C. All fiber shall support a minimum of 10/40/100 Gb/s applications

D. Cladding Diameter: 125.0 ± 1.0 μm

E. Core-to-Cladding Concentricity: $\leq$ 0.5 μm

F. Cladding Non-Circularity: ≤ 1.0 %
G. Where armored fiber cabling is utilized, Contractor shall provide an armored fiber grounding kit to the ground cable jacket at both ends.

2.5 FIBEROPTIC PATCH CORDS
A. LC connector to LC connector.
B. MTP connector to MTP connector.
C. MTP connector to LC connector.
D. Angle-polished connectors (APC'S).
E. Provide factory-terminated and -tested patch cords in quantities as indicated on the drawings and in lengths as required for the following:
1. Laser-Optimized, 50 micron, multi-mode, as required.
a. Patch cords must meet the same performance specifications as outlined above for 50 micron, laser-optimized optical fiber cable.
2. Single-mode, as required.
a. Patch cords must meet the same performance specifications as outlined above for OS2 optical fiber cable.

PART 3 - EXECUTION

3.1 GENERAL CABLE INSTALLATION
A. The wiring system for fiberoptic applications shall be configured as documented on the Contract/Bid Documents.
B. Furnish and install the fiberoptic cables in accordance with the drawings and instructions provided by the Engineer and manufacturer's recommendations.
C. All cables shall be installed in an electrically or optically continuous fashion between the designated origin and destination points. That is, all cables must be home-run with no unspecified splices, couplers or intermediate connection points along the specified channel.
D. All cables shall be securely held in place by an industry-acceptable practice that also meets applicable codes.
E. Each reel of cable shall be provided with a manufacturer's report certifying performance.

3.2 CABLE LABLING
A. Labels for the individual cables will be furnished and installed by the IT Contractor.
B. Color coding shall be in accordance with the latest TIA-606 standards.
C. Labels shall be placed on both ends of every cable at least 4 inches from the point at which the cable jacket is opened to expose individual fiber strands or from the connector or terminal block.
D. All labels shall be visually and physically accessible at work locations, and when cables are mounted to frames, blocks, racks, etc., where the proper mounting procedure allows ready access to individual cables. When cables are mounted to punch-down wiring blocks with integrated labeling capacity, the wiring labels shall be affixed on cables as above and the blocks shall be labeled using machine-generated black uppercase lettering on a permanent adhesive stock, duplicating the information on the cable identification label.
E. Provide all cable tags. Label each tag with the appropriate origin and destination as shown on the drawings, and as indicated in Section 27 05 53 of the specifications.
F. All cable ID nomenclature shall be formatted at the direction of the Owner.
G. After pulling and terminating cables, place the appropriate cable tag as noted above. Temporary tags are acceptable for use during construction. All temporary tags must be removed and replaced with permanent machine-generated tags prior to acceptance.
H. If, at any time during the job, the permanent cable tag becomes illegible or is defaced or removed, immediately replace it with a duplicate preprinted cable tag.
I. Labeling for patch panels shall be installed as shown on drawing details.
J. Provide a nameplate on each patch panel, cross-connect field, equipment rack, cabinet, etc. Unless otherwise noted, use a permanent adhesive label stock covered with a permanent water-

resistant sealer.

3.3 TESTING

A. Contractor shall provide sufficient skilled labor to complete testing within the agreed-upon test period.

B. Contractor must fulfill all Owner, Engineer and manufacturer's warranty/test requirements.

C. Contractor must be qualified to provide system certification for the cabling solution provided. At the completion of the installation, Contractor must supply said system certification along with copies of all applications and correspondence pertaining to the system certification.

D. Contractor's company shall have a minimum of 3 years' experience installing and testing fiberoptic cabling systems. All Installers assigned by the Contractor to the installation shall have factory certification that they are qualified to install and test the provided products.

E. Contractor is responsible for supplying all of the required test equipment used to conduct acceptance tests.

F. Contractor is responsible for submitting acceptance documentation as defined below.

G. Owner reserves the right to be present during any or all of testing.

H. Testing shall be of the permanent link. A link is defined as the passive cabling network between two (2) cross-connects (patch panels or outlets). This includes cable, connectors and splices, but does not include active components. The link test contains the representative connector loss at the patch panel associated with the mating of patch cords, but does not include the performance of the connector at the equipment interface.

I. Prior to testing, submit for review and approval copies of test report forms proposed for use.

1. Each test report form shall contain the following general information: date of preparation, date of test, project name, Contractor's name, media type, make, model, software revision and serial number of test equipment used, date of last calibration and names of test crew.

J. All cabling not tested strictly in accordance with these procedures shall be retested at no additional cost to the Owner.

K. Acceptance shall be subject to completion of all work, successful post-installation testing that yields 100% pass rating, and receipt of full documentation as described below.

L. Either the test equipment shall be fully charged prior to each day's testing or a fresh set of batteries shall be brought to the job site.

M. Remove all defective cables from the cable pathways. Do not abandon cables in place.

N. The Engineer reserves the right to observe the conduct of any or all portions of the testing process.

O. The Engineer further reserves the right to conduct, using the Contractor's equipment and labor, a random retest of up to five percent (5%) of the cable plant to confirm documented test results.

P. All test results and corrective procedures are to be documented and submitted to the Engineer within ten (10) working days of test completion.

Q. In addition to the specified test, the Contractor shall be prepared to be present while the Owner or Owner's designated representatives install and conduct performance tests of the transport electronics connected to the cabling system. The Contractor shall be prepared to conduct on-the-spot cable tests and be responsible for cable plant repairs, as necessary. Successful equipment performance tests do not relieve the Contractor of the specified testing, repair, and documentation requirements.

R. All cables shall be factory tested for continuity before shipment. Submit documentation to the Engineer that the cable has been tested by the manufacturer to industry standards.

S. The Contractor shall provide a thorough testing program for the communications cabling plant and Final Acceptance testing. The testing program being proposed shall be submitted to the Engineer for approval before testing begins. Provide all required test equipment. The Owner's representatives may choose to observe any or all testing. Final Acceptance testing shall be performed jointly by the Contractor and the Owner's representative. The Contractor shall provide procedures, a list of test equipment, and operating instructions before the tests.

T. Subsystems shall be tested individually before testing for end-to-end connectivity. All faults shall

be corrected and retested. All test results shall be completely documented.

U. All cable that fails manufacturer's or specified testing criteria shall be replaced at no additional cost to Owner.

V. Owner reserves the right to independently test any or all of the cable plant. If more than three percent (3%) of the tested cable plant within a floor, system or area fails, the Contractor will be required to take the following actions at no additional cost to Owner:
   1. Reimburse Owner for all costs incurred for independent testing.
   2. Work overtime to remedy defects and retest entire floor, system or area as defined by Owner. This corrective work shall not impact the planned occupancy dates.
   3. Reimburse Owner for supervision representation by their duly appointed representative during action taken in Paragraph 2. above.
   4. Contractor shall provide all test results to Owner at periods of twenty percent (20%) of scheduled test completion time.

W. Fiber Tester
   1. Corning Tester
      a. Fiber Continuity Test: The Contractor shall utilize the Corning UniCam continuity test system during the termination of all fiber connectors. The Contractor shall be responsible for obtaining all equipment that is necessary to perform the continuity test including, but not limited to, the following:
         1). Enhanced UniCam installation tool.
         2). MTP UniCam tool coupler.
         3). Fault finder test box assembly.
         4). UniCam length gauge.
      b. Dual-Fiber Field Test: The Contractor shall be responsible for performing a dual-fiber test. This test will return results of the actual loss that will be realized during day-to-day transmissions over the fiber. The Contractor shall be responsible for obtaining the proper training on this procedure from Corning as well as obtaining all required testers and adapters.
      c. Test equipment shall be capable of measuring relative or absolute optical power in accordance with ANSI/TIA/EIA-526-14A, “Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant”, and ANSI/TIA/EIA-526-7 Method A, “Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant, Insertion Loss Using An Optical Power Meter”.
      d. Test equipment shall incorporate 850 nm and 1,300 nm LED sources in same unit with output power of ≥ -20 dBm at each wavelength. Detectors shall have a dynamic range of at least +3 dB to -55 dB.
      e. Sources and meters shall automatically synchronize wavelengths to prevent calibration-related errors.
      f. The time-of-flight methodology shall be employed when measuring the fiber length optically.
      g. Type of fiber test equipment must be approved by the Engineer prior to use on the job.

X. Fiberoptic Tests
   1. After installation of connectors, visually inspect each fiber end-face at 10X magnification. Refinish any fibers showing visible defects and/or striations in the core area.
   2. Unless otherwise specified, 50 micron enhanced multimode fiber cabling must meet the performance specifications of ANSI/TIA/EIA-568-C. Attenuation and length shall be tested.
   3. All optical fibers shall be individually tested with connectors attached. Each cable span shall be tested individually. Tests shall be conducted selectively after cross-connection of the cable spans.
   4. An optical loss set (OLS) that combines the optical power meter (OPM) and optical source

with adjustable output power level shall be used. The OLS/OPM shall display measured transmission loss directly in dB by comparing the optical power received after transmission through the fiber path to its own optical source power. Once this difference is adjusted to zero for a cable under test, all fibers in the cable are then measured relative to the zeroed source power and displayed in dB.

5. Link attenuation shall be tested in accordance with ANSI/TIA/EIA-526-14A. Reference measurements shall be made in accordance with Reference Method A, Two Jumper Reference. Optical loss shall be measured on each fiber at both 850 nm and 1,300 nm. Loss shall be measured on each fiber in both directions.
6. Strands whose measured attenuation fall outside the acceptable range by power meter testing shall be subject to further inspection and testing to determine the nature of the fault. At a minimum, an OTDR shall be used to determine a loss factor for each connector pair, the exact length of the fiber and to identify the presence of any core damage.
7. Faults related to connectorization shall be corrected, and the fiber retested as stated above until acceptable attenuation measurements are received.
8. Where defects cannot be corrected, replace any cable having fewer than the manufacturer's guaranteed number of serviceable fibers.
9. Link length shall be optically measured and shall not be calculated using cable sheath length markings.
10. Cabling shall meet the ANSI/TIA/EIA-568-A loss and length criteria for all links. It includes the cross-connect connectors and splices (if any). Calculate the total expected link loss based on the number of mated connector pairs, the connector's published loss per mated pair and the cable's published loss based on distance. Demonstrate that measured link loss does not exceed the calculated link loss by more than five percent (5%).

Link Criteria:

Attenuation @ 850 nm	≤ fiber length (km) x 3.5 dB/km + number of connector pairs x 0.75 dB + number of splices x 0.3 dB
Attenuation @ 1,300 nm	≤ fiber length (km) x 1.5 dB/km + number of connector pairs x 0.75 dB + number of splices x 0.3 dB
Length:	≤ 2,000 m. (6,560 ft.)

Y. Testing of Installed Single-Mode Fiber Cable

1. Link attenuation shall be tested in accordance with ANSI/TIA/EIA-526-7 Method A. Reference measurements shall be made in accordance with Method A.1 or equivalent. Optical loss shall be measured on each fiber at 1,310 nm. Loss shall be measured on each fiber from each direction (bi-directionally).
2. Link length shall be optically measured and shall not be calculated using cable sheath length markings.
3. Cabling shall meet the following loss and length criteria. It includes the cross-connect connectors and splices (if any).
4. Link Criteria

Length	< = 90 m (295 ft.)	91 - 1,000 m (3,281 ft.)	1,001 - 2,000 m (6,562 ft.)	2,001 - 5,000 m (16,404 ft.)
Attenuation	1,310 nm	< = 2.0 dB	< = 3.0 dB	< = 3.3 dB	< = 4.7 dB

5. Contractor must warrant in writing that 100% of the installation meets the requirements specified above.
6. Random retesting, if performed, shall be at the expense of the Owner, using standard labor rates. Any failing cabling shall be retested and restored to a passing condition.

Z. Documentation
1. Upon completion of all tests, six (6) copies of the test results shall be submitted for review. Prior to cutover, the Contractor shall perform a random sampling test, jointly with the Owner or Owner's representative, of one (1) in six (6) optical fibers selected by the representative to verify conformance to the Specifications.
2. Test reports shall be submitted in electronic format. Handwritten or hardcopy test reports are not acceptable.
3. Electronic reports are to be submitted on CD format. If proprietary software is used, disk or CD shall contain any necessary software required to view test results. If the results are delivered in a standard format like Excel, Access, CSV files, etc., then software to read these files is not provided. Electronic reports must be accompanied by a certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report. Certificate must reference traceable circuit numbers that match the electronic record.
4. Fiber test reports shall include the following information for each cabling element tested:
   a. Actual measured attenuation (loss) at 850 nm and 1,300 nm, expected attenuation at 850 nm and 1,300 nm per Part 2, Section 3, and the margin. An individual test that fails the link attenuation criteria shall be marked as FAIL.
   b. Reference method.
   c. Number of mated connectors and number of splices (if any).
   d. Actual length and expected length. Any individual test that fails the link length criteria shall be marked as FAIL.
   e. Group refractive index (GRI) at 850 nm and 1,300 nm.
   f. Tester manufacturer, model, serial number and software version.
   g. Circuit ID number and project/job name.
   h. Auto-test specification used.
   i. Overall pass/fail indication.
   j. Date and time of test.
   k. At a minimum, also provide cable number, fiber count, individual fiber numbers, connector types, number of connectors/patches, calculated maximum link loss, length of run, measured link loss for each fiber.
5. Test reports shall be submitted at 20% intervals of testing schedule, within seven (7) business days of completion of testing.

AA. Acceptance: Once all work has been completed, test documentation has been submitted, and Owner is satisfied that all work is in accordance with the Contract Documents, the Owner shall notify the Contractor in writing of the formal acceptance of the system.

3.4 AS-BUILTS

A. Provide as-built drawings at the completion of the work to document the location of all buried conduit, boxes, cable, etc. Drawings shall clearly identify locations, quantities, sizes, etc., for coordination with future construction.

END OF SECTION 27 03 00

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SECTION 27 05 06

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 Summary

A. Furnish and install all Communication Systems as specified herein and as required for proper distribution of all wire, cable, and electrical conductors throughout the Project as indicated on the Drawings, and in accordance with the Contract Documents.

1.2 Related Documents

A. Refer to Section 27 00 00.03 – Table of Contents for Communications for specification sections that apply to all work herein.

1.3 Reference Standards

A. All grounding system components shall be designed, manufactured, and tested in accordance with the latest applicable industry standards including the following:

1. TIA-607-C - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

1.4 Quality Assurance

A. After completion of installation, but prior to Substantial completion, Contractor shall certify in writing that products and materials installed, and processes used, do not contain asbestos or polychlorinated biphenyls (PCB's), in a format acceptable to the Owner. In the event no product or material is available that does not contain asbestos, PCB or hazardous materials as determined by the Owner, a "Materials Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.

B. In the event that materials, products, and/or processes being proposed for this project contain, or may emit, any volatile organic compounds (VOC's), formaldehyde formulations, or hazardous out-gassing, as determined by the manufacturer, a "Materials Safety Data Sheet", as described above, shall be submitted as part of the shop drawing process for review by the Engineer and/or Owner.

C. All equipment and material to be furnished and installed on this project shall be UL or ETL listed, in accordance with the requirements of the Authority having jurisdiction, and suitable for its intended use on this project.

1.5 Submittals

A. The following submittal data shall be furnished according to Section 27 00 00 and shall include, but not be limited to:

1. Grounding System Tests, including report forms.
2. All equipment associated with the telecommunications grounding system.

1.6 Warranty

A. Comply with the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 Unauthorized Materials

A. Materials and products required for work of this section shall not contain asbestos, polychlorinated biphenyls (PCB's) or other hazardous materials identified by the Owner.

2.2 General

A. All equipment and materials provided under this Section of the Specifications shall be new, UL listed, and bear the UL label.

B. All technology spaces shall be provided with a copper telecommunications ground bar (TGB) bolted, brazed, or riveted to the associated enclosure or cabinet. Refer to each individual equipment Specification Section for additional grounding requirements.

C. All conduit, cable tray, raceways, junction boxes, pull boxes, etc. shall be made electrically

continuous by means of grounding conductors, bonding jumpers, grounding bushings, couplings, fittings, etc. as recommended by the TIA J-STD-607-A.

2.3 Acceptable Manufacturers

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of the Contract Documents.

B. All products must meet the requirements of the Buy American Act.

C. All substitutions must be included in the Contractor's Base Bid, and must be accompanied by a letter of equivalency certifying the products equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be all inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Project specifications/documents will not be revised to reflect the substitution should the substitution be approved.

D. If it complies with these Specifications, conduit and fittings manufactured by one of the following manufacturers will be acceptable:

1. Ground Bar
    a. Chatsworth Products Inc.
2. Grounding Conductors.

2.4 Ground Bar

A. Solid copper ground bar, 1/4 in. thick for wall mounting in Data Center Rooms, complete with insulated standoffs, 20 in. x 4 in.

2.5 Grounding Conductors

A. All grounding electrode conductors shall be bare or green insulated copper conductors sized as indicated on the Drawings.

B. All conductors shall be run in conduit unless otherwise noted.

PART 3 - EXECUTION

3.1 Installation

A. Telecommunications Signal Ground System (TIA-607-B Compliant System)

1. Furnish and install in data/communication closets or adjacent to wall-mounted technology cabinets which are mounted in non-Technology Rooms (such as an MER) as indicated on plans, a telecommunications grounding and bonding (TGB) infrastructure for low-noise signal grounding of sensitive electronic equipment.
2. The TGB grounding system shall include the following:
    a. All bonding conductors and connectors shall be listed for the purpose intended and approved by a Nationally Recognized Testing Laboratory (NRTL).
    b. All bonding conductors shall be insulated and copper. The minimum bonding conductor size shall be a No. 6 AWG.
    c. Bonding conductors should not be placed in ferrous metallic conduit. If it is necessary to place bonding conductors in ferrous metallic conduit that exceeds 1 m. (3 ft.) in length, the conductors shall be bonded to each end of the conduit with a conductor sized as a No. 6 AWG, minimum.
    d. Each telecommunications bonding conductor shall be labeled. Labels shall be located on conductors as close as practicable (i.e., ease of access to read the label) to their point of termination. Labels shall be nonmetallic and include the information depicted below. Refer to ANSI/TIA/EIA 606 for additional labeling requirements.

WARNING

IF THIS CONNECTOR OR CABLE IS
LOOSE OR MUST BE REMOVED,
PLEASE CALL THE BUILDING
TELECOMMUNICATIONS
MANAGER

e. Each telecommunications bonding conductor shall be marked appropriately by a distinctive green color.

f. The bonding conductor for telecommunications shall bond the telecommunications main grounding busbar (TMGB), located in the designated Technology Room as shown on Plan (see grounding riser), to the main electrical service ground bus bar.

g. A telecommunications bonding backbone cable (TBB) shall be the conductor that interconnects the TMGB to all telecommunications grounding busbars (TGB's) which are located in the Technology Rooms, and the Main Incoming Service (Power) Switchboard Room.

h. The TBB shall be an insulated copper conductor. TBB conductors shall be installed and protected from physical and mechanical damage.

i. TBB conductors should be installed without splices, where practicable. Where splices are necessary, they should be minimum and shall be accessible and located in telecommunications spaces. Joined segments of a TBB shall be connected using irreversible compression-type connectors, exothermic welding, or equivalent. All joints shall be adequately supported and protected from damage.

j. The TMGB should be located to result in the straightest route considering the total length of the bonding conductor from the telecommunications primary protectors to the TMGB. This bonding conductor is intended to conduct lightning and AC fault currents from the telecommunications primary protectors. A minimum of 300 mm (1 ft.) separation shall be maintained between this insulated conductor and any DC power cables, switchboard cable, or high frequency cables, even when isolated by metallic conduit or EMT.

k. The TMGB shall:
   1). be a predrilled copper busbar with electronic plating provided with standard NEMA bolt hole sizing and spacing for the type of connectors to be used, and
   2). be sized in accordance with the immediate requirements of the application and with consideration of future growth, and
   3). have minimum dimensions of 6 mm thick x 100 mm wide and be variable in length.

l. Where a lighting, utility, distribution, PDU, etc., panelboard for telecommunications is located in the same room or space as the TMGB, that panelboard's equipment ground shall be bonded to the TMGB.

m. The connections of the bonding conductor for telecommunications and the TBB's to the TMGB shall utilize listed 2-hole compression connectors, exothermic type welded connections, or equivalent.

n. All metallic raceways for telecommunications cabling located within the same room or space as the TMGB shall be bonded to the TMGB. In addition, all power conduit which enters Technology Rooms shall be bonded to the TMGB. Bond straps shall be connected to power conduit at the immediate entrance to the room.

o. The TMGB shall be insulated from its support with a 50 mm (2 in.) separation.

p. The extension of the telecommunication grounding system (from the TMGB) to

local grounding centers in technology riser closets and/or rooms shall be the Telecommunication Grounding Bus Bar (TGB). TGB's shall be located in all Technology Rooms. The TGB shall:

1). be a predrilled copper busbar with electrotin plating provided with standard NEMA bolt hole sizing and spacing for the type of connectors to be used, and

2). have minimum dimensions of 6 mm thick x 50 mm wide and be variable in length to meet the application requirement with consideration of future growth.

q. The bonding conductor between a TBB and TGB shall be continuous and routed in the shortest possible straight-line path.

r. Where a panelboard for telecommunications is located within the same room or space as the TGB, that panelboard's equipment ground shall be bonded to the TGB.

s. All metallic raceways for telecommunications cabling located within the same room or space as the TGB shall be bonded to the TGB.

t. All technology racks and cabinets shall be bonded to the TGB.

u. Connections of TBB's to the TGB shall utilize listed 2-hole compression connectors.

v. The TGB shall be insulated from its support with a 50 mm (2 in.) separation.

3.2 Testing

A. Grounding System Testing

1. Upon completion of the electrical system, including all grounding, the Subcontractor shall test the system for continuity, stray currents, ground shorts, etc. These tests shall be performed in a manner acceptable to the Engineer. Approved instruments, apparatus, services, and qualified personnel shall be utilized. If stray currents, shorts, etc., are detected, eliminate or correct as required. The test procedure shall be as outlined:

a. An ohmmeter reading less than 100 ohms shall indicate that the system contains ground shorts (stray currents), as well as to confirm continuity, at some point along the system neutral.

b. The systems shall be retested after correction of all ground shorts is complete. Final readings shall be tabulated for review by the Engineer.

2. The maximum resistance to ground from any point in the electrical system shall be 5 ohms.

3.3 "As-Builts"

A. Provide "as-built" drawings at the completion of the work to document the location of all buried conduit, boxes, cable, etc. Drawings shall clearly identify locations, quantities, sizes, etc., for coordination with future construction.

END OF SECTION 27 05 06

SECTION 27 05 28.33

CONDUITS AND BACKBOXES FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install all Conduits as specified herein and as required for proper distribution of all wire, cable, electrical conductors and low voltage cabling throughout the Project as indicated on the Drawings, and in accordance with the Contract Documents.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 23, 26 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 27 00 00.03 – Table of Contents for Communications for specification sections that apply to all work herein.

1.3 REFERENCE STANDARDS

A. All cable pathways and its components shall be designed, manufactured, and tested in accordance with the latest applicable industry standards and codes including the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City.
   a. New York City Building Code.
   b. New York City Electrical Code.
   c. International Building Code.
   d. International Electrical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. ANSI C80.1 - Rigid Galvanized Conduit.
   b. ANSI C80.3 - Electrical Metallic Tubing.
   c. ANSI C80.5 - Rigid Aluminum Conduit.
   d. ANSI/TIA/EIA-569.A.
   e. UL Standard 1 - Flexible Metal Electrical Conduit.
   f. UL Standard 1242 - Intermediate Metal Conduit.
   g. UL Standard 1653 - Electrical Nonmetallic Tubing
   h. UL Standard 360 - Liquid-Tight Flexible Conduit.
   i. UL Standard 467 - Electrical Grounding and Bonding.
   j. UL Standard 6 - Rigid Galvanized Conduit.
   k. UL Standard 651 - Non-Metallic Conduit.
   l. UL Standard 651 (ANSI F512, NEMA TC-2) - Non-Metallic Conduit.
   m. UL Standard 797 - Electrical Metallic Tubing.

1.4 QUALITY ASSURANCE

A. After completion of installation, but prior to Substantial completion, Contractor shall certify in writing that products and materials installed, and processes used, do not contain asbestos or polychlorinated biphenyls (PCB’s), in a format acceptable to the Owner. In the event no product or material is available that does not contain asbestos, PCB or hazardous materials as determined by the Owner, a "Materials Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.

B. In the event that materials, products, and/or processes being proposed for this Project contain, or may emit, any volatile organic compounds (VOC’s), formaldehyde formulations, or hazardous out-gassing, as determined by the manufacturer, a “Materials Safety Data Sheet”, as described above, shall be submitted as part of the shop drawing process for review by the Engineer and/or Owner.

C. All adhesives specified herein or utilized in the manufacture of equipment or components which

are specified herein shall meet or exceed the VOC limits of South Coast Air Quality Management District Rule No. 1168. All sealants specified herein or utilized in the manufacture of equipment or components which are specified herein shall meet or exceed Bay Area Air Resources Board Reg. 8, Rule 51. Submit as part of the shop drawing process for review by the Engineer and/or Owner, supporting documentation which demonstrates conformance with these requirements.

D. All equipment and material to be furnished and installed on this project shall be UL or ETL listed, in accordance with the requirements of the Authority having jurisdiction, and suitable for its intended use on this project.

1.5 SUBMITTALS

A. The following submittal data shall be furnished according to Section 27 05 00 and shall include but not be limited to:

B. Conduit, including samples, complete with fittings, materials, connector details, etc.

1.6 WARRANTY

A. Comply with the requirements of the Contract Documents and Section 27 05 00.

PART 2 - PRODUCTS

2.1 UNAUTHORIZED MATERIALS

A. Materials and products required for work of this section shall not contain asbestos, polychlorinated biphenyls (PCB's) or other hazardous materials identified by the Owner.

2.2 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of the Contract Documents.

B. All substitutions must be included in the Contractor's Base Bid, and must be accompanied by a letter of equivalency certifying the products equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be all inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Project specifications/documents will not be revised to reflect the substitution should the substitution be approved.

C. If it complies with these specifications, conduit and fittings manufactured by one of the following manufacturers will be acceptable:

1. Electrical Metallic Tubing (EMT)
   a. Allied.
   b. Republic.
   c. Robroy Industries.
   d. Triangle.
   e. Western.
   f. Wheatland.
2. Electrical Nonmetallic Tubing
   a. Cantex.
   b. Carlon.
   c. Kraloy.
3. Liquid-tight Flexible Metal Conduit Fittings
   a. American Brass Company.
   b. Midwest.
   c. O-Z/Gedney.
4. Rigid Aluminum Conduit and Fittings
   a. Alcoa.
   b. Harvey
   c. Kaiser.

d. Reynolds.

5. Rigid Nonmetallic Electrical Conduit and Fittings
   a. Carlon.
   b. Certainteed.
   c. Triangle.
6. Rigid Steel Conduit and Fittings (exposed to the weather)
   a. Occidental Coating Company.
   b. Perma-Cote.
   c. Robroy Industries “Plasti-Bond-Red”.
   d. Triangle.
7. Rigid Steel and Intermediate Metal Conduit
   a. Allied.
   b. Republic.
   c. Triangle.
   d. Western.
   e. Wheatland.
8. Rigid Steel and Intermediate Metal Conduit Fittings
   a. Appleton.
   b. Crouse-Hinds.
   c. Efcor.
   d. Midwest.
   e. O-Z/Gedney.
   f. Raco.
   g. Spring City.
   h. Steel City.
   i. Thomas & Betts.

D. If it complies with these specifications, backboxes manufactured by one of the following manufacturers will be acceptable:
   1. Thomas & Betts
   2. Carlon.
   3. Kraloy.

2.3 NON-FLEXIBLE CONDUIT

A. General
   1. The minimum size conduit that shall be permitted is 3/4 inch.
   2. In general, conduit shall not be embedded in the floor slabs except specifically where permitted on the Contract Drawings.

B. Rigid Steel Conduit: Rigid steel conduit (RGS) shall be used where conduit is underground, exposed to the weather, in concrete slabs (where permitted by an accepted deduct alternate), in hazardous locations, used for systems operating at over 600 volts, or greater than 4 in. in diameter. Conduit shall have a cross-section formed with a sufficient degree of accuracy to permit the cutting of clean, true, full threads. Conduit shall be joined with pipe couplings and shall be secured in cabinets, outlets, etc., with double locknuts. Conduits terminating in cabinets, outlets, etc., shall be provided with Midwest Catalog Number 931 to 942, or approved equal steel insulating grounding bushings. All fittings shall be cast iron or galvanized or cadmium-plated and threaded.
   1. Rigid steel conduit shall be hot-dipped galvanized inside and out.
   2. Where exposed to weather, rigid steel conduit shall be Robroy Industries "Plasti-Bond-Red" complete with "Plasti-Bond-Red" fittings, or approved equal plastic coated non-flexible metal conduit and fit-tings. Exposed threads, damaged coatings, etc., shall be field-coated with Robroy Industries "Plasti-Bond-Red Touch-Up", or approved equal.
   3. Full lengths of pipe shall have galvanized or zinc-coated threads on both ends.

4. Running threads shall not be used. Where such a device is required, use T&B "Erickson" type union or O-Z/Gedney Type SSP split coupling, or approved equal.

C. Rigid Aluminum Conduit: At the option of the Contractor, aluminum rigid conduit may be used instead of rigid steel conduit except where conduit is underground, in concrete slabs (where permitted by an accepted deduct alternate), exposed to the weather, used for systems operating at over 600 volts, used in parking areas, used in loading docks, encased in concrete, where specifically noted otherwise in the Construction Documents, and where required by applicable Codes. Aluminum couplings and fittings, shall be used and installed as recommended by the Manufacturer using Crouse-Hinds STL-6 compound, or approved equal. All elbows shall be hot-dipped or electroplated galvanized steel. Rigid aluminum conduit shall be used for telecommunications signal ground systems.

D. Intermediate metal conduit (IMC) may be used in lieu of RGS where subjected to any water or moisture condition or where buried in slab. Conduit shall be hot-dipped or electroplated galvanized. All fittings shall be cast iron or cast iron alloy, galvanized or cadium plated.

E. Electrical Metallic Tubing (EMT)

1. At the Contractor's option, electrical metallic tubing (EMT) may be used instead of rigid aluminum conduit or IMC except where RGS, IMC or rigid aluminum conduit are specifically required.
2. EMT may not be utilized in sizes above 4 inch diameter.
3. EMT shall be formed with a sufficient degree of accuracy to permit the use of connectors. EMT shall be joined with Midwest Catalog Nos. 460-469 steel couplings, or approved equal. EMT and rigid steel conduit shall be joined with Midwest Catalog Nos. 420-422 steel couplings, or approved equal. Conduits shall be secured with Midwest Catalog Nos. 1450-1459 or approved equal steel set screw type insulated connectors at panels, junction boxes, outlets, etc. All connectors and couplings, etc., shall be steel and set screw type.
4. At the Contractor's option, metallic tubing using "Unicouple" type connectors may be used instead of tubing and individual couplings. Where "Unicouple" connectors are used in vertical conduit runs, all flared conduit ends shall be oriented downward to prevent moisture from being "funneled" into the conduit.
5. PVC Conduit: PVC conduit shall be used where conduit is underground, in concrete slabs, where required to be encased in concrete, used for systems operating at over 600 volts, or greater than 4 in. in diameter. Conduit shall have a cross-section formed with a sufficient degree of accuracy to permit the cutting of clean, true, full threads. Conduit shall be joined with weatherproof solvent, cement and approved pipe couplings. PVC conduit shall be provided with steel insulating grounding bushings as manufactured by Kraloy, Carlon, or approved equal. All rigid PVC (nonmetallic conduit) shall be Schedule 80 (extra-heavy wall EPC-80). All elbows shall be cast iron or galvanized or cadmium-plated and threaded.

2.4 SURFACE-MOUNTED OUTLET BOXES

A. Single or double gang.
B. Used to install faceplate where outlet cannot be recessed into wall or floor box.
C. Refer to drawings for configuration.

PART 3 - EXECUTION

3.1 GENERAL

A. Examine and compare the telecommunications pathway drawings and specifications with the drawings and specifications of other Trades; report any discrepancies between them to the Engineer and obtain from him written instructions for changes necessary in the work.
B. Install and coordinate the telecommunications pathways work in cooperation with other Trades installing interrelated work. Before installation, make proper provisions to avoid interferences in a manner accepted by the Construction Manager/General Contractor. All repairs or changes

required in the work of the Contractor caused by his neglect shall be made by him at his own expense.

C. The locations of cable trays, conduits, outlets and other equipment indicated on the drawings are approximately correct and are understood to be subject to such revision as may be found necessary or desirable at the time the work is installed.

D. Telecommunications pathways running parallel to electrical cables/conduits shall be separated by a minimum of 12 in. When crossing, maintain a 3 in. minimum separation. Maintain a minimum 12 in. separation from all fluorescent lighting fixtures.

E. Telecommunications pathways shall cross electrical cables/conduits at 90 degree angles only.

F. The Contractor shall maintain a current copy of this bid specification at the job site at all times.

G. The Contractor shall maintain a complete file of shop drawings and other submissions at the job site at all times. These shop drawings and submissions shall be made available to the Construction Manager/General Contractor, Owner, Engineer or Architect at his request.

H. Keep all items protected before and after installation, with dust- and moisture-proof barrier materials. It shall be the Contractor's responsibility to ensure the integrity of these protective measures throughout the life of the project.

I. Clean up all debris generated by installation activities.

J. At all times during the construction, the Contractor shall protect all equipment from damage and theft.

K. Upon project completion, provide as-built drawings and documentation as defined herein.

L. All telecommunications pathways provided as part of this work shall provide smooth surfaces wherever contact could be made with correctly installed telecommunications cabling. All burrs, threaded sections, or other sharp or abrasive edges or surfaces in cable bearing sections shall be finished smooth or with rounder edging provided.

M. Provide expansion joints in the cable trays/runways wherever trays/runways span a building expansion joint.

N. Cables shall follow conduit routes and trunk patterns or main pathways reflected on drawings. Tributary pathways shall be established for cable distribution from the main cable pathway to the telecommunications outlet. Where specific routes are not indicated, cables shall follow room boundaries under raised floor or above hung ceiling for distribution into walls, outlets, channels, or conduits.

3.2 INSTALLATION

A. Telecommunications Raceway System

1. The telecommunications raceway system shall consist of conduit, sleeves, enclosed trough, open cable tray, outlet boxes, faceplates, bushed cover plates, junction boxes, terminal, strip cabinets, pull boxes, etc. The entire layout shall be installed as indicated and in accordance with the requirements of the company supplying telecommunications service.
2. Wall outlet boxes shall be of size and type to suit each individual location. In general, double-gang 4 inch square boxes with plaster rings, 2-1/2 inches deep, and bushed cover stainless steel plates shall be provided at each telephone location. Plaster rings and cover plates shall be suitable for single gang or double gang outlets, as required.
3. Provide empty conduit, 3/4 inch minimum (u.o.n.), for telecommunications outlets.
4. Where conduit bends are required in telecommunications raceway systems, the radius of the raceway bend shall not be less than twelve times the diameter of the raceway.
5. All telecommunications raceways shall be provided with a suitably sized "true-measure" drag line indicating length of pull, tied off at each end, for cable installation by others.
6. Telecommunications cabling shall be provided. Fireproofing of telecommunications raceways shall be by this Section after installation of telecommunications cabling.
7. All runs of 2 inches and larger shall not contain more than 180 degrees of bends or 100

feet in length without a pull box.

8. It is the responsibility of this Contractor to coordinate all in-ceiling telecom cable paths with electrical work.
9. Install identification stickers (furnished by others) on each raceway as follows:
   a. Vertical runs - Every 15 feet (minimum of one per floor).
   b. Horizontal runs - Every 25 feet (minimum of one per run).
   c. Pull boxes - Every two 90 degree angles or 100 ft.
10. All conduits shall be EMT except where rigid galvanized steel is specified (i.e., parking garage, roof, etc.).

B. Conduit Hangers and Supports: All horizontal conduits throughout the building shall be thoroughly and substantially supported with individually approved expansion ring hangers or supported in groups using Unistrut or Kindorf channels and suitable hangers. Hangers shall not be spaced more than ten feet apart. Perforated extension bar hangers will not be accepted in any part of the Work. All vertical conduits shall be substantially supported at floor lines to carry the weight of the conduit and cable in a satisfactory manner with allowance for expansion and contraction. Special hangers and supports shall be provided where they may be required because of any peculiarities of construction. Where exposed to weather, conduit hangers and supports shall be Robroy Industries "Plasti-Bond-Red", or approved equal. Damaged hangers and supports shall be field-coated with Robroy Industries "Plasti-Bond-Red Touch-Up", or approved equal. Hanger rod sizes shall be as recommended by the hanger manufacturer for the service intended.

C. Pull Boxes: Horizontal conduit runs may be supported by beam, special brackets or adjustable trapeze hangers with each conduit strapped at each support point. Conduits 3/4 in. in size within hung ceilings may be supported to black iron ceiling structural members with heavy iron tie wire. Furnish pull boxes where recommended by EIA/TIA, as indicated on the drawings, or where required to facilitate pulling and supporting conductors, regardless of whether shown on drawings or not. All such boxes must be made accessible and built of heavy gauge steel, unless otherwise specified.

3.3 AS-BUILTS

A. Provide as-built drawings at the completion of the work to document the location of all buried conduit, boxes, cable, etc. Drawings shall clearly identify locations, quantities, sizes, etc., for coordination with future construction.

END OF SECTION 27 05 28.33

SECTION 27 11 00

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install all entry points, patch panels, ladder racks, equipment racks, cabinets and wire managers as specified herein and as required for proper distribution of all wire, cable, and electrical conductors throughout the project as indicated on the drawings, and in accordance with the Contract Documents.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 23, 26, 27 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 27 00 00.03 – Table of Contents for Communications for specification sections that apply to all work herein.

1.3 REFERENCE STANDARDS

A. All entry ways, patch panels, ladder racks, equipment racks, cabinets, and wire managers shall be designed, manufactured, and tested in accordance with the latest applicable industry standards, regulations, codes and ordinances of federal, state, and local Authorities Having Jurisdiction. Modifications required by the above said authorities having jurisdiction shall be made without additional cost to the Owner. The following codes and standards shall be included:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City.
   a. New York City Building Code.
   b. New York City Electrical Code.
   c. International Building Code.
   d. International Electrical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. TIA Telecommunications Building Wiring Standards
   b. BICSI “Telecommunications Distribution Methods Manual”.

1.4 SUBMITTALS

A. The following submittal data shall be furnished according to Section 27 05 00 and shall include but not be limited to:

1. Entrance protection.
2. Racks, cabinets, frames and enclosures.
3. Termination blocks and patch panels.
4. Cable management and ladder rack.
5. Rack-mounted power protection and power strips.
6. Firestop and penetration sealant.

1.5 WARRANTY

A. Comply with the requirements of the Contract Documents and Section 27 05 00.

PART 2 - PRODUCTS

2.1 UNAUTHORIZED MATERIALS

A. Materials and products required for work of this Section shall not contain asbestos, polychlorinated biphenyls (PCB’s) or other hazardous materials identified by the Owner.

2.2 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of the Contract Documents.

B. All substitutions must be included in the Contractor's Base Bid, and must be accompanied by a letter of equivalency certifying the products equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be all inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Project specifications/documents will not be revised to reflect the substitution should the substitution be approved.

C. If it complies with these specifications, racks, cabinets, cable management hardware and fittings manufactured by one of the following manufacturers will be acceptable:
1. APC.
2. Belden.
3. Chatsworth Products Inc.
4. Ortronics.
5. Panduit.
6. Rittal.
7. Siemon.

D. If it complies with these specifications, termination blocks and patch panels manufactured by one of the following manufacturers will be acceptable:
1. Belden.
2. Commscope.
3. Leviton/Berk-Tek.
4. Ortronics/Essex.
5. Panduit/General.

E. If it complies with these specifications, ladder racks manufactured by one of the following manufacturers will be acceptable:
1. Chatsworth Products Inc.
2. Copper B-Line Inc.
3. EZ Tray.
4. Flex Tray.
5. Legrand.
6. Panduit.

F. If it complies with these specifications, firestop and penetration sealant manufactured by one of the following manufacturers will be acceptable:
1. 3M.
2. Hilti.
3. Nelson.
4. STI.

2.3 EQUIPMENT RACKS, CABINETS AND WALL MOUNTED ENCLOSURES

A. Free-standing Racks (2-Post Frame and 4-Post Frame)
1. Complies with EIA and IEC standards.
2. Rack size as indicated on drawings.
3. Racks shall be 19 inch panel width, EIA standard hole configuration, steel construction with raceway provisions for inter-rack cabling, all required brackets, wire management trough installed vertically on both sides.
4. Provide complete with mounting screws.
5. Front- and rear-mounted vertical wire management rings (size as specified on drawings).
6. All equipment racks and cabinets shall be installed with seismic restraints and vibration isolation devices at all locations.
7. Racks to be secured per manufacturer's specifications.
8. 4-post racks shall be provided with end of row panels.

B. Equipment Cabinets
1. Complies with EIA and IEC standards.

2. Cabinet size as indicated on drawings.
3. Cabinets shall be 19 inch panel width, of high-strength lightweight aluminum construction, with raceway provisions for intercabinet cabling, all required brackets, vertical cabling rings, EIA rails, and hardware.
4. Each cabinet shall be provided with two (2) front and two (2) rear vertical ring sections mounted on the side rails (top to bottom).
5. All telecom cabinets shall have front and rear mesh doors.
6. All telecom cabinets shall be provided with end of row panels.

2.4 CABLE MANAGEMENT HARDWARE

A. Vertical wire managers shall be in accordance with the associated rack height. Vertical wire manager width shall be as indicated on drawings.
B. Provide all assembly hardware and protective edge guards.
C. Horizontal 19 in. Rack-mounted Wire Manager: Shall be full metal construction; for use of managing patch cords in cabinets and racks; 1, 2 or 4 units height as indicated on drawings; color: black.
D. Velcro Cable Ties: Attached to backboards using flat headed screws with rigid support; lengths vary as required.
E. “J” Hooks: Shall be sized appropriately by the Contractor and approved for Category 6A cables; suitable for attachment to beam flanges, “U” channel, purlings, deck plates, smooth or threaded rod; for use as a cable support in ceilings and beneath access floors; provided every 5 ft. OC (max) for open cable runs; not to be fastened to hung ceiling support structures.

2.5 RACK-MOUNTED MODULAR AUGMENTED CATEGORY 6 PATCH PANELS

A. Modular jacks (individual jacks).
B. 48-port high density- angled unless otherwise indicated on plans.
C. Quantities per Drawings and Cabling Schedule.
D. Complete with T568B RJ-45 (Category 6A) jacks.
E. 110 style rear side terminations.
F. Patch panels shall have each port number and patch panel name permanently labeled.
G. Rack-mountable in standard 19 inch EIA racks.
H. Provide one (1) strain relief bracket attached to rear of rack behind each patch panel.

2.6 RACK-MOUNTED FIBER-OPTIC PATCH PANELS

A. Port quantities as indicated on the drawings.
B. To accept LC adapter modules.
C. Complete with door lock, connector panels, slide-out rails, jumper troughs, strain relief spool.
D. Loaded with connector panels and LC couplers unless otherwise indicated on plans.
E. Rack-mountable in standard 19 inch EIA racks.

2.7 LADDER RACK AND CABLE TRAY

A. All ladder rack and ladder runway shall be installed with seismic restraints and vibration isolation devices at all locations as described on the drawings.
B. Ladder rack system shall be made of straight sections, fittings, including brackets, rods, clamps, jumpers, fasteners, concrete inserts, etc., and accessories as defined in the latest NEMA standards publication VE-1. Ladder rack shall be UL classified as equipment grounding conductors.
C. Ladder rack shall consist of two (2) longitudinal members (side rails) with transverse members (rungs) welded to the side rails. Rungs shall be spaced 9 inches on center for straight sections. Rung spacing in radiused fittings shall be 2 inches on center and measured at the center of the tray’s width. Rungs shall have a minimum cable bearing surface of 7/8 in. with raised edges. No portion of the rungs shall protrude below the bottom plane of the side rails.
D. Cable tray shall have an overall nominal depth of 4 in. unless otherwise noted on plans. Load width shall be as indicated on the drawings.
E. Straight sections side rails shall be I-beam and shall be supplied in standard lengths of 12 feet.

F. Side rails of straight sections and fittings shall be compatible so that standard splice plates can be used to join straight sections and fittings. Fittings shall have 3 inch tangents beyond the curved section to accommodate the standard splice plates.
G. Splice plates shall be the bolted type, using either square neck or ribbed-neck carriage bolts and serrated flange locknuts. The resistance of fixed splice connections between an adjacent section of tray shall not exceed 0.00033 ohm. The cable tray shall be designed so that a splice plate located anywhere along the span shall not decrease the strength of the cable tray system.
H. Splice plates shall be furnished with straight sections and fittings.
I. All accessories shall be furnished as required to protect, support and install the ladder rack system.
J. Ladder rack shall be capable of carrying a uniformly distributed load of 132 lbs./ft. with safety factor of 2.0 when supported as simple span and tested per NEMA VE1-4.01. Load and safety factors specified are applicable to both the side rails and rung capacities.
K. Ladder rack shall be made to manufacturing tolerances as specified by NEMA (see NEMA VE1-2.03 and VE1-2.04).
L. Provide bend sections with a minimum 24 inch radius.
M. Coordinate installation of ladder rack with all other Trades.
N. Submit proposed supporting criteria, including loading characteristics, to the Structural Engineer for review.
O. Submit shop drawings indicating routing and proposed method of installation complete with dimensions BEFORE commencing work.

PART 3 - EXECUTION

3.1 GENERAL

A. Examine and compare the telecommunications pathway drawings and specifications with the drawings and specifications of other trades; report any discrepancies between them to the Engineer and obtain from him written instructions for changes necessary in the work.
B. Install and coordinate the telecommunications pathways work in cooperation with other Trades installing interrelated work. Before installation, make proper provisions to avoid interferences in a manner accepted by the Construction Manager/General Contractor. All repairs or changes required in the work of the Contractor caused by his neglect shall be made by him at his own expense.
C. The locations of ladder racks, conduits, outlets and other equipment indicated on the drawings are approximately correct and are understood to be subject to such revision as may be found necessary or desirable at the time the work is installed.
D. Telecommunications pathways running parallel to electrical cables/conduits shall be separated by a minimum of 12 in. When crossing, maintain a 3 in. minimum separation. Maintain a minimum 12 in. separation from all fluorescent lighting fixtures.
E. Telecommunications pathways shall cross electrical cables/conduits at 90 degree angles only.
F. The Contractor shall maintain a current copy of this bid specification at the job site at all times.
G. The Contractor shall maintain a complete file of shop drawings and other submissions at the job site at all times. These shop drawings and submissions shall be made available to the Construction Manager/General Contractor, Owner, Engineer or Architect at his request.
H. Keep all items protected before and after installation, with dust- and moisture-proof barrier materials. It shall be the Contractor's responsibility to ensure the integrity of these protective measures throughout the life of the project.
I. Clean up all debris generated by installation activities.
J. At all times during the construction, the Contractor shall protect all equipment from damage and theft.
K. Upon project completion, provide "as-built" drawings and documentation as defined herein.
L. All telecommunications pathways provided as part of this work shall provide smooth surfaces wherever contact could be made with correctly installed telecommunications cabling. All burrs,

threaded sections, or other sharp or abrasive edges or surfaces in cable bearing sections shall be finished smooth or with rounder edging provided.

M. Provide expansion joints in the cable trays/runways wherever trays/runways span a building expansion joint.

N. Cables shall follow conduit routes and trunk patterns or main pathways reflected on drawings. Tributary pathways shall be established for cable distribution from the main cable pathway to the telecommunications outlet. Where specific routes are not indicated, cables shall follow room boundaries under raised floor or above hung ceiling for distribution into walls, outlets, channels, or conduits. Cabling below raised floors shall follow specified routes and shall always be routed parallel or perpendicular to building construction (no diagonals).

3.2 "J" HOOKS

A. No more than seventeen (17) 4-pair cables shall be suspended in each 2 in. "J" hook support. If smaller cable supports are used, do not fill support more than 40% full.

B. All cable distribution from the cable trays/conduits to points of vertical transition to outlet locations shall be supported by means of 2 inch "J" hooks on 5 foot centers (max). Ceiling support grids and service hangers shall not be used for support of telecommunications cabling.

C. Main cabling pathways consist of the pathways out from the TR in conduit or other means of cable support as detailed below. Tributary cable paths consist of the pathways from the main cable pathway to the telecommunications outlet.

D. "J" hooks shall be directly attached to the ceiling deck or hung from the deck by a threaded rod. (Length of the threaded rod shall not exceed 3 feet and the distance between rings shall not exceed 5 feet.)

E. Using removable hook and loop type (Velcro®) cable fasteners, cables must be neatly tie-wrapped in bundles at the midpoint between "J" hooks.

3.3 LADDER RACK

A. Ladder racks shall be supported by trapeze hangers. Supports shall be located where practicable so that connections between the sections of the ladder rack fall between the support point and the quarter section of the span. The support centers shall be in accordance with the load and span requirements as outlined by the manufacturer. A support shall be placed within 2 feet on each side of any connection to a fitting.

B. Splice plates shall be the bolted type, using either square-neck or ribbed-neck carriage bolts and serrated flange locknuts. The resistance of fixed splice connections between an adjacent section of tray shall not exceed 0.00033 ohm. The ladder rack shall be designed so that a splice plate located anywhere along the span shall not decrease the strength of the ladder rack system.

C. Splice plates shall be furnished with straight sections and fittings.

D. All accessories shall be furnished as required to protect, support and install a ladder rack system.

E. Ladder rack shall be capable of carrying a uniformly distributed load of 132 lbs./ft. with safety factor of 2.0 when supported as simple span and tested per NEMA VE1-4.01. Load and safety factors specified are applicable to both the side rails and rung capacities.

F. Ladder rack shall be made to manufacturing tolerances as specified by NEMA (see NEMA VE1-2.03 and VE1-2.04).

G. Where runways come together, use adjustable, junction splice kits, and appropriate radial junction kits in order to maintain proper cable turning radius.

H. Where cables spill over the side of the ladder rack, or through the ladder rack, provide cable runway radius drops.

I. Provide all required appurtenances required for installation of runway ladder rack system.

J. Submit shop drawings indicating proposed method of installation complete with dimensions before commencing work.

K. Ladder rack shall have an overall nominal depth and width as shown on plans.

L. Coordinate with all other Trades.

M. Submit proposed supporting criteria, including loading characteristics, to the Structural Engineer

for review.

N. Ladder rack shall be routed to maintain the minimum EMI spacing as defined under the EMI/RFI Avoidance section.

O. Ladder rack shall not be routed directly above fluorescent light fixtures.

P. Cable runways shall be supported in the TR using wall mounting brackets and/or ceiling supports as indicated in accordance with manufacturer's recommendations. Support all cable runways which do not run adjacent to walls with ceiling-hung threaded rod for all spans in excess of five (5) feet. Use manufacturer's original fittings at all bends, joints, offsets, etc.

3.4 ENTRY FIRESTOP – PENETRATION SEALANT

A. When passing through partitions or floors, provide firestopping in the following manner:

B. Rigidly connect appropriate raceway between the trays passing through partition or floor. Raceways shall afford same area as tray.

C. Place firestop material at each end and around each conduit as specified for Electrical Penetration Fire Seals.

D. Provide fire-resistant materials of a type and composition necessary to restore fire ratings to all wall, floor or ceiling penetrations utilized for the installation of the telecommunications wiring system. All materials must be UL classified and meet NEC and local code.

E. Seal all penetrations through fire-rated walls, floors and walls created by or made on the behalf of the Contractor to prevent the passage of smoke, fire, toxic gas or water through the penetration before, during or after a fire. Seal all penetrations through which the Contractor routes telecommunications cabling. The fire rating of the penetration seal shall be at least that of the floor or wall into which it is installed, so that the original fire rating of the floor or wall is maintained as required by Article 300-21 of the National Electric Code.

F. When damming or lining materials are to be left in place after the seal is complete, all such materials shall be non-flammable.

G. Any sealant shall be applied to the opening as per the manufacturer's printed instructions.

H. The sealant chosen shall remain resilient and pliable to allow for the removal and/or addition of cable without the necessity of drilling holes. It shall adhere to itself to allow any and all repairs to be made with the same material. It shall allow for vibration, expansion and/or contraction of anything passing through the penetration without affecting the seal, or cracking, crumbling and spalling.

I. When sealant is placed into a penetration, the material shall completely surround all the items within the penetration and maintain pressure against the walls of the penetration as well as the pass-through items. No heat shall be required to further expand the material to prevent the passage of smoke.

J. The material shall be distinctively colored to clearly distinguish it from standard construction materials such as mortar, cement, caulking, etc., which are not approved for restoration of the fire rating of building structures.

K. The material shall have been subjected to fire exposure in accordance with standard time-temperature curve in the Standard, UL, ASTM E 119, and NFPA 251. The firestop material shall have also been subjected to the hose stream test in accordance with UL IOB.

L. Where conduits or sleeves penetrate fire- or smoke-rated walls, partitions, floor slabs, etc., the space between pass holes and the conduit shall be caulked with a UL listed, intumescent type, firestop system. Space between pass hole and conduit shall be sized in accordance with the manufacturer's requirements for conduit size and damming material thickness for the type of rated construction for which the system is to be used.

M. When firestops have been compromised during the construction process, always provide temporary firestopping until installation is complete.

N. See Section 27 05 00, Article 1.21 "Sleeves, Cutting, Patching, and Firestopping" for more details.

3.5 AS-BUILTS

A. Provide as-built drawings at the completion of the work to document the location of all buried

conduit, boxes, cable, etc. Drawings shall clearly identify locations, quantities, sizes, etc., for coordination with future construction.

END OF SECTION 27 11 00

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SECTION 27 13 00

COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 Summary

A. Furnish and install all backbone cabling as specified herein and as required for proper distribution of all cable throughout the project as indicated on the drawings, and in accordance with the Contract Documents.

1.2 Related Sections

A. Refer to Divisions 01, 14, 21, 22, 23, 26 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 27 00 00.03 – Table of Contents for Communications for specification sections that apply to all work herein.

1.3 Reference Standards

A. All backbone cabling shall be designed, manufactured, and tested in accordance with the latest applicable industry standards and codes including the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City.
   a. New York City Building Code.
   b. New York City Electrical Code.
   c. International Building Code.
   d. International Electrical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. ANSI R211.
   b. ANSI/TIA -568-C.
   c. ANSI/TIA569.A.
   d. ANSI/TIA -606-A.
   e. BICSI “Telecommunications Distribution Methods Manual”.
   f. BOCA National Building Code, 1996; Seismic exposure Group II – Performance Category “C”.
   g. IEEE Std 1100-1992 “Powering and Grounding Sensitive Electronic Equipment”.

1.4 Quality Assurance

A. After completion of installation, but prior to final completion, Contractor shall certify in writing that products and materials installed, and processes used, do not contain asbestos or polychlorinated biphenyls (PCB’s), in a format acceptable to the Owner. In the event no product or material is available that does not contain asbestos, PCB or hazardous materials as determined by the Owner, a "Materials Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.

B. In the event that materials, products, and/or processes being proposed for this Project contain, or may emit, any volatile organic compounds (VOC’s), formaldehyde formulations, or hazardous out-gassing, as determined by the manufacturer, a “Materials Safety Data Sheet”, as described above, shall be submitted as part of the shop drawing process for review by the Engineer and/or Owner.

C. All adhesives specified herein or utilized in the manufacture of equipment or components which are specified herein shall meet or exceed the VOC limits of South Coast Air Quality Management District Rule No. 1168. All sealants specified herein or utilized in the manufacture of equipment or components which are specified herein shall meet or exceed Bay Area Air Resources Board Reg. 8, Rule 51. Submit as part of the shop drawing process for review by the Engineer and/or Owner, supporting documentation which demonstrates conformance with these requirements.

D. All equipment and material to be furnished and installed on this Project shall be UL or ETL listed,

in accordance with the requirements of the Authority having jurisdiction, and suitable for its intended use on this Project.

1.5 Submittals

A. The following submittal data shall be furnished according to Section 27 05 00 and shall include but not be limited to:
   1. Single Mode and Laser Optimized Multimode fiberoptic cable, including samples, complete with fittings, materials, connector details, etc.
   2. Category 5e - 25 Pair Copper Riser Cable, including samples, complete with fittings, materials, connector details, etc.

1.6 Warranty

A. Comply with the requirements of the Contract Documents and Section 27 05 00.

PART 2 - PRODUCTS

2.1 Unauthorized Materials

A. Materials and products required for work of this Section shall not contain asbestos, polychlorinated biphenyls (PCB's) or other hazardous materials identified by the Owner.

2.2 Acceptable Manufacturers

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of the Contract Documents.

B. All substitutions must be included in the Contractor's Base Bid, and must be accompanied by a letter of equivalency certifying the products equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be all inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Project specifications/documents will not be revised to reflect the substitution should the substitution be approved.

C. If it complies with these specifications, fiberoptic cable manufactured by one of the following manufacturers will be acceptable:
   1. Belden.
   2. Ortronics/Essex.
   3. Corning.
   4. Leviton/Berk-Tek.
   5. Panduit/General.
   6. TE.

D. If it complies with these specifications, UTP manufactured by one of the following manufacturers will be acceptable:
   1. Belden.
   2. Ortronics/Essex.
   3. Leviton/Berk-Tek.
   4. Panduit/General.
   5. TE.

2.3 Multi-Mode Fiber-Optic Cable

A. Provide plenum and/or riser rated fiber, laser optimized multi-mode, fiber cable with integral strength member and individually jacketed 50 µm strands.

B. Cabling shall be rated, and installed in a manner consistent with the requirements of the National Electrical Code (NEC).

C. All fibers in the cable must be usable and meet required specifications.

D. All fiber shall be run in 1-1/4 in. innerduct, orange in color.

E. All single mode fiber jackets shall be Yellow in color.

F. All multi-mode fiber jackets shall be Orange in color.

G. Each optical fiber shall be sufficiently free of surface imperfections and inclusions to meet the

optical, mechanical, and environmental requirements of this specification.

H. Each optical fiber shall consist of a doped silica core surrounded by a concentric glass cladding. The fiber shall be a matched clad design.

I. Each optical fiber shall be proof tested by the fiber manufacturer at a minimum of 100 kpsi (0.7 GN/m^2).

J. The fiber shall be coated with a dual layer acrylate protective coating. The coating shall be in physical contact with the cladding surface.

K. The attenuation specification shall be a maximum value for each cabled fiber at 23 ± 5°C on the original shipping reel.

L. All fiber shall support 500 meter link lengths for 10 Gb/s applications.

M. The fiber shall meet the requirements of TIA/EIA-492AAAD, "Detail Specification for 850-nm Laser-Optimized, 50-µm Core Diameter/125-µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers."

N. mandrel shall not exceed 0.5 dB at 850 nm or 1,300 nm.

2.4 Single-Mode Optical Fiber (Dispersion Unshifted)

A. The single-mode fiber utilized in the optical fiber cable shall meet TIA/EIA-492CAAA, "Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers," and ITU recommendation G.652, “Characteristics of Single-Mode Optical Fibre Cable

B. All single-mode jackets shall be yellow in color.

C. Cabled Fiber Polarization Mode Dispersion (PMD): ≤ 0.5 $\mathrm{ps}/\sqrt{\mathrm{km}}$

2.5 Category 5E - 25-Pair Cable

A. Category 5e - 25-Pair Cable shall be furnished and installed as shown on plan and in accordance with the most current requirements of the applicable ANSI/TIA/EIA Standards.

B. Cabling shall be rated and installed in a manner consistent with the requirements of the National Electrical Code (NEC).

C. 24 AWG bare copper wire insulated with polyethylene.

D. Cable jacket to be plenum/non-plenum rated.

PART 3 - EXECUTION

3.1 Installation

A. General Cable Installation

1. The wiring system shall be used for interconnecting telephones, PBX, LAN/WAN equipment (i.e., switches, routers, computers, etc.), televisions, fax machines, and any other equipment compatible with the wiring system herein described. The wiring system, including both copper and fiber optic applications, shall be configured as documented on the Contract/Bid Documents.
2. Furnish and install the telecommunications cables/wires in accordance with the drawings and instructions provided by the Engineer and manufacturer’s recommendations.
3. All cables shall be installed in an electrically or optically continuous fashion between the designated origin and destination points. That is, all cables must be “homerun” with no unspecified splices, couplers, or intermediate connection points along the specified channel.
4. All cables shall be securely held in place by an industry-acceptable practice, which also meets applicable codes.
5. Each reel of cable shall be provided with a manufacturer's report certifying performance.

B. EMI/RFI Avoidance

1. To avoid electromagnetic interference (EMI), cables shall be routed in such a way as to maintain the following minimum distance from possible sources of EMI:
   a. 48 inches from large motors or transformers.
   b. 12 inches from fluorescent or any other lighting type that requires a transformer or

ballast.

c. 3 inches from fluorescent fixtures with remotely installed ballasts.

d. Wherever possible, pathways shall cross perpendicular (at a 90 degree angle) to electrical power cables and conduit. When this is not possible and telecommunications cables must take a path parallel to electrical cables or conduit, the telecommunications cables shall maintain a distance of no less than 12 inches from the electrical cabling and conduit.

C. Cable Pulling

1. To limit the incidence of micro-bending of the individual fiber strands, mesh-type, swivel-eye fiber optic pulling grips shall be employed for all fiber optic cable pulling. This type of pulling grip is recommended for all other building cable as required.

a. Pulling tension shall be monitored with a dynamometer (tension gauge) to ensure that manufacturer's recommended tensile ratings are not exceeded.

b. Follow manufacturers' instructions for installing, connecting, and adjusting all equipment and telecommunications cabling. Where no instructions are included or available, follow industry standards.

c. Sheaves and cable guides shall be used to maintain recommended cable bend radii when pulling. At no times shall the cable be bent to less than ten (10) times its outside diameter.

d. The maximum length of horizontal UTP cable from any work station to the termination point must not exceed 90 meters (295 feet).

e. Completely install each horizontal station cable as an uninterrupted segment from the appropriate TR Room to the designated outlet location as indicated on the drawings. There shall be no unspecified splices or mechanical couplers installed between the cable points of origin and termination.

D. Cable Dressing and Terminating

1. Technology Rooms

a. All cables shall be dressed in a neat manner at all points throughout the installation.

b. At every two-foot interval in Technology Rooms, provide removable hook and loop type (Velcro) cable fasteners for each cable bundle segment that is within the room. Submit cable tie criteria to the Engineer for review prior to pulling cable.

c. Technology Rooms shall be utilized to provide a point of interconnection between the telecommunications risers, telecommunications equipment and horizontal (station outlet) wiring.

d. Patch cords shall be dressed across ladder rack and/or wire guide.

2. Modular Patch Panels

a. Cabling shall be properly installed using sufficient management hardware (jumper troughs, etc.).

b. Cabling shall be installed across the top of the strain-relief bar (parallel to the bar), in neat large-radius sweeps, tie-wrapped and routed into the area between the applicable 110 termination strips located in the rear of the modular patch panel.

c. Desi-strip label shall be installed between the 110 termination strips located in the rear of the modular patch panel.

d. No more outer insulation than is needed to terminate the cable in this position shall be stripped from the cable.

e. Individual pairs shall maintain twist integrity to within 0.5 in. of the termination point.

3.2 Testing

A. General

1. Contractor shall provide sufficient skilled labor to complete testing within the agreed-upon test period.

2. Contractor must fulfill all Owner's, Engineer's, and Manufacturer's Warranty/Test

requirements.

3. Contractor must be qualified to provide system certification for the cabling solution provided. At the completion of the installation, Contractor must supply said system certification along with copies of all applications and correspondence pertaining to the system certification.
4. Contractor's company shall have a minimum of 3 years' experience installing and testing fiber optic cabling systems. All installers assigned by the Contractor to the installation shall have factory certification that they are qualified to install and test the provided products.
5. Contractor is responsible for supplying all of the required test equipment used to conduct acceptance tests.
6. Contractor is responsible for submitting acceptance documentation as defined below.
7. Owner reserves the right to be present during any or all of testing.
8. Testing shall be of the permanent link. A link is defined as the passive cabling network between two cross-connects (patch panels or outlets). This includes cable, connectors and splices but does not include active components. The link test contains the representative connector loss at the patch panel associated with the mating of patch cords but does not include the performance of the connector at the equipment interface.
9. Prior to testing, submit for review and approval copies of test report forms proposed for use.
    a. Each test report form shall contain the following general information: Date of preparation, date of test, project name, Contractor's name, media type, make, model, software revision, and serial number of test equipment used, date of last calibration and names of test crew.
    b. Paired and Multi-Conductor Metallic Cable Test Reports: As a minimum, also provide cable number, cable type, pair or conductor count, individual pair or conductor numbers, number of cross-connects and/or patches in each pair, results of each test for each pair or conductor, total number of serviceable pairs or conductors in cable.
    c. 25-Pair, Category 5E, UTP Cables: Provide test reports created by automated cable tester for each tested cable.
10. All cabling not tested strictly in accordance with these procedures shall be retested at no additional cost to the Owner.
11. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and receipt of full documentation.
12. Either the test equipment shall be fully charged prior to each day's testing or a fresh set of batteries shall be brought to the job site.
13. Remove all defective cables from the cable pathways. Do not abandon cables in place.
14. The Engineer reserves the right to observe the conduct of any or all portions of the testing process.
15. The Engineer further reserves the right to conduct, using the Contractor's equipment and labor, a random retest of up to five (5) percent of the cable plant to confirm documented test results.
16. All test results and corrective procedures are to be documented and submitted to the Engineer within ten (10) working days of test completion.
17. In addition to the specified test, be prepared to be present while the Owner or Owner's designated representatives install and conduct performance tests of the transport electronics connected to the cabling system. Be prepared to conduct on-the-spot cable tests and effect cable plant repairs, as necessary. Successful equipment performance tests do not relieve the Contractor of the specified testing, repair, and documentation requirements.
18. All cables shall be factory tested for continuity before shipment. Submit documentation to

the Engineer that the cable has been tested by the manufacturer to industry standards.

19. The Contractor shall provide a thorough testing program for the communications cabling plant, and final acceptance testing. The testing program being proposed shall be submitted to the Engineer for approval before testing begins. Provide all required test equipment. The Owner's representatives may choose to observe any or all testing. Final acceptance testing shall be performed jointly by the Contractor and the Owner's representative. The Contractor shall provide procedures, a list of test equipment and operating instructions before the tests.
20. Subsystems shall be tested individually before testing for end-to-end connectivity. All faults shall be corrected and retested. All test results shall be completely documented.
21. All cable that fails manufacturer's or specified testing criteria shall be replaced at no additional expense to Owner.

B. Test Equipment
   1. General
      a. Test equipment used under this Contract shall be from manufacturers that have a minimum of five (5) years' experience in producing field test equipment. Manufacturers must be ISO 9001 certified.
      b. All test tools of a given type shall be from the same manufacturer and have compatible electronic results output.
      c. Test equipment shall store at least 100 tests in internal memory.
      d. Test equipment shall employ a serial port to facilitate uploading of saved information from tester to PC.
      e. Test equipment shall be capable of nulling out the loss and length of the test jumpers used to interface with the cable plant.

C. Fiber-Optic Tests
   1. After installation of connectors, visually inspect each fiber end-face at 10X magnification. Refinish any fibers showing visible defects and/or striations in the core area.
   2. Unless otherwise specified, 50 micron enhanced multimode fiber cabling must meet the performance specifications of ANSI/TIA/EIA-568-C. Attenuation and length shall be tested.
   3. All optical fibers shall be individually tested with connectors attached. Each cable span shall be tested individually. Tests shall be conducted selectively after cross-connection of the cable spans.
   4. An optical loss set (OLS) which combines the optical power meter (OPM) and optical source with adjustable output power level shall be used. The OLS/OPM shall display measured transmission loss directly in dB by comparing the optical power received after transmission through the fiber path to its own optical source power. Once this difference is adjusted to "zero" for a cable under test, all fibers in the cable are then measured relative to the "zeroed" source power and displayed in dB.
   5. Link attenuation shall be tested in accordance with ANSI/TIA/EIA-526-14A. Reference measurements shall be made in accordance with Reference Method A, Two Jumper Reference. Optical loss shall be measured on each fiber at both 850 nm and 1300 nm. Loss shall be measured on each fiber in both directions.

D. Unshielded Twisted Pair Tests (UTP) Test Report shall include:
   1. For all unshielded twisted pair connections, tests shall include, but not necessarily be limited to, tests for: Polarity reversals, wire transpositions, resistance, continuity, AC and DC voltages, opens, shorts, power and ground faults, and proper station operating conditions.
   2. For Category 5e Cabling: Attenuation, NEXT, PSNEXT, Return Loss, ELFEXT, and PSELFEXT data that indicate the worst-case result, the frequency at which it occurs, the limit at that point, and the margin. These tests shall be performed in a swept frequency manner from 1 MHz. to highest relevant frequency, using a swept frequency interval that

is consistent with TIA and ISO requirements. Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards. Any individual test that fails the relevant performance specification shall be marked as a FAIL.

3. Fiber test reports shall include the following information for each cabling element tested:
   a. Actual measured attenuation (loss) at 850 nm and 1,300 nm, expected attenuation at 850 nm and 1,300 nm per Part 2 Section 3, and the margin. An individual test that fails the link attenuation criteria shall be marked as FAIL.
   b. Reference method.
   c. Number of mated connectors and number of splices (if any).
   d. Actual length and expected length. Any individual test that fails the link length criteria shall be marked as FAIL.
   e. Group refractive index (GRI) at 850 nm and 1,300 nm.
   f. Tester manufacturer, model, serial number and software version.
   g. Circuit ID number and project/job name.
   h. Auto-test specification used.
   i. Overall pass/fail indication.
   j. Date and time of test.
   k. As a minimum, also provide cable number, fiber count, individual fiber numbers, connector types, number of connectors/patches; calculated maximum link loss, length of run, measured link loss for each fiber.

E. Documentation
   1. Upon completion of all tests, six (6) copies of the test results shall be submitted for review. Prior to cutover, the Contractor shall perform a random sampling test, jointly with the Owner or Owner's representative, of one in six optical fibers selected by the representative, to verify conformance to the Specifications.
   2. Test reports shall be submitted in electronic format. Hand-written or hard copy test reports are not acceptable.
   3. Electronic reports are to be submitted on CD format. If proprietary software is used, the CD shall contain any necessary software required to view test results. If the results are delivered in a standard format like Excel, Access, CSV files, etc., then software to read these files is not provided. Electronic reports must be accompanied by a certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report. Certificate must reference traceable circuit numbers that match the electronic record.
   4. Test reports shall be submitted at 20% intervals of testing schedule, within seven (7) business days of completion of testing.

F. Acceptance: Once all work has been completed, test documentation has been submitted, and Owner is satisfied that all work is in accordance with the Contract Documents, the Owner shall notify the Contractor in writing of the formal acceptance of the system.

3.3 As-Builts

A. Provide as-built drawings at the completion of the work to document the location of all buried conduit, boxes, cable, etc. Drawings shall clearly identify locations, quantities, sizes, etc., for coordination with future construction.

END OF SECTION 27 13 00

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SECTION 27 13 13

COMMUNICATIONS COPPER BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install all backbone cabling as specified herein and as required for proper distribution of all cable throughout the project as indicated on the drawings, and in accordance with the Contract Documents.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 21, 22, 23, 26 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 27 00 00.03 – Table of Contents for Communications for specification sections that apply to all work herein.

1.3 REFERENCE STANDARDS

A. All backbone cabling shall be designed, manufactured, and tested in accordance with the latest applicable industry standards and codes including the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City.
   a. New York City Building Code.
   b. New York City Electrical Code.
   c. International Building Code.
   d. International Electrical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. TIA Telecommunications Building Wiring Standards
   b. BICSI “Telecommunications Distribution Methods Manual”.

1.4 SUBMITTALS

A. The following submittal data shall be furnished according to Section 27 05 00 and shall include but not be limited to:

1. Category 5e - 25 Pair Copper Riser Cable, including samples, complete with fittings, materials, connector details, etc.
2. RG-11 Quad-Shielded Coaxial Cable, including samples, complete with fittings, materials, connector details, etc.

1.5 WARRANTY

A. Comply with the requirements of the Contract Documents and Section 27 05 00.

PART 2 - PRODUCTS

2.1 UNAUTHORIZED MATERIALS

A. Materials and products required for work of this Section shall not contain asbestos, polychlorinated biphenyls (PCB’s) or other hazardous materials identified by the Owner.

2.2 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of the Contract Documents.

B. All substitutions must be included in the Contractor’s Base Bid, and must be accompanied by a letter of equivalency certifying the products equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be all inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Project specifications/documents will not be revised to reflect the substitution should the substitution be approved.

C. If it complies with these specifications, copper backbone cable manufactured by one of the following manufacturers will be acceptable:
   2. Belden.
   3. Commscope
   4. Leviton/Berk-Tek.
   5. Ortronics/Essex.
   6. Panduit/General.

2.3 CATEGORY 5E - 25-PAIR CABLE

A. Category 5e - 25-Pair Cable shall be furnished and installed as shown on plan and in accordance with the most current requirements of the applicable TIA Standards.

B. Cabling shall be rated and installed in a manner consistent with the requirements of the National Electrical Code (NEC).

C. 24 AWG bare copper wire insulated with polyethylene.

D. Cable jacket to be plenum/riser rated as indicated on drawings.

2.4 RG-11 QUAD SHIELDED COAXIAL CABLE

A. RG-11 quad shielded coaxial cable shall be furnished and installed as shown on plan and in accordance with the most current requirements of the applicable TIA Standards.

B. Cabling shall be rated and installed in a manner consistent with the requirements of the National Electrical Code (NEC).

C. 75 OHM solid 14 AWG copper clad steel conductor.

D. Cable jacket to be plenum/riser rated as indicated on drawings

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Cable Installation
   1. The wiring system shall be used for interconnecting telephones, PBX, LAN/WAN equipment (i.e., switches, routers, computers, etc.), televisions, fax machines, and any other equipment compatible with the wiring system herein described. The wiring system copper (25-pair, RG-11) shall be configured as documented on the Contract/Bid Documents.
   2. Furnish and install the telecommunications cables/wires in accordance with the drawings and instructions provided by the Engineer and manufacturer’s recommendations.
   3. All cables shall be installed in an electrically or optically continuous fashion between the designated origin and destination points. That is, all cables must be “homerun” with no unspecified splices, couplers, or intermediate connection points along the specified channel.
   4. All cables shall be securely held in place by an industry-acceptable practice, which also meets applicable codes.
   5. Each reel of cable shall be provided with a manufacturer's report certifying performance.

B. EMI/RFI Avoidance
   1. To avoid electromagnetic interference (EMI), cables shall be routed in such a way as to maintain the following minimum distance from possible sources of EMI:
      a. 48 inches (1,220 mm) from large motors or transformers.
      b. 12 inches (305 mm) from fluorescent or any other lighting type that requires a transformer or ballast.
      c. 5 inches (77 mm) from fluorescent fixtures with remotely installed ballasts.
      d. Wherever possible, pathways shall cross perpendicular (at a 90 degree angle) to electrical power cables and conduit. When this is not possible and telecommunications cables must take a path parallel to electrical cables or conduit, the telecommunications cables shall maintain a distance of no less than 12 inches (305 mm) from the electrical cabling and conduit.

C. Cable Pulling
1. A mesh-type, swivel-eye pulling grips shall be employed for all cable pulling as required.
a. Pulling tension shall be monitored with a dynamometer (tension gauge) to ensure that manufacturer's recommended tensile ratings are not exceeded.
b. Follow manufacturers' instructions for installing, connecting, and adjusting all equipment and telecommunications cabling. Where no instructions are included or available, follow industry standards.
c. Sheaves and cable guides shall be used to maintain recommended cable bend radii when pulling. At no times shall the cable be bent to less than ten (10) times its outside diameter.
d. The maximum length of coaxial RG-11 cable from any work station to the termination point must not exceed 500 feet

D. Cable Dressing and Terminating
1. General
a. Cables shall be securely held in place by an industry-acceptable practice, and installed with sufficient bending radius so as not to kink, shear, or damage the cables (10 times the respective cable's outside diameter).
b. Provide a "mockup" of all cable terminations, labeling and dressing for each workstation, patch panel, and every other type of terminating device for Owner's review prior to commencing work.
c. All cables shall be dressed in a neat manner, observing cable and bend radius limit at each equipment rack or endpoint.
d. Work deemed by the Consulting Engineer not to conform to the cable dressing and termination methods described within the Contract Documents shall be redressed or removed and replaced as required at the direction of the Consulting Engineer at no additional cost to the Owner. Failure to properly dress and terminate cable as reflected in the documents shall result in the forfeiture of all or a portion of the Contract.
e. Location and placement of the required terminating and distribution hardware shall be as shown on the drawings.
f. After dressing cable to its final location, its outer sheath shall be removed to a point that allows the conductor to be splayed and terminated in a neat and uniform fashion. Every effort shall be made to maintain sheath integrity by removing only as much as is practical to accomplish termination.
g. The Contractor shall be responsible for the provision of all frames, blocks, terminations, supports, frame anchors, and mounting hardware necessary to fully install a complete telecommunications cabling system.

7. Technology Rooms (TR's)/Intermediate Distribution Frame (IDF)
h. All cables shall be dressed in a neat manner at all points throughout the installation.
a. At a maximum of every 18 inch (450 mm) interval in TR Rooms, provide removable hook and loop type (Velcro) cable fasteners for each cable bundle segment that is within the room. Submit cable tie criteria to the Engineer for review prior to pulling cable.
i. Technology Rooms shall be utilized to provide a point of interconnection between the telecommunications risers, telecommunications equipment and horizontal (station outlet) wiring.
j. Patch cords shall be dressed across ladder rack and/or wire guide.

2. Modular Patch Panels
a. Cabling shall be properly installed using sufficient management hardware (jumper troughs, etc.).
b. Cabling shall be installed across the top of the strain-relief bar (parallel to the bar),

in neat large-radius sweeps, Velcroed and routed into the area between the applicable 110 termination strips located in the rear of the modular patch panel.

c. Desi-strip label shall be installed between the 110 termination strips located in the rear of the modular patch panel.

d. No more outer insulation than is needed to terminate the cable in this position shall be stripped from the cable.

e. Individual pairs shall maintain twist integrity to within 0.5 in. of the termination point.

E. Cable Connector Protection

1. Keep all items protected before and after installation, with dust and moisture proof barrier materials. It shall be the Contractor's responsibility to ensure the integrity of these protective measures throughout the life of the project.

2. All installed connectors shall be protected and insulated by one of the following methods.

a. Any installed connector exposed to construction activities shall be protected with a clear, heat-sealed 3 mil plastic bag sealed shut with waterproof tape after installation. The bag must be removable for testing. Any protective bags removed for testing or other installation activities must be replaced immediately after such activities are completed.

b. Any connector, which is normally shipped with an insulating protective cover over the connector pins, shall be left with the cover in place after the connector has been installed on the cable. The protective cover shall be taped in place if easily dislodged.

c. Any connector fouled or damaged as a result of activities related to the construction process shall be replaced at no cost to Owner.

3.2 TESTING

A. General

1. Contractor shall provide sufficient skilled labor to complete testing within the agreed-upon test period.

2. Contractor must fulfill all Owner's, Engineer's, and Manufacturer's Warranty/Test requirements.

3. Contractor must be qualified to provide system certification for the cabling solution provided. At the completion of the installation, Contractor must supply said system certification along with copies of all applications and correspondence pertaining to the system certification.

4. Contractor's company shall have a minimum of 3 years' experience installing and testing cabling systems. All installers assigned by the Contractor to the installation shall have factory certification that they are qualified to install and test the provided products.

5. Contractor is responsible for supplying all of the required test equipment used to conduct acceptance tests.

6. Contractor is responsible for submitting acceptance documentation as defined below.

7. Owner reserves the right to be present during any or all of testing.

8. Testing shall be of the permanent link. A link is defined as the passive cabling network between two (2) cross-connects (patch panels or endpoint). This includes cable, connectors and splices but does not include active components. The link test contains the representative connector loss at the patch panel associated with the mating of patch cords but does not include the performance of the connector at the equipment interface.

9. Prior to testing, submit for review and approval copies of test report forms proposed for use.

a. Each test report form shall contain the following general information: Date of preparation, date of test, project name, Contractor's name, media type, make, model, software revision, and serial number of test equipment used, date of last calibration and names of test crew.

b. Paired and Multi-Conductor Metallic Cable Test Reports: As a minimum, also provide cable number, cable type, pair or conductor count, individual pair or conductor numbers, number of cross-connects and/or patches in each pair, results of each test for each pair or conductor, total number of serviceable pairs or conductors in cable.
c. 25-Pair, Category 5E, UTP Cables: Provide test reports created by automated cable tester for each tested cable.
d. RG-11 Quad Shielded Coaxial Cables: Provide test reports created by automated cable tester for each tested cable.

10. All cabling not tested strictly in accordance with these procedures shall be retested at no additional cost to the Owner.
11. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and receipt of full documentation.
8. Contractor shall remove all defective cables from the cable pathways. Defective cables shall not be permitted to remain in place and must be removed in its entirety.
12. The Engineer reserves the right to observe the conduct of any or all portions of the testing process.
13. The Engineer further reserves the right to conduct, using the Contractor's equipment and labor, a random retest of up to five percent (5%) of the cable plant to confirm documented test results.
14. All test results and corrective procedures are to be documented and submitted to the Engineer within ten (10) working days of test completion.
15. In addition to the specified test, be prepared to be present while the Owner or Owner's designated representatives install and conduct performance tests of the transport electronics connected to the cabling system. Be prepared to conduct on-the-spot cable tests and effect cable plant repairs, as necessary. Successful equipment performance tests do not relieve the Contractor of the specified testing, repair, and documentation requirements.
16. All cables shall be factory tested for continuity before shipment. Submit documentation to the Engineer that the cable has been tested by the manufacturer to industry standards.
17. The Contractor shall provide a thorough testing program for the communications cabling plant, and final acceptance testing. The testing program being proposed shall be submitted to the Engineer for approval before testing begins. Provide all required test equipment. The Owner's representatives may choose to observe any or all testing. Final acceptance testing shall be performed jointly by the Contractor and the Owner's representative. The Contractor shall provide procedures, a list of test equipment and operating instructions before the tests.
9. All category cabling test results shall be submitted to the manufacturer for cable plant warranty. The Contractor shall be responsible for obtaining the maximum warranty provided by the category cabling manufacturer and submitting the warranty to the Client/Owner. The warranty shall be issued under the Client/Owner's name.

B. Test Equipment
1. General
a. Test equipment used under this Contract shall be from manufacturers that have a minimum of five (5) years' experience in producing field test equipment. Manufacturers must be ISO 9001 certified.
b. All test tools of a given type shall be from the same manufacturer and have compatible electronic results output.
c. Test equipment shall store at least 100 tests in internal memory.
d. Test equipment shall employ a serial port to facilitate uploading of saved information from tester to PC.

e. Test equipment shall be capable of nulling out the loss and length of the test jumpers used to interface with the cable plant.

C. Unshielded Twisted Pair Tests (UTP) Test Report shall include:

1. For all unshielded twisted pair connections, tests shall include, but not necessarily be limited to, tests for: Polarity reversals, wire transpositions, resistance, continuity, AC and DC voltages, opens, shorts, power and ground faults, and proper station operating conditions.
2. For Category 5e Cabling: Attenuation, NEXT, PSNEXT, Return Loss, ELFEXT, and PSELFEXT data that indicate the worst-case result, the frequency at which it occurs, the limit at that point, and the margin. These tests shall be performed in a swept frequency manner from 1 MHz. to highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements. Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards. Any individual test that fails the relevant performance specification shall be marked as a FAIL.
3. Test reports shall be submitted at 20% intervals of testing schedule, within seven (7) business days of completion of testing.

B. Administration

1. Administration of the documentation shall include test results of each permanent link.
2. The test result information for each link shall be recorded in the memory of the field-test instrument upon completion of the test.
3. The test result records saved within the field-test instrument shall be transferred into a Windows-based database utility that allows for the maintenance, inspection and archiving of these test records.

C. Record Copy and As-Built Drawings

1. Provide record copy drawings periodically throughout the project as requested by the Construction Manager or Owner, and at end of the project on a CD or DVD. Record copy drawings at the end of the project shall be in CAD format and include notations reflecting the as built conditions of any additions to or variation from the drawings provided such as, but not limited to cable paths and termination point. The as-built drawings shall include, but are not limited to block diagrams, frame and cable labeling, cable termination points, equipment room layouts and frame installation details. The as-builts shall include all field changes made up to construction completion:
   a. Field directed changes to Contractor-developed pull schedule.
   b. Horizontal cable routing changes.
   c. Associated detail drawings.

3.3 AS-BUILTS

A. Provide as-built drawings at the completion of the work to document the location of all buried conduit, boxes, cable, etc. Drawings shall clearly identify locations, quantities, sizes, etc., for coordination with future construction.

END OF SECTION 27 13 13

SECTION 27 15 00

COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install all UTP cable, connectors, and mounting devices as specified herein and as required for proper distribution of all wire, cable, and electrical conductors throughout the project as indicated on the drawings and in accordance with the Contract Documents.

1.2 RELATED SECTIONS

A. Refer to Divisions 01, 14, 22, 21, 23, 26 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 27 00 00.03 – Table of Contents for Communications for specification sections that apply to all work herein.

1.3 REFERENCE STANDARDS

A. All UTP cable, connectors, and mounting devices shall be designed, manufactured, and tested in accordance with the latest applicable industry standards and codes, including the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City.
   a. New York City Building Code.
   b. New York City Electrical Code.
   c. International Building Code.
   d. International Electrical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. TIA Telecommunications Building Wiring Standards
   b. BICSI Telecommunications Distribution Methods Manual

1.4 SUBMITTALS

A. The following submittal data shall be furnished according to Section 27 05 00 and shall include, but not be limited to:

2. Category cabling, complete with materials list, UL listing, samples, etc.
3. Jacks, faceplates, and or surface-mounted boxes, etc.
4. Matrix indicating where each type of equipment is to be used.
5. Cable-pulling lubricant.

1.5 WARRANTY

A. Comply with the requirements of the Contract Documents and Section 27 05 00.

PART 2 - PRODUCTS

2.1 UNAUTHORIZED MATERIALS

A. Materials and products required for work of this section shall not contain asbestos, polychlorinated biphenyls (PCB's) or other hazardous materials identified by the Owner.

2.2 ACCEPTABLE MANUFACTURERS

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment that does not comply with the performance and/or physical characteristic requirements of the Contract Documents.

B. All substitutions must be included in the Contractor's Base Bid, and must be accompanied by a letter of equivalency certifying the products equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Project specifications/documents will not be revised to reflect the substitution should the substitution be approved.

C. If they comply with these specifications, UTP cable, coaxial cable and all station components including, but not limited to, faceplate, jacks, etc., manufactured by one of the following manufacturers will be acceptable:
   1. Belden.
   2. CommScope.
   3. Ortronics/Essex.
   4. Leviton/Berk-Tek.
   5. Panduit/General.

D. If they comply with these specifications, limited power (LP) cable and all station components manufactured by one of the following manufacturers will be acceptable:
   1. Belden.
   2. Ortronics/Essex.
   3. Leviton/Berk-Tek.
   4. Panduit/General.

E. If they comply with these specifications, fiberoptic cable and all station components manufactured by one of the following manufacturers will be acceptable:
   1. Belden.
   2. CommScope.
   3. Corning.
   4. Ortronics/Essex.
   5. Leviton/Berk-Tek.
   6. Panduit/General.

PART 3 - EXECUTION

3.1 GENERAL

A. General Cable Installation
   1. The wiring system shall be used for interconnecting telephones, PBX, LAN/WAN equipment (i.e., switches, routers, computers, etc.), fax machines, and any other equipment compatible with the wiring system described herein. The wiring system, including both copper and fiberoptic applications, shall be configured as documented on the Contract/Bid Documents.
   2. Furnish and install the telecommunications cables/wires in accordance with the drawings and instructions provided by the Engineer and manufacturer's recommendations.
   3. All cables shall be installed in an electrically or optically continuous fashion between the designated origin and destination points. That is, all cables must be home run with no unspecified splices, couplers, or intermediate connection points along the specified channel.
   4. All cables shall be securely held in place by an industry-acceptable practice that also meets applicable codes.
   5. Each reel of cable shall be provided with a manufacturer's report certifying performance.

B. Horizontal Cable Distribution
   1. Follow room boundaries when pulling cables through ceilings and floors for distribution into walls, conduits, wiring channels, outlets, etc.
   2. All cable distribution in mechanical spaces shall be via conduit.
   3. All other outlet configurations shall be provisioned in accordance with the plans.

C. EMI/RFI Avoidance
   1. To avoid electromagnetic interference (EMI), cables shall be routed in such a way as to maintain the following minimum distance from possible sources of EMI:
      a. 48 inches (1,220 mm) from large motors or transformers.
      b. 12 inches (305 mm) from fluorescent or any other lighting type that requires a transformer or ballast.

c. 5 inches (77 mm) from fluorescent fixtures with remotely installed ballasts.
d. Wherever possible, pathways shall cross perpendicular (at a 90 degree angle) to electrical power cables and conduit. When this is not possible and telecommunications cables must take a path parallel to electrical cables or conduit, the telecommunications cables shall maintain a distance of no less than 12 inches (305 mm) from the electrical cabling and conduit.

D. Cable Pulling
1. To limit the incidence of microbending of the individual fiber strands, mesh-type, swivel-eye fiberoptic pulling grips shall be employed for all fiberoptic cable pulling. This type of pulling grip is recommended for all other building cable as required.
a. Pulling tension shall be monitored with a dynamometer (tension gauge) to ensure that manufacturer's recommended tensile ratings are not exceeded.
b. Follow manufacturer's instructions for installing, connecting, and adjusting all equipment and telecommunications cabling. Where no instructions are included or available, follow industry standards.
c. Sheaves and cable guides shall be used to maintain recommended cable bend radii when pulling. At no times shall the cable be bent to less than ten (10) times its outside diameter.
d. The maximum length of horizontal UTP cable from any work station to the termination point must not exceed 295 feet (90 meters).
e. Completely install each horizontal station cable as an uninterrupted segment from the appropriate Technology Room (TR) to the designated outlet location as indicated on the drawings. There shall be no unspecified splices or mechanical couplers installed between the cable points of origin and termination.

E. Cable Dressing and Terminating
1. General
a. Cables shall be securely held in place by an industry-acceptable practice, and installed with sufficient bending radius so as not to kink, shear, or damage the cables (ten [10] times the respective cable's outside diameter).
b. Provide a mock-up of all cable terminations, labeling, and dressing for each workstation, patch panel, and every other type of terminating device for Owner's review prior to commencing work.
c. All cables shall be dressed in a neat manner, observing cable and bend radius limit at each workstation, equipment rack, and within furniture systems.
d. Work deemed by the Consulting Engineer not to conform to the cable dressing and termination methods described within the Contract Documents shall be redressed or removed and replaced as required at the direction of the Consulting Engineer at no additional cost to the Owner. Failure to properly dress and terminate cable as reflected in the documents shall result in the forfeiture of all or a portion of the Contract.
e. Location and placement of the required terminating and distribution hardware shall be as shown on the drawings.
f. After dressing UTP cable to its final location, its outer sheath shall be removed to a point that allows the conductor to be splayed and terminated in a neat and uniform fashion. Every effort shall be made to maintain sheath integrity by removing no more than 0.5 in. of sheath to accomplish termination.
g. The Contractor shall be responsible for the provision of all frames, blocks, terminations, supports, frame anchors, and mounting hardware necessary to fully install a complete telecommunications cabling system.
2. Technology Rooms (TR's)/Intermediate Distribution Frame (IDF)
a. All cables shall be dressed in a neat manner at all points throughout the installation.

b. At a maximum of every 18 inch (450 mm) interval in TR's, provide removable hook-and-loop-type (Velcro) cable fasteners for each cable bundle segment that is within the room. Submit cable tie criteria to the Engineer for review prior to pulling cable.
c. Technology Rooms shall be utilized to provide a point of interconnection between the telecommunications risers, telecommunications equipment and horizontal (station outlet) wiring.
d. Patch cords shall be dressed across ladder rack and/or wire guide.

3. Modular Patch Panels
a. Cabling shall be properly installed using sufficient management hardware (jumper troughs, etc.).
b. Cabling shall be installed across the top of the strain-relief bar (parallel to the bar), in neat large-radius sweeps, Velcroed and routed into the area between the applicable 110 termination strips located in the rear of the modular patch panel.
c. DESI Strip label shall be installed between the 110 termination strips located in the rear of the modular patch panel.
d. No more than 0.5 in. of outer insulation shall be removed in the termination of the cable.
e. Individual pairs shall maintain twist integrity to within 0.5 in. of the termination point.
f. All RJ-45 jacks shall be color-coded and approved by the Engineer prior to installation. Where a specified color is not available, the Contractor shall submit alternates to the Engineer for approval. Refer to drawings for colors.

4. Outlets
a. At least 12 in. (305 mm) of slack shall be left at each terminal box or behind each faceplate after jack installation is completed to allow for easy dismounting and extension of outlet covers and wire terminations.
b. Once the outlet side of UTP cables has been terminated, the jacks shall then be inserted into the appropriate faceplates for wall-mounted receptacles, as indicated on the drawings
c. Exercise particular caution with reference to the location and color of outlets and have precise and definite locations accepted by the Owner/Architect/Construction Manager/General Contractor before proceeding with the installation.

F. Cable Connector Protection
1. Keep all items protected before and after installation, with dust- and moisture-proof barrier materials. It shall be the Contractor's responsibility to ensure the integrity of these protective measures throughout the life of the project.
2. All installed connectors shall be protected and insulated by one of the following methods.
a. Any installed connector exposed to construction activities shall be protected with a clear, heat-sealed 3 mil plastic bag sealed shut with waterproof tape after installation. The bag must be removable for testing. Any protective bags removed for testing or other installation activities must be replaced immediately after such activities are completed.
b. Any connector that is normally shipped with an insulating protective cover over the connector pins shall be left with the cover in place after the connector has been installed on the cable. The protective cover shall be taped in place if easily dislodged.
c. Any connector fouled or damaged as a result of activities related to the construction process shall be replaced at no cost to Owner.

3.2 TESTING
A. General
1. Contractor shall provide sufficient skilled labor to complete testing within the agreed-upon test period.

2. Contractor must fulfill all Owner's, Engineer's and manufacturer's warranty/test requirements.
3. Contractor must be qualified to provide system certification for the cabling solution provided. At the completion of the installation, Contractor must supply said system certification along with copies of all applications and correspondence pertaining to the system certification.
4. Contractor's company shall have a minimum of 3 years' experience installing and testing fiberoptic cabling systems. All Installers assigned by the Contractor to the installation shall have factory certification that they are qualified to install and test the provided products.
5. Contractor is responsible for supplying all of the required test equipment used to conduct acceptance tests.
6. Contractor is responsible for submitting acceptance documentation as defined below.
7. Owner reserves the right to be present during any or all of testing.
8. Testing shall be of the permanent link. A link is defined as the passive cabling network between two (2) cross-connects (patch panels or outlets). This includes cable, connectors and splices, but does not include active components. The link test contains the representative connector loss at the patch panel associated with the mating of patch cords, but does not include the performance of the connector at the equipment interface.
9. Prior to testing, submit for review and approval copies of test report forms proposed for use.
    a. Each test report form shall contain the following general information: date of preparation, date of test, project name, Contractor's name, media type, make, model, software revision, and serial number of test equipment used, date of last calibration and names of test crew.
    b. Paired and Multi-Conductor Metallic Cable Test Reports: At a minimum, also provide cable number, cable type, pair or conductor count, individual pair or conductor numbers, number of cross-connects and/or patches in each pair, results of each test for each pair or conductor, total number of serviceable pairs or conductors in cable.
    c. 4-Pair Category Cables: Provide test reports created by automated cable tester for each tested cable.
10. All cabling not tested strictly in accordance with these procedures shall be retested at no additional cost to the Owner.
11. Acceptance shall be subject to completion of all work, successful post-installation testing that yields 100% PASS rating, and receipt of full documentation as described below.
12. Contractor shall remove all defective cables from the cable pathways. Defective cables shall not be permitted to remain in place and must be removed in their entirety.
13. The Engineer reserves the right to observe the conduct of any or all portions of the testing process.
14. The Engineer further reserves the right to conduct, using the Contractor's equipment and labor, a random retest of up to five percent (5%) of the cable plant to confirm documented test results.
15. All test results and corrective procedures are to be documented and submitted to the Engineer within ten (10) working days of test completion.
16. In addition to the specified test, be prepared to be present while the Owner or Owner's Designated Representatives install and conduct performance tests of the transport electronics connected to the cabling system. Be prepared to conduct on-the-spot cable tests and effect cable plant repairs, as necessary. Successful equipment performance tests do not relieve the Contractor of the specified testing, repair, and documentation requirements.
17. All cables shall be factory-tested for continuity before shipment. Submit documentation to

the Engineer that the cable has been tested by the manufacturer to industry standards.

18. The Contractor shall provide a thorough testing program for the communications cabling plant and final acceptance testing. The testing program being proposed shall be submitted to the Engineer for approval before testing begins. Provide all required test equipment. The Owner's Representatives may choose to observe any or all testing. Final acceptance testing shall be performed jointly by the Contractor and the Owner's Representative. The Contractor shall provide procedures, a list of test equipment, and operating instructions before the tests.
19. All category cabling test results shall be submitted to the manufacturer for cable plant warranty. The Contractor shall be responsible for obtaining the maximum warranty provided by the Category cabling manufacturer and submitting the warranty to the Client/Owner. The warranty shall be issued under the Client/Owner's name.

B. Test Equipment
1. Test equipment used under this Contract shall be from manufacturers that have a minimum of three (3) years' experience in producing field test equipment. Manufacturers must be ISO 9001-certified.
2. All testers shall meet Level III accuracy in accordance with ANSI/TIA-1152.
3. All test tools of a given type shall be from the same manufacturer and have compatible electronic results output.
4. Test equipment shall be capable of nulling out the loss and length of the test jumpers used to interface with the cable plant.
5. 4-pair UTP automated cable tester shall:
   a. Be compliant with TIA/ISO/IEC standards.
   b. Provide bi-directional testing to the latest standards for both basic links and channels.
   c. Provide certification for Cat6/6A links to 500 MHz with Level III accuracy.
   d. Latest Fluke tester or equivalent.
   e. The field-test instrument shall be within the calibration period recommended by the manufacturer, maximum of 12 months between calibration periods.

C. Category Cabling Test Report shall include:
1. For all unshielded twisted-pair connections, tests shall include, but not necessarily be limited to, tests for:
   a. Polarity reversals.
   b. Wire transpositions.
   c. Resistance, continuity.
   d. AC and DC voltages.
   e. Opens.
   f. Shorts.
   g. Power and ground faults.
   h. Proper station operating conditions.
2. For All Category Cabling: Attenuation, NEXT, PSNEXT, Return Loss, ELFEXT, and PSELFEXT data that indicate the worst-case result, the frequency at which it occurs, the limit at that point, and the margin. These tests shall be performed in a sweep frequency manner from 1 MHz to highest relevant frequency, using a sweep frequency interval that is consistent with TIA and ISO requirements. Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards. Any individual test that fails the relevant performance specification shall be marked as a FAIL.

D. Administration
1. Administration of the documentation shall include test results of each permanent link.
2. The test result information for each link shall be recorded in the memory of the field-test instrument upon completion of the test.

3. The test result records saved within the field-test instrument shall be transferred into a Windows-based database utility that allows for the maintenance, inspection and archiving of these test records.

E. Record Copy and As-Built Drawings

1. Provide record copy drawings periodically throughout the project as requested by the Construction Manager or Owner, and at end of the project on a CD or DVD. Record copy drawings at the end of the project shall be in CAD format and include notations reflecting the as-built conditions of any additions to or variation from the drawings provided such as, but not limited to, cable paths and termination point. The as-built drawings shall include, but are not limited to, block diagrams, frame and cable labeling, cable termination points, Equipment Room layouts and frame installation details. The as-builts shall include all field changes made up to construction completion:
   a. Field-directed changes to Contractor-developed pull schedule.
   b. Horizontal cable routing changes.
   c. Associated detail drawings.

3.3 AS-BUILTS

A. Provide as-built drawings at the completion of the work to document the location of all buried conduit, boxes, cable, etc. Drawings shall clearly identify locations, quantities, sizes, etc., for coordination with future construction.

END OF SECTION 27 15 00

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SECTION 27 16 00

COMMUNICATIONS CONNECTING CORDS, DEVICES AND ADAPTERS

PART 1 - GENERAL

1.1 Summary

A. Furnish and install all fiber, coaxial and UTP patch cords, connectors, and mounting devices as specified herein and as required for proper distribution of all wire, cable, and electrical conductors throughout the project as indicated on the drawings, and in accordance with the Contract Documents.

1.2 Related Sections

A. Refer to Divisions 01, 14, 21, 22, 23, 26 and 28 for the scope of work furnished and installed under those divisions on which work in this division may be dependent.

B. Refer to Section 27 00 00.03 – Table of Contents for Communications for specification sections that apply to all work herein.

1.3 Reference Standards

A. All fiber and UTP patch cords, connectors, and mounting devices shall be designed, manufactured, and tested in accordance with the latest applicable industry standards and codes, including the following:

1. Codes: Perform all work in accordance with the latest applicable codes and standards for New York City.
   a. New York City Building Code.
   b. New York City Electrical Code.
   c. International Building Code.
   d. International Electrical Code.
2. Reference Standards: Perform all work in accordance with, but not limited to, the following standards:
   a. TIA Telecommunications Building Wiring Standards
   b. BICSI “Telecommunications Distribution Methods Manual”.

1.4 Submittals

A. The following submittal data shall be furnished according to Section 27 05 00 and shall include but not be limited to:

1. Category 6 stranded patch cord.
2. Augmented Category 6 stranded patch cord.
3. Optical fiber patch cord.

1.5 Warranty

A. Comply with the requirements of the Contract Documents and Section 27 05 00.

PART 2 - PRODUCTS

2.1 Unauthorized Materials

A. Materials and products required for work of this section shall not contain asbestos, polychlorinated biphenyls (PCB’s) or other hazardous materials identified by the Owner.

2.2 Acceptable Manufacturers

A. Being listed herein as an acceptable manufacturer does not permit the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of the Contract Documents.

B. All substitutions must be included in the Contractor’s Base Bid, and must be accompanied by a letter of equivalency certifying the products equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be all inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Project specifications/documents will not be revised

to reflect the substitution should the substitution be approved.

C. If it complies with these specifications, copper patch cords manufactured by the following manufacturer will be acceptable:
   1. Belden.
   2. Commscope.
   3. Leviton/Berk-Tek.
   4. Ortronics/Essex.
   5. Panduit/General.

D. If it complies with these specifications, fiber patch cords manufactured by the following manufacturer will be acceptable:
   1. Belden.
   2. Commscope.
   3. Corning.
   4. Leviton/Berk-Tek.
   5. Ortronics/Essex.
   6. Panduit/General.

2.3 Category 6A Stranded Patch Cord

A. Augmented Category 6 rated.
B. Color blue.
C. 4-pair stranded cable construction.
D. 8-position modular plugs.
E. Category 6A patch cords shall be provided in the lengths and quantities listed on the drawings.
F. Provide factory terminated and tested Category 6A patch cords in quantities as indicated on the drawings and in lengths as required.

2.4 Optical Fiber Patch Cord

A. LC connector to LC connector, as required.
B. 50 micron, multi-mode, as required. Patch cords must meet the same performance specifications as outlined in Section 27 13 00.
C. OS2, single-mode, as required. Patch cords must meet the same performance specifications as outlined in Section 27 13 00.
D. Provide quantity of cords equal to one-third of the total number of strands installed. Lengths shall be as necessary to patch riser strands into switches with a maximum of two feet of slack, based on equipment elevations.

PART 3 - EXECUTION

3.1 Installation

A. General Cable Installation
   1. The wiring system shall be used for interconnecting telephones, PBX, LAN/WAN equipment (i.e., switches, routers, computers, etc.), televisions, fax machines, and any other equipment compatible with the wiring system herein described. The wiring system, including both copper and fiber optic applications, shall be configured as documented on the Contract/Bid Documents.
   2. Furnish and install the telecommunications cables/wires in accordance with the drawings and instructions provided by the Engineer and manufacturer’s recommendations.
   3. All cables shall be securely held in place by an industry-acceptable practice, which also meets applicable codes.
   4. Each patch cord shall be provided with a manufacturer's report certifying performance.

B. EMI/RFI Avoidance
   1. To avoid electromagnetic interference (EMI), cables shall be routed in such a way as to maintain the following minimum distance from possible sources of EMI:

a. 48 inches from large motors or transformers.
b. 18 inches from fluorescent or any other lighting type that requires a transformer or ballast.
c. Wherever possible, pathways shall cross perpendicular (at a 90 degree angle) to electrical power cables and conduit. When this is not possible and telecommunications cables must take a path parallel to electrical cables or conduit, the telecommunications cables shall maintain a distance of no less than 12 inches from the electrical cabling and conduit.

C. Cable Dressing and Terminating
1. General
a. Cables shall be securely held in place by an industry-acceptable practice, and installed with sufficient bending radius so as not to kink, shear, or damage the cables (10 times the respective cable's outside diameter).
b. Provide a "mockup" of labeling and dressing for each workstation, patch panel, and every other type of terminating device for Owner’s review prior to commencing work.
c. All cables shall be dressed in a neat manner, observing cable and bend radius limit at each workstation, equipment rack, and within furniture systems.
d. Work deemed by the Consulting Engineer not to conform to the cable dressing and termination methods described within the Contract Documents shall be redressed or removed and replaced as required at the direction of the Consulting Engineer at no additional cost to the Owner. Failure to properly dress and terminate cable as reflected in the documents shall result in the forfeiture of all or a portion of the Contract.
e. Location and placement of the required terminating and distribution hardware shall be as shown on the drawings.
2. Technology Rooms
a. At every two-foot interval in Technology Rooms, provide removable hook and loop type (Velcro) cable fasteners for each patch cord bundle that is within the room. Submit cable criteria to the Engineer for review prior to pulling cable.
b. Technology Rooms shall be utilized to provide a point of interconnection between the telecommunications risers, telecommunications equipment and horizontal (station outlet) wiring.
c. Patch cords shall be dressed across ladder rack and/or wire guide.
d. For any POE++ application, Contractor shall submit bundle size criteria for Engineer review and approval prior to installation.
3. Copper Patch Panels
a. Cabling shall be properly installed using sufficient management hardware (jumper troughs, etc.).
b. All patch panels shall be provided with strain relief bars. Cabling shall be installed across the top of the strain-relief bar in neat large-radius sweeps, tie-wrapped and routed into the area between the applicable termination points located in the rear of the modular patch panel.
c. Desi-strip label shall be installed between the termination points located in the rear of the modular patch panel.
d. No more outer insulation than is needed to terminate the cable in this position shall be stripped from the cable.
e. Individual pairs shall maintain twist integrity to within 0.5 in. of the termination point.
f. Labeling shall comply with latest TIA-606 administration standard.

D. Cable Connector Protection

1. Keep all items protected before and after installation, with dust and moisture proof barrier materials. It shall be the Contractor's responsibility to ensure the integrity of these protective measures throughout the life of the project.
2. All installed connectors shall be protected and insulated by one of the following methods.
   a. Any installed connector exposed to construction activities shall be protected with a clear, heat-sealed 3 mil plastic bag sealed shut with waterproof tape after installation. The bag must be removable for testing. Any protective bags removed for testing or other installation activities must be replaced immediately after such activities are completed.
   b. Any connector, which is normally shipped with an insulating protective cover over the connector pins, shall be left with the cover in place after the connector has been installed on the cable. The protective cover shall be taped in place if easily dislodged.
   c. Any connector fouled or damaged as a result of activities related to the construction process shall be replaced at no cost to Owner.

3.2 Testing

A. General

1. Contractor shall provide sufficient skilled labor to complete testing within the agreed-upon test period.
2. Contractor must fulfill all Owner's, Engineer's, and Manufacturer's Warranty/Test requirements.
3. Contractor must be qualified to provide system certification for the cabling solution provided. At the completion of the installation, Contractor must supply said system certification along with copies of all applications and correspondence pertaining to the system certification.
4. Contractor's company shall have a minimum of 3 years' experience installing and testing fiber optic cabling systems. All installers assigned by the Contractor to the installation shall have factory certification that they are qualified to install and test the provided products.
5. Contractor is responsible for supplying all of the required test equipment used to conduct acceptance tests.
6. Contractor is responsible for submitting acceptance documentation as defined below.
7. Owner reserves the right to be present during any or all of testing.
8. Testing shall be of the permanent link. A link is defined as the passive cabling network between two cross-connects (patch panels or outlets). This includes cable, connectors and splices but does not include active components. The link test contains the representative connector loss at the patch panel associated with the mating of patch cords but does not include the performance of the connector at the equipment interface.
9. Prior to testing, submit for review and approval copies of test report forms proposed for use.
   a. Each test report form shall contain the following general information: Date of preparation, date of test, project name, Contractor's name, media type, make, model, software revision, and serial number of test equipment used, date of last calibration and names of test crew.
   b. Paired and Multi-Conductor Metallic Cable Test Reports: As a minimum, also provide cable number, cable type, pair or conductor count, individual pair or conductor numbers, number of cross-connects and/or patches in each pair, results of each test for each pair or conductor, total number of serviceable pairs or conductors in cable.
   c. 4-Pair, Category 6A, UTP Cables: Provide test reports created by automated cable tester for each tested cable.

10. All cabling not tested strictly in accordance with these procedures shall be retested at no additional cost to the Owner.
11. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and receipt of full documentation.
12. Either the test equipment shall be fully charged prior to each day's testing or a fresh set of batteries shall be brought to the job site.
13. Remove all defective cables from the cable pathways. Do not abandon cables in place.
14. The Engineer reserves the right to observe the conduct of any or all portions of the testing process.
15. The Engineer further reserves the right to conduct, using the Contractor's equipment and labor, a random retest of up to five (5) percent of the cable plant to confirm documented test results.
16. All test results and corrective procedures are to be documented and submitted to the Engineer within ten (10) working days of test completion.
17. In addition to the specified test, be prepared to be present while the Owner or Owner's designated representatives install and conduct performance tests of the transport electronics connected to the cabling system. Be prepared to conduct on-the-spot cable tests and effect cable plant repairs, as necessary. Successful equipment performance tests do not relieve the Contractor of the specified testing, repair, and documentation requirements.
18. All cables shall be factory tested for continuity before shipment. Submit documentation to the Engineer that the cable has been tested by the manufacturer to industry standards.
19. The Contractor shall provide a thorough testing program for the communications cabling plant, and final acceptance testing. The testing program being proposed shall be submitted to the Engineer for approval before testing begins. Provide all required test equipment. The Owner's representatives may choose to observe any or all testing. Final acceptance testing shall be performed jointly by the Contractor and the Owner's representative. The Contractor shall provide procedures, a list of test equipment and operating instructions before the tests.
20. Subsystems shall be tested individually before testing for end-to-end connectivity. All faults shall be corrected and retested. All test results shall be completely documented.
21. All cable that fails manufacturer's or specified testing criteria shall be replaced at no additional expense to Owner.
22. Owner reserves the right to independently test any or all of the cable plant. If more than 3% of the tested cable plant within a floor, system or area fails, the Contractor will be required to take the following actions at no additional cost to Owner:
    a. Reimburse Owner for all costs incurred for independent testing.
    b. Work overtime to remedy defects and retest entire floor, system or area as defined by Owner. This corrective work shall not impact the planned occupancy dates.
    c. Reimburse Owner for supervision representation by their duly appointed representative during action taken in Paragraph b above.
    d. Contractor shall provide all test results to Owner at periods of 20% of scheduled test completion time.

B. Test Equipment
1. Test equipment used under this Contract shall be from manufacturers that have a minimum of five (5) years' experience in producing field test equipment. Manufacturers must be ISO 9001 certified.
2. All test tools of a given type shall be from the same manufacturer and have compatible electronic results output.
3. Test equipment shall store at least 100 tests in internal memory.

4. Test equipment shall employ a serial port to facilitate uploading of saved information from tester to PC.
5. Test equipment shall be capable of nulling out the loss and length of the test jumpers used to interface with the cable plant.
6. 4-Pair UTP Automated Cable Tester shall:
   a. Be compliant with TIA/ISO/IEC standards.
   b. Provide bi-directional testing to the latest standards for both basic links and channels.
   c. Provide certification for Cat5e/6A links to 500 MHz. with Level 3 accuracy.
   d. Microtest OMNIScanner 2, Fluke DSP-4000 Series or equivalent.

C. Unshielded Twisted Pair Tests (UTP) Test Report shall include:
1. For all unshielded twisted pair connections, tests shall include, but not necessarily be limited to, tests for: Polarity reversals, wire transpositions, resistance, continuity, AC and DC voltages, opens, shorts, power and ground faults, and proper station operating conditions.
2. Category 6A Cable Unshielded Twisted Pair Tests (UTP): Each cable shall be capable of carrying a bit rate signaling of 10 Gbps as outlined by the most current (at the time of the installation) revision of the ANSI/TIA/EIA Category 6A standard. Signal amplifiers shall not be required for channel lengths of up to 100 meters (including patch cords). Each individual cable shall be tested and certified to meet or exceed the following minimum performance criteria as outlined by the ANSI/TIA/EIA standards.

D. Documentation
1. Upon completion of all tests, six (6) copies of the test results shall be submitted for review. Prior to cutover, the Contractor shall perform a random sampling test, jointly with the Owner or Owner's representative, of one in six optical fibers selected by the representative, to verify conformance to the Specifications.
2. Test reports shall be submitted in electronic format. Hand-written or hard copy test reports are not acceptable.
3. Electronic reports are to be submitted on CD format. If proprietary software is used, the CD shall contain any necessary software required to view test results. If the results are delivered in a standard format like Excel, Access, CSV files, etc., then software to read these files is not provided. Electronic reports must be accompanied by a certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report. Certificate must reference traceable circuit numbers that match the electronic record.
4. Test reports shall be submitted at 20% intervals of testing schedule, within seven (7) business days of completion of testing.

E. Acceptance: Once all work has been completed, test documentation has been submitted, and Owner is satisfied that all work is in accordance with the Contract Documents, the Owner shall notify the Contractor in writing of the formal acceptance of the system.

3.3 As-Builts

A. Provide as-built drawings at the completion of the work to document the location of all buried conduit, boxes, cable, etc. Drawings shall clearly identify locations, quantities, sizes, etc., for coordination with future construction.

END OF SECTION 27 16 00

SECTION 28 05 00

COMMON WORK RESULTS FOR SECURITY MANAGEMENT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Division 28 of the Specifications requires the furnishing and installing of all items, including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to provide an integrated Security Management System (SMS) as indicated by the design documents and the equipment specified. The SMS shall be comprised of the following subsystems: Access Control System (ACS), Video Surveillance System (VSS), and Intrusion Detection System (IDS). Elements of the Work include, but are not limited to, materials, labor, supervision, supplies, equipment, transportation, rigging, storage, tools, scaffolding, machinery, appliances, utilities, testing, commissioning, warranties, and all required permits and licenses.

B. Before submittal of bid, examine all drawings, specifications, addenda, alternates, special conditions, and all other Contract Documents of all Division and Sections of this project, verify all governing conditions at the site, and become fully informed as to the extent and character of the work required, as well as its relation to other work in the building. Submittal of a bid is an agreement to all requirements of the Contract Documents, and no consideration will be granted for any claimed misunderstanding thereof.

C. Submittal of a bid is deemed a representation by the bidder that it is qualified in all respects properly to perform the work for which it is bidding and has experience with similar work. Bidders are deemed to be aware, on the basis of their background and experience, of materials which may be required in the discharge of their responsibilities, even though unspecified. For example, claims for extras for unspecified supporting materials will not be considered if the need for such materials would have been reasonably obvious to bidders skilled and experienced in the work to be done and the submittal of a bid shall be deemed a waiver of any such claims.

D. All statements, requirements, and contractual obligations imposed upon the Contractor awarded this Division of the Contract Documents shall also be applicable to his Subcontractors, Agents acting on behalf of the Contractor, servants and/or employees. All correspondence, agreements, and final responsibility for completion of work shall rest solely with this Contractor.

1.2 REFERENCES

A. The entire installation and all equipment, materials and methods shall comply with the currently enforced versions of all applicable laws, rules, regulations, standards, legislation, codes and ordinances of New York City, including but not limited to the following:

1. Underwriters Laboratory
2. UL294 - Access Control System Units
3. National Fire Protection Association
4. NFPA70 - National Electrical Code
5. NFPA 101- Life Safety Code
6. New York City Electrical Code.

B. Modifications required by the above said authorities having jurisdiction (AHJ) shall be made without additional cost to the Owner.

C. Secure and pay for necessary approvals, permits, inspections carting, legal dumping, etc., and deliver the official records of the granting of permits to the Owner without additional cost to the Owner.

D. All equipment, materials, and methods to be furnished and/or installed by this Division shall comply with all applicable requirements of laws, codes, ordinances, legislation, standards, etc., of all federal, state, and local authorities, whether indicated on the Contract Documents or not.

E. Where Contract Document requirements are in excess of rules, regulations and Code

requirements, and are permitted under the Code, the Contract Documents shall govern. In the event of a conflict between the Contract Documents and the applicable laws, rules, regulations, codes, and ordinances of federal, state, and local authorities having jurisdiction, the latter shall govern.

F. Where alterations to and/or deviations from the Contract Documents are required by the Authorities listed above, report the requirements to the Architect and Engineer and secure his written approval before starting the required modifications.

G. Pay royalties or fees required in connection with the use of patented devices, or systems, and save the Owner, the Architect, the Engineer and the Construction Manager harmless from any claims or lawsuits arising from such use and indemnify each thereof against attorneys in connection therewith.

H. Abbreviations of Regulatory Bodies

AABC	American Association of Balancing Contractors.
ADA	Americans with Disabilities Act.
AGA	American Gas Association.
AISC	American Institute of Steel Construction.
AMCA	Air Movement and Control Association
ANSI	American National Standards Institute.
ARI	Air Conditioning and Refrigeration Institute.
ASA	Acoustical Society of America.
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers.
ASME	American Society of Mechanical Engineers.
ASPE	American Society of Plumbing Engineers.
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials.
AWS	American Welding Society.
AWWA	American Water Works Association.
BCCNY	Building Code of the City of New York
BS&A	New York City Board of Standards & Appeals.
CDA	Copper Development Association.
CISPI	Cast Iron Soil Pipe Institute.
ECCCNYS	Energy Conservation Construction Code of New York State.
EPA	Environmental Protection Agency.
ETL	Electric Testing Laboratory.
FM	Factory Mutual.
IEEE	Institute of Electrical and Electronic Engineers.
IRI	Industrial Risk Insurers.
LEED	Leadership in Energy and Environmental Design.
MCAA	Mechanical Contractors Association of America.
MEA	Materials Equipment Approval.
MSDS	Materials Safety Data Sheet.
MSS	Manufacturers' Standardization Society Standards.
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association.
NETA	National Electrical Testing Agency
NFPA	National Fire Protection Association.
NUSIG	National Uniform Seismic Installation Guidelines.
NYCEC	New York City Electrical Code.

NYSERDA	New York State Energy Research and Development Authority.
NYSGBTC	New York State Green Building Tax Credit.
OSHA	Occupational Safety Health Administration.
OTCR	New York City Office of Technical Certifications and Research.
PDI	Plumbing and Drainage Institute.
TEMA	Tubular Exchangers Manufacturers Association.
UL	Underwriters Laboratories.
USGBC	United States Green Building Council.

I. Definitions

1. For purposes of these Specifications the following definitions apply:
   a. ARCHITECT: the Architect of record.
   b. ENGINEER: the Engineer of record.
   c. CONTRACTOR: the individual, partnership or corporation to whom has been awarded the Contract for providing the work associated with this Division.
   d. CONSTRUCTION MANAGER: an individual or group that contracts with another organization or individual (Owner) for the scheduling and coordination of all design and construction processes including the selection, hiring and oversight of specialty trade contractors for a building or other structure.
   e. PROVIDE: to "furnish" and "install"
   f. INSTALL: to join; unite; fasten; link; attach; set up or otherwise connect together; complete, tested and ready for normal satisfactory operation.
   g. FURNISH: to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories, and all other items customarily required for the proper and complete application.
   h. AS DIRECTED: as directed by the Architect or the Engineer.
   i. CONCEALED: embedded in masonry or other construction, installed behind wall furring or within double partitions, or installed within hung ceilings or accessible raised floor cavities.
   j. SUBMIT: submit to the Architect and/or the Engineer for review.
   k. FINISHED SPACES: spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
   l. EXPOSED: exposed to view.
   m. SUPPLY: to purchase, procure acquire, and deliver complete with related accessories.
   n. WORK: includes labor, materials, equipment, services, and all related accessories necessary for the proper and complete installation of complete systems.
   o. ACCESS CONTROL SYSTEM (ACS): includes card readers, door controllers, Ethernet modules, door contacts, anti-piggy back detection, system software license, access cards, Video Surveillance System (VSS) integration, power supplies, and all related accessories.
   p. INTERCOM SYSTEM (ICS): includes all master control stations, sub-stations, cable, ACS and VSS software integration, and all related accessories.
   q. INTRUSION DETECTION SYSTEM (IDS): includes all remote and local alarms, remote monitoring, panic buttons, window/door contacts.
   r. VIDEO SURVEILLANCE SYSTEM (VSS): includes cameras, camera mounts, switches, servers, storage devices, software, ACS integration and all related accessories.
   s. VIDEO MANAGEMENT SYSTEM (VMS): Includes the complete integration of the ACS, ICS, and VSS, all consoles, monitors, LAN access, data base entry, tours,

camera licenses, software licenses and all related accessories.

t. "SECURITY MANAGEMENT SYSTEM (SMS): Includes the complete integration of the ACS, ICS, and VSS, all consoles, monitors, LAN access, data base entry, tours, and all related accessories.

u. WIRING: Includes raceway, fittings, wire, boxes, and all related accessories.

v. INDICATED: As shown or noted on the drawings or specifications.

w. CONTRACT DOCUMENTS: All documents associated with the project, including all drawings and specifications of all trades.

x. BENEFICIAL USE: The state of installation in which all equipment related to the system being described is installed, functional, tested, and has been signed off by the Owner.

1.3 RELATED DOCUMENTS

A. The General and Supplementary General Conditions accompanying these Specifications are hereby made a part of the requirements for the work under this Section of the Specifications. Where General Conditions and Supplementary General Conditions clauses are repeated in these Specifications, it is to call special attention to them, or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this Section shall be considered waived unless specifically stated herein.

B. Refer to Owner's "Commissioning Requirements" for the scope of work related to systems furnished and installed under Division 28.

C. The following specification sections apply to all Work herein:

1. Section 28 0513 - Conductors and Cables for Security Management Systems.
2. Section 28 0526 - Grounding and Bonding for Security Management Systems.
3. Section 28 0800 - Commissioning of Security Management Systems.
4. Section 28 1300 - Access Control.
5. Section 28 1600 - Intrusion Detection.
6. Section 28 2300 - Video Surveillance.

D. Certain materials will be furnished, installed, or furnished and installed, under other Sections of the Contract Documents. Examine the Contract Documents to ascertain these requirements.

E. Refer to Divisions 08, 21, 22, 23, 25, 26 and 27 for the scope of work related to systems furnished and installed under Division 28.

1.4 QUALITY ASSURANCE

A. After completion of installation, but prior to Final Completion, this Contractor shall certify in writing that products and materials installed, and processes used, do not contain asbestos or polychlorinated biphenyls (PCB's), in a format acceptable to the Owner. In the event no product or material is available that does not contain asbestos, PCB or hazardous materials as determined by the Owner, a "Materials Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.

B. All adhesives specified herein or utilized in the manufacture of equipment or components which are specified herein shall meet or exceed the VOC limits of South Coast Air Quality Management District Rule No. 1168. All sealants specified herein or utilized in the manufacture of equipment or components which are specified herein shall meet or exceed Bay Area Resources Board Reg. 8, Rule 51. Submit as part of the shop drawing process for review by the Engineer and/or Owner, supporting documentation which demonstrates conformance with these requirements.

C. In the event that materials, products, and/or processes being proposed for this Project contain, or may emit, any volatile organic compounds (VOC), formaldehyde formulations, or hazardous out-gassing, as determined by the manufacturer, a "Materials Safety Data Sheet", as described above, shall be submitted as part of the shop drawing process for review by the Engineer and/or Owner.

D. Furnish all equipment, materials and accessories new and free from defects.

E. All equipment and material to be furnished and installed on this Project shall be approved for use

in New York City, listed by UL, ETL or any other recognized agency, listed in accordance with the requirements of the City of New York or any other Authority having jurisdiction, and be suitable for their intended use on this Project.

1.5 ENGINEERING REFERENCE POINTS

A. The Construction Manager will provide benchmarks, monuments, and other reference points on the job which will be available for this Contractor's use.

B. Maintain all existing bench marks, monuments and other reference points and perform all field engineering required to ensure that work under this Section shall conform with grades, elevations and lines required.

1.6 GUARANTEE

A. Submit a single guarantee stating that all portions of the work are in accordance with Contract requirements. Guarantee all work against faulty and improper material and workmanship for a period of two years from date of final acceptance by the Owner; except that where guarantees or warranties for longer terms are specified herein, such longer term shall apply. At no additional cost to Owner, within 2 hours after notification, correct any deficiencies which occur during the guarantee period, all to the satisfaction of the Owner and Architect.

B. Guarantee that the materials and workmanship supplied under this Division will be of the best quality currently available, that the apparatus will be erected in a practical manner and in accordance with best practices, that it will be complete in operation, nothing being omitted in the way of labor and material required to make this so, although not specifically shown or mentioned herein and that it will be delivered in proper working order, complete and perfect in every respect without additional cost - whether or not shown in detail on the drawings or described in detail in this Specification.

C. Be responsible for all damage to or caused by the Work performed under this Division for a period of two years from date of the acceptance of work under this Contract. Repair at no cost to Owner all such damage which occurs within 2 hours' notice thereof by the Owner. Damage which occurs prior to the completion of this Work shall be repaired at once. Be responsible for any damage and repair thereof and reimburse Owner for all expense incurred thereby. Indemnify the Owner, the Architect, the Engineer and the Construction Manager against loss, liability, damage or expense, including reasonable attorneys' fees, in connection with any claim resulting from such deficiencies which may be asserted by any third party, including tenants.

1.7 INDEMNIFICATION

A. This Contractor shall covenant and agree that he/she will provide and maintain a safe place to work and comply with all laws and regulations of any governmental authority having jurisdiction thereof. This Contractor agrees to indemnify, defend and hold harmless the Owner, Owner's agents, the Architect, and the Engineer from and against any liability, loss damage or expense, including attorneys' fees, arising from a failure or alleged failure on the part of this Contractor to discharge the obligations assumed by him or them in the performance of the work, including any act or omission allegedly resulting in death or personal injury or property damage or improper construction, construction techniques, or the use of improper or inappropriate material or tools.

1.8 COMPLETE PERFORMANCE OF WORK

A. This Contractor and his Subcontractors under this Section of the Specifications shall provide all labor, materials, supervision, supplies, tools, scaffolding, machinery, equipment, appliances, and services (including transportation, rigging, storage utilities, etc.) and all required permits and licenses necessary to complete the SMS Work under this Contract. All systems and equipment shall be complete in every respect and all items of material, equipment and labor shall be furnished, installed, tested and commissioned for a fully operational system.

B. This Contractor shall coordinate his Work with the Work of the other trades so as to resolve conflicts without impeding job progress or the Project construction schedule. Provide notice with the bid proposal of any concrete work required by this Section that is not indicated on the Structural

or Architectural Drawings or Drawings of other trades.

C. This Contractor shall examine all Contract Documents for all Sections of the Specifications in order to determine the extent of Work required to be completed under this Section. Failure to examine all the Contract Documents for this Project will not relieve this Contractor of the responsibility to perform all the Work required for a complete, fully operational and satisfactory installation.

D. Work shall be executed in strict accordance with the best practice of the trades in a thorough, workmanlike manner by competent skilled technicians and trade personnel.

E. This Contractor shall provide a competent, experienced full-time Superintendent who is authorized to make decisions on behalf of the Contractor.

F. Provide all temporary services and security system maintenance as required by the Construction Manager.

G. All labor, materials, apparatus, and appliances essential to the complete and proper functioning of the systems described and/or indicated herein, or which may be reasonably implied as essential, whether mentioned in the Contract Documents or not, shall be furnished and installed by this Contractor. The entire installation shall be ready in every respect for satisfactory and efficient operation when completed.

H. In cases of doubt as to the work intended, or in the event of need for explanation thereof, request supplementary written instructions in the form of a Request For Information (RFI) from the Architect and/or Engineer.

I. Coordinate the work specified and shown on the Contract Documents with all other trades.

J. Be responsible for material and workmanship until completion and final acceptance. Replace any of same which may be damaged, lost or stolen, without additional cost to Owner. Guard the building and its contents against damage by this Contractor and repair any damage free of charge.

K. Agree that any controversy or dispute to which the Contractor, the Owner and the Engineers are parties shall be submitted to the American Arbitration Association for decision in accordance with the rules of such Association for construction industry disputes. All Contractors likewise agree to submit to such arbitration any dispute between or among them, the Construction Manager, the Owner and the Engineers, and the Contractor agrees to make available to the Engineers, on demand, signed copies of the contract between the Owner and the Contractor and between the Contractor and his Subcontractors or Agents acting on his behalf. The Contractor and each Subcontractor or Agents acting on his behalf agree that by submitting a bid, which is accepted, this paragraph shall be deemed a written agreement to submit any controversy thereafter arising to arbitration.

L. Where, due to union regulations or trade agreements, any of the work shown on the drawings or specified herein is not considered this trade's work, subcontract the work in question, but assume full responsibility for the complete installation. Except for such changes as may be specifically approved by the Architects and Engineer, in accordance with alternates or options stated hereinafter, all work must be in full accordance with the intent of the plans and specifications, complete in every way and ready for satisfactory and efficient operation when delivered to the Owner.

M. Provide all signage required by the authorities having jurisdiction (e.g., on electrical equipment, power supplies, etc.).

N. Provide all rigging required for complete installation and furnish drawings showing necessary points of support, loads imposed, reactions and supplementary bracing. This shall be submitted to Owner for approval.

O. Become thoroughly acquainted with the work involved, obtain and verify, at the building, all measurements necessary for the proper installation of work. Furnish to other contractors any information relating to work of this Division necessary for the proper installation of their contracts. Confer with other contractors for finish work adjacent to work of this section and arrange to have visible portions of the work (such as access doors, grilles, escutcheons, etc.) fit in and harmonize

with the finish work of other Sections in a manner satisfactory to the Architect and Owner.

P. Transmit to trades doing work of other Sections all information required for work to be provided under their respective sections (such as, electric wiring, access doors, and the like) in ample time for installation.

Q. Wherever this Contractor's work interconnects with work of other Contractors, this Contractor shall coordinate his work with these Contractors to ensure that all Contractors have the information necessary so that they may properly install all the necessary connections and equipment. Identify all work items (conduit, power circuits, fire disconnects, etc.) in an approved manner in order that the other Trades may know where to install such items such as access doors, panels, etc.

R. Provide required supports and hangers for conduit, cable tray, ladder rack and equipment so that loading will not exceed allowable loadings of structure. Submittal of a bid shall be deemed a representation that the Contractor submitting such bid has ascertained allowable loadings and has included in his estimates the costs associated in furnishing required supports. Submit drawings showing all points of support, loads imposed, etc., to the Architect for review.

S. Field drilling, cutting and/or reinforcing of all openings, including holes in structural metal deck, structural slabs, or structural walls, required for work under this Section shall be coordinated through the Construction Manager and approved by the Structural Engineer. All such drilling, cutting and reinforcing costs shall be borne by this Contractor.

T. Sidewalks and streets adjoining the property shall be kept broom clean and free of debris, rubbish, trash and obstructions of any kind caused by work of this Contractor, which will affect the condition and safety of streets, walks, utilities and property.

U. All recommendations and requirements of the manufacturer.

1.9 DESCRIPTION OF BID DOCUMENTS

A. The Drawings show the general layout of the various items of equipment. However, layout of equipment, accessories, specialties, and conduit systems are diagrammatic unless specifically dimensioned, and do not necessarily indicate every required fitting, support, or similar items required for a complete installation. Consult the Architectural Drawings and details for exact locations of fixtures and equipment located in finished construction and/or surfaces. Where same is not definitively located, obtain the information from the Architect before proceeding by submitting a dimensioned submittal for review. Any reasonable changes in locations indicated shall be made by this Contractor without additional cost to the Owner.

B. The Contractor shall follow the Drawings in laying out the Work and check drawings of all trades to verify spaces in which Work will be installed. Maintain maximum headroom and where space conditions appear inadequate, the Architect shall be notified before proceeding with the installation. (See "Submittals" Article below.)

C. Specifications in general, describe quality and type of materials and equipment.

D. The drawings show the various systems schematically. No added compensation will be permitted for variations due to field conditions.

E. Where disagreements occur within the Contract Documents, the item or arrangement of better quality, greater quantity or higher cost shall be included in the base bid. Request, through the Construction Manager, clarification in writing from the Architect or Engineer on which item and manner in which the work shall be installed.

F. Work not shown on the drawings but called for in the Specifications, or vice versa, shall be provided by the Contractor without additional expense to the Owner.

G. The commercially standard items of equipment and the specific names mentioned herein are intended to identify standards of quality and performance necessary for the proper functioning of the work.

1.10 SUBMITTALS

A. The term "shop drawings" shall include layout, detail, and assembly drawings, diagrams, schedules, catalogue sheets, printed descriptive matter, and tabular and graphical presentations

of operating and performance data that describe work required by the Contract Documents. Catalogs and catalog sheets shall be clearly annotated indicating the specific items being proposed.

B. Prior to Final Acceptance, the following data shall be furnished in accordance with the Conditions of the Construction Contract, Division 01 Specifications, and this Division of the Specifications, and shall include but not be limited to:
   1. Record Drawings.
   2. Operating and Maintenance Manuals.
   3. Contractor Coordination Drawings.

C. In addition, during the installation period, submit detailed shop layout drawings for each floor of the project, including all Equipment Rooms, showing equipment and conduit work and other distribution services described herein, including locations and sizes of all openings in cellular steel floor decks, walls and floors. Shop drawings with multiple parts shall be submitted as a package. Shop drawings shall be 3/8 inch equal to 1 ft. 0 in. scale. Conduit shop drawings shall also indicate the point loading and spacing of each hanger and the method of support. Drawings shall include full coordinated plans and sections for Equipment Rooms, floor plans and risers. In addition, required detail drawings, such as anchor and guide details for floor-mounted equipment, etc., shall be submitted.

D. While the Contractor shall have access to the Engineer's drawings, neither these Engineer's drawings nor electronic files nor any other reproduced copy of the Engineer's drawings at any scale shall be used by the Contractor to generate any shop drawings. Shop drawings shall be completely drawn at the appropriate scale on clean sheets by this Contractor and/or any Subcontractor retained by this Contractor for any purpose on the project.

E. Shop drawings for Equipment Rooms, and for conduit and similar distribution services shall show by dimension the exact size and location of each element of the system in both the horizontal and vertical plane, as well as relationship to the building structure, architectural construction, equipment, and the work of other Trades. Where new work is added to an existing structure, the shop drawings shall show the location of all existing services and equipment. Pads, foundations, anchorages, supports and attachments to the building structure where required for the installation of the work shall be shown in layout and detail with sizes, dimensions, materials and methods of construction noted. The work described in any shop drawing submission shall be carefully checked by this Contractor for all clearances (including those required for maintenance and servicing, e.g., racked-out position of equipment), field conditions, maintenance of architectural conditions and proper coordination with all Trades on the job. Each submitted shop drawing shall include a certification by the Construction Manager that all related job conditions have been checked and that no conflict exists. Shop drawing submissions will either be rejected without such certification or the Construction Manager shall remedy all conflicts without any costs to the Owner.

F. Identify each sheet of printed submittal pages (using arrows, underlining or circling) to show applicable sizes, types, model numbers, ratings, capacities and options actually being proposed. Cross out non-applicable information. Note specified features and all applicable accessories, options, trip settings, sizes, materials, painting, etc.

G. For each room or area of the building containing SMS, ACS, VSS, ICS, IDS etc., the following is required to be submitted for review and acceptance at the time of the equipment submittal.
   1. Floor Plans

H. Plan views (including sections and elevations) of equipment indicated in the exact location in which it is intended to be installed. These plans shall be of a scale not less than 1/4 in. = 1 ft. 0 in. They shall be prepared in the following manner:
   1. Indicate the physical boundaries of the space, including door swings, ceiling/clear heights and ceiling types (as applicable).
   2. Note all Code-required clearances from all equipment by dimensions, including all service

and maintenance requirements (e.g., racked-out position of equipment, etc.).

3. Illustrate all electrical equipment proposed to be contained herein. Include top and bottom elevations of all electrical equipment. The drawings must be prepared utilizing the dimensions contained in the individual equipment submittals.
4. Illustrate all other equipment therein, such as conduits, detectors, luminaires, ducts, registers, pull boxes, crown boxes, splice boxes, wireways, structural elements, etc.
5. Note the operating weight of each piece of equipment.
6. Note the heat release from each piece of electrical equipment in terms of Btu per hour. This information shall be that which is supplied by the respective manufacturers.
7. Indicate maximum normal allowable operating temperature for each piece of equipment (as per each respective manufacturer's recommendation).

I. The Contractor shall submit shop drawings of the following work for review

1. Individual system riser diagrams for all electronic security systems. These shall include all devices required to complete the installation of the SMS, such as access switches, access control panels, CPU's, monitors, servers, storage (SAN/RAID), request to exit, card readers, push buttons, door contacts, IP cameras, intercoms, etc.
2. Schematic system diagrams showing all interconnect and information flow between electronic security systems, including a brief operational description.
3. Part plans and elevations of all security equipment within closets/IDF's, including security pathways, power supplies, panels, and switches.
4. Part plans and elevations of all access and monitoring consoles. This shall include all screens, CPU's, keyboards, badge printers, etc.
5. Wiring schematic for all fail-safe electric locking devices, even if locking equipment is specified as part of another contract (i.e., architectural).
6. All items of manufactured material and equipment for associated systems (ACS, VSS, ICS, IDS).
7. Other specific items of work as required by the provisions of the technical sections of the Contract Documents should be included in Submittal section.

J. Submit manufacturer's data or shop drawings of all proposed equipment, including, but not limited to, the following:

Client Workstations
Access System Controllers
Access System Controller Power Supply
Card Reader Interface Module Power Supply
Power Supply Interface
Battery Back-up
Ethernet Interface Module
Door Position Switches (Door Contacts)
Card Access Readers
Request to Exit Motion Sensors (REX)
Request-to-Exit Pushbuttons
Emergency Door Release
Card Access Servers
Panic Buttons
Cameras and Lenses
Stand-Alone Video Storage Device
Monitors
Software Package
Video Servers
Intercom Master Stations
Intercom Substations
Cable
Cable Identification Tags
Cable Supports
Ethernet Switches

K. This Contractor shall provide a Compliance Review of all Specifications and drawings with submittals.

1. The first section of the Compliance Review will be a review of the drawings.
2. The second section will be a paragraph-by-paragraph review of the Specifications with the following information, “C”, “D”, or “E”, marked in the margin of the original Specification and any subsequent addenda.

a. "C": Comply with no exceptions.
b. "D": Comply with deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the specification can be satisfied.
c. "E": Exception, do not comply. For each and every exception, provide a numbered footnote with reasons and possible alternatives.

Unless a deviation or exception is specifically noted in the Compliance Review, it is assumed that the submission is in complete compliance with the plans and Specifications. Deviations or exceptions taken in cover letters, subsidiary documents, by omission, or by contradiction do not release this Contractor from being in complete compliance, unless the exception or deviation has been specifically noted (explicitly, not by implication) in the Compliance Review.

1.11 ARCHITECT'S AND/OR ENGINEER'S REVIEW

A. The Architect and/or Engineer will review shop drawings and samples for conformance with the design concept of the project and the information contained in the Contract Documents.

B. The Architect's and/or Engineer's review of shop drawings and samples is only for the convenience of the Owner in following the work and does not relieve the Contractor of responsibility for deviations from the requirements of the Contract Documents.

C. The Architect's and/or Engineer's review shall not be construed as a complete or detailed check of the work submitted, nor shall it relieve the Contractor of responsibility for errors of any sort in the shop drawings and samples, or from the necessity of furnishing any work required by the Contract Documents which may have been omitted from the shop drawing submittals. The review of a separate item shall not indicate review of the complete assembly in which it functions. Nothing in the Architect's and/or Engineer's review of shop drawings and samples shall be considered as authorizing 1) a departure from Contract Documents, or 2) additional cost to the Owner, or 3) a deviation from Code requirements, or 4) increased time for completion of the work.

D. The Architect and/or Engineer will review shop drawings and samples with reasonable promptness and will return them to the Contractor stamped to indicate the appropriate action as follows:
1. "NO EXCEPTIONS TAKEN" means that fabrication, manufacture or construction may proceed providing the submittal complies with the Contract Documents.
2. "MAKE CORRECTIONS NOTED" means that fabrication, manufacture or construction may proceed providing the submittal complies with the Architect's and/or Engineer's notations and the Contract Documents. A copy of the corrected submittal shall be returned to the Architect and/or Engineer for record. If, for any reason, the Contractor cannot comply with the notations, the Contractor shall resubmit as described for submittals stamped "REVISE AND RESUBMIT".
3. "REVISE AND RESUBMIT" means that the Contractor must comply with the Architect's and/or Engineer's notations and resubmit before fabrication, manufacture or construction may proceed. Submittals stamped in this manner are not permitted on the job site.
4. "REJECTED" means that the submittal does not comply with the Contract Documents and that fabrication, manufacture or construction shall not proceed. Submittals stamped in this manner are not permitted on the job site.
5. "REVIEWED" means the submittal has been subjected to a limited review for completeness of intended use. Submittals stamped in this manner need not be resubmitted unless review by the Architect or other Consultants has indicated otherwise.

E. All shop drawings and samples shall be identified as follows:
1. Date of submittal
2. Title of project (including floor and room designations where applicable).
3. Name of Contractor and date of his approval.
4. Name of Subcontractor, manufacturer, or supplier and date of submittal to Contractor.

5. Number of submission
6. Any qualification, departure or deviations from the requirements of the Contract Documents.
7. UL or other nationally recognized listing agency standard number (including a copy of each standard), or any local listing or approval where required.
8. Such additional information as may be required by the Specifications for the particular material being furnished.
9. When the submitted materials modify components, styles, etc., on the same drawing, or alternate or options available for the intended material, the material shall be appropriately annotated in a manner to avoid any misunderstanding of the submission.

F. Architect's and/or Engineer's review is for general compliance with the design concept and contract documents. Markings or comments or the lack thereof shall not be construed as relieving the Contractor from compliance with the project Contract Documents. The Contractor remains solely responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of construction, for performing his work in a safe manner, and for coordinating his work with that of other Trades.

G. No part of the work shall be started in the shop or in the field until the Architect and/or Engineer have reviewed the shop drawings and samples for that portion of the work. Thereafter, the work shall be executed in accordance with the Contract Documents and the indicated status of the reviewed shop drawing.

H. Shop drawings and samples shall be submitted for review sufficiently in advance of the scheduled start of the work in the shop or in the field to allow ample time, in consideration of the number and complexity of the drawings in the submittal, for the Architect and/or Engineer to make an orderly review. No extension of the time to complete the work will be granted to the Contractor by reason of his failure in this respect.

I. The Contractor shall carefully check shop drawings and samples, including those received by him from Subcontractors and vendors, for accuracy, completeness of required information and conformance with the Contract Documents. Shop drawings found to be inaccurate, incomplete or not in conformance with the Contract Documents shall be corrected before being submitted to the Architect and/or Engineer for review.

J. Each submitted shop drawing shall bear the Contractor's stamped and signed certification that the work has been checked for all related job conditions, for maintenance of architectural conditions, for Code requirements, and coordinated with the shop drawings of other affected trades for interrelated work, as required for the proper and complete performance of the work. No shop drawing submittal will be reviewed without this certification.

K. Shop drawings for manufactured material and equipment shall include model numbers, dimension drawings, operating weights, material specifications, operating features and controls, wiring diagrams, performance characteristics, service procedures, including clearance requirements for maintenance work, and conformance to specified Codes and Code ratings. Note that in addition to these requirements, other specific submittal data, and forms of data submission, are required by the Contract Documents for particular items of equipment and material.

L. Samples shall be identical in all respects to the material which is to be installed or applied in the execution of the work, and shall be of sufficient size or quantity to permit proper evaluation and review. Manufacturer's descriptive labels and printed application instructions which are normally attached to the material or its packaging shall be furnished with the sample. Samples shall be submitted for review when requested by the Architect and/or Engineer.

M. Within three (3) weeks after award of the Contract, the Contractor shall submit for the Architect's and/or Engineer's review a list of the manufacturers, vendors, and Subcontractors whose products and services he proposes to use for the work. Proposed substitutions for material and equipment required by the Contract Documents shall be submitted to the Architect and/or Engineer for review

during this period per the process outlined in the Contract Documents. Submittals proposing or requesting substitutions shall be expressly identified as such in a letter of transmittal, with the reasons for requesting the substitution stated. Submittals for this purpose shall be complete in every respect, shall conform to all the information requirements for shop drawing and sample submittals, and shall include, at no cost to the Owner, the necessary revisions to other related work required by the Contract Documents. The judgment of the Architect and/or Engineer with respect to the adequacy and acceptability of a proposed substitution shall be final and binding on the Contractor, and shall not be subject to question in any other place. After the expiration of this period, substitutions for material or equipment shall not be proposed or requested in shop drawing and Sample submittals, and the Contractor will be required to execute the work in accordance with the provisions of the Contract Documents.

N. Within six (6) weeks after award of the Contract, the Contractor shall submit a schedule listing all shop drawings and samples with the projected date that each item will be submitted to the Architect and/or Engineer for review.

O. Since manufacturing methods vary, reasonable minor variations are expected; however, performance and material requirements specified herein are the minimum standards acceptable. The Engineer retains the sole right to judge the equality of equipment that deviates from the Contract Documents, to reject any alternative submitted by the Contractor, and to require the specified materials and equipment which conform to the requirements of the Contract Documents be furnished.

1.12 MANUFACTURER'S RECOMMENDATIONS

A. With the exceptions as specified and/or indicated on the Contract Documents, the Contractor shall provide or install equipment per Manufacturer's current printed instructions and recommendations. Copies of such printed recommendations shall be kept at the Project site and made available as required.

B. Where the manufacturer's recommendations conflict with the Contract Documents, the conflict shall be brought to the Engineer's attention immediately.

1.13 SPACE LIMITATIONS

A. The equipment selections used in the preparation of the Contract Documents will fit into the physical spaces provided and indicated, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearance in accordance with Code requirements, the requirements of the Local Authorities Having Jurisdiction, and the equipment manufacturer's recommendations.

B. In the preparation of Drawings, a reasonable effort to accommodate acceptable equipment manufacturer's space requirements has been made. However, since space requirements and equipment arrangement vary according to each manufacturer, the responsibility for initial access, maintenance access, code required access, and proper fit rests with this Contractor.

C. Physical dimensions and arrangements of equipment to be installed shall be subject to the Architect's and Engineer's review.

D. Carefully check space requirements with other Sections of the Contract Documents to insure that all material can be installed in the spaces allotted thereto.

E. Coordinate the installation of conduit, switches, access control panels, and equipment, etc., installation with lighting fixtures, special ceiling construction, air distribution equipment and the structure. Provide additional rises, drops and offsets as required. If work provided under this Division is found to be in conflict with the architecture, structure, or other trade Work which is either existing or shown on the Contract Documents, the work provided under this Division shall be relocated without additional cost to the Owner.

F. No piping, equipment, ductwork, conduit, etc., shall be installed in the eight (8) inch high zone directly above the proposed finished ceiling to allow for future build-out and flexibility unless otherwise specifically shown on the Drawings or prior written authorization is received from the

Engineer. Wherever possible, security cable distribution shall be installed tight to structure.

G. Architectural drawings shall be checked for ceiling height requirements. Where no ceiling height is stated, request direction from Architect prior to commencing work.

H. The Contractor shall follow the Drawings in laying out the Work and check drawings of all trades to verify spaces in which Work will be installed. Maintain maximum headroom and where space conditions appear inadequate, the Architect and Engineer shall be notified before proceeding with the installation.

1.14 CONTRACTOR'S COORDINATION DRAWINGS

A. Contractor shall furnish (in writing, with copies to the Architect and Construction Manager any information necessary to permit the Work of all trades to be installed satisfactorily and with the least possible interference or delay.

B. This Contractor shall prepare a complete set of construction "Coordination Drawings" indicating the equipment actually purchased and the exact routing and elevations for all lines such as piping, busway, conduit, ductwork, etc., including conduit embedded in concrete. All dimensions shall be referenced to building structural center lines. The "Coordination Drawing" preparation and completion shall comply with the requirements of the project construction schedule. The sheet metal drawings, prepared on electronic media (CAD) at a scale not less than 3/8 in. = 1 ft. 0 in., shall serve as the base drawings to which all other Contractors will overlay and add their work. Each trade shall draw their work on separate layers represented by individual colors. Each "Coordination Drawing" shall be completed and signed off by the other Contractors and this Contractor prior to the installation of the work in the area covered by the specific coordination drawing. The Contractor's work shall be installed in accordance with the shop drawings and the "Coordination Drawings". If the Contractor allows one trade to install their work before coordinating with the work of other trades, the Contractor shall make necessary changes to correct the condition without extra cost to the Owner. The Contractor's "Coordination Drawings" indicating piping, conduit, busway, and equipment support points and loads exceeding 200 lb. imposed on the building structure shall be submitted to the Project Structural Engineer for review and approval. The elevation, location, support points, static, dynamic and expansion forces and loads imposed on the structure at support, and anchor points, and the size of all lines shall be indicated. All beam penetrations and slab penetrations shall be indicated and sized and shall be coordinated. All work routed underground or embedded in concrete shall be indicated by dimension to column and building lines and shall be coordinated. This requirement for "Coordination Drawings" shall not be construed as authorization for the Contractor or Subcontractor to make any unauthorized changes to the Contract Drawings. Prior to final acceptance of the work of this Division, the Contractor shall give the drawing files, in AutoCAD on CD-ROM or DVD, containing the Contractor's coordination documentation to the Owner.

1.15 COMPOSITE WIRING DIAGRAMS

A. For each item or piece of equipment furnished as part of this Division where there is joint wiring interface responsibility, the project-specific wiring and interlock diagrams shall be provided to the other Division Contractors which are required to make interconnections to the system.

B. For each item or piece of equipment furnished as part of the work of other Divisions where there is joint wiring interface responsibility which includes work for this Contractor, the project-specific wiring and interlock diagrams shall be provided from the other Division Contractors. This Contractor shall modify the wiring and interlock diagram as required for his portion of the work and return it.

C. All diagrams shall be generated based on shop drawings and submitted, revised and modified in a timely fashion. Coordinate the timing with the construction schedule.

D. The following systems, items, etc., at a minimum, will require composite wiring diagrams. This list is in no way exhaustive and should include any and all systems which require wiring by multiple Contractors.

1. Fire alarm and detection system.
2. Security management system.
3. Emergency power system.
4. Local area network.
5. Electric doors.

E. One diagram shall be provided for each piece of equipment. Diagrams shall be suitable for insertion in a three-ring binder. This process shall be completed prior to commencement of work on the particular piece of equipment or in the area within which the equipment is located.

F. This Contractor shall review the completed diagram and verify that work provided by other Contractors will be in compliance with applicable Codes and that the system will function and operate as intended. The completed diagram shall include all line and low voltage system inter- and intra-wiring, including wiring from/to sensors, readers, class E disconnects, etc. Any errors or omissions shall be brought to the attention of the Engineer immediately.

G. All internal wiring of panels shall be included in the composite wiring diagram in detail. For items such as access control panels, any jumpers added or removed shall be labeled "added" or "removed."

H. This Contractor shall coordinate his/her Division with the requirements of all other Division Contractors as to the need for terminal strips, etc., required by them to interface with and/or control equipment furnished under this Division. Each conductor termination on the composite wiring diagram shall be suitably identified by a termination number or symbol. In addition, each conductor termination shall be suitably indexed to identify the termination location of the other end of the wire.

I. The composite wiring diagrams shall include description of the sequence of operation. The description shall include complete identification of each item shown (relay, power supply, controller, etc.), and each item's exact operation shall be related to the sequence.

1.16 RECORD DRAWINGS

A. The Contractor shall maintain on a daily basis at the Project site a complete set of "Record Drawings". The "Record Drawings" shall consist of a set of black and white prints and AutoCAD files of the Contractor Coordination Drawings for this Division. The prints shall include the updated AutoCAD files which shall be periodically electronically updated to show the precise location of all buried or concealed work and equipment, including embedded piping and valves, and all changes and deviations in the work from that shown on the Contract Documents. This requirement shall not be construed as authorization for the Contractor to make changes in the layout or work without written definite instructions from the Architect or Engineer. Prior to commencing work, the Contractor shall obtain from the Architect or Engineer a set of AutoCAD format Architectural and Engineering Drawings on CD-ROM or DVD, to be used only to produce the Contractor's Coordination Drawings. The continuously updated coordination drawings shall be used to produce the final "Record Drawings" which shall be delivered to the Owner in AutoCAD electronic format upon Project completion. The Contractor shall give to the Engineer a written release signed by a corporate officer of the Contractor prior to receipt of the Engineering Drawings.

B. Dimensions shall clearly and accurately delineate the work as installed; locations shall be suitably identified by at least two dimensions to permanent structures.

C. Upon completion of the Work, the Contractor shall certify all "Record Drawings" on the front lower right-hand corner adjacent to the above marking with a rubber stamp impression or an electronic image that states the Project name, the Contractor's name, the area covered and the date.

D. Prior to final acceptance of the Work of this Division, the Contractor shall submit properly certified "Record Drawings" to the Architect and Engineer for review and shall make changes, corrections, or additions as the Architect and/or Engineer may require to the "Record Drawings". Submit four (4) prints of each version until accepted.

E. After the Architect's and Engineer's review, and any required Contractor revisions, the "Record

Drawings" shall be delivered to the Construction Manager on CD-ROM or DVD in AutoCAD format for the Owner's use. Upon acceptance, provide ten (10) black-and-white prints and four (4) electronic versions on discs within sixty (60) days of Final Acceptance.

1.17 ELECTRICAL EQUIPMENT AND EQUIPMENT ROOM PRECAUTIONS

A. No piping, ducts or other equipment foreign to the electrical installation shall be installed within the dedicated zone above switchboards, panelboards, distribution boards, and motor control centers to a height of six (6) feet above the equipment or the structural ceiling whichever is lower. The area above the dedicated space shall not be permitted to contain foreign systems unless acceptable per Code and reviewed by the Engineer.

B. Provide all necessary personal protective equipment to OSHA requirements when working in areas within live electrical equipment.

1.18 EQUIPMENT AND MOUNTING

A. Furnish and install galvanized anchor bolts for all equipment placed on concrete equipment pads, inertia blocks, or on concrete slabs. Bolts shall be of the size and number recommended by the manufacturer of the equipment and as required for seismic restraint. Anchor bolts shall be located by means of suitable templates. When equipment is placed on vibration isolators, the equipment shall be secured to the isolator and the isolator secured to the floor, pad, or supported as recommended by the vibration isolation manufacturer.

B. Where allowed by the Architect and the Structural Engineer, equipment may be mounted on gypsum board partitions, the mounting screws shall pass through the gypsum board and be securely attached to the partition studs or framework. At the Contractor's option, the mounting screws may pass through the gypsum board and be securely attached to 8 in. high, continuous length, 16 gauge galvanized metal backplates which are attached to a minimum of three (3) metal studs. Toggle bolts installed in gypsum board partitions will not be acceptable. Submit all loads imposed to the Architect for review.

1.19 CUTTING AND PATCHING

A. Coordinate all required cutting and patching with other Divisions of the Specifications.

B. Furnish to the Construction Manager necessary information so that openings for this work can be built into the floors and walls in sufficient time.

C. Set sleeves for pipes and conduits accurately before concrete floors are poured, or set boxes on the forms to leave openings in the floors and subsequently set required sleeves in the openings.

D. Should Contractor neglect to perform preliminary work, and should cutting be required in order to install equipment, the expense of this cutting and restoring of surfaces to their original condition shall be borne by this Contractor.

1.20 UTILITY CONNECTIONS

A. Arrange and pay costs for all specified utilities including the following:

1. Connection to a utility, i.e., carriers, for dial-out and internet.
2. Payment of service charges.
3. Provisions for temporary utilities.
4. Connections to electric and other utility points of service interface.

1.21 PROTECTION OF EQUIPMENT AND MATERIALS

A. Protect from damage, water, dust, etc., material and equipment provided under this Division, both in storage and installed, in accordance with manufacturer's recommendations, until Notice of Completion has been filed and accepted.

B. Arrange with Construction Manager for storage facilities for materials and equipment.

C. All products stored off site and delivered to the site must be kept in factory packing with shipping bars, retainers and positioning devices in place until installation. Equipment which is subject to damage from moisture and/or dust must be wrapped, covered and protected, and stored indoors in a suitably controlled environment with factory covering in place until the room in which the equipment is to be placed is ready (i.e., conditioned, concrete sealed, floor finished, walls painted,

etc.).

D. Material, equipment or apparatus damaged because of improper storage or protection will be rejected.

E. Wrap, cover and protect equipment from damage due to moisture, water, dust, spray on fireproofing and construction debris during construction

F. Cover and protect all openings left in floor for passage of pipes or conduits. Protect conduits/pipes with suitable coverings as soon as set. Close all open ends of pipes or conduits with a plug fitting and conduits with caps to prevent obstruction and damage.

G. Protect equipment and all systems against freezing in cold weather.

H. Prior to starting equipment, remove all protective materials, shipping bars, retainers, positioning devices.

I. Protect the work, equipment, and material of all other Divisions from damage by work of this Division or this Division's personnel, and correct all damage thus caused without additional cost to the Owner.

J. Be responsible for all work, materials and equipment until finally inspected, tested, commissioned and accepted; protect work against theft, injury or damage; and carefully store material and equipment received on site which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of dust, dirt, and obstructing material.

K. No equipment rated for indoor use (NEMA 1) shall be set or stored in areas that are not fully enclosed and protected. If required by the schedule to deliver this equipment before the space is completed, assume all responsibility to provide a weatherproof enclosure with temporary heating and/or cooling to prohibit the entrance of moisture (condensation, etc.). Enclosure shall be built for use while working on the equipment (i.e., plastic wrap that is removed to work on the equipment shall NOT be acceptable).

L. All equipment surfaces shall be free of moisture or water.

1.22 CONSTRUCTION REVIEW

A. Work may be reviewed at any time by the Architect or Engineer.

B. Advise the Architect and/or Engineer that work is ready for review with a minimum of two (2) weeks' notice, at the following times:

1. Prior to backfilling buried work.
2. Prior to concealment of work in walls and above ceilings.
3. When all requirements of Contract have been completed.

1.23 EQUIPMENT NOISE AND VIBRATION

A. Equipment and systems, as defined herein, shall be quiet and free of apparent vibration while in operation.

B. Vibration shall not be apparent to the senses in occupied areas of the building. To this end, both the balancing of rotating machinery and the installation of vibration isolation at various locations are required.

C. It shall be the responsibility of this Contractor to obtain equipment that is quiet in operation as compared to other available equipment of its size, capacity, and type; to install equipment so that a minimum amount of noise and/or vibration is transmitted to the building; and to fabricate all systems so that noises generated in the systems are held to an absolute minimum.

D. Any additional precautions deemed necessary to provide a quiet installation shall be done as part of the Work of this Division, subject to review by the Engineer and without additional cost to the Owner. After the systems are in operation, it shall be the responsibility of the Contractor to make any changes to equipment or Work installed that may be required to provide systems which are quiet in operation and comply with the acoustic requirements as specified herein.

E. Except in various special areas listed herein, the system noise level, in occupied spaces, shall be equal to or less than the "lowest value in the range" of the noise criteria curves for the particular

space in accordance with the current edition of Applications Volume of the ASHRAE Handbook. The noise criteria curves shall be based on ANSI Standard S1.6-1984 (R-1990) octave bands and a sound pressure level in decibels referenced to 0.002 microbars. Sound levels within the occupied spaces must meet the criteria described above and with all building, wall partition, floor, ceiling plenum depth, and ceiling construction in place as they exist for the individual spaces. The attenuation through boundary construction of Equipment Rooms must be considered in selecting equipment for acceptable noise level as described herein.

F. The system noise level in the Tenant occupied or future Tenant-occupied spaces of the Project shall not exceed NC-35 (except as noted hereinbelow). This shall include all areas occupied by the Tenant, including areas directly under piping or any equipment.

G. Areas that shall conform to noise criteria other than NC-35 shall include the following:

Lobby, Toilets, Corridors, General Offices and Cafeteria	NC-40
Storage	NC-50

1.24 ELECTRONIC MEDIA REQUIREMENTS

A. All information, including, but not limited to, shop drawing submittals, "as-built" drawings, test results, and Operation and Maintenance Manuals shall be submitted on DVD(s)/CD-ROM(s) prior to the completion of the project.
   1. All drawings shall be in AutoCAD format.
   2. All cut sheets, submittals, manuals and associated information shall be in .pdf format.
   3. Each CD-ROM shall be indexed to allow ready access to all information.

B. Provide a minimum of six (6) copies of each DVD/CD-ROM, unless additional copies are requested elsewhere in the Contract Documents.

1.25 RUBBISH REMOVAL

A. Comply with the project's Construction Waste Management Plan.

B. At the conclusion of each day's work, clean up and stockpile on site, at location designated by the Construction Manager, all rubbish, debris and trash, which may have accumulated during the day as a result of work of this Division and of this Division's presence on the job. Construction Manager will then remove stockpiled rubbish.

1.26 VERIFYING EXISTING CONDITIONS

A. Before commencing work, examine all adjoining work on which this work is in any way dependent for perfect workmanship according to the intent of this Specification, and report to Construction Manager any condition which prevents performance of first-class work. No “waiver of responsibility” for incomplete, inadequate or defective adjoining work will be considered unless sufficient notice has been filed prior to commencing work.

1.27 FINAL REVIEW

A. At a time designated, the entire installation shall be reviewed for compliance with the Contract Documents. The Contractor shall be available at all times during this Review.

B. The Contractor shall demonstrate prior to the Final Review that all systems and all equipment have been properly installed, balanced and adjusted and are in compliance with the requirements of the Contract Documents. After these demonstration tests are completed satisfactorily, but prior to the Final Review field visit by the Engineer, submit to the Engineer a written certification that 1) attests to Contract Document compliance for this Project, and 2) certifies that the equipment and materials installed in this Project under this Division contain no asbestos or PCB's.

C. Certificates and Documents required herein shall be in order and presented to the Architect and Engineer at least two (2) weeks prior to the Final Review.

D. After the Final Review, any changes or corrections noted as necessary for the Work to comply with the Contract Documents shall be accomplished without delay in order to secure final acceptance of the Work.

1.28 EARLY OCCUPANCY

A. All Divisions are responsible for completing those systems which are necessary to allow partial occupancy of the buildings even if systems in the unoccupied areas are incomplete. Partial or early occupancy schedules will be developed by the Construction Manager. Specific attention is necessary for any areas involving special spaces such as technology areas, fire alarm systems, smoke control systems, elevators, generators, etc., which will require early operation to allow the occupancy to be arranged on a schedule consistent with the needs of the project. Refer to the construction schedule for this Project for the schedule of completion dates assigned to the various portions of the Project and schedule all work accordingly.

B. Requirements for temporary occupancy shall be verified with the Authorities Having Jurisdiction.

1.29 DATE OF COMPLETION

A. The date for the final performance and acceptance testing shall comply with the Project construction schedule and shall be sufficiently in advance of the Contract completion date to permit the execution of the testing and commissioning by this Division prior to occupancy and the close-out of the Contract. Any adjustments and/or alterations which the final acceptance tests indicate as necessary for the proper and satisfactory functioning of all equipment and systems shall be completed prior to the close-out of the Contract. Re-tests shall not relieve this Division of completion date responsibility.

B. Provide a detailed schedule of completion indicating when each system component and entire system is to be completed outlining when tests will be performed. Completion schedule shall be submitted to the Architect, Engineer, and Owner for review at a time requested by the Construction Manager after the notice to proceed has been given to this Division. This schedule shall be updated periodically by this Division as the Project progresses. Each update shall be submitted to the Construction Manager, Architect, Engineer, and Owner for review.

1.30 TESTING OF THE SECURITY MANAGEMENT SYSTEM

A. The entire SMS installation shall be inspected by the manufacturer and tested by this Division to ensure safety to building occupants and operating personnel, conformity to Code Authorities and to the Contract Documents, including the General Conditions for design services and construction procedures. The Contractor shall obtain, at no cost to the Owner, a certificate of completion.

B. Recognized safety procedures and techniques shall be used during energizing and de-energizing of all equipment to ensure employee safety and protect the work.

C. During the progress of the Work and upon completion, tests shall be made as specified and as required by authorities having jurisdiction including inspectors, Owner, Owner's Insurance Agency, Architect, Commissioning Authority, or Engineer. Tests shall be conducted by this Division and shall include the services of qualified personnel as well as all equipment, apparatus, and services required.

D. Each wiring system with devices connected must test free from short circuits and from grounds and must have an insulation resistance between conductors and ground, based on maximum load, not less than the requirements of the relevant industry standards such as NETA, IEEE, ANSI, etc.

E. As directed by the Construction Manager, prior to the execution of testing, submit in writing proposed test procedures, recording forms, list of personnel and qualifications, and test equipment for the Engineer's and Owner's review.

F. Provide all testing as required by Code and the authorities having jurisdiction of the SMS, equipment and components as specified herein, and in accordance with the requirements of the Contract Documents. Tests shall include but not be limited to the items specified in this Section and in other Division 28 Sections.

G. Coordinate all work with the Owner's Commissioning Authority and Commissioning Agent.

H. Provide standby and support services to the Owner's Commissioning Authority and Commissioning Agent.

I. Submit evidence to show that the testing personnel are qualified to perform the required work.

J. All test procedures shall be in accordance with the manufacturer's recommendations for the equipment being tested.
K. The submittal data to be furnished shall include, but not be limited to, the following:
   1. Method of Procedures (MOP's) for all tests proposed.
   2. Recording Forms.
   3. Test Data and Results, including the following:
L. Test performed.
M. Test procedure.
N. System and area tested.
O. Date(s) and time(s) of test.
P. Ambient environmental conditions.
Q. Test criteria.
R. Test results.
S. Additional pertinent data.
   1. Instruments, including documentation that such instruments were properly calibrated at the time of the testing.
   2. Personnel to be present and qualifications.
T. Provide all materials, including fuels where appropriate, supplies, services and temporary equipment, including test equipment required for testing of specified SMS components as well as integrated system tests, including any re-tests required to obtain acceptable results.
U. Testing materials that fail to provide acceptable test results shall be repaired or replaced with suitable materials as required to obtain acceptable test results.
V. Prove the capacity and performance and/or demonstrate operating controls and safety devices of each piece of equipment by field tests as requested and/or specified in various Divisions of the Contract Documents. Notify the Engineer and Owner in writing at least two (2) months prior to the day of each test.
W. Submit proposed commissioning process and test procedures, recording forms and test equipment for review at least six (6) months prior to the execution of the commissioning and testing.
X. All instruments used for testing must have been calibrated within a period of three (3) months prior to testing. Written confirmation of the calibration and the method of calibration shall be submitted to the Engineer one (1) month prior to the start of the testing commencement.
Y. After testing and/or commissioning systems, remove all dirt, dust, smears, stains, paint spots, and the like; clean and touch up finishes; and leave in like-new condition.

1.31 OPERATING INSTRUCTIONS

A. Provide the services of a factory-trained specialist to supervise the commissioning and testing, startup, and operation of all equipment specified herein and to instruct the Owner's operators during a five (5) day operating instruction period at or near the Project site. The operating instruction period shall be defined as straight time working hours and shall not include nights, weekends, or travel time to and/or from the Project and shall include a period for videotaping of the operating instructions. See individual sections of these specifications for additional instructions by manufacturer trained specialists.
B. The Owner shall be notified in writing at least two (2) weeks before each operating instruction period begins. Do not commence the instruction period until the Owner has issued his written acceptance of the starting time.

1.32 OPERATION AND MAINTENANCE MANUALS

A. Provide operating instructions and maintenance data books for all equipment and materials furnished under this Division.
B. Submit six (6) copies of operation and maintenance manuals for review at least ten (10) weeks before Final Review of the Project. Assemble all data in a completely indexed electronic volume(s)

and identify the size, model, and features indicated for each item. Include the Project Name and Logo printed on the outside of the CD-ROM's/DVD's. The media shall be submitted and subjected to the same approval process as detailed for shop drawings and samples as described hereinbefore, but shall be returned as "Reviewed". Submit six (6) copies of the "Reviewed" operation and maintenance books to the Construction Manager upon Project completion.

C. Operation and Maintenance manuals shall include complete lubrication, cleaning, and servicing data compiled in clearly and easily understandable form. Data shall show serial numbers and model numbers of each piece or equipment, complete lists of replacement parts (including part numbers), ratings, and actual loads. Manuals shall include information specific to the actual equipment model installed, including all options.

D. Include the following information where applicable:
   1. Identifying name and mark number.
   2. Locations of major equipment (where several similar items are used, provide a list).
   3. Complete nameplate data.
   4. “Reviewed” submittals.
   5. Parts lists.
   6. Performance curves and data.
   7. Wiring diagrams.
   8. Lubrication charts.
   9. Manufacturers' recommended operation and maintenance instructions with all non-applicable information deleted.
   10. List of spare parts recommended for normal service requirements.
   11. Assembly and disassembly instructions with exploded view Drawings where available.
   12. Troubleshooting diagnostic instructions where available.
   13. Description of alarm and trouble codes for software-based systems.
   14. Set points.

1.33 CERTIFICATION

A. Any certifications required by the Contract Documents, in addition to those required for shop drawings, product data, equipment and other items, shall be so certified by the Owner, a Partner, or a Corporate Officer of the firm required to provide the Certification, or by another person duly authorized to sign binding agreements for and in behalf of the Owner, Partner, or Corporation.

1.34 WARRANTY PERIOD

A. The warranty period shall be no less than two (2) full years, unless specified otherwise hereinafter.

B. During the warranty period, the Contractor shall guarantee the following in a form satisfactory to the Owner:
   1. All work installed will be free from any and all defects in workmanship and/or materials.
   2. All equipment, systems and apparatus will develop capacities and performance characteristics specified.
   3. The systems shall operate without malfunction.

C. Remedy, without cost to the Owner, any defects within a reasonable time to be specified in notice from the Architect or Engineer. In default thereof, the Owner may have such work done and charge back all costs.

D. The start of the warranty period, as defined in the General Conditions, shall commence on the issue of a "final acceptance letter" by the Owner or the Owner's Representative for each item of material, equipment, or system.

E. Confer with the Construction Manager prior to the bid date concerning the project schedule and determine if there is a need to operate any items of equipment or systems for temporary light, power, heating and/or cooling or other reasons prior to "Substantial Completion". All required extended warranty costs for equipment, materials, and systems shall be included in the bid.

F. Provide complete documentation of all prefunctional, functional, component, and system tests

prior to Owner acceptance and turnover of components or systems. In addition, the Owner reserves the right to review all test objectives, test plans and test cases, and witness all preoperational tests. Provide the Owner with a comprehensive schedule detailing the preparation of testing documentation and the conduct of all component or system tests.

G. Warrant that all components, subsystems and systems will perform their specified functions from the date of turnover and commercial operation through the useful life of the system, as determined by the various equipment manufacturers and installing Contractor(s). In the event components fail for any reason, be responsible to repair, replace and reimburse the Owner for all costs associated with the component, subsystem or system that failed to perform the specified function.

1.35 DELIVERY, DRAYAGE AND HAULING

A. Include all drayage, hauling, hoisting, shoring, and placement in the building of equipment and materials specified herein, including any equipment prepurchased by the Construction Manager for installation by this Contractor. Be responsible for the timely delivery, introduction and placement of equipment to the Project as required by the construction schedule for this Project. If any item of equipment is received prior to the time it is required, be responsible for its proper storage and protection until such time as it may be required. Pay for all costs of demurrage or storage in a bonded warehouse.

B. If any item of equipment is not delivered to or installed at the Project site in a timely manner as required by the Project construction schedule, the Contractor shall be solely responsible for disassembly, re-assembly, manufacturer's supervision, shoring, general construction modifications, delays, overtime costs, manufacturer's re-certification, etc. No additional cost or delays shall be incurred by the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

A. Refer to all other Divisions for additional equipment requirements.

PART 3 - EXECUTION

3.1 GENERAL

A. Installation shall be in accordance with the Contract Documents for all Divisions pertaining to the individual equipment and/or systems.

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SECTION 28 05 13

CONDUCTORS AND CABLES FOR SECURITY MANAGEMENT SYSTEMS

PART 1 - GENERAL

1.1 Summary

A. Furnish and install conductors and cables throughout the Project as indicated on the Drawings, and in accordance with the requirements of the Contract Documents.

1.2 Related Sections

A. Refer to Divisions 08, 21, 22, 23, 25, 27 and 28 for the scope of work furnished and installed under those Divisions on which work in this Division may be dependent.

B. Refer to Section 28 00 00.03 – Table of Contents for Security for specification sections that apply to all work herein.

1.3 Reference Standards

A. All cable, conductors and all components shall be designed, manufactured, and tested in accordance with the latest applicable industry standards and codes, including the following:

1. BCCNY - Building Code of the City of New York.
2. IBCNJ - International Building Code.
3. NEC - National Electrical Code
4. NEMA WC-5 - Thermoplastic Insulated Wire and Cable.
5. NEMA WC-7 - Cross-Linked Thermosetting Polyethylene Insulated Wire and Cable.
6. NYCEC - New York City Electrical Code.
7. UL Standard 4 - Armored Cable.
8. UL Standard 44 - Thermoset-Insulated Wires and Cables.
9. UL Standard 83 - Thermoplastic - Insulated Wires.
10. UL Standard 486A-B - Wire Connectors.
11. UL Standard 486C - Splicing Wire Connectors.
12. UL Standard 486D - Sealed Wire Connector Systems.
13. UL Standard 486E - Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors.
14. UL Standard 493 - Thermoplastic - Insulated Underground Feeder and Branch Circuit Cables.
15. UL Standard 1479 - Fire Tests of Through-Penetration Firestops.
16. UL Standard 1569 - Metal Clad Cables.
17. UL Standard 1581 - Electrical Wires, Cables and Flexible Cords.
18. UL Standard 2196 - Tests for Fire Resistive Cables.
19. UL Standard 2225 - Cables and Cable Fittings for Use in Hazardous (Classified) Locations.
20. TIA-568-C.1 - Commercial Building Telecommunications Cabling Standard.

1.4 Submittals

A. Submittal data shall be furnished in accordance with Section 28 0500 and shall include, but not be limited to:

1. Cable, conductors, complete with material list, samples, etc.
2. Lugs, taps, and splice materials, etc.
3. Matrix indicating where each type of cable is to be used.
4. Cable pulling lubricant.

1.5 Warranty

A. Comply with the requirements of the Contract Documents and Section 28 0500.

PART 2 - PRODUCTS

2.1 General

A. All conductors shall be copper, and shall be UL listed. The conductivity shall be in accordance with the IEEE and NEC.

B. All SMS cables shall be plenum rated. Shielded cables shall be provided as required to avoid interference from any EMI, or any other stray electronic signals.

2.2 Acceptable Manufacturers

A. Being listed herein as an acceptable manufacturer does not allow the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of these Specifications.

B. Any and all substitutions must be included in the Contractor's Base Bid, as a voluntary DEDUCT alternate in the Contractor's Bid Proposal, and must be accompanied by a letter of equivalency certifying the products equivalency in all performance and physical characteristics to the products listed herein. The proposed substitutions shall be all inclusive of all cost and physical implications throughout the project. Under no circumstances should the substitution result in added cost to the project. Project Specifications/documents will not be revised to reflect the substitution should the substitution be approved.

C. If it complies with these Specifications, conductors or cable manufactured by one of the following manufacturers will be acceptable (Category 6A cabling shall be the same manufacturer as the data cabling):

1. Security Conductors
   a. Belden
   b. West Penn.

D. If it complies with these Specifications, wire connectors and lugs manufactured by one of the following manufacturers will be acceptable:

1. Hubbell.
2. Ideal.
3. MAC Products.
4. Thomas & Betts/Blackburn.

E. If it complies with these Specifications, cable pulling lubricants manufactured by one of the following manufacturers will be acceptable:

1. American Polywater Corporation.
2. Electro-Compound Company.
3. Ideal Industries.

2.3 Ratings

A. Copper Conductors

1. Shall have an operating temperature range of 0°C to 75°C.
2. Conductor Insulation shall match that of the outer jacket material and shall be at a minimum plenum rated.

2.4 Conductor Sizes

A. All cables and conductors shall be sized as indicated on the Drawings or as specified herein. If a larger gauge wire is necessary due to the distance between the SMS head end and an end device (i.e., door lock), the Contractor shall be responsible for providing the larger gauge wire at no additional cost to the Owner.

B. Storage

1. Cables are to be shipped from the manufacturer with ends temporarily sealed against moisture ingress.
2. When cables are cut in the field, the ends are to be sealed by means of standard sealing compound and tape or equivalent means acceptable to the manufacturer.
3. Cables shall be stored in a dry location.

C. Handling
1. Cable shall be uncoiled by rolling, or by means of a supply reel (available from the manufacturer) rather than pulling from the periphery or the center of the coil. This will greatly ease the handling and prevent possible snarling and kinking.
2. Reasonable precautions shall be taken to prevent damage to the cable from damaging blows with sharp instruments and pulling over sharp objects.

2.5 Category 6A UTP
A. General
1. Category 6A UTP shall be furnished and installed as shown on plan and in accordance with the most current proposals of the applicable ANSI/TIA/EIA and BICSI Standards. The SMS Contractor shall refer to Division 27 drawings and specifications for the UTP manufacturer.
2. Cabling shall be rated and installed in a manner consistent with the requirements of the NEC and NYC Electrical Code.
3. All 4-pair UTP cabling shall be installed such that the permanent link length does not exceed 90 meters.
4. All UTP cable shall be color-coded as shown on plan and as approved by the SMS Engineer. Where colors are not specified, the Contractor shall include a multitude of colors and shall submit a request for coloration from the Engineer as part of the shop drawing process

B. Components
1. Connectors, couplings or jack modules shall be provided per the Contract/Bid Documents on all cables terminating at a camera location, ACS Ethernet interface, and patch panels dedicated to cameras.
2. A Category 6A RJ-45 jack shall be utilized and terminated TIA-568B. The SMS Contractor shall provide face plates and backboxes for all camera locations.
3. Patch panels shall be located as per the Contract Documents. If an exact location is not provided, the SMS Contractor shall coordinate a location within a local IDF. If no rack space is available, the Contractor shall provide a wall mount rack.
4. Patch panels shall have each port number and patch panel name permanently labeled.

PART 3 - EXECUTION

3.1 General
A. All cables shall be individually identified with typewritten labels at either end of the cable. Labels shall be installed 6 in. from the termination end of the cable. They shall be installed such that they are easily readable without disturbing the final termination of the cable. The label shall be based on the location/door it serves and shall match the SMS database naming convention and record drawings.
B. Conductor Pulling: Conductor pulling tensions shall not exceed manufacturer's recommended values. Where necessary, UL listed lubricants, compatible with the type of insulation involved, may be used to facilitate cable pulling.

3.2 Installation - Security Conductors
A. Splicing and Tapping: Conductors shall not be spliced between the points of origin and termination. If splices are necessary, their use must be approved in writing by the Engineer before installation. Splices, if allowed, shall be made in boxes or gutters.
B. Vertical Supports: Conductors in vertical raceways shall be supported at intervals as required by Code. Provide additional supports if so indicated on the Drawings or recommended by the cable manufacturer. Obtain documentation from cable manufacturers stating acceptance of support manufacture type and spacing utilized.
1. Wall or Floor Penetrations: When cable penetrates a wall or floor, a sleeve shall be placed

in the opening to protect the cable during pulling. Once the cable is in place, the opening shall be firestopped using an approved firestop system. A list of Underwriters Laboratories approved systems appears in the "Through-Penetration Firestop Systems" in the UL Fire Resistance Directory, Guide XHEZ.

2. Cable Terminations: Cable must be terminated with an approved termination kit in a manner consistent with manufacturer's installation sheets.
3. Workmanship: Following the recommendations of the manufacturer will consistently produce satisfactory installations. The installer shall avail himself of the services of the Manufacturers Field Technician who will offer the instruction of proper installation techniques.

3.3 Installation - Category 6A UTP

A. This wiring system shall be used for interconnecting cameras, ACS and ICS equipment to LAN equipment (i.e., switches, servers computers, etc.).
B. Furnish and install the Category 6A UTP in accordance with the drawings and instructions provided by the Engineer and the manufacturer's recommendations.
C. All cables shall be installed in an electrically continuous fashion between the designated origin and destination points. That is, all cables must be "homerun" with no unspecified splices, couplers, or intermediate connection points along the specified channel.
D. Cable shall be securely held in place by an industry-acceptable practice (no tie wraps), and installed with sufficient bending radius (10 times the cable's outside diameter) so as not to kink, shear, or damage the cable.
E. Location and placement of the required terminating and distribution hardware shall be as shown on the drawings.
F. After dressing UTP cable to its final location, its outer sheath shall be removed to a point that allows the conductor to be splayed and terminated in a neat and uniform fashion. Every effort shall be made to maintain sheath integrity by removing only as much as is necessary to accomplish termination. Individual pairs shall maintain twist integrity to within 0.5 in. of the termination point.
G. At every two-foot interval in Technology Rooms, provide removable hook-and-loop type (Velcro®) cable fasteners for each cable bundle segment that is within the room. Submit cable tie criteria to the Engineer for review prior to pulling cable.
H. At least 9 in. of slack shall be left at each terminal box or behind each faceplate after jack installation is completed to allow for easy dismounting and extension of outlet covers and wire terminations.

3.4 Testing Category 6A UTP

A. General
   1. Contractor shall provide sufficient skilled labor to complete testing within the agreed-upon test period.
   2. Contractor must fulfill all Owner's, Engineer's, and Manufacturer's Warranty/Test requirements.
   3. Contractor must be qualified to provide system certification for the cabling solution provided. At the completion of the installation, Contractor must supply said system certification along with copies of all applications and correspondence pertaining to the system certification.
   4. Contractor's company shall have a minimum of three (3) years' experience installing and testing fiber optic cabling systems. All installers assigned by the Contractor to the installation shall have factory certification that they are qualified to install and test the provided products.
   5. Contractor is responsible for supplying all of the required test equipment used to conduct acceptance tests.
   6. Contractor is responsible for submitting acceptance documentation as defined below.

7. Owner reserves the right to be present during any or all of testing.
8. Where a basic link exists, testing shall be of the basic link. A link is defined as the passive cabling network between two cross-connects (patch panels or outlets). This includes cable, connectors and splices but does not include active components. The link test contains the representative connector loss at the patch panel associated with the mating of patch cords but does not include the performance of the connector at the equipment interface.
9. Where a channel exists, testing shall be of the channel. A channel is defined as the passive cabling network between active equipment. This includes cable, connectors, splices, patch cords and equipment cords but does not include active components.
10. Prior to testing, submit for review and approval copies of test report forms proposed for use.
    a. Each test report form shall contain the following general information: Date of preparation, date of test, project name, Contractor's name, media type, make, model, software revision, and serial number of test equipment used, date of last calibration and names of test crew.
    b. Paired and Multi-Conductor Metallic Cable Test Reports: As a minimum, also provide cable number, cable type, pair or conductor count, individual pair or conductor numbers, number of cross-connects and/or patches in each pair, results of each test for each pair or conductor, total number of serviceable pairs or conductors in cable.
    c. 4-Pair, Category 6A, UTP Cables: Provide test reports created by automated cable tester for each tested cable.
11. All cabling not tested strictly in accordance with these procedures shall be retested at no additional cost to the Owner.
12. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and receipt of full documentation as described below.
13. Either the test equipment shall be fully charged prior to each day's testing or a fresh set of batteries shall be brought to the job site.
14. Remove all defective cables from the cable pathways. Do not abandon cables in place.
15. The Engineer reserves the right to observe the conduct of any or all portions of the testing process.
16. The Engineer further reserves the right to conduct, using the Contractor's equipment and labor, a random retest of up to five (5) percent of the cable plant to confirm documented test results.
17. All test results and corrective procedures are to be documented and submitted to the Engineer within ten (10) working days of test completion.
18. In addition to the specified test, be prepared to be present while the Owner or Owner's designated representatives install and conduct performance tests of the transport electronics connected to the cabling system. Be prepared to conduct on-the-spot cable tests and effect cable plant repairs, as necessary. Successful equipment performance tests do not relieve the Contractor of the specified testing, repair, and documentation requirements.
19. All cables shall be factory tested for continuity before shipment. Submit documentation to the Engineer that the cable has been tested by the manufacturer to industry standards.
20. The Contractor shall provide a thorough testing program for the communications cabling plant, and final acceptance testing. The testing program being proposed shall be submitted to the Engineer for approval before testing begins. Provide all required test equipment. The Owner's representatives may choose to observe any or all testing. Final acceptance testing shall be performed jointly by the Contractor and the Owner's representative. The

Contractor shall provide procedures, a list of test equipment and operating instructions before the tests.

21. Subsystems shall be tested individually before testing for end-to-end connectivity. All faults shall be corrected and retested. All test results shall be completely documented.
22. All cable that fails manufacturer's or specified testing criteria shall be replaced at no additional expense to Owner.
23. Owner reserves the right to independently test any or all of the cable plant. If more than 3% of the tested cable plant within a floor, system or area fails, the Contractor will be required to take the following actions at no additional cost to Owner:
    a. Reimburse Owner for all costs incurred for independent testing.
    b. Work overtime to remedy defects and retest entire floor, system or area as defined by Owner. This corrective work shall not impact the planned occupancy dates.
    c. Reimburse Owner for supervision representation by their duly appointed representative during action taken in b. above.
    d. Contractor shall provide all test results to Owner at periods of 20% of scheduled test completion time.

B. Category 6A UTP TEST Equipment

1. Test equipment used under this Contract shall be from manufacturers that have a minimum of five (5) years' experience in producing field test equipment. Manufacturers must be ISO 9001 certified.
2. All test tools of a given type shall be from the same manufacturer and have compatible electronic results output.
3. Test equipment shall store at least 100 tests in internal memory.
4. Test equipment shall employ a serial port to facilitate uploading of saved information from tester to PC.
5. Test equipment shall be capable of nulling out the loss and length of the test jumpers used to interface with the cable plant.
6. 4-Pair UTP Automated Cable Tester
    a. Tester shall be compliant with TIA/ISO/IEC standards.
    b. Tester shall provide bi-directional testing to the latest standards for both basic links and channels.
    c. Tester shall provide certification for Cat5e/6/6A links.
7. Unshielded Twisted Pair Tests (UTP) Test Report shall include:
    a. For all unshielded twisted pair connections, tests shall include, but not necessarily be limited to, tests for: Polarity reversals, wire transpositions, resistance, continuity, AC and DC voltages, opens, shorts, power and ground faults, and proper station operating conditions.
    b. For Category 5e or 6A Cabling: Attenuation, NEXT, PSNEXT, Return Loss, ELFEXT, and PSELFEXT data that indicate the worst-case result, the frequency at which it occurs, the limit at that point, and the margin. These tests shall be performed in a swept frequency manner from 1 MHz. to highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements. Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards. Any individual test that fails the relevant performance specification shall be marked as a FAIL.

C. Documentation

1. Upon completion of all tests, six (6) copies of the test results shall be submitted for review. Prior to cutover, the Contractor shall perform a random sampling test, jointly with the Owner or Owner's representative, of one in six optical fibers selected by the representative, to verify conformance to the Specifications.

2. Test reports shall be submitted in electronic format. Hand-written or hard copy test reports are not acceptable.
3. Electronic reports are to be submitted on CD format. If proprietary software is used, disk or CD shall contain any necessary software required to view test results. If the results are delivered in a standard format like Excel, Access, CSV files, etc., then software to read these files is not provided. Electronic reports must be accompanied by a certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report. Certificate must reference traceable circuit numbers that match the electronic record.

END OF SECTION 28 05 13

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SECTION 28 05 26

GROUNDING AND BONDING FOR SECURITY MANAGEMENT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install electrical grounding systems as indicated on the Drawings and as specified herein, and in accordance with the requirements of the Contract Documents.

1.2 RELATED DOCUMENTS

A. Refer to Divisions 08, 21, 22, 23, 25, 27 and 28 for the scope of work furnished and installed under those Divisions on which work in this Division may be dependent.

B. Refer to Section 28 00 00.03 – Table of Contents for Security for specification sections that apply to all work herein.

1.3 REFERENCE STANDARDS

A. All grounding system components shall be designed, manufactured, and tested in accordance with the latest applicable industry standards and codes, including the following:

1. BCCNY - Building Code of the City of New York.
2. J-STD-607-C - Commercial Building Grounding and Bonding Requirements for Telecommunications.
3. NEC - National Electrical Code
4. NYCEC - New York City Electrical Code.
5. UL Standard 467 - Grounding and Bonding Equipment.

1.4 SUBMITTALS

A. Submittal data shall be furnished in accordance with Section 28 0500 and shall include, but not be limited to:

1. Grounding system tests, including report forms.
2. Grounding site plans and risers.
3. Ground clamps, rods, plates, etc.

1.5 WARRANTY

A. Comply with the requirements of the Contract Documents and Section 28 0500.

PART 2 - PRODUCTS

2.1 GENERAL

A. All equipment and materials provided under this Section of the Specifications shall be new, UL listed, and bear the UL label.

B. All access control panels, switches, equipment, etc., shall be provided with a grounding terminal connected to the device frame or enclosure. Refer to each individual equipment manufacturer's Specification Section for additional grounding requirements.

C. All conduit, cable tray, raceways, junction boxes, pull boxes, etc., shall be made electrically continuous by means of grounding conductors, bonding jumpers, grounding bushings, couplings, fittings, etc., as required by the Code and the Authorities Having Jurisdiction.

2.2 GROUNDING CONDUCTORS

A. All grounding conductors shall be bare or green insulated copper conductors sized as required by Code or indicated on the Drawings, whichever is larger. Where the Authorities Having Jurisdiction require grounding electrode conductor sizing in excess of that shown on the Drawings or specified herein, the larger size conductor shall be installed.

B. All equipment grounding conductors shall be green insulated copper conductors sized as indicated on the Drawings. Where the Authorities Having Jurisdiction require equipment grounding conductor sizing in excess of that shown on the Drawings or specified herein, the larger size conductor shall be installed.

C. All bonding conductors shall be flexible copper bonding jumpers sized in accordance with the Code for grounding electrode conductors.
D. All conductors shall be run in conduit unless otherwise noted.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Bonding and grounding conductors shall be sized, shall be run in conduit, and shall be connected to various services in accordance with the requirements of the authorities having jurisdiction and the New York City Electric Code, Article 250.
B. Grounding shall be done in accordance with the requirements of, and subject to the approval of the Architect, Engineer, and local inspection authorities. Approved materials, devices, and workmanship shall be utilized. All conductor terminations shall be in accordance with Section 28 0513.
C. Building Equipment Ground: All exposed non-current-carrying metal parts of permanently mounted Security equipment, all terminal devices and the conduit system shall be effectively grounded and securely bonded to the reference ground point of its separately derived service ground. The equipment ground path from conduit, equipment and metal enclosures shall be continuous and permanent, and shall have the capacity to safely conduct any fault currents imposed on it with sufficiently low impedance to facilitate the operation of the circuit protective devices.

END OF SECTION 28 05 26

SECTION 28 13 00

ACCESS CONTROL

PART 1 - GENERAL

1.1 Summary

A. Furnish and install access control equipment as indicated on the Contract Documents. Access control includes the installation of all items, including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to provide an Access Control System (ACS) fully integrated with the Security Management System (SMS). The ACS shall provide the following functions:

1. Access control at designated doors.
2. Remote and local alarm monitoring of door contacts, window sensors and panic buttons.
3. Integrated badging system for issuing access control, photo identification, complete with data base entry and storage.
4. An interface with the VSS to provide automatic camera and full-motion recording during a programmed event.

1.2 References

A. The entire installation and all equipment, materials and methods shall comply with the currently enforced versions of all applicable laws, rules, regulations, standards, legislation, codes and ordinances of New York City, including, but not limited to, the following:

1. Section 28 0500 - Common Work Results for Security Management Systems.
2. Section 28 0513 - Conductors and Cables for Security Management Systems.
3. Section 28 0526 - Grounding and Bonding for Security Management Systems.
4. Section 28 0800 - Commissioning of Security Management Systems.
5. Section 28 1600 - Intrusion Detection.
6. Section 28 2300 - Video Surveillance.

B. Modifications required by the above said Authorities Having Jurisdiction (AHJ) shall be made without additional cost to the Owner

1.3 Maintenance Service

A. The SMS Contractor shall include in their bid response service and maintenance of the ACS for two (2) years from the completion of final acceptance testing. The SMS Contractor shall provide an ADD alternate price to extend this service and maintenance agreement for an additional (2) years. The Owner may choose to exercise this alternate up to one (1) month before the end of the initial two (2) year service and maintenance agreement.

1.4 Access Cards

A. The SMS Contractor shall furnish and install 100 access cards capable of single-sided printing, numbered 1-100, placed in plastic sleeves in a 3-ringed binder. Coordinate security level for these temporary cards with the Owner.

B. The SMS Contractor shall provide the labor to integrate the new ACS system into the existing ACS.

C. The SMS Contractor shall provide the labor to program access levels based on Owner input. At a minimum, the Contractor shall include fifteen (15) access levels for the complete occupancy of the Owner.

PART 2 - PRODUCTS

2.1 Access System Controllers

A. Access system controller shall be one of the approved manufacturers or an approved equal

1. AMAG
2. LENEL
3. S2
4. Software House

B. Controller capability shall be as follows:
1. UL 294 and 1076 listed.
2. Two (2) dedicated inputs for tamper and power failure status.
3. Biometric template storage support.
4. On-board memory of 64MB.
5. Host dual-path communication, Ethernet TCP/IP or dial-up communications.
6. Lithium battery back-up for event memory.
7. Alarm masking.
8. AES 256-bit symmetrical block encryption conforming to the FIPS-197 standard for communications.
9. Enhanced anti-passback capabilities.
10. Built in Video Analytics.

C. Controller Communication shall be via the Owners LAN. The Contractor shall include a Network Interface Card (NIC) Software House.

2.2 Access System Device Power Supply

A. The Device power supply shall be Altronix or approved equal for use with Software House systems.

B. The controller power supply shall have the following:
1. UL 294 and UL1481 listed.
2. Sixteen (16) Class 2 Rated 12 VDC or 24 VDC.
3. 4 amps continuous supply current at 12 VDC or 24 VDC.
4. Filtered and electronically regulated outputs.
5. Low battery supervision.
6. Short circuit protection.
7. Selectable 12 VDC or 24 VDC.
8. Zero (0) voltage drop upon transfer to battery backup.
9. Two (2) 12 VDC batteries providing 4 hour battery backup.

C. The SMS Contractor shall be responsible for providing all device power supplies as required to support the installation of the card access system. The SMS Contractor shall provide dedicated device power supplies in each Security Room/Closet location. No device power supplies shall be permitted to feed door controller boards located within other rooms/closets. The SMS Contractor shall be responsible for the installation of a dedicated 20 amp, 120V circuit (UPS power if available). The SMS Contractor shall not exceed 16 amps of connected load per 120V, 20 amp circuit. Coordinate exact location and wiring with project electrician.

2.3 Door Lock Power Supply

A. The door lock power supply shall be Altronix or approved equal. The door lock power supply shall have eight (8) independently controlled fail-safe and or fail-secure outputs. Each output shall have the ability to be individually selectable for fire alarm disconnect to allow emergency egress.

B. The door lock power supply shall include:
1. UL 294 and UL1481 listed.
2. 6 amps continuous supply current at 12 VDC or 24 VDC.
3. Filtered and electronically regulated outputs.
4. Low battery supervision.
5. Short circuit protection.
6. Fire Alarm Disconnect Input Options:
   a. Normally open (NO) or normally closed (NC) dry contact input.
   b. Polarity reversal input from FACP signaling circuit.

c. Selectable 12 VDC or 24 VDC.
d. Zero (0) voltage drop upon transfer to battery backup
e. Two (2) 12 VDC batteries providing 4 hour battery backup

C. The SMS Contractor shall be responsible for providing all lock power supplies as required to support the installation of the card access system. The SMS Contractor shall provide dedicated lock power supplies in each Security Room/Closet location. The SMS Contractor shall not utilize lock power supplies to power locks which are not controlled by reader boards within the same Security Room/Closet as the lock power supply. The SMS Contractor shall be responsible for the installation of a dedicated 20 amp, 120V circuit (UPS power if available). The SMS Contractor shall not exceed 16 amps of connected load per single 120V, 20 amp circuit. Coordinate exact location and wiring with the Project Electrician. All fire disconnects shall be provided by the SMS Contractor unless specifically noted within the electrical Contract Documents.

D. The SMS Contractor shall be responsible for providing individual fire disconnects to each Security Room/Closet that contains ACS door lock power supplies. The SMS Contractor shall coordinate the programming for the following events with the fire alarm vendor.
1. Manual Station Pull: This event shall release all fail safe doors located on the floor of the manual pull.
2. Detection Device Release (Duct Smoke Detector, Elevator Detector/Recall): All ACS doors on all floors shall be released.
3. Water Flow: All ACS doors on all floors shall be released.

2.4 Door Contacts
A. Shall monitor the status of doors and windows as indicated on the Contract Documents.
B. Steel door contacts shall be Sentrol Model 1076-W or equal for all recessed applications.
C. Wood door (non-steel doors) contacts shall be Sentrol Model 1075 with associated brackets for exposed mounting.
D. Door contacts shall have a response time of 1ms or less and be rated for 1,000,000 cycles.

2.5 Request-To-Exit Detectors
A. Request-to-exit devices shall be installed in accordance with any applicable building or life safety codes.
B. Request-to-exit detectors shall allow a person to exit an access-controlled door.
C. Request-to-exit detectors shall be Bosch Model DS150i or equal.

2.6 Card Readers
A. Card readers shall be an HID multiCLASS reader or equal Multi-Technology reader.
B. The proximity reader shall have the following capabilities:
1. 125 kHz Proximity
a. HID or Indala proximity cards, key fobs and tags
b. AWID Credentials
c. EM4102 Credentials
2. 13.56 MHz Contactless Smart Cards
a. ISO 15693 - read only; 2k bit (256 Byte), 16k bit (2k Byte) and 32k bit (4k Byte) iCLASS Credentials; serial number
b. ISO 14443A - read only; MIFARE and DESFire® (serial number)
c. ISO 14443B - read only; 2k bit (256 Byte), 16k bit (2k Byte) and 32k bit (4k Byte) iCLASS Credentials; serial number
d. US Government PIV
e. FeliCa IDm (require Transit p/n 6149)
f. CEPAS CAN or CSN (require Transit p/n 6149)

2.7 Visitor Badge Printer
A. The badge printer shall be capable of double-sided color printing.
B. Each badge printer shall be supplied with digital camera, workstation, monitor/keyboard, and mouse.

C. The visitor badge printer shall read and reprogram multiple smart card formats and support user-selected text and images.
D. The SMS Contractor shall provide printing supplies for 3,000 visitor badges.
E. The SMS Contractor shall program the badge printer within the existing Visitor Management software.
F. Warranty and factory tech support for the printer shall be two (2) years unlimited with service loaner. The two (2) years shall be from final acceptance of the Security Management System.

2.8 Access Control Software

A. Access control Software shall integrate with Parking Control Equipment specified under Section 11 12 00".
B. The software shall be capable of the following:
1. VSS integration.
2. ICS integration.
3. IDS integration.
4. Multiple site management.
5. Visitor management software.
6. Web access.
7. Remote access via web portal.
C. The SMS Contractor shall provide all necessary licenses and fees to provide monitoring stations, card access stations and readers as indicated on the Contract Documents.
D. The SMS Contractor shall provide software and all necessary licenses to integrate visitor registration into the existing access system. The SMS Contractor shall set up a web portal to allow users to log in and preregister guests.
E. The SMS Contractor shall purchase all necessary licenses to allow the Owner's visitor management software to read and reprogram multiple smart card formats for use at the building turnstiles. This station shall report all registered visitors to the Owner's Security Director. All visitors shall be registered at the lobby or through a web portal. All programming associated with the visitor management system shall be the responsibility of the SMS Contractor.
F. The SMS Contractor shall integrate with the existing card access server.

PART 3 - EXECUTION

3.1 General

A. Installation shall be in accordance with the Contract Documents for all Divisions pertaining to the individual equipment and/or systems.
B. The Security Contractor shall work with the Owner and its representatives to configure the Access Control System (ACS) based on the Owner's operating standards, and industry best practices. If the Owner's standards are in conflict with best practices, the SMS Contractor shall inform the Owner in writing where the conflict exists.
C. The SMS Contractor shall provide the following:
1. Automated access control at designated doors.
2. An integrated video badging system for issuing access control and identification, complete with database creation and storage.
3. The SMS Contractor shall provide integration to the existing access control systems, such that a single card may be used at the existing and new expansion spaces. The Contractor shall include all integration of existing card access data bases from the existing system.
4. A direct software interface between the ACS and the Video Surveillance System (VSS), to provide automatic camera scene display in an alarm event (tailgate, forced entry, hold open).
5. Set up and configure communications between the ACS panels, servers, operator work stations and remote work stations.
6. Coordinate the ACS requirements with the architectural door hardware supplier to ensure

door hardware will function as intended.

7. The SMS Contractor shall provide power for all electrified door hardware and interface all electrified door hardware supplied and installed by others with the fire system as required by Code.

D. The system shall support multiple operator workstations via Local Area Network/Wide Area Network (LAN/WAN). The communications between the workstations and the server shall be supervised and generate an alarm when the server is unable to communicate with a workstation. The operators shall have the ability to log on to workstations remotely and monitor activity. The system shall support concurrent client workstation licensing. The system shall allow client workstations to connect to the database server as long as the maximum number of concurrent licenses has not been exceeded.

E. The system shall provide support for Lightweight Directory Access Protocol (LDAP) for enabling a user to locate resources such as files and devices in the network, whether on a public internet (via VPN) or on a corporate network.

F. The system shall provide for ADA capability. In the event that a defined card is presented, ADA controls shall be triggered such as extended strike time, and extended held time for a reader.

G. The SMS Contractor shall provide the user with an interactive map of all security devices. The map shall display the state and condition of alarm points. When an alarm occurs, the associated map shall appear on the alarm monitor, and shall indicate the alarm status. The system shall allow for multiple maps to be displayed at any single time.

END OF SECTION 28 13 00

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SECTION 28 16 00

INTRUSION DETECTION

PART 1 - GENERAL

1.1 Summary

A. Furnish and install intrusion detection equipment as indicated on the Contract Documents. Intrusion detection includes the installation of all items, including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to provide an Intrusion Detection System (IDS) fully integrated with the Security Management System (SMS). The IDS shall provide the following functions:

1. An interface with the VSS to provide automatic camera and full-motion recording during an alarm event.
2. Local alarm monitoring of door contacts, window sensors and panic or duress buttons.
3. Panic or duress buttons with connection to Security with email notification.
4. Door control integration for forced entry.

1.2 References

A. Refer to Divisions 08, 21, 22, 23, 25, 27 and 28 for the scope of work furnished and installed under those Divisions on which work in this Division may be dependent.

B. Refer to Section 28 00 00.03 – Table of Contents for Security for specification sections that apply to all work herein.

1.3 Maintenance Service

A. The SMS Contractor shall include in their bid response service and maintenance of the Intrusion detection system (IDS) for two (2) years from the completion of final acceptance testing. The SMS Contractor shall provide an add alternate price to extend this service and maintenance agreement for an additional two (2) years. The Owner may choose to exercise this alternate up to one (1) month before the end of the initial two (2) year service and maintenance agreement.

PART 2 - PRODUCTS

2.1 Intrusion Detection System

A. IDS panel shall be BOSCH or equal.

B. IDS system shall comply with the following:

1. UL365, Police Station Burglar Alarm Units and Systems.
2. UL464, Audible Signal Appliances.
3. UL609, Local Burglar Alarm Units and Systems.
4. UL864, Control Units for Fire-Protective Signaling Systems (9th Edition).
5. UL1076, Proprietary Burglar Alarm Units and Systems.
6. UL1610, Central-Station Burglar-Alarm Units.
7. UL1635, Digital Alarm Communicator System Units.

2.2 Duress Buttons

A. All duress buttons shall be dual action. Provide Sentrol Model #3040 Series panic switch or equal.

B. The duress button shall trigger the following events at a minimum:

1. Alarm to the Security Office and Engineering Office (including email notification).
2. Full-motion video recording of alarm condition.

PART 3 - EXECUTION

3.1 General

A. Installation shall be in accordance with the Contract Documents for all Divisions pertaining to the individual equipment and/or systems.

B. The Security Contractor shall work with the Owner and its representatives to configure the Intrusion Detection System (IDS) based on the Owner's operating standards, and industry best

practices. If the Owner's standards are in conflict with best practices, the SMS Contractor shall inform the Owner in writing where the conflict exists.

C. The SMS Contractor shall provide the user with an interactive map of all security devices. The map shall display the state and condition of alarm points. When an alarm occurs, the associated map shall appear on the alarm monitor, and shall indicate the alarm status. The system shall allow for multiple maps to be displayed at any single time.

END OF SECTION 28 16 00

SECTION 28 23 00

VIDEO SURVEILLANCE

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install video surveillance equipment as indicated on the Contract Documents. Video surveillance includes the installation of all items, including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to provide a Video Surveillance System (VSS) fully integrated with the Security Management System (SMS). The VSS shall provide the following functions:

1. Video recording at designated doors and locations as indicated on the Contract Documents.
2. An interface with the ACS, ICS, and IDS to provide full-motion (H.264/MPEG-4, JPEG, 15F/s) recording during an alarm event.
3. Video Compression H.264, MPEG-4, JPEG
4. Traditional camera adjustments.
5. Multiple monitor-only locations.
6. Master or control center graphical user interface, which allows an administrator to modify a camera's configuration settings.
7. Export an image in JPEG format at variable compression settings.
8. Export video based on a user-determined start time and end time.

1.2 REFERENCES

A. The entire installation and all equipment, materials and methods shall comply with the currently enforced versions of all applicable laws, rules, regulations, standards, legislation, codes and ordinances of New York City, including, but not limited to, the following:

1. Section 28 0500 - Common Work Results for Security Management Systems.
2. Section 28 0513 - Conductors and Cables for Security Management Systems.
3. Section 28 0526 - Grounding and Bonding for Security Management Systems.
4. Section 28 0800 - Commissioning of Security Management Systems.
5. Section 28 1300 - Access Control.
6. Section 28 1600 - Intrusion Detection.

B. Modifications required by the above said Authorities Having Jurisdiction (AHJ) shall be made without additional cost to the Owner

C. Regulatory Requirements

1. Video Compression
   a. H.264
   b. MPEG-4: Part 2 - ISO/IEC 1449602.
   c. MJPEG.
2. Emission / Immunity
   a. FCC Part 15, Subpart B, Class A Digital Device.
3. Transmission
   a. Ethernet: IEEE 802.3 / 802.3u / 802.3af.
4. Safety
   a. UL Listed 60950-1.
5. Ingress Protection
   a. IEC IP66.
6. Environmental Sustainability
   a. RoHS Directive Compliant.

1.3 MAINTENANCE SERVICE

A. The SMS Contractor shall include in their bid response service and maintenance of the VSS for

two (2) years from the completion of final acceptance testing. The SMS Contractor shall provide an Add Alternate price to extend this service and maintenance agreement for an additional two (2) years. The Owner may choose to exercise this alternate up to one (1) month before the end of the initial two (2) year service and maintenance agreement.

1.4 VSS STORAGE

A. The SMS Contractor shall provide local rack-mount video storage of at least 600 TB (thirty [30] days of video 8f/s during normal activity). The onsite storage shall be programmed to backup nightly to the Owners' Data Center. The SMS Contractor shall provide the offsite video storage of at least 600 TB (thirty [30] days of video). The carrier circuit between the project location and the offsite Data Center shall be provided by the Owner. All programming for the backup from local storage device to the offsite device shall be the responsibility of the SMS Contractor. The SMS Contractor shall provide all required jumpers, switch ports, etc. Video shall be stored based on a First In First Out (FIFO).

PART 2 - PRODUCTS

2.1 VMS SOFTWARE

A. The SMS Contractor shall integrate a Genetec building-wide system and provide all applicable camera and user licenses. The SMS Contractor shall program all cameras, servers, switches, and storage devices into the software package. The SMS Contractor shall provide all hardware and software integration with the ACS, IDS, and ICS systems.

B. Alternate manufacturers
   1. ISS
   2. Milestone

C. The SMS Contractor shall include the labor to program alarm events on all cameras including compression level/format, image resolution, frame rate, conditional recording, retention time, archiving frequency, and archiving location.

D. The SMS Contractor shall program all monitoring/client stations including only all user rights based on the Owner/Client's input. The programming shall include User Authentication, multiple screen support, mixed content views, pane view/full screen toggles, ACS inputs and IDS inputs.

E. The SMS Contractor shall program all cameras into a graphical map with visual status of cameras and other inputs.

F. The SMS Contractor shall include the labor to set up a viewing station per the Owner requirements.

G. The SMS Contractor shall provide software upgrades for all VSS software for a minimum of five (5) years.

2.2 VIDEO IP SWITCH

A. All IP switches shall be provided by the Owner (except switches for the aggregation of servers required for onsite storage and offsite storage).

B. The Contractor shall provide the integration between the dedicated Video Surveillance System network and the Owner's LAN/WAN.

2.3 VIDEO MANAGEMENT SERVER

A. The SMS Contractor shall provide Video Management Servers with the following minimum specifications:
   1. Cisco C3X60 Server Node E-52695 V2 CPU 4GB Raid Cache.
   2. Two (2) Network Interface Cards (NIC) per server, one (1) for streaming video and one (1) for client access.
   3. On board storage of at least 360TB RAID 5 Storage.

B. The SMS Contractor shall provide all patch cords for servers, storage devices, cameras, switches, etc.

2.4 IP CAMERAS

A. IP cameras shall have meet the following minimum specifications:

1. Image device 1/3 in. Progressive scan RGB, 10 megapixel.
2. Lens 3.8x (3.0 mm to 9.0 mm) variable focal length.
3. Angle adjustment of 350 deg, tilt +/- 80 deg.
4. Minimum illumination 1 lux, f2.0.
5. Video motion detection.
6. Active tampering alarm
7. Network interface RJ45 10Base-T/100Base-TX auto negotiation.
8. Compression and Frame rate H.264, MJPEG and MPEG-4 32 fps each simultaneously.
9. PoE (IEE802.3af compliant)/ 24 VAC, 50 Hz/60 Hz.
10. Operating temperature -14 to122 deg. F.

B. Provide Color to Black and White Switching (Day/Night) automatic switching IR cut filter mechanism, which increases or decreases sensitivity (color mode) based on ambient light conditions.

C. Camera setup menu via Web Browser:
1. Backlight compensation.
2. Video compression level.
3. Image resolution.
4. Auto/manual white balance.
5. Black level.
6. Color level.
7. Gamma curve.
8. Enhance.
9. Shutter speed.
10. Sensitivity up.
11. AGC.
12. Exposure value.
13. Monitor type.
14. Day/night.
15. Motion detection.
16. Snapshot function.
17. Video Overlay
    a. Camera ID
    b. Time/Date
18. Mask.

2.5 CLIENT WORKSTATIONS

A. The workstation shall include a dedicated 17 in. or larger SVGA monitor with true color support. The workstation shall have all administrative rights to all SMS software, the CPU shall meet the following minimum specifications:
1. Memory 8GB, 1333MHz, DDR3 SDRAM, ECC (2 DIMMS).
2. Processor Quad Core Intel™ Xeon W3550 3.0GHz, 8M L3, 4.8GT/s, Turbo.
3. Dedicated accelerated video card with at least 64 MB onboard RAM.
4. 1 GB or greater network interface card.
5. Hard drive 2TB
6. Internal 19:1 USB media card reader.
7. Chassis intrusion switch.
8. Keyboard and mouse.
9. Operating system shall be compatible with the SMS, ACS, ICS, IDS software.

B. The SMS Contractor shall provide software and license for all client workstations as indicated on the Contract Documents.

2.6 INTEGRATED MONITORING STATIONS

A. The workstation shall include a dedicated 17 in. or larger SVGA monitor with true color support.

The user shall have the ability to pull up a camera in a separate window. All windows shall be overwritten by an alarm condition window. The CPU shall meet the following minimum specifications:

1. Memory 8GB, 1333MHz, DDR3 SDRAM, ECC (2 DIMMS).
2. Processor Quad Core Intel™ Xeon W3550 3.0GHz, 8M L3, 4.8GT/s, Turbo.
3. Dedicated accelerated video card with at least 64 MB onboard RAM.
4. 1 GB or greater network interface card.
5. Hard drive 2TB
6. Internal 19:1 USB media card reader.
7. Chassis intrusion switch.
8. Keyboard and mouse.
9. Operating system shall be compatible with the SMS, ACS, ICS, IDS software.

B. The SMS Contractor shall provide software and license for all integrated monitoring stations as indicated on the Contract Documents.

2.7 VIDEO WALL STATIONS

A. Video wall stations shall be three (3) 42 in. wall-mounted monitors with all cameras multiplexed. No control shall be required from this location. Automatic full-screen shot for alarm conditions shall be displayed.

PART 3 - EXECUTION

3.1 GENERAL

A. Installation shall be in accordance with the Contract Documents for all Divisions pertaining to the individual equipment and/or systems.

B. The Security Contractor shall work with the Owner and its representatives to configure the Video Surveillance System (VSS) based on the Owner's operating standards, and industry best practices. If the Owner's standards are in conflict with best practices, the SMS Contractor shall inform the Owner in writing where the conflict exists.

C. The SMS Contractor shall provide the following:

1. A direct software interface between the ACS and the Video Surveillance System (VSS), to provide automatic camera scene display in an alarm event (tailgate, forced entry, hold open).
2. Setup and configure communications between cameras, switches, storage local and offsite storage, client workstations, integrated monitoring workstations, video wall locations, and web-based remote monitoring stations.
3. Coordinate the VSS requirements with the Architectural Contract Documents to ensure the system will function as intended.

D. The system shall support multiple operator workstations via Local Area Network/Wide Area Network (LAN/WAN). The communications between the workstations and the server shall be supervised and generate and alarm when the server is unable to communicate with a workstation. The operators shall have the ability to log on to workstations remotely and monitor activity. The system shall support concurrent client workstation licensing. The system shall allow client workstations to connect to the database server as long as the maximum number of concurrent licenses has not been exceeded.

E. The system shall provide support for Lightweight Directory Access Protocol (LDAP) for enabling a user to locate resources such as files and devices in the network, whether on a public internet (via VPN) or on a corporate network.

F. The SMS Contractor shall provide the user with an interactive map of all security devices. The map shall display the state and condition of alarm points. When an alarm occurs, the associated map shall appear on the alarm monitor, and shall indicate the alarm status. The system shall allow for multiple maps to be displayed at any single time.

G. All hardware and software shall be installed in accordance with the manufacturer's recommended

procedures. Ensure system and network configuration is fully coordinated with the Owner's Information Technology Department.

3.2 QUALITY ASSURANCE

A. Provide manufacturers' authorized field representation for engineering, installation, testing and commissioning as required by Section 28 0800.

END OF SECTION 28 23 00

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SECTION 28 31 11

ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 Summary

A. This specification describes an addressable Fire Detection and alarm signaling system. The control panel shall be intelligent device addressable, analog detecting, low voltage and modular, with digital communication techniques, in full compliance with all applicable codes and standards. The features and capacities described in this specification are required as a minimum for this project and shall be furnished by the successful contractor.

1.2 Quality Assurance

A. List any relevant requirements specific to the project of the RFP

1.3 Sustainalbility Requirements

A. List if any applicable

1. Note Post Consumer requirements if required by the RFP or necessay to achieve LEED Silver

PART 2 - PRODUCTS

2.1 Control Panel

A. Power Supply

B. System Enclosure

C. Intelligent Initiating Devices

1. Smoke Detectors – Addressable

2. Heat Detectors – Addressable

3. Duct Smoke Detectors – Addressable

4. Detector Bases – Addressable

5. Manual Pull Stations – Addressable

6. Addressable Interface Devices

D. Conventional Initiating Devices

E. Device Programming Unit:

F. Notification Appliances

1. Strobes, Horns, Horn/Strobes

G. Dialer

2.2 Performance Requirements

PART 3 - EXECUTION

3.1 General Execution Requirements

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

3.2 Commisioning

A. The CXA along with the electrical contractor and other contracted subcontractors, including the fire alarm subcontractor shall prepare detailed testing plans, procedures, and checklists for fire alarm systems, subsystems, and equipment

END OF SECTION 28 31 11

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and all related Specification Sections, apply to this Section.

B. Site Clearing shall be performed in accordance with Section 201 of the New York State Department of Transportation Standard Specifications, latest edition.

1.2 SUMMARY

A. This Section includes the following:

1. Protecting existing trees to remain.

2. Removing existing trees, shrubs, groundcovers, plants, and grass.

3. Clearing and grubbing.

4. Stripping and stockpiling topsoil.

5. Removing above- and below-grade site improvements.

6. Disconnecting, capping or sealing, and removing site utilities.

7. Temporary erosion and sedimentation control measures.

B. Related Sections include the following:

1. Division 1 Section “Construction Waste Management”

2. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.

1.3 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site. See Section “Earthwork” for additional information.

B. The following items shall be salvaged and will remain under the Owner’s property:

1. Parking kiosks

2. Signage

3. Grates from inlet structures

4. Inlet structures

5. Light poles

6. Street furniture

1.5 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.

2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

B. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

C. Do not commence site clearing operations until temporary erosion and sedimentation control measures and construction fence are in place. Preserve and maintain existing sediment control measures including silt fence and sediment basins.

D. Improvements immediately adjacent to construction area will be occupied. Conduct all site clearing operations so that neighboring areas will not be disrupted.

E. Provide not less than 72 hours notice of operations that will affect any common driveways.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT

A. The contractor, subcontractors, and their personnel shall follow the procedures and practices for waste separation, collection and transport as defined in the contractor's "Waste Management Plan" as required by Division 01 Section "Construction Waste Management."

3.2 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

C. Protect existing site improvements that will remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.3 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to the Local Soil Erosion and Sediment Control regulations.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.4 TREE PROTECTION

A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.

1. Do not store construction materials, debris, or excavated material within fenced area.

2. Do not permit vehicles, equipment, or foot traffic within fenced area.

3. Maintain fenced area free of weeds and trash.

B. Do not excavate within tree protection zones, unless otherwise indicated.

C. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Engineer.

1. Replace trees that cannot be repaired and restored to full-growth status, as determined by Engineer.

3.5 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

1. Arrange with utility companies to shut off indicated utilities.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer not less than two days in advance of proposed utility interruptions.

C. Excavate for and remove underground utilities indicated to be removed.

D. The CONTRACTOR shall call New York 811 at 1-800-272-4480, not less than three full business days prior to the start of any excavation, to have all utilities marked and shall excavate, test pit, or otherwise determine the exact location and elevations of said utilities. The Contractor shall notify the CONSTRUCTION MANAGER of any conflicts. The CONTRACTOR shall arrange for any necessary utility relocations or plan changes and shall reschedule his operations appropriately.

E. Utility removals/relocations shall be in accordance with any applicable notes contained on the Project Drawings and in accordance with these specifications.

3.6 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.

2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.

3. Use only hand methods for grubbing within tree protection zone.

4. Chip removed tree branches and dispose of off-site.

5. Remove stumps.

3.7 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Limit height of topsoil stockpiles to 72 inches.

2. Do not stockpile topsoil within tree protection zones.

3. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.8 SITE IMPROVEMENTS

A. Remove existing below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

C. Existing sheet piling at the perimeter shall remain.

D. Sheet piling supporting street furniture shall be removed.

3.9 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Contractor to submit disposal tickets for all materials removed from the site. See Section “Earthwork” for additional information.

END OF SECTION 31 10 00

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SECTION 31 12 00

EARTH MOVING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, and Bid Documents, apply to this Section.

B. Earthwork shall be performed in accordance with Section 200 of the New York State Department of Transportation Standard Specifications, latest edition.

C. Geotechnical Report

1.2 SUMMARY

A. Section includes the following:

1. Preparing and grading subgrades.
2. Excavating and backfilling.
3. Removal of rock and other underground obstructions.
4. Re-spreading existing topsoil.
5. Temporary Seeding

1.3 RELATED WORK

A. Related Sections include the following:

1. Division 01 Section “Construction Waste Management”

1.4 DEFINITIONS

A. Excavation: consists of the removal of material encountered to subgrade elevations and the reuse or disposal of materials removed.

B. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

C. Borrow: Soil material obtained off-site when sufficient approved soil material is not available for excavations.

D. Unauthorized excavation consists of removing materials beyond indicated subgrade elevations or dimensions without direction to the Engineer. Unauthorized excavation, as well as remedial work directed by the Engineer, shall be at the Contractor's expense.

E. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

1.5 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract

B. Samples of the following:

1. 50 lb. samples-sealed in air-tight containers, or each proposed fill and backfill soil material from on-site or borrow sources to the Owner/Owner's representative for testing. Contractor shall provide samples well in advance of commencing any fill operation.

C. Test Reports: In addition to test reports required under field quality control, the Contractor will also provide the following:

1. Laboratory analysis of each soil material proposed for fill and backfill from on-site and borrow sources.

2. One optimum moisture-maximum density curve for each soil material.

1.6 QUALITY ASSURANCE

A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.

B. Testing and Inspection Service: Owner will employ a qualified independent geotechnical engineering testing agency to classify proposed on-site and borrow soils to verify the soils comply with specified requirements and to perform required field and laboratory testing.

C. Before commencing earthwork, meet with representatives of the governing authorities, Owner, Engineer, consultants, independent testing agency, and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least 10 working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

1.7 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by the Engineer and then only after acceptable temporary utility services have been provided.

1. Provide a minimum 7 days notice to the Engineer and receive written notice to proceed before interrupting any utility.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shutoff services if lines are active.

C. See geotechnical report.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide approved borrow soil materials from off-site when sufficient approved soil materials are not available from excavations. The Contractor shall supply the Owner with the name and address of the source for any imported fill material required to complete the backfill operations.

B. Satisfactory Soil Materials: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM; free of rock or gravel larger than 2 inches (50 mm) in any dimension, debris, waste, frozen material, vegetation and other deleterious matter.

C. Unsatisfactory Soil Materials: ASTM D 2487 soil classification groups GC, ML, MH, CL CH, OL, OH, and PT.

D. Backfill and fill materials: Satisfactory soil materials.

2.2 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

B. Grass seed mix: See contract drawings

2.3 MULCHES

A. Straw Mulch: provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

PART 3 EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT

A. The contractor, subcontractors, and their personnel shall follow the procedures and practices for waste separation, collection and transport as defined in the contractor's "Waste Management Plan" as required by Division 01 Section "Construction Waste Management."

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect subgrades against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 DEWATERING

A. See Section 31 23 19 - DEWATERING

3.4 STABILITY OF EXCAVATIONS

A. Comply with local codes, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations

3.5 EXCAVATION

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

B. All excavated topsoil shall be temporarily stockpiled by the contractor and shall be reused.

C. All other excavated materials shall be disposed of off-site. See Section “Soil Sampling and Analysis” for soil sampling coordination requirements.

3.6 APPROVAL OF SUBGRADE

A. Notify Engineer when excavations have reached required subgrade.

B. When Engineer determines that unforeseen unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

1. Unforeseen additional excavation and replacement material will be paid according to the Contract provisions for changes in work.

C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Engineer, at no additional cost to the owner.

3.7 STORAGE OF SOIL MATERIALS

A. Stockpile excavated materials acceptable for backfill and fill soil materials, including acceptable borrow materials. Stockpile soil materials without intermixing. Place, grade and shape stockpiles to drain surface water. Cover to prevent wind-blown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.8 BACKFILL

A. Backfill excavations promptly, but not before completing the following:

1. Removal of trash and debris from excavation

2. Removal of temporary shoring and bracing, and sheeting.

3. Properly compact subgrade.

3.9 FILL

A. Preparation: Remove vegetation, topsoil, debris, wet, and unsatisfactory soil materials, construction, and deleterious materials from ground surface prior to placing fills.

1. Plow strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing surface.

B. When subgrade or existing ground surface to receive fill has a density less than that required for fill, break up ground surface to depth required, pulverize, moisture-condition or aerate soil and recompact to required density.

C. Place fill material in layers to required elevations for each location listed below.

1. Under grass, use excavated or borrow soil material.

2. Under walks and pavements, use subbase or base material as shown on the contract drawings.

D. Utilize topsoil from existing topsoil stockpiles for fill in grass areas.

3.10 COMPACTION

A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 6 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

B. Percentages of Maximum Dry Density Requirements. Compacted soil to not less than the following percentages of maximum dry density according to ASTM D 1557:

1. Under all structural areas such as sidewalks, curbs and pavements, etc., compact the top 12 inches (300mm) below subgrade and each layer of backfill or fill material at 95 percent maximum dry density.

2. Under lawn or unpaved areas, compacted the top 6 inches (150 mm) below subgrade and each layer of backfill or fill material at 90 percent maximum dry density.

3.11 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between existing adjacent grades and new grades.

2. Cut out soft spots, fill low spots, and trim high spots to conform to required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations.

C. All disturbed areas shall be stabilized in accordance with Soil Erosion and Sediment Control Standards following grading operations.

3.12 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged.

B. Sow seed at the rate RECOMMENDED BY SEED MANUFACTURER.

C. Rake seed lightly into top 1/8 inch of topsoil, roll lightly, and water with fine spray.

D. Protect seeded areas by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into topsoil with suitable mechanical equipment.

3.13 FIELD QUALITY CONTROL

A. Testing Agency Services: Engage a qualified independent certified testing agency to verify placement of all construction material including soil to mee the project specifications. Contractor shall provide notification at least 2 days in advance to the independent testing agency to perform density and compaction testing.

B. Allow testing agency to inspect and test each subbase and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.

1. Perform field in-place density tests according to ASTM D 1556 (sand cone method), ASTM D 2167 (rubber balloon method), or ASTM D 2937 (drive cylinder method), as applicable.

a) Field in-place density tests may also be performed by the nuclear method according to ASTM D 2922, provided that calibration curves are periodically checked and adjusted to correlate to test performed using ASTM D 1556. With each density calibration check, check the calibration curves furnished with the moisture gages according to ASTM D 3017.

b) When field in-place density tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of work, on each different type of material encountered, and at intervals as directed by the Engineer.

C. When testing agency reports that subgrades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, recompact and retest until required density is obtained. The Contractor is responsible for all cost associated with correcting deficient work.

3.14 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, and lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace material to depth directed by the Engineer, reshape and recompact at optimum moisture content to the required density.

C. Settling: Where settling occurs during the Project, remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing at no additional cost to the Owner.

D. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence or restoration to the greatest extent possible.

3.15 DISPOSAL, SURPLUS AND WASTE MATERIALS

A. Disposal of surplus soil, construction material, trash and debris shall be legally disposed of off the Owner’s property.

B. All materials removed from the site shall be disposed legally. The Contractor shall submit disposal tickets for all materials removed from the site.

END OF SECTION 31 12 00

SECTION 31 23 19

DEWATERING

PART 1 GENERAL

1.1 WORK INCLUDED

A. The dewatering of all areas where work must be performed under this Contract is the responsibility of the Contractor and no additional sum will be allowed for any dewatering operation, overtime, equipment rental or any other expense incurred due to the occurrence of surface runoff water, groundwater or water from possible leakage of existing roof leaders, structures and piping in the vicinity of the Contractor's operations.

1.2 RELATED WORK

A. Division 1 Section "Construction Waste Management"

B. Division 31 Section "Excavation Support and Protection"

C. Division 31 Section "Earth Moving"

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. The Contractor shall furnish all materials and equipment necessary to carry out all dewatering required during construction.

PART 3 EXECUTION

3.2 CONSTRUCTION WASTE MANAGEMENT

A. The contractor, subcontractors, and their personnel shall follow the procedures and practices for waste separation, collection and transport as defined in the contractor's "Waste Management Plan" as required by Division 01 Section "Construction Waste Management."

3.1 At all times, the Contractor is to maintain and operate proper and adequate surface and subsurface dewatering in order to keep the construction-site dry and in such condition that construction of structures and utilities and placement and compaction of fill and backfill may proceed unhindered by saturation of the area.

3.2 The Contractor is to prevent surface water and subsurface or groundwater from flooding or spilling into excavations, and from flooding the project site or surrounding area. They are to remove all water in order to prevent softening of structure or pipe foundation bottoms, undercutting footings, and soil consistency changes detrimental to the stability of sub-grades and foundations. The Contractor is further to provide and maintain pumps, well points, sumps, suction and discharge lines, or other dewatering system components necessary to convey all water away from excavations.

3.3 The Contractor is to obtain, at their own cost, any permits required for construction dewatering and any costs for disposal of dewatered material.

3.4 The Contractor shall furnish all materials and equipment necessary to carry out all de-watering.

END OF SECTION 31 23 19

SECTION 31 50 00

EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes temporary excavation support and protection systems.

B. Related Sections:

1. Division 03, Section 03 30 00, “Cast In Place Concrete, Structural” for concrete.
2. Division 31, Section 31 23 19, "Dewatering" for dewatering system for excavations.

1.3 PERFORMANCE REQUIREMENTS

A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.

1. Delegated Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
2. Prevent surface water from entering excavations by grading, dikes, or other means.
3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
4. Monitor vibrations, settlements, and movements.

1.4 SUBMITTALS

A. Shop Drawings: For excavation support and protection system.

B. Delegated-Design Submittal: For excavation support and protection system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Other Informational Submittals:

1. Photographs or Videotape: Show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of excavation support and protection systems. Submit before Work begins.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify Engineer no fewer than two days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Engineer's written permission.

B. Project-Site Information:

1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.

2. The Contractor is advised that during the project remedial investigation, bedrock was encountered approximately 16 feet below grade.

C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Engineer if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

D. Excavation required for the work proposed on this project will require the design and installation of an excavation support and protection system which must support the adjacent roadway during excavation. The Contractor shall submit shop drawings and calculations signed and sealed by an engineer licensed in the state of New York for each excavation support and protection system proposed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that are either new or in serviceable condition.

B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.

C. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.

D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of 4 inches.

E. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.

F. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

G. Helical piles conforming to ASTM 1011/1018 HSLA 55 or equal.

H. Pipe piles conforming to ASTM A500.

I. Other materials recommended by Contractor's qualified professional engineer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

1. Shore, support, and protect utilities encountered.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces are not impeded.

D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.

E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

3.2 REMOVAL AND REPAIRS

A. Remove temporary excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.

1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlaying construction and abandon remainder.
2. Fill voids immediately with approved backfill compacted to density specified in Division 31 Section "Earth Moving."
3. Repair or replace, as approved by Engineer, adjacent work damaged or displaced by removing excavation support and protection systems.

END OF SECTION 315000

SECTION 32 12 16

ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Hot-Mix Asphalt Paving shall be performed in accordance with Section 400 of the New York State Department of Transportation Standard Specifications, latest edition.

1.2 SUMMARY

A. Section Includes restoration of existing pavement due to utility installation and the following:

1. Cold milling of existing hot-mix asphalt pavement.
2. Hot-mix asphalt paving.
3. Asphalt surface treatments.
4. Epoxy pavement-marking paint.

B. Related Sections:

1. Division 02 Section "Structure Demolition" for demolition, removal, and recycling of existing asphalt pavements.
2. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.
3. Division 32 Section “Pavement Markings” for all pavement marking requirements.

1.3 DEFINITION

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
1. Job-Mix Designs: For each job mix proposed for the Work.

B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces.

C. Qualification Data: For qualified manufacturer and Installer.

D. Material Certificates: For each paving material, from manufacturer.

E. Material Test Reports: For each paving material.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by the NYSDOT.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of NYSDOT for asphalt paving work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F.
2. Tack Coat: Minimum surface temperature of 60 deg F.
3. Slurry Coat: Comply with weather limitations in ASTM D 3910.
4. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
5. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 55 deg F for water-based materials, and not exceeding 95 deg F. Comply with manufacturer’s recommended application temperatures and humidity levels.

PART 2 - PRODUCTS

2.1 ASPHALT MATERIALS AND PAVING MIX

A. All asphalt materials shall comply with Section 702 of the New York State Department of Transportation Specifications.

2.2 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by the NYSDOT and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

B. Proceed with paving only after unsatisfactory conditions have been corrected.

C. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of asphalt.

3.2 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.3 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at minimum temperature of 250 deg F.
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.4 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations".
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.5 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927, but not less than 94 percent nor greater than 100 percent.
2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.6 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.
2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.
2. Surface Course: 1/8 inch.
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage an independent qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency shall take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.

2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

a. One core sample will be taken for every 1,000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

E. Replace and compact hot-mix asphalt where core tests were taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION 32 12 16

SECTION 32 12 64

PAVEMENT JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Joint Sealants shall be performed in accordance with Section 705 of the New York State Department of Transportation Standard Specifications, latest edition.

1.2 RELATED WORK

A. Related Sections include the following:
1. Division 01 Section “Construction Waste Management”

1.3 SUMMARY

A. This Section includes the following:

1. Expansion and contraction joints within concrete curb.

2. Joints between concrete and asphalt pavement.

B. Related Sections include the following:

1. Division 1 Section “Construction Waste Management”

2. Division 2 Section "Hot-Mix Asphalt Paving" for constructing joints between concrete and asphalt pavement.

3. Division 2 Section "Cement Concrete Pavement" for constructing joints within concrete curb.

1.4 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants when ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: As indicated by manufacturer's designations.

2.2 COLD-APPLIED JOINT SEALANTS

A. Multicomponent Gasoline-Resistant Sealant for Concrete: Pourable, chemically curing elastomeric formulation complying with the following requirements for formulation and with ASTM C 920 for type, grade, class, and uses indicated:

1. Coal-Tar-Modified Polymer Formulation: Type M; Grade P; Class 25; Uses T and, as applicable to joint substrates indicated, O.

2. Bitumen-Modified Urethane Formulation: Type M; Grade P; Class 25; Uses T, M, and, as applicable to joint substrates indicated, O.

2.3 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.2 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of backer materials.

2. Do not stretch, twist, puncture, or tear backer materials.

3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.

2. Completely fill recesses provided for each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealants from surfaces adjacent to joint.

2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.

G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.3 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.4 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 32 12 64

SECTION 32 13 13

CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Cement Concrete Pavement shall be performed in accordance with Section 500 of the New York State Department of Transportation Standard Specifications, latest edition.

1.2 SUMMARY

A. This Section includes exterior cement concrete pavement for the following:

1. Concrete pads and slabs.
2. Curbs.
3. Sidewalks.

B. Related Sections include the following:

1. Division 31 Section "Earth Moving" for subgrade preparation, grading, and subbase course.
2. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants of joints in concrete pavement and at isolation joints of concrete pavement with adjacent construction.
3. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Qualification Data: For manufacturer.

D. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:

1. Aggregates.

E. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Admixtures.
4. Curing compounds.
5. Applied finish materials.
6. Bonding agent or epoxy adhesive.
7. Joint fillers.

F. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

C. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete", unless modified by requirements in the Contract Documents.

D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces. Use flexible or curved forms for curves with a radius 100 feet or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout the Project:

1. Portland Cement: ASTM C 150, Type I/II.

B. Normal-Weight Aggregates: Aggregate shall be provided as per Section 901.12 of the New Jersey Department of Transportation Specifications.

1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.

C. Water: ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Water: Potable.

2.5 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to requirements, and as follows:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.6 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): As per NYSDOT Specification Section 502 and as per plans.
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: As per NYSDOT Specification Section 502.
3. Slump Limit: As per NYSDOT Specification Section 502.

C. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a loaded 10-wheel tandem-axle dump truck weighing not less than 15 tons.
3. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction according to requirements in Division 31 Section "Earth Moving".

C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire.

E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.

1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
2. Provide tie bars at sides of pavement strips where indicated.
3. Butt Joints: Use epoxy bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet, unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows to match jointing of existing adjacent concrete pavement:

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius.

3.6 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

C. Do not add water to concrete during delivery or at Project site.

D. Do not add water to fresh concrete after testing.

E. Cold-Weather Placement: Comply with ACI 306.1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

F. Hot-Weather Placement: Comply with ACI 301.

3.7 FLOAT FINISHING

A. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturers written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these.

3.9 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least 1 composite sample for each 100 cu. yd. or fraction thereof of each concrete mix placed each day.

a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.

C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.11 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.

B. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

C. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 13 13

SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Related Sections include the following:
1. Division 32 Section "Asphalt Paving" for HMA paving.

1.3 SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings:

1. Indicate layout of pavement markings.

PART 2 - PRODUCTS

2.1 PAVEMENT MARKINGS

A. Pavement-Marking: Thermoplastic traffic markings in accordance with the NYSDOT Standard Specifications, latest edition.

1. Color: As indicated.

a. Use blue for spaces accessible to people with disabilities.

B. Glass Beads: AASHTO M 247, Type 1.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean and prepare substrates according to ASTM C 1127 and manufacturers written recommendations to produce clean, dust-free, dry substrate for traffic coating application.

3.2 PAVEMENT MARKINGS

A. Apply traffic paint for striping and other markings with mechanical equipment to produce uniform straight edges. Apply at manufacturer's recommended rates.

B. Spread glass beads uniformly into thermoplastic traffic paint at a rate of 6 lb/gal.

3.3 PROTECTING AND CLEANING

A. Protect traffic coatings from damage and wear during remainder of construction period.

B. Clean spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 32 17 23

SECTION 32 17 26

TACTILE WARNING SURFACING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

1. This Section specifies furnishing and installing Cast in Place Detectable/Tactile Warning Surface tiles where indicated.

1.3 SUBMITTALS

A. Product data: Submit manufacturer's literature describing products, installation procedures and routine maintenance.

B. Samples for Verification Purposes: Submit one (1) 12" x 12" size tile sample.

C. Shop drawings are required for products specified showing fabrication details, composite structural system, tile surface profile, fastener and anchor locations, plans of tile placement including joints, and material to be used as well as outlining installation materials and procedure.

D. Material Test Reports: Submit complete test reports from qualified accredited independent testing laboratories to qualify that materials proposed for use are in compliance with requirements and meet or exceed the properties indicated on the specifications.

E. Maintenance Instructions: Submit copies of manufacturer's specified installation and maintenance practices for each type of Warning tile and accessory as required.

PART 2 - PRODUCTS

2.1 CAST IN PLACE DETECTABLE/TACTILE WARNING SURFACE TILE

A. Vitrified Polymer Composite (VPC) Cast in Place Detectable/Tactile Warning Surface tile. Existing engineered and field tested products, which have been in successful service for a period of three (3) years are subject to compliance with requirements, may be incorporated in the work and shall meet or exceed the specified test criteria and characteristics.

B. Color: Color shall be selected by the Owner.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the cast-in-place Tactile Warning Surface tile in accordance with the manufacturer's recommended instructions.

B. The factory-installed plastic sheeting must remain in place during the entire installation process to prevent the splashing of concrete onto the finished surface of the tile.

C. The concrete shall be poured and finished true and smooth to the required dimensions and slope prior to the tile placement. Immediately after finishing concrete, an electronic level shall be used to check that the required slope is achieved. The tile shall be placed true and square to the curb edge in accordance with the contract drawings. The Cast in Place Warning tiles shall be tamped (or vibrated) into the fresh concrete to ensure that the field level of the tile is flush to the adjacent concrete surface.

D. The embedment process shall not be accomplished by stepping on the tile as this may cause uneven setting which can result in air voids under the tile surface. The tile field level (base of truncated dome) shall be set flush to adjacent surfaces to permit proper water drainage and eliminate tripping hazards between adjacent finishes.

E. Immediately after placement, the tile elevation is to be checked to adjacent concrete. The elevation and slope shall be set consistent with contract drawings to permit water drainage to curb as the design dictates. Ensure that the field surface of the tile is flush with the surrounding concrete and back of curb so that no ponding is possible on the tile at the back side of curb.

F. While concrete is workable, a 3/8" radius edging tool shall be used to create a finished edge of concrete, then a steel trowel shall be used to finish the concrete around the tile's perimeter, flush to the field level of the tile.

3.2 CLEANING, PROTECTING AND MAINTENANCE

A. Protect tiles against damage during construction period to comply with Warning surface manufacturer's specification.

B. Protect tiles against damage from rolling loads following installation by covering with plywood or hardwood.

C. Clean tiles not more than four days prior to date scheduled for inspection intended to establish date of substantial completion in each area of project. Clean tile by method specified by Tactile Warning Surfacing manufacturer.

END OF SECTION 32 17 26

SECTION 32 84 00

PLANTING IRRIGATION

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the supply and installation of irrigation system components including PVC piping and fittings, irrigation head nozzles, quick coupling valves, gate valves, control wiring, blow-off fittings, and all other work and materials required to install the irrigation system as described herein.

B. The extent of work for the irrigation system improvements includes furnishing all labor, materials, and equipment for the proper installation which includes trenching, backfilling, supply and installation of irrigation components, wiring and configuring the irrigation controller, testing all systems and making operative, and as-built drawings.

C. This section also includes the installation of an irrigation booster pump. Work for the booster pump will include the supply and installation of the booster pump, wire and conduit, connection to the proposed water service, connection to the electrical panel, and all other work and materials described herein.

D. Related Sections
1. Division 2 Section “Restoration” for restoration and trench restoration.
2. Division 31 Section “Earth Moving” for trench excavation and backfill.
3. Division 31 Section “Site Clearing” for removal and disposal of items marked for removal and miscellaneous debris.
4. Division 22 Section “Domestic Water Piping” for internal water piping
5. Division 22 Section “Facility Water Distribution Piping” for external piping to the irrigation system.

1.2 SUBMITTALS

A. Product data for all pipes, fittings, gate valves, compressed air fittings, quick coupling valves, wiring, irrigation head nozzles, and any other irrigation components used for the construction of irrigation system modifications.

B. Shop drawing of booster pump.

C. Concrete slab design for booster pump.

D. Record drawings: during the course of the installation, the CONTRACTOR shall be responsible for recording all changes made during installation. CONTRACTOR shall submit As-Built Drawings with details for approval. Drawings submitted must show CONTRACTOR’S title block with name, address, scale, and project name.

E. Maintenance Data: Submit maintenance data and parts lists for irrigation system materials and products. Include these data, products, shop drawings, and record drawings in a maintenance manual.

1.3 FIELD QUALITY CONTROL

A. The following tests are required:
   1. Pump Run Test
   2. Hydrostatic Test
   3. System Test

B. All piping work shall be performed in accordance with Division 22 Section “Domestic Water Piping” and Division 22 Section “Facility Water Distribution Piping”.

C. All materials and execution shall be completed in accordance with manufacturer’s recommendations.

PART 2 - PRODUCTS

2.1 IRRIGATION COMPONENTS

A. All piping and fittings shall be schedule 40 PVC or High Density Polyethylene.

B. A suitable connection shall be furnished and installed to connect an air compressor to blow out the system for winterization.

C. The irrigation system equipment shall utilize low-flow irrigation heads and high-efficiency/low flow nozzles.

D. The irrigation system shall utilize a 2-wire decoder system that connects to a central irrigation controller and site irrigation valves.

E. The central irrigation controller shall be a weather-tracking, automatic controller.

PART 3 - EXECUTION

3.1 IRRIGATION SYSTEM

A. The CONTRACTOR shall furnish and install a complete irrigation system, in accordance with all Federal, State, and Local codes and with all manufacturers recommendations.

B. Excavation shall be accomplished using suitable equipment, which will not unduly disturb the pipe bed. All underground piping, fittings and valves shall be assembled to provide watertight connections and full support of components throughout. Due care shall be exercised during installation of the piping to ensure the pipelines and valves are kept clean.

C. The contractor shall install irrigation heads in accordance with the manufacturer’s specifications.

D. Piping from control valves to individual heads shall have a minimum cover of twelve inches (12”).

E. Heads and nozzles shall be aimed to provide the required spray pattern without overspray.

3.2 IRRIGATION BOOSTER PUMP

A. The CONTRACTOR shall install a reinforced concrete pad, designed by a professional engineer in the State of New York, and mount the booster pump in a manner approved by the ENGINEER.

B. The CONTRACTOR shall install all necessary conduit and wiring from the pump to the service panel to provide power to the proposed booster pump. All electrical work shall be performed in accordance with the NEC and Division 26 specifications.

C. CONTRACTOR shall be responsible for reviewing the system's features, operations and procedures with the appropriate OWNER'S representatives to train them on all annual winterizing and start-up maintenance functions.

3.3 TESTING

A. Run Testing: The pumping system shall be completely run tested prior to shipment to verify the performance. A complete test of the pumping system shall include operation at condition point flow, pressure, voltage, and amperage.

END OF SECTION 32 84 00.

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SECTION 32 92 00

TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Turf and Grasses shall be performed in accordance with Sections 800 of the New York Department of Transportation Standard Specifications, latest edition.

1.2 SUMMARY

A. This Section includes the following:

1. Seeding.
2. Topsoil.
3. Straw Mulch.
4. Sod.
5. Mowing.

B. Related Sections include the following:

1. Division 31 Section "Site Clearing" for topsoil stripping and stockpiling.
2. Division 31 Section "Earth Moving" for excavation, filling and backfilling, and rough grading.
3. Division 33 Section "Sub-drainage" for subsurface drainage.

C. All areas disturbed and all areas within the property boundaries are to be restored with topsoil, fertilizer and seed if no other material is defined.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Manufactured Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

C. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

D. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture, identifying source, including name and telephone number of supplier.

C. Product Certificates: For sod, soil amendments and fertilizers, signed by product manufacturer.

D. Planting Schedule: Indicating anticipated planting dates for each type of planting.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful lawn establishment.

B. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Seed: Deliver seed in original sealed, labeled, and undamaged containers.

1.7 SCHEDULING

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: 3/1-4/30
2. Fall Planting: 8/15-11/15

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.

1.8 LAWN MAINTENANCE

A. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:

1. Lawns: 3 months from date of Substantial Completion.

a. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established, continue maintenance during next planting season.

B. Maintain and establish lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn.

1. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.
1. Seed listed below is from Jonathan Green. This or an approved equal is required on this project. Proportioned by weight as follows:

a. 50 percent Onyx Tall Fescue.
b. 25 percent Lion Tall Fescue.
c. 25 percent Black Magic Fescue.

2.2 TOPSOIL

A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 6 percent organic material content; free of stones 1 inch or larger in any dimension and other extraneous materials harmful to plant growth.

1. Topsoil Source: Import topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from bogs or marshes.

2.3 FERTILIZER

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.4 STRAW MULCH

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive lawns and grass for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydro seeding overspray.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 LAWN PREPARATION

A. Limit lawn subgrade preparation to areas to be planted.

B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future.

C. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Restore areas if eroded or otherwise disturbed after finish grading and before planting.

3.4 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged.

B. Sow seed at rates and using methods recommended by seed manufacturer.

C. Protect seeded areas by spreading straw mulch.

END OF SECTION 32 92 00

SECTION 33 46 00

SUB-DRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Sub-drainage shall be performed in accordance with Sections 706 and 707 of the New York State Department of Transportation Standard Specifications, latest edition.

1.2 SUMMARY

A. This Section includes sub-drainage systems for the following:
1. Retaining walls.

B. Related Sections include the following:

1. Division 1 Section “Construction Waste Management”

2. Division 31 Section "Earth Moving" for drainage stone.

3. Division 32 Section "Segmental Retaining Walls" for retaining walls.

1.3 DEFINITIONS

A. PE: Polyethylene plastic.

B. Sub-drainage: Drainage system that collects and removes subsurface or seepage water.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Perforated-wall pipe and fittings.

2. Solid-wall pipe and fittings.

3. Geotextile filter fabrics.

4. Aggregate

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Refer to the "Piping Applications" Article in Part 3 for applications of pipe, tube, fitting, and joining materials.

2.2 PERFORATED-WALL PIPES AND FITTINGS

A. Perforated PE Pipe and Fittings:

1. NPS 6 and Smaller: ASTM F 405 or AASHTO M 252, Type CP; corrugated, for coupled joints.

2. Couplings: Manufacturer's standard, band type.

2.3 SOIL MATERIALS

A. Backfill, drainage course, impervious fill, and satisfactory soil materials are specified in Division 31 Section "Earth Moving."

2.4 GEOTEXTILE FILTER FABRICS

A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. when tested according to ASTM D 4491.

1. Structure Type: woven, monofilament or multifilament.

2. Style(s): Flat.

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT

A. The contractor, subcontractors, and their personnel shall follow the procedures and practices for waste separation, collection and transport as defined in the contractor’s “Waste Management Plan” as required by Division 01 Section "Construction Waste Management."

3.2 EXAMINATION

A. Examine surfaces and areas for suitable conditions where sub-drainage systems are to be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.4 RETAINING-WALL DRAINAGE INSTALLATION

A. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

B. Place supporting layer of drainage course over compacted subgrade to compacted depth of not less than 4 inches.

C. Encase pipe with sock-style geotextile filter fabric before installing pipe.

D. Install drainage piping as described herein and in accordance with Section 2 “Storm Drainage.”

E. Add drainage course to width of at least 6 inches on side away from wall and to top of pipe to perform tests.

F. After satisfactory testing, cover drainage piping to width of at least 6 inches on side away from footing and above top of pipe to within 12 inches of finish grade.

G. Place drainage course in layers not exceeding 3 inches in loose depth; compact each layer placed and wrap top of drainage course with flat-style geotextile filter fabric.

H. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.

I. Fill to Grade: Place satisfactory soil fill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Fill to finish grade.

3.5 PIPING INSTALLATION

A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.

1. Retaining-Wall Sub-drainage: When water discharges at end of wall into stormwater piping system, install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 36 inches, unless otherwise indicated.

2. Lay perforated pipe with perforations down.

3. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.

B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.

C. Install PE piping according to ASTM D 2321.

3.6 PIPE JOINT CONSTRUCTION

A. Join PE pipe, tubing, and fittings with couplings for soil-tight joints according to AASHTO's "Standard Specifications for Highway Bridges," Division II, Section 26.4.2.4, "Joint Properties."

B. Join perforated, PE pipe and fittings with couplings for soil-tight joints according to AASHTO's "Standard Specifications for Highway Bridges," Division II, Section 26.4.2.4, "Joint Properties"; or according to ASTM D 2321.

3.7 FIELD QUALITY CONTROL

A. Testing: After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

3.8 CLEANING

A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION 33 46 00

SECTION 33 49 23

STORMWATER DETENTION STRUCTURES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes gravity site storm sewerage accessories, manholes and catch basins.

B. Related Sections:

1. Division 1 Section “Construction Waste Management”

2. Division 33 Section “HDPE Storm Drainage”

3. Division 31 Section “Excavation, Trenching and backfill for Utility Systems”

1.2 REFERENCES

A. AASHTO T180 (American Association of State Highway and Transportation Officials) - Moisture-Density Relations of Soils Using a 10-lb. Rammer and an 18-in. Drop.

B. ASTM A74 - Cast Iron Soil Pipe and Fittings.

C. ASTM C76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

D. ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

E. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

F. ASTM C969 - Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb. Rammer and 12 inch Drop.

G. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

A. Product Data: Submit data indicating pipe, pipe accessories.

B. Manufacturer's Installation Instructions: Submit special procedures required to install Products specified.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements

D. Shop Drawings – for all precast structures.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents:

1. Accurately record actual locations of pipe runs, connections, catch basins, cleanouts, and invert elevations.

B. Operation and Maintenance Data: Procedures for submittals.

1.5 COORDINATION

A. Coordinate the Work with termination of storm sewer connection outside building, trenching, connection to municipal sewer utility service.

PART 2 PRODUCTS

2.1 MATERIALS

A. See Contract drawings.

B. Waterproofing Membrane: Cold fluid applied bitumen-modified polyurethane waterproofing system designed to perform as a continuous barrier against liquid migration through the stormwater detention vault. Basis-of-Design Manufacturer: Sika Corporation, 201 Polito Avenue, Lyndhurst NJ 07071.

C. Waterproofing System: Fluid-Applied Membrane System: Sikagard 7600 or approved equal, Sika Flexitape Heavy, or approved equal.:

1. Sikagard 7600, 120 mils wet film thickness
2. Reinforcing fabric recommended for moving transitions, embedded into a separate 30 mil detail coat beneath the first coat.

2.2 ACCESSORIES

A. Filter Fabric: Non-biodegradable, woven

B. Grout: Specified in Section 033000.

2.3 CATCH BASINS, AREA DRAINS AND MANHOLES

A. Grate and Frame: Cast iron construction, as manufactured by Campbell Foundry or approved equal and shall be constructed as shown on the contract drawings:

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify excavation base is ready to receive work and excavations, dimensions, and elevations are as indicated on the drawings.

3.2 PREPARATION

A. Hand trim excavations to required elevations. Correct over excavation as required to meet the proper elevations.

B. Remove large stones or other hard matter, which could damage structures or impede consistent backfilling or compaction.

3.3 BEDDING

A. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 WATERPROOFING SYSTEM

A. Apply waterproofing system as specified by the product manufacturer.

3.5 INSTALLATION

A. Form bottom of excavation clean and smooth to correct elevation.

B. Form and place Cast-In-Place Concrete base pad, with provision for storm sewer pipe end sections.

C. Level top surface of base pad; sleeve concrete shaft sections to receive storm sewer pipe sections.

D. Establish elevations and pipe inverts for inlets and outlets as indicated on Drawings.

3.6 FIELD QUALITY CONTROL

A. Testing is the responsibility of the Contractor

B. Compaction Testing: In accordance with ASTM D698 AASHTO T180 ASTM D2922 ASTM D3017.

C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to the Owner.

3.7 PROTECTION OF FINISHED WORK

A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

1. Take care not to damage or displace installed pipe and joints during construction of pipe supports, backfilling, testing, and other operations.

2. Repair or replace pipe that is damaged or displaced from construction operations at no cost to the Owner.

END OF SECTION 33 49 23

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LIFE-CYCLE COSTS

Borough-Based Jails Program
Life Cycle Cost - Form G
NYC Department of Design and Construction
Queens Site Parking Garage

DATE
<Proposer Name>

	Component	Present Value	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
A	Lump Sum Amount (Put in Year 0)	$ 1,085,000	$1,085,000												
B	Operation Cost (include breakdown of major operational replacement and labor)	$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1	AHU Unit Replacement	$ 412,206	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
2	Fan Unit Replacement	$ 58,725	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
3	Split Systems Unit Replacement	$ 58,725	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
4	ASHP Unit Replacement	$ 412,206	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
5	Locked Fans Unit Replacement	$ 58,725	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
6		$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
7		$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
8	Yearly Maintenance	$ 1,312,002	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000
9	Snow Removal	$ 4,404,347	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000
10	Fire/Jockey Pump (1)Replacement	$ 188,633	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700
11	Electric Water Heaters (6) Replacements	$ 62,189	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670
12	Ejector/Sump/Elev Pit pumps (3)Replacements	$ 163,043	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000
13	Domestic & GW Booster Pumps (2) Replacements	$ 116,459	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
C	Maintenance Cost (include breakdown of major maintenance replacement and labor)	$ 587,246	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000
1	AHU Compressor Replacement	$ 38,722	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$25,000	$0	$0
2	AHU Fan Motor Replacement	$ 30,978	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$20,000	$0	$0
3	Split Systems	$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
4	ASHP Compressor Replacement	$ 78,040	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$50,000	$0	$0
5	ASHP Fan Motor Replacement	$ 46,824	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$30,000	$0	$0
6	ASHP Pumps	$ 78,040	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$50,000	$0	$0
7	Fire/Jockey Pump Testing	$ 349,378	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
8		$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
9	Replacement Light Fixtures	$ 501,288	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
10	Joint Sealant Replacement	$ 1,778,978	$0	$0	$0	$0	$0	$0	$0	$520,000	$0	$0	$0	$0	$0
11	Traffic Membrane	$ 377,709	$0	$0	$0	$0	$0	$70,000	$0	$0	$0	$0	$70,000	$0	$0
12	Sealer	$ 2,025,268	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$800,000	$0	$0
13	Concrete Repairs	$ 382,966	$0	$0	$0	$0	$0	$64,000	$0	$11,000	$0	$0	$64,000	$0	$0
D	Energy Costs (Electric/Gas)	$ 18,133,127	$ 617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70
E	Utility Cost (Water/Sewer/Garbage)	$ 85,700	$1,885	$1,979	$2,077	$2,180	$2,289	$2,403	$2,523	$2,649	$2,781	$2,920	$3,066	$3,219	$3,379
F	Total Present Value	$ 32,826,523													

	Component	Present Value	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25
A	Lump Sum Amount (Put in Year 0)	$ 1,085,000													
B	Operation Cost (include breakdown of major operational replacement and labor)	$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1	AHU Unit Replacement	$ 412,206	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
2	Fan Unit Replacement	$ 58,725	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
3	Split Systems Unit Replacement	$ 58,725	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
4	ASHP Unit Replacement	$ 412,206	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
5	Locked Fans Unit Replacement	$ 58,725	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
6		$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
7		$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
8	Yearly Maintenance	$ 1,312,002	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000
9	Snow Removal	$ 4,404,347	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000
10	Fire/Jockey Pump (1)Replacement	$ 188,633	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700
11	Electric Water Heaters (6) Replacements	$ 62,189	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670
12	Ejector/Sump/Elev Pit pumps (3)Replacements	$ 163,043	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000
13	Domestic & GW Booster Pumps (2) Replacements	$ 116,459	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
C	Maintenance Cost (include breakdown of major maintenance replacement and labor)	$ 587,246	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000
1	AHU Compressor Replacement	$ 38,722	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2	AHU Fan Motor Replacement	$ 30,978	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
3	Split Systems	$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
4	ASHP Compressor Replacement	$ 78,040	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
5	ASHP Fan Motor Replacement	$ 46,824	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
6	ASHP Pumps	$ 78,040	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
7	Fire/Jockey Pump Testing	$ 349,378	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
8		$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
9	Replacement Light Fixtures	$ 501,288	$0	$0	$335,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
10	Joint Sealant Replacement	$ 1,778,978	$0	$520,000	$0	$0	$0	$0	$0	$0	$520,000	$0	$0	$0	$0
11	Traffic Membrane	$ 377,709	$0	$0	$70,000	$0	$0	$0	$0	$70,000	$0	$0	$0	$0	$70,000
12	Sealer	$ 2,025,268	$0	$0	$0	$0	$0	$0	$0	$800,000	$0	$0	$0	$0	$0
13	Concrete Repairs	$ 382,966	$0	$11,000	$64,000	$0	$0	$0	$0	$64,000	$11,000	$0	$0	$0	$64,000
D	Energy Costs (Electric/Gas)	$ 18,133,127	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	##########	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70
E	Utility Cost (Water/Sewer/Garbage)	$ 85,700	$3,547	$3,724	$3,910	$4,105	$4,310	$4,525	$4,751	$4,988	$5,237	$5,498	$5,772	$6,060	$6,363
F	Total Present Value	$ 32,826,523													

	Component	Present Value	Year 26	Year 27	Year 28	Year 29	Year 30	Year 31	Year 32	Year 33	Year 34	Year 35	Year 36	Year 37	Year 38
A	Lump Sum Amount (Put in Year 0)	$ 1,085,000													
B	Operation Cost (include breakdown of major operational replacement and labor)	$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1	AHU Unit Replacement	$ 412,206	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
2	Fan Unit Replacement	$ 58,725	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
3	Split Systems Unit Replacement	$ 58,725	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
4	ASHP Unit Replacement	$ 412,206	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
5	Locked Fans Unit Replacement	$ 58,725	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
6		$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
7		$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
8	Yearly Maintenance	$ 1,312,002	$45,000	$45,000	$45,000	$45,000	$45,000	$25,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000
9	Snow Removal	$ 4,404,347	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000
10	Fire/Jockey Pump (1)Replacement	$ 188,633	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700
11	Electric Water Heaters (6) Replacements	$ 62,189	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$0	$0	$0	$0	$0
12	Ejector/Sump/Elev Pit pumps (3)Replacements	$ 163,043	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$0	$0	$0	$0	$0
13	Domestic & GW Booster Pumps (2) Replacements	$ 116,459	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$0	$0	$0	$0	$0
C	Maintenance Cost (include breakdown of major maintenance replacement and labor)	$ 587,246	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000
1	AHU Compressor Replacement	$ 38,722	$0	$0	$0	$0	$25,000	$0	$0	$0	$0	$0	$0	$0	$0
2	AHU Fan Motor Replacement	$ 30,978	$0	$0	$0	$0	$20,000	$0	$0	$0	$0	$0	$0	$0	$0
3	Split Systems	$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
4	ASHP Compressor Replacement	$ 78,040	$0	$0	$0	$50,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
5	ASHP Fan Motor Replacement	$ 46,824	$0	$0	$0	$30,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
6	ASHP Pumps	$ 78,040	$0	$0	$0	$50,000	$0	$0	$0	$0	$0	$0	$0	$0	$0
7	Fire/Jockey Pump Testing	$ 349,378	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$0	$0	$0	$0	$0
8		$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
9	Replacement Light Fixtures	$ 501,288	$0	$0	$0	$0	$335,000	$0	$0	$0	$0	$0	$0	$0	$0
10	Joint Sealant Replacement	$ 1,778,978	$0	$0	$520,000	$0	$0	$0	$0	$0	$0	$520,000	$0	$0	$0
11	Traffic Membrane	$ 377,709	$0	$0	$0	$0	$70,000	$0	$0	$0	$0	$70,000	$0	$0	$0
12	Sealer	$ 2,025,268	$0	$0	$0	$0	$800,000	$0	$0	$0	$0	$0	$0	$0	$0
13	Concrete Repairs	$ 382,966	$0	$0	$11,000	$0	$64,000	$0	$0	$0	$0	$75,000	$0	$0	$0
D	Energy Costs (Electric/Gas)	$ 18,133,127	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70
E	Utility Cost (Water/Sewer/Garbage)	$ 85,700	$6,681	$7,015	$7,401	$7,771	$8,159	$0	$0	$0	$0	$0	$0	$0	$0
F	Total Present Value	$ 32,826,523													

	Component	Present Value	Year 39	Year 40	Year 41	Year 42	Year 43	Year 44	Year 45	Year 46	Year 47	Year 48	Year 49	Year 50
A	Lump Sum Amount (Put in Year 0)	$ 1,085,000												
B	Operation Cost (include breakdown of major operational replacement and labor)	$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1	AHU Unit Replacement	$ 412,206	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
2	Fan Unit Replacement	$ 58,725	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
3	Split Systems Unit Replacement	$ 58,725	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
4	ASHP Unit Replacement	$ 412,206	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
5	Locked Fans Unit Replacement	$ 58,725	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
6		$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
7		$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
8	Yearly Maintenance	$ 1,312,002	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000
9	Snow Removal	$ 4,404,347	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000
10	Fire/Jockey Pump (1)Replacement	$ 188,633	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$0	$0	$0	$0
11	Electric Water Heaters (6) Replacements	$ 62,189	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
12	Ejector/Sump/Elev Pit pumps (3)Replacements	$ 163,043	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
13	Domestic & GW Booster Pumps (2) Replacements	$ 116,459	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C	Maintenance Cost (include breakdown of major maintenance replacement and labor)	$ 587,246	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000
1	AHU Compressor Replacement	$ 38,722	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$25,000
2	AHU Fan Motor Replacement	$ 30,978	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$20,000
3	Split Systems	$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
4	ASHP Compressor Replacement	$ 78,040	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$50,000
5	ASHP Fan Motor Replacement	$ 46,824	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$30,000
6	ASHP Pumps	$ 78,040	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$50,000
7	Fire/Jockey Pump Testing	$ 349,378	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
8		$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
9	Replacement Light Fixtures	$ 501,288	$0	$0	$0	$0	$0	$0	$335,000	$0	$0	$0	$0	$0
10	Joint Sealant Replacement	$ 1,778,978	$0	$0	$0	$520,000	$0	$0	$0	$0	$0	$0	$0	$0
11	Traffic Membrane	$ 377,709	$0	$70,000	$0	$0	$0	$0	$70,000	$0	$0	$0	$0	$70,000
12	Sealer	$ 2,025,268	$0	$800,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$800,000
13	Concrete Repairs	$ 382,966	$0	$64,000	$0	$11,000	$0	$0	$64,000	$0	$0	$0	$0	$64,000
D	Energy Costs (Electric/Gas)	$ 18,133,127	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70
E	Utility Cost (Water/Sewer/Garbage)	$ 85,700	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
F	Total Present Value	$ 32,826,523												

Borough-Based Jails Program **DATE**
Life Cycle Cost - Form G **<Proposer Name>**
NYC Department of Design and Construction
Queens Site Parking Garage

	Component	Present Value	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16
A	Lump Sum Amount (Put in Year 0)	$ 1,085,000	$1,085,000																
B	Operation Cost (include breakdown of major operational replacement and labor)	$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1	AHU Unit Replacement	$ 412,206	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
2	Fan Unit Replacement	$ 58,725	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
3	Split Systems Unit Replacement	$ 58,725	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
4	ASHP Unit Replacement	$ 412,206	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
5	Locked Fans Unit Replacement	$ 58,725	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
6		$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
7		$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
8	Yearly Maintenance	$ 1,312,002	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000
9	Snow Removal	$ 4,404,347	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000
10	Fire/Jockey Pump (1)Replacement	$ 188,633	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700
11	Electric Water Heaters (6) Replacements	$ 62,189	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670
12	Ejector/Sump/Elev Pit pumps (3)Replacements	$ 163,043	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000
13	Domestic & GW Booster Pumps (2) Replacements	$ 116,459	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
C	Maintenance Cost (include breakdown of major maintenance replacement and labor)	$ 587,246	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000
1	AHU Compressor Replacement	$ 38,722	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$25,000	$0	$0	$0	$0	$0	$0
2	AHU Fan Motor Replacement	$ 30,978	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$20,000	$0	$0	$0	$0	$0	$0
3	Split Systems	$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
4	ASHP Compressor Replacement	$ 78,040	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$50,000	$0	$0	$0	$0	$0	$0
5	ASHP Fan Motor Replacement	$ 46,824	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$30,000	$0	$0	$0	$0	$0	$0
6	ASHP Pumps	$ 78,040	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$50,000	$0	$0	$0	$0	$0	$0
7	Fire/Jockey Pump Testing	$ 349,378	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
8		$ -	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
9	Replacement Light Fixtures	$ 501,288	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$335,000	$0
10	Joint Sealant Replacement	$ 1,778,978	$0	$0	$0	$0	$0	$0	$0	$520,000	$0	$0	$0	$0	$0	$0	$520,000	$0	$0
11	Traffic Membrane	$ 377,709	$0	$0	$0	$0	$0	$70,000	$0	$0	$0	$0	$70,000	$0	$0	$0	$0	$70,000	$0
12	Sealer	$ 2,025,268	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$800,000	$0	$0	$0	$0	$0	$0
13	Concrete Repairs	$ 382,966	$0	$0	$0	$0	$0	$64,000	$0	$11,000	$0	$0	$64,000	$0	$0	$0	$11,000	$64,000	$0
D	Energy Costs (Electric/Gas)	$ 18,133,127	$ 617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70
E	Utility Cost (Water/Sewer/Garbage)	$ 85,700	$1,885	$1,979	$2,077	$2,180	$2,289	$2,403	$2,523	$2,649	$2,781	$2,920	$3,066	$3,219	$3,379	$3,547	$3,724	$3,910	$4,105
F	Total Present Value	$ 32,826,523																	

	Component	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30	Year 31	Year 32	Year 33
A	Lump Sum Amount (Put in Year 0)																	
B	Operation Cost (include breakdown of major operational replacement and labor)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1	AHU Unit Replacement	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
2	Fan Unit Replacement	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
3	Split Systems Unit Replacement	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
4	ASHP Unit Replacement	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
5	Locked Fans Unit Replacement	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
6		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
7		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
8	Yearly Maintenance	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$25,000	$45,000	$45,000
9	Snow Removal	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000
10	Fire/Jockey Pump (1)Replacement	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700
11	Electric Water Heaters (6) Replacements	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670	$2,670
12	Ejector/Sump/Elev Pit pumps (3)Replacements	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000
13	Domestic & GW Booster Pumps (2) Replacements	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
C	Maintenance Cost (include breakdown of major maintenance replacement and labor)	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000
1	AHU Compressor Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$25,000	$0	$0	$0
2	AHU Fan Motor Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$20,000	$0	$0	$0
3	Split Systems	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
4	ASHP Compressor Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$50,000	$0	$0	$0	$0
5	ASHP Fan Motor Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$30,000	$0	$0	$0	$0
6	ASHP Pumps	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$50,000	$0	$0	$0	$0
7	Fire/Jockey Pump Testing	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
8		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
9	Replacement Light Fixtures	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$335,000	$0	$0	$0
10	Joint Sealant Replacement	$0	$0	$0	$0	$520,000	$0	$0	$0	$0	$0	$0	$520,000	$0	$0	$0	$0	$0
11	Traffic Membrane	$0	$0	$0	$70,000	$0	$0	$0	$0	$70,000	$0	$0	$0	$0	$70,000	$0	$0	$0
12	Sealer	$0	$0	$0	$800,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$800,000	$0	$0	$0
13	Concrete Repairs	$0	$0	$0	$64,000	$11,000	$0	$0	$0	$64,000	$0	$0	$11,000	$0	$64,000	$0	$0	$0
D	Energy Costs (Electric/Gas)	$617,564.70	$617,564.70	$617,564.70	##########	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70
E	Utility Cost (Water/Sewer/Garbage)	$4,310	$4,525	$4,751	$4,988	$5,237	$5,498	$5,772	$6,060	$6,363	$6,681	$7,015	$7,401	$7,771	$8,159	$0	$0	$0
F	Total Present Value																	

	Component	Year 34	Year 35	Year 36	Year 37	Year 38	Year 39	Year 40	Year 41	Year 42	Year 43	Year 44	Year 45	Year 46	Year 47	Year 48	Year 49	Year 50
A	Lump Sum Amount (Put in Year 0)																	
B	Operation Cost (include breakdown of major operational replacement and labor)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
1	AHU Unit Replacement	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
2	Fan Unit Replacement	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
3	Split Systems Unit Replacement	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
4	ASHP Unit Replacement	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
5	Locked Fans Unit Replacement	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000
6		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
7		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
8	Yearly Maintenance	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000	$45,000
9	Snow Removal	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000
10	Fire/Jockey Pump (1)Replacement	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$6,700	$0	$0	$0	$0
11	Electric Water Heaters (6) Replacements	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
12	Ejector/Sump/Elev Pit pumps (3)Replacements	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
13	Domestic & GW Booster Pumps (2) Replacements	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
C	Maintenance Cost (include breakdown of major maintenance replacement and labor)	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000
1	AHU Compressor Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$25,000
2	AHU Fan Motor Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$20,000
3	Split Systems	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
4	ASHP Compressor Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$50,000
5	ASHP Fan Motor Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$30,000
6	ASHP Pumps	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$50,000
7	Fire/Jockey Pump Testing	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
8		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
9	Replacement Light Fixtures	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$335,000	$0	$0	$0	$0	$0
10	Joint Sealant Replacement	$0	$520,000	$0	$0	$0	$0	$0	$0	$520,000	$0	$0	$0	$0	$0	$0	$0	$0
11	Traffic Membrane	$0	$70,000	$0	$0	$0	$0	$70,000	$0	$0	$0	$0	$70,000	$0	$0	$0	$0	$70,000
12	Sealer	$0	$0	$0	$0	$0	$0	$800,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$800,000
13	Concrete Repairs	$0	$75,000	$0	$0	$0	$0	$64,000	$0	$11,000	$0	$0	$64,000	$0	$0	$0	$0	$64,000
D	Energy Costs (Electric/Gas)	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70	$617,564.70
E	Utility Cost (Water/Sewer/Garbage)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
F	Total Present Value																	

BIM EXECUTION PLAN

As per the requirements of the RFP and per our practice, a BIM Execution Plan (BEP) is needed to enable effective collaboration among the broad project team members. This team consists of all Trade and Non-Trade Contractors, Architects, Consulting Engineers and other consultants engaged by the D-B Team to develop the BIM model and required deliverables for the Queens Parking Garage and Community Space project.

The information contained within the forthcoming NYCDDC BBJ BIM Guidelines and Standards 2020 will be the basis for the development of the BEP. The implementation of policies and protocols will be provided by the D-B Team for the implementation of a successful design through Building Information Modeling, such as, but not limited to; Electronic Communication Protocols, BIM Information/Data Exchange, Permission Files and the roles, responsibilities and staffing requirements for each member of the D-B Team.

In the first 30 days after NTP, early in the planning stages of the project, the team members will document their respective BIM strategies for the BEP. This BEP document is intended to record the agreed to terms between the broad project team on how the parties will structure their respective portions of the BIM deliverables in order to enable clear understanding by the other parties who will be interpreting and using them. The BEP will cover the following RFP required BIM deliverables:

- Trade and Non-Trade Coordination Model
- As Built Documentation Model

Additional BIM modeling required during design phase and not addressed in RFP but covered by the BEP are:

- Final Design Documents
- Construction Documents

The BIM Execution Plan will address the following management strategies:

- BIM Management
- Enterprise Asset Management
- Delivery and Implementation Methodology

MODEL MANAGERS/MODEL LEADERS

The D-B Team will assign a Project Model Manager throughout the design and construction phases of the Project. The DB Project Model Manager will be responsible for the following among the D-B Team members:

- Communicating the BIM vision to the D-B Team
- Transferring modeling content from one party to another
- Validating the Level of Detail and controls as defined for each Project phase and/or Sub-Phase
- Validating modeling content during each phase
- Combining or linking (integration) of multiple Models and validating the integration of multiple Models
- Participating in design review and Model coordination sessions
- Communicating issues among the D-B Team such as, but not limited to, the elimination of redundant objects
- Keeping file naming accurate
- Managing version control
- Properly storing the Models in a collaborative project management system

Each member firm of the design consultant team will assign a Project Model Leader for each design discipline throughout the design and construction phase of the Project. In addition to fulfilling the responsibilities described above, each Project Model Leader, including the Project Model Manager, will be responsible for the following among their team (discipline) members:

- Quality Control
- Communicating the BIM vision
- Organizing training
- Being the main point of contact
- Managing the implementation of BIM
- Scheduling weekly meetings
- Facilitating the exchange of information and data
- Generating Interference Checks (“Revit”) as well as Coordination and Clash Detection Reports (“NavisWorks”) and the resolution of coordination errors and clashes (conflicts) within Models and Contract Documents

The following is a preliminary outline of the BEP that will be developed from the NYCDDC BBJ BIM Guidelines and Standards 2020:

1.0 SECTION 1 – BIM GUIDELINES
1.1 GENERAL REQUIREMENTS
1.2 PROCESS AND QUALITY OF DELIVERABLES
1.3 BIM MODELS
1.4 COORDINATION/CLASH DETECTION
2.0 SECTION 2 – REVIT STANDARDS
2.1 GENERAL
2.2 FILE USAGE AND TYPES
2.3 BEST PRACTICES AND PROCEDURES
2.4 REVIT WORKFLOW

Schedule PART 03

SUMMARY SCHEDULE

The Project Schedule is our primary tool for monitoring progress on critical activities against milestone completion dates. The first step in establishing a project is to estimate how long each activity will take, from the time it is started until the time it is finished. This duration estimate for each activity is the time for the work to be done plus associated waiting time.

The Project Manager will perform weekly Periodic Progress Analyses (PPA) on all critical activities and bi-weekly updates on the entire schedule. This proactive approach to monitoring field progress enables us to identify potential conflicts and focus on recovery measures well before they impact the project schedule.

To develop accurate and complete information, we focus on critical input channels when building a schedule. These include: Owner requirements, subcontractor feedback, field staff, document issuances, design changes, historical data and material lead times. We use Primavera P6, which is both a project requirement and a widely used tool in the industry given its ability to track multiple critical paths (to both the project completion and progress milestones).

In addition to continuous maintenance of the Baseline Schedule, we create monthly four-week look-ahead schedules, with buy-in from all project subcontractors confirmed at weekly project coordination meetings. As part of that process, we send focused, highlighted schedules to key project personnel. We believe the use of sub-schedules improves our efficiency and enables individuals to focus on their primary spheres of responsibility. After the information is gathered and updated, we host a review session with the team to evaluate the project's status and develop strategies to resolve lagging tasks.

Additionally, daily and weekly reporting of upcoming work supports the tracking of both the Master Schedule and the four-week look-ahead schedule.

Upon Notice to Proceed, we will immediately commence Site Validation to uncover any unforeseen conditions, determine any potential hazardous materials, and to solidify the site boundaries, areas of disturbance, site layout control, and site logistic controls. Hunter Roberts identifies and tracks all long lead items through a Required-on-Job log, and tailors the schedule to prioritize those approvals and material or equipment releases accordingly.

SCHEDULE RECOVERY

The key to effective project control is to measure actual progress and compare it to planned progress on a timely and regular basis and to take necessary corrective action immediately. The project schedule control process involves regularly gathering data on project performance and comparing it with the planned performance. Variance analysis will be conducted regularly throughout the project to compare planned schedule with actual performance in order to discover delays or variations in the project schedule. For example, the planned start, duration, and anticipated completion date would be compared with the actual start date, duration, and completion date for that activity.

HRCG will swiftly identify these variances and follow the below recovery plan in order to quickly mitigate delays:

- Identify Delayed Activities
- Investigate and Identify Root Causes
- Determine a Cut-off Date
- Establish Recovery Measures
- Recalculate the schedule to evaluate the efforts of the planned corrective actions.

If the planned corrective actions do not result in an acceptable schedule, these steps are repeated until the NYCDDC finds the revised plan acceptable. It is necessary to analyze the newly calculated schedule to determine whether it needs further attention.

Throughout the construction phase, our field team continuously monitors the actual work in place against the units of progress required by the project schedule.

We will focus on the critical path, long lead, and seasonally restrictive (planting, paving, concrete work, etc.) items defined by the project schedule and identify areas that require additional manpower, acceleration, or revised logic to maintain control of the schedule. This proactive approach allows the team to gain float, where possible, critical items which will act as a schedule contingency for unexpected events which may impact the completion date.

We will also investigate the potential need to fast-track the approvals process. We call this an early package Submittal Review Conference. The purpose of this conference is to assemble all the applicable design team members, subcontractor, material/equipment vendors, and Hunter Roberts' staff into a local office site facility for the purpose of reviewing and approving the long-lead item submittals. This conference will last approximately one day. The importance of expediting the submittal review process at this early stage cannot be overemphasized. This effort will enable the early release and fabrication of critical materials, possibly cutting three to four weeks off the projected lead times. With the

cooperation of the team, additional conferences may be scheduled to complete the balance of the submittal reviews.

An important step to assure the knowledge of the project's quality, safety and logistics requirements will be conducting on-site pre-work conferences with each subcontractor. These conferences will be attended by the Hunter Roberts field staff and the subcontractors' project manager and foreman responsible for on-site supervision. These meetings are used to reinforce the project-specific and trade-specific requirements, as well as addressing any special safety, coordination, or quality issues.

Throughout the construction phase, Hunter Roberts will prepare and issue remedial work lists and preliminary and final punch lists. These lists will be assembled as a result of our daily field inspections and will be reviewed at every subcontractor meeting. In addition, Hunter Roberts engages the design team early in the punch list process. The key to fast, efficient punch list resolution is early identification. All work lists and punch lists will be tracked in our ProCore project control system for tracking work completion in real-time. A final copy of completed and approved lists will be included in our turnover package.

The D-B Team has prepared a Project Schedule in accordance with Volume 2 – Article 6 of the RFP documents. Our schedule is driven by several early milestones:

- Site Validation
- PDC Approval
- DOB Approval of SOE/Foundation
- DEP Approval of Stormwater/Storm Sewer

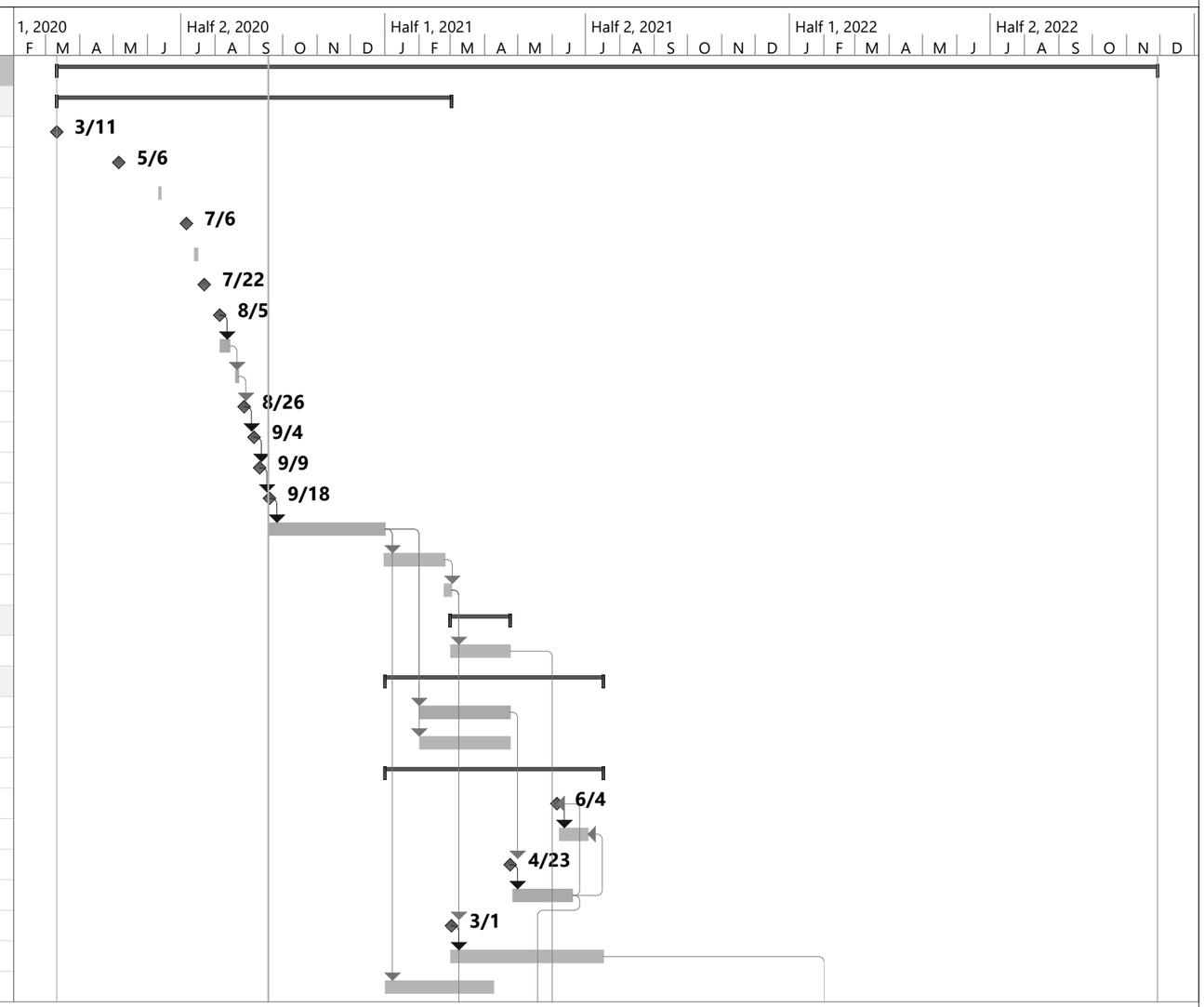
These early approvals will allow for mobilization in May 2021 which is critical to meeting Substantial Completion.

DDC Queens Garage & Community Space

Proposal Schedule

HUNTER ROBERTS CONSTRUCTION GROUP

ID	Task Name	Duration	Start	Finish
1	**DDC Queens Garage**	**709 days**	**Wed 3/11/20**	**Mon 11/28/22**
2	**DB/CM RFP & Award**	**254 days**	**Wed 3/11/20**	**Mon 3/1/21**
3	Issuance of Draft RFP	0 days	Wed 3/11/20	Wed 3/11/20
4	Deadline for Proposers RFI's on Draft RFP	0 days	Wed 5/6/20	Wed 5/6/20
5	Initial Dialogue Meetings with Proposers	2 days	Thu 6/11/20	Fri 6/12/20
6	Issue Final RFP to Proposers	0 days	Mon 7/6/20	Mon 7/6/20
7	First CDM's with Proposers	3 days	Mon 7/13/20	Wed 7/15/20
8	Deadline for Proposers RFI's on the Final RFP	0 days	Wed 7/22/20	Wed 7/22/20
9	Addendum # 1 Issued	0 days	Wed 8/5/20	Wed 8/5/20
10	Deadline for Interim Design Submittal	7 days	Wed 8/5/20	Thu 8/13/20
11	CDM # 2	3 days	Wed 8/19/20	Fri 8/21/20
12	Deadline for RFI's on Addendum 1	0 days	Wed 8/26/20	Wed 8/26/20
13	Addendum # 2 Issued	0 days	Fri 9/4/20	Fri 9/4/20
14	Deadline for a Request for Admin Org Changes	0 days	Wed 9/9/20	Wed 9/9/20
15	DB Proposal Submission (2:00pm)	0 days	Fri 9/18/20	Fri 9/18/20
16	DB Team Selected	15 wks	Fri 9/18/20	Thu 12/31/20
17	Closing Deadline	39 days	Thu 12/31/20	Tue 2/23/21
18	Notice to Proceed	5 days	Tue 2/23/21	Mon 3/1/21
19	**Post-Award Activities**	**40 days**	**Mon 3/1/21**	**Fri 4/23/21**
20	Site Validation	8 wks	Mon 3/1/21	Fri 4/23/21
21	**Design Activities**	**141 days**	**Fri 1/1/21**	**Fri 7/16/21**
22	Complete Excavation/Foundation/SOE Permit Docs	12 wks	Mon 2/1/21	Fri 4/23/21
23	Complete NB Filing Docs	12 wks	Mon 2/1/21	Fri 4/23/21
24	**Permitting**	**141 days**	**Fri 1/1/21**	**Fri 7/16/21**
25	File Combined Sewer Permit	0 days	Fri 6/4/21	Fri 6/4/21
26	Issuance of Combined Sewer Permit	20 days	Mon 6/7/21	Fri 7/2/21
27	File Excavation/Foundation/SOE Permit	0 days	Fri 4/23/21	Fri 4/23/21
28	Issuance of Excavation/Foundation/SOE Permit	2 mons	Mon 4/26/21	Fri 6/18/21
29	File New Building Permit	0 days	Mon 3/1/21	Mon 3/1/21
30	Issuance of New Building Permit	5 mons	Mon 3/1/21	Fri 7/16/21
31	NYC PDC Approvals	3.5 mons	Fri 1/1/21	Thu 4/8/21



Project: DDC Garage & Community Center
Date: Fri 9/18/20

HUNTER ROBERTS CONSTRUCTION GROUP

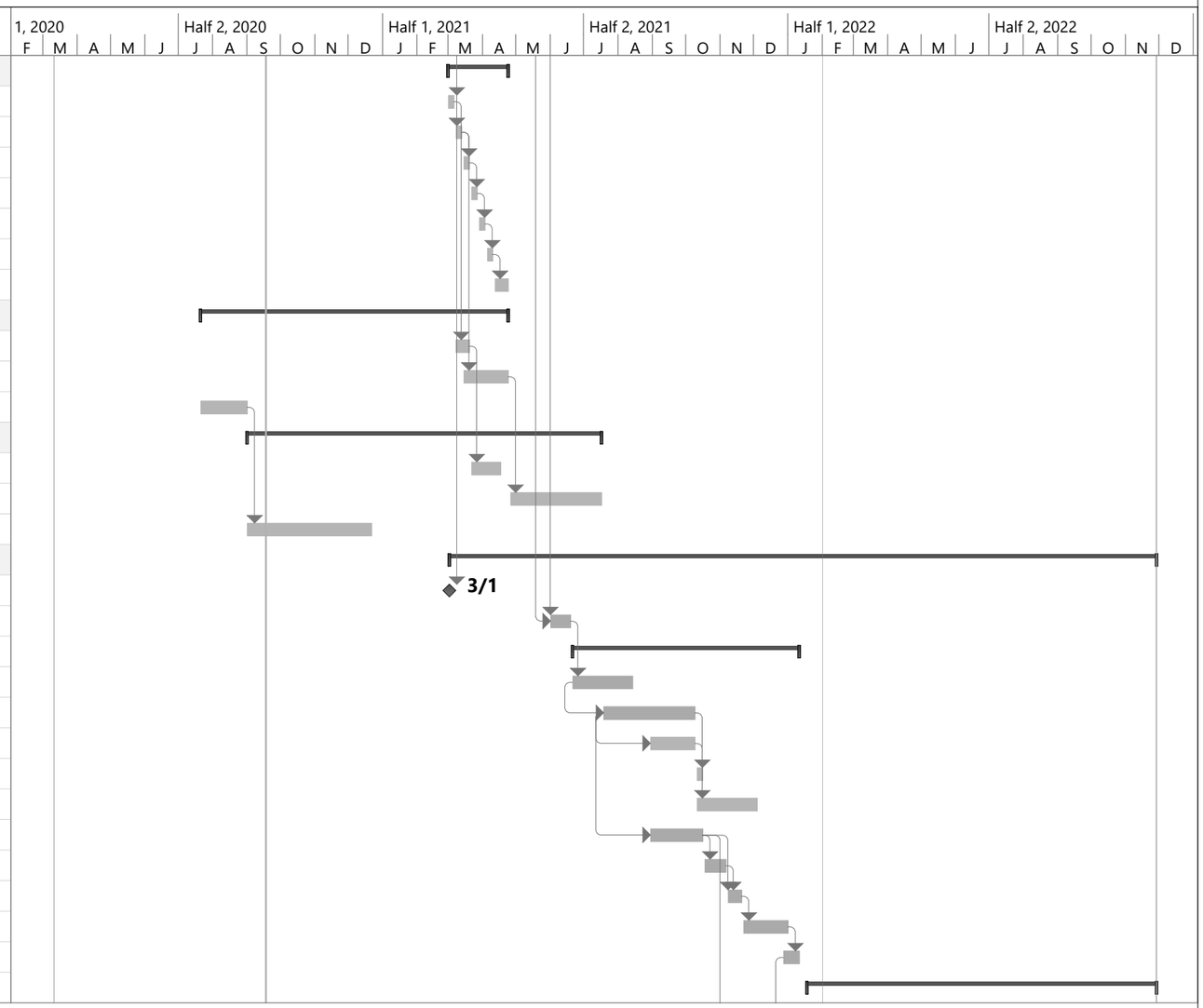
Task	Inactive Milestone	Start-only	Critical Split
Split	Inactive Summary	Finish-only	Progress
Milestone	Manual Task	External Tasks	Manual Progress
Summary	Duration-only	External Milestone	
Project Summary	Manual Summary Rollup	Deadline	
Inactive Task	Manual Summary	Critical	

DDC Queens Garage & Community Space

Proposal Schedule

HUNTER ROBERTS CONSTRUCTION GROUP

ID	Task Name	Duration	Start	Finish
32	**Procurement**	**40 days**	**Mon 3/1/21**	**Fri 4/23/21**
33	Foundation & Utilities	1 wk	Mon 3/1/21	Fri 3/5/21
34	Precast	1 wk	Mon 3/8/21	Fri 3/12/21
35	Electric	1 wk	Mon 3/15/21	Fri 3/19/21
36	HVAC	1 wk	Mon 3/22/21	Fri 3/26/21
37	Plumbing	1 wk	Mon 3/29/21	Fri 4/2/21
38	Carpentry	1 wk	Mon 4/5/21	Fri 4/9/21
39	Remaining Trades	2 wks	Mon 4/12/21	Fri 4/23/21
40	**Engineering**	**199 days**	**Tue 7/21/20**	**Fri 4/23/21**
41	SOE	2 wks	Mon 3/8/21	Fri 3/19/21
42	Precast	6 wks	Mon 3/15/21	Fri 4/23/21
43	Major Plumbing Equipment	6 wks	Tue 7/21/20	Mon 8/31/20
44	**Fabrication**	**229 days**	**Tue 9/1/20**	**Fri 7/16/21**
45	SOE	4 wks	Mon 3/22/21	Fri 4/16/21
46	Precast	60 days	Mon 4/26/21	Fri 7/16/21
47	Detention Tank/System	80 days	Tue 9/1/20	Mon 12/21/20
48	**Construction Phase**	**455 days**	**Mon 3/1/21**	**Mon 11/28/22**
49	Notice to Proceed	0 days	Mon 3/1/21	Mon 3/1/21
50	Mobilization	14 days	Tue 6/1/21	Fri 6/18/21
51	**Excavation / Foundation**	**146 days**	**Mon 6/21/21**	**Mon 1/10/22**
52	SOE	40 days	Mon 6/21/21	Fri 8/13/21
53	Excavation / Foundation Removals	60 days	Mon 7/19/21	Fri 10/8/21
54	New Detention System	30 days	Mon 8/30/21	Fri 10/8/21
55	Disconnect & Remove Existing Detention Tank	5 days	Mon 10/11/21	Fri 10/15/21
56	Install Underground MEP	40 days	Mon 10/11/21	Fri 12/3/21
57	Form / Pour Footings	35 days	Mon 8/30/21	Fri 10/15/21
58	Waterproofing	15 days	Mon 10/18/21	Fri 11/5/21
59	Form / Pour SOG	10 days	Mon 11/8/21	Fri 11/19/21
60	Form / Pour Foundation Walls	30 days	Mon 11/22/21	Fri 12/31/21
61	Stone Site	10 days	Tue 12/28/21	Mon 1/10/22
62	**Parking Garage**	**225 days**	**Tue 1/18/22**	**Mon 11/28/22**



Project: DDC Garage & Community Center
Date: Fri 9/18/20

HUNTER ROBERTS CONSTRUCTION GROUP

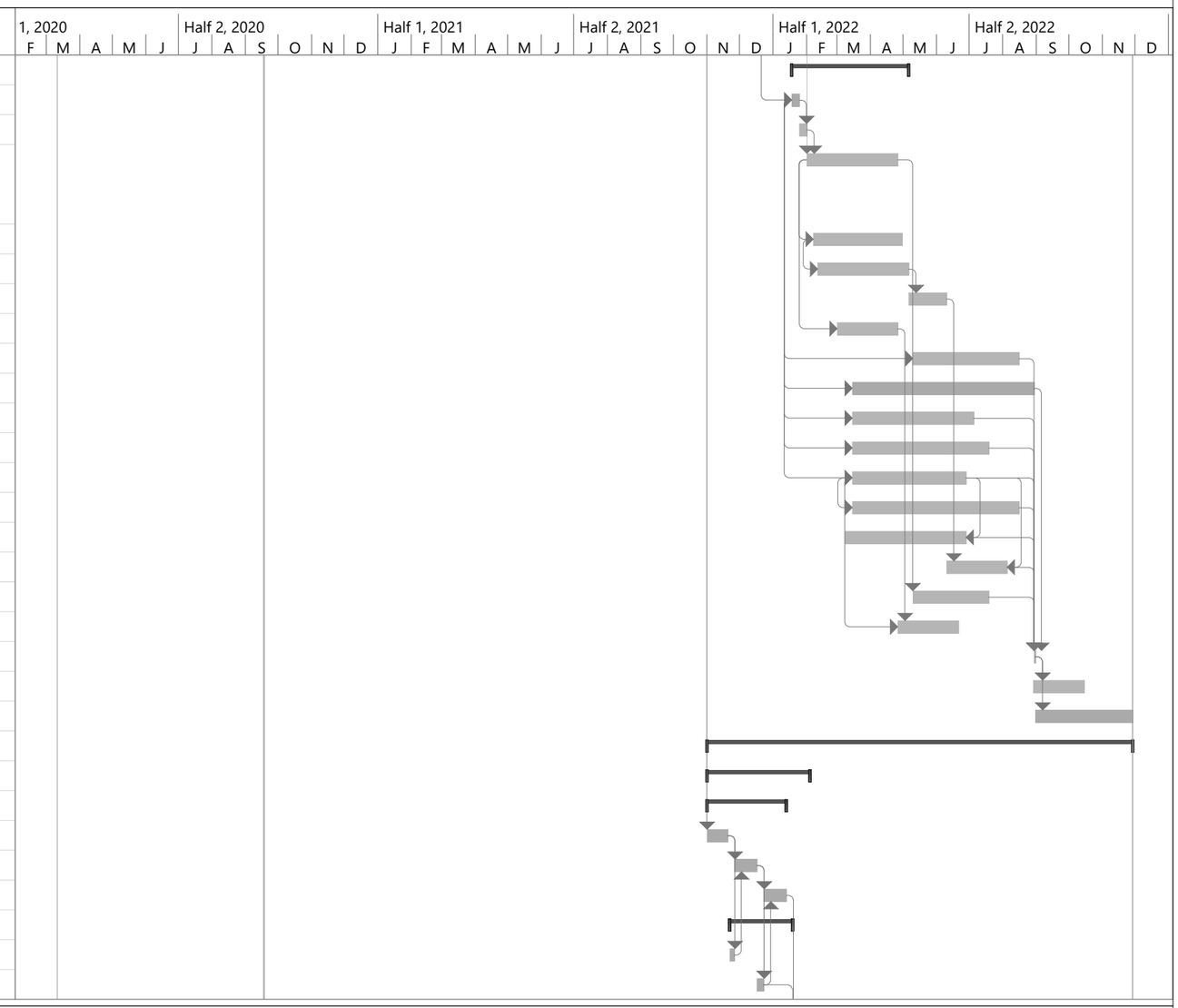
Task	Inactive Milestone	Start-only	Critical Split
Split	Inactive Summary	Finish-only	Progress
Milestone	Manual Task	External Tasks	Manual Progress
Summary	Duration-only	External Milestone	
Project Summary	Manual Summary Rollup	Deadline	
Inactive Task	Manual Summary	Critical	

DDC Queens Garage & Community Space

Proposal Schedule

HUNTER ROBERTS CONSTRUCTION GROUP

ID	Task Name	Duration	Start	Finish
63	**Precast Structure**	**78 days**	**Tue 1/18/22**	**Thu 5/5/22**
64	Crane Path Install	5 days	Tue 1/18/22	Mon 1/24/22
65	Mobilization	5 days	Tue 1/25/22	Mon 1/31/22
66	Erect Precast Members (Columns, Spandrels, Tee's)	60 days	Tue 2/1/22	Mon 4/25/22
67	Welding	60 days	Mon 2/7/22	Fri 4/29/22
68	Caulking	60 days	Fri 2/11/22	Thu 5/5/22
69	**Install Roof Steel / Photovoltaic Supports**	**25 days**	**Fri 5/6/22**	**Thu 6/9/22**
70	**Stairs**	**40 days**	**Tue 3/1/22**	**Mon 4/25/22**
71	**Elevators**	**70 days**	**Tue 5/10/22**	**Mon 8/15/22**
72	**HVAC**	**120 days**	**Tue 3/15/22**	**Mon 8/29/22**
73	**Plumbing**	**80 days**	**Tue 3/15/22**	**Mon 7/4/22**
74	**Sprinkler**	**90 days**	**Tue 3/15/22**	**Mon 7/18/22**
75	**Electrical**	**75 days**	**Tue 3/15/22**	**Mon 6/27/22**
76	**Fire Alarm**	**110 days**	**Tue 3/15/22**	**Mon 8/15/22**
77	**Light Fixtures**	**80 days**	**Tue 3/8/22**	**Mon 6/27/22**
78	**Photovoltaic Panels**	**40 days**	**Fri 6/10/22**	**Thu 8/4/22**
79	**Sitework**	**50 days**	**Tue 5/10/22**	**Mon 7/18/22**
80	**Finishes / Surfacing / Striping / Equipment**	**40 days**	**Tue 4/26/22**	**Mon 6/20/22**
81	**Substantial Completion - Garage**	**1 day**	**Tue 8/30/22**	**Tue 8/30/22**
82	**TCO Process - Parking Garage**	**35 days**	**Mon 8/29/22**	**Fri 10/14/22**
83	**Closeout - Garage**	**90 days**	**Wed 8/31/22**	**Mon 11/28/22**
84	**Community Center**	**281 days**	**Mon 11/1/21**	**Mon 11/28/22**
85	**Superstructure**	**69 days**	**Mon 11/1/21**	**Thu 2/3/22**
86	**Steel**	**53 days**	**Mon 11/1/21**	**Wed 1/12/22**
87	Erect Steel - 1st Floor	15 days	Mon 11/1/21	Fri 11/19/21
88	Erect Steel - 2nd Floor	15 days	Fri 11/26/21	Thu 12/16/21
89	Erect Roof Steel	15 days	Thu 12/23/21	Wed 1/12/22
90	**Concrete**	**42 days**	**Mon 11/22/21**	**Tue 1/18/22**
91	1st Floor Deck	4 days	Mon 11/22/21	Thu 11/25/21
92	2nd Floor Deck	4 days	Fri 12/17/21	Wed 12/22/21



Project: DDC Garage & Community Center
Date: Fri 9/18/20

HUNTER ROBERTS CONSTRUCTION GROUP

Task	Inactive Milestone	Start-only	Critical Split
Split	Inactive Summary	Finish-only	Progress
Milestone	Manual Task	External Tasks	Manual Progress
Summary	Duration-only	External Milestone	
Project Summary	Manual Summary Rollup	Deadline	
Inactive Task	Manual Summary	Critical	

DDC Queens Garage & Community Space

Proposal Schedule

ID	Task Name	Duration	Start	Finish
93	Roof Deck	4 days	Thu 1/13/22	Tue 1/18/22
94	**Spray on Fireproofing**	**12 days**	**Wed 1/19/22**	**Thu 2/3/22**
95	SOFP 1st Floor Deck	4 days	Wed 1/19/22	Mon 1/24/22
96	SOFP 2nd Floor Deck	4 days	Tue 1/25/22	Fri 1/28/22
97	SOFP Roof Deck	4 days	Mon 1/31/22	Thu 2/3/22
98	**Envelope / Ext Wall / Roofing**	**70 days**	**Wed 1/19/22**	**Tue 4/26/22**
99	**MEPS / Interiors**	**145 days**	**Wed 2/9/22**	**Tue 8/30/22**
100	**Cellar**	**110 days**	**Wed 2/9/22**	**Tue 7/12/22**
109	**1st Floor**	**110 days**	**Wed 3/9/22**	**Tue 8/9/22**
118	**2nd Floor**	**110 days**	**Wed 3/30/22**	**Tue 8/30/22**
127	**Substantial Completion - Community Center**	**0 days**	**Tue 8/30/22**	**Tue 8/30/22**
128	**TCO Process - Community Center**	**35 days**	**Mon 8/29/22**	**Fri 10/14/22**
129	**Closeout - Community Center**	**90 days**	**Wed 8/31/22**	**Mon 11/28/22**

Project: DDC Garage & Community Center
Date: Fri 9/18/20

Task		Inactive Milestone		Start-only		Critical Split	
Split		Inactive Summary		Finish-only		Progress	
Milestone		Manual Task		External Tasks		Manual Progress	
Summary		Duration-only		External Milestone			
Project Summary		Manual Summary Rollup		Deadline			
Inactive Task		Manual Summary		Critical			

Construction Solution PART 04

CONSTRUCTION EXECUTIVE SUMMARY

Hunter Roberts has a cultural philosophy of striving for continuous improvement and operational excellence. On this project we will exhibit such a philosophy by taking a lead “from the front” approach.

As the Design Builder we will take ownership and accountability through the course of Construction Operations to deliver a functional parking garage and a flexible community center of the highest design quality.

Through our team of excellent project leaders with stellar and proven track records, we will execute our work in a safe, professional and respectful manner. Our team will work harmoniously to deliver a product that is a set above.

We start our projects with the end in mind; the end on this project is to deliver a facility to the community that exceeds standards within the desired parameters. We will partner with trusted and reliable subcontractors and ensure fair and ethical practices are kept. We will aggressively pursue M/WBE Goals, while achieving the best design and value for the community.

In everything we do, safety and the safekeeping of the community will be in the forefront of our minds to deliver a product that meets and exceeds expectations.

CONSTRUCTION PLAN

PHASING PLAN
PHASE 1 – MOBILIZATION / SOE / SITE DRAINAGE / EXCAVATION / FOUNDATIONS

Existing Parking Lot / Temporary Parking: The existing parking lot will be prepared for construction with the installation of concrete jersey barriers (running west to east; 126th Street to 132nd Street). Jersey barriers will have painted plywood at the top, creating a neat and safe site fence separating the new temporary parking lot (to the South) from the construction site (to the North). All striping will be completed as well.

132nd Street: We do not anticipate any major disruptions to the pedestrian sidewalk or the parking lanes along 132nd Street during the early phases of the project. We are continuing to develop the Support of Excavation design, and with the large soil cut required and export along with it, we are reviewing the impact on the existing sheeting, as well as the reinforcement of existing or placement of new sheeting that will require closures of the sidewalk and possibly the parking lane, however we are continuing to develop this design and will have more detail for the final submission.

Union Turnpike: No impact. Sidewalk and all vehicular lanes remain open.

126th Street: We are investigating the potential sidewalk and parking lane closures on 126th Street. Understanding the importance of maintaining as many existing parking spaces as possible, we have created an offset in the proposed site fence along the 126th Street. In an effort to utilize the existing curb cut for the existing parking garage as the future entrance to the construction site, we are going to have 126th Street serve as the main entrance and exit for all construction vehicles and construction personnel. To secure the site, we will plan to install two (2) personnel turnstiles that will have card-reader access to the site for all qualified, trained and certified construction workers. We will also have two (2) access gates, one a rolling gate at the existing curb cut, and the second a swing gate at the south elevation of the site allowing emergency vehicles and construction vehicles to enter.

Note: Issuance of the Notice to Proceed is anticipated on or about March 8, 2021, which will be considered the start date and the beginning of the 595 Calendar Day duration. Although construction activities are not scheduled to begin until June 2021, the overall duration clock starts three (3) months prior, which absorbs approximately ninety (90) days of the allotted 595 duration.

PHASE 2 – PARKING GARAGE AND COMMUNITY CENTER STRUCTURE & ENVELOPE

Existing Parking Lot / Temporary Parking: Prior to mobilization of cranes to the site, a sidewalk shed (overhead protection) will be provided adjacent to the jersey barrier/ plywood site fence that was constructed for Phase 1. This Shed will let and maintain a minimum 5' clear walking path for pedestrians accessing the Temporary Parking Lot.

132nd Street: The erection of both the precast structure for the parking garage and the steel structure for the Community Center will require access lanes for truck deliveries, as well as space for lay-down of materials. Therefore the proposed preliminary plan is to close the parking lane along 132nd street, which will be utilized to deliver the 60' +/- precast Double T structural elements, and have the crane pick the precast from the flatbed trucks parked in what was the parking lane. The lane will be closed off with concrete jersey barriers and plywood fence (8' high). This lane will serve as the loading and delivery area for the entire precast operation. The expected duration of this lane closure will be approximately three (3) to four (4) months.

Union Turnpike: No impact. Sidewalk and all vehicular lanes remain open.

126th Street: The steel erection operation will operate from the West elevation of the site and will include a hydraulic crane situated within the site footprint for a portion of the steel erection, and then from the sidewalk & existing car parking lane for the remainder of the steel erection. Therefore, the proposed preliminary logistics plan will include the closing of the sidewalk, re-directing pedestrian traffic across to the west elevation of 126th Street, and a closing of the car parking lane to allow for steel deliveries to the site, crane placement during erection and lay-down for steel members delivered to the site. The expected duration of this lane closure will be approximately two (2) to three (3) months.

Schedule: The anticipated duration from precast crane mobilization (Garage) and steel crane (Community Center) mobilization, to the be-mobilization of the foundation operation is twelve (12) months. We expect this work to take place between Q3 2022 and Q1 2023. The activities included in this time period are:

- Precast Erection
- Precast Welding
- Precast Caulking
- Steel Structure Erection
- Metal Deck Installation
- Concrete on Metal Deck Placement

- Spray-on-Fireproofing
- Building Envelope (Façade and Roofing)

PHASE 3 – MEPS / SITE WORK / FIT OUT

Existing Parking Lot / Temporary Parking: Maintain overhead protection until all façade and roof work is completed.

132nd Street: Site work will commence which will include the necessary and temporary closures of sidewalks and streets to complete the improvements required at roadways and sidewalks. The closures for parking and sidewalks will be reduced to shorter periods to allow for this work.

Union Turnpike: Site work will commence which will include the necessary and temporary closures of sidewalks and streets to complete the improvements required at roadways and sidewalks. The closures for parking and sidewalks will be reduced to shorter periods to allow for this work

126th Street: Site Work, as noted above.

Schedule: It is expected that the MEPS, Elevator, Fit out and Site work will commence in Q3 2022 and continue through late Q2 2023. TCO is expected in late June 2023.

SHOP DRAWINGS

At Hunter Roberts, we consistently center our approach and overall project strategy around Pre-Planning. As with safety, anticipating a challenge before it approaches allows us to mitigate risk and deliver projects successfully. As part of this pre-plan way of working, we see shop drawings and submittals as an opportunity to pre-plan and build work in our heads and on paper prior to the work being executed in the field. This allows us the opportunity to coordinate contiguous work and get ahead of challenges to mitigate the risk for delay.

Shop drawings and submittals for critical long lead items are the first step in delivering a project on time. Not many things can derail a project schedule like a delay in curtain wall fabrication or releases of critical MEP systems.

For this project the following critical bid packages will be closely monitored to ensure efficiency and overall project success:

Foundations: Foundation structure will need to be coordinated with the precast structure. Shop drawings for the foundations will need to include critical information and be coordinated with the precast Subcontractor. This is critical for structural load points along with embedment locations.

Structural: The structural steel scope will need to be closely coordinated with the foundation work, utilities, carpentry, photovoltaic panels, precast, and other trades. Shop drawings for structural steel will be critical for a swift approval process so the steel fabrication can begin as early as possible. Steel is not only the framing for the community center but also the supports for the solar panels on the garage rooftop. Fabrication and delivery can take 3-4 months, so it is critical that these shop drawings be complete and accurate.

Site Utilities: Incoming site utilities will require coordination with the foundation structure; ensuring the coordination between the two trades will allow for seamless installation and integration of the contiguous systems.

Precast: Shop drawings for the precast structure will involve the foundation contractor, MEP coordination, and logistical coordination with the construction manager. The shop drawings will locate drain bodies, sprinkler piping, electrical conduit, plumbing chases & piping, precast stair locations, certain elements of exterior wall, etc. It will be critical to coordinate all disciplines during the precast shop drawing process.

Cast-in-Place: Shop drawings for the cast-in-place scope of work will include drawings for concrete formwork which will need to be coordinated with mechanical trades for equipment pads; the scope is integrated in many other trade packages and so it needs to be reviewed and properly coordinated to ensure the work is completed correctly the first time.

Exterior Wall: Exterior walls include the following scopes of work:

- Integrated art façade
- Storefront glazing
- Metal panels
- Façade fins
- Window wall
- Stone facing

These all present their own unique challenges. Exterior wall elements can have the longest lead time on a project. These elements are also usually rigid in nature, requiring materials to be released prior to field measurements being made. It is critical to examine and coordinate shop drawings for all the above-mentioned scope packages with diligence and care to allow for a successful installation. It is also critical to understand how the pieces of an exterior wall come together as an assembly. There are many complex details and caveats to piecing together multiple wall systems while still achieving a watertight and airtight system.

MEPS: The MEPS trades for this project are as follows:

- Mechanical
- Electrical
- Plumbing
- Fire Protection

These subcontractors will submit shop drawings for each level of the project; once approved by the design team the MEPS Coordination process will begin. It will be critical to start this process early in order to allow the precast subcontractor enough time to fabricate their pieces with the

leave-outs, sleeves, sloping, etc., required for the project. In addition to shop drawings, the major MEPS systems will require approved submittals and engineering.

Elevator: Typically the project element with the longest lead time, the elevator will require the subcontractor to submit their shop drawings and submittals for approval in the first group of submissions. Three elevators, two serving the parking garage and one serving the community center, will each need to be coordinated with the structural steel, carpentry, mechanical, electrical, and other trades. Shop drawings will show dimensions, mountings, finishes, and requirements for each of the elevators. During the shop drawing process, the subcontractor will also need to provide a maximum regenerative energy matrix for each elevator for different operating scenarios such as elevator recall and operation under emergency power in start-up, testing, commissioning, and final operation.

Site Protection: Site Protection consists of the hoist, site fence, and sidewalk shed scopes. This subcontractor will have to prepare and submit shop drawings for the hoist assembly, typical shed assembly and dimensions, and site fence/site protection plans so that they can be reviewed for completion and accuracy against the design documents. Their positioning must also be coordinated with the other exterior scope packages like landscaping, site work, foundations and excavation, and others.

SCHEDULE OF SUBMITTALS

Hunter Roberts has prepared an initial Schedule of Submittals which we will review with NYCDDC after our initial submission to ensure all items included and review requirements are mutually agreed upon. Any comments from NYCDDC will be fully addressed in the final Schedule of Submittals.

COORDINATION

HRCG understands the importance of closely coordinating with all Adjacent Works Component Projects and Key Stakeholders. We have outlined in detail our plans for executing a seamless coordination plan within our NYCDDC and Key Stakeholder Coordination and Communications section.

SITE VALIDATION PLAN

Immediately after the Closing date, Hunter Roberts Construction will submit the required documentation to obtain access to the site to perform Site Validation tasks. During the Site Validation period, we will confirm that the existing site information provided with the RFP is accurate. Our design and construction plans are predicated on the accuracy of the existing information. Consequently, our objective is to complete the Site Validation work and studies prior to the 120-day limit so that we can complete the design and commence the AHJ filing and approval process as early as possible. We plan to complete the following studies:

Survey: Topographic, boundary and utility survey of the existing lot (Block 9657/Lot 1). The extents of the survey will extend approximately 50' beyond the lot line to include adjacent streets. (See Figure 1). The survey will include the following site features:

- Topographic and utilities survey
- All existing ground and roadways including pavement markings
- All existing buildings and structures
- Driveways, depressed curbs, crosswalks and ramps
- All sidewalk hardware including manhole covers catch basins
- Existing underground utilities and utility structures
- All underground foundation structures
- Existing street furniture including sign poles, traffic signals, muni-meters and bike racks
- All hedges, fences and grass areas
- Tree centerline and breast height
- Sidewalk and roadway surface materials
- Overhead utility lines
- Elevations for all street surface hardware
- Metes and bounds

Mapping will be completed in Civil 3D 2019 along with signed PDF sheets and AutoCAD drawings files. The survey will adhere to the mapping standards outlined in the RFP. Our site validation budget for the survey includes additional laser scanning and GPR (ground penetrating radar) studies that may be required to accurately identify all of the site features and utility infrastructure.

Geotechnical Investigation: Although our team has already completed an extensive analysis of the existing geotechnical information that was provided in the RFP, we will complete a stand-along boring program and geotechnical investigation as part of our Site Validation plan. The geotechnical investigation will include the following tasks:

- Approximately 13 new borings to bedrock or adequate bearing soil as required by NYCBC.
- Approximately 5 borings will extend to a depth of 100' below existing grade and the remaining 6 borings will extend to approximately 50' below existing grade. Given our existing knowledge of the site, we do not anticipate encountering bedrock.
- An ATV or truck mounted drilling rig will be used for the drilling
- Groundwater depth observations will be made
- Continuous standard split-spoon sampling will be conducted for each boring from ground surface to a depth of 12' and, if feasible, at 5' intervals thereafter. Samples will be sent to Matrix New World (geotechnical engineer). Spoils will be returned to the bore hole and asphalt and concrete surfaces will be patched.
- In addition to contacting One-Call, a GPR (ground penetrating radar) study will be completed to verify that all drilling locations are 'clear'.
- A laboratory subcontracted to Matrix (geotechnical engineer) will conduct geotechnical test on select soil samples. Testing will include moisture content, grain size analyses and Atterberg limits (plasticity indices) on select

samples to aid the evaluation.
- Geotechnical Report including: test boring location plan, boring logs, description of subsurface conditions, design parameter recommendations, results of laboratory testing, seismic design parameters, general foundation design recommendations
- Soil samples will be retained for 6 months unless a request is made to retain the samples for a longer duration.

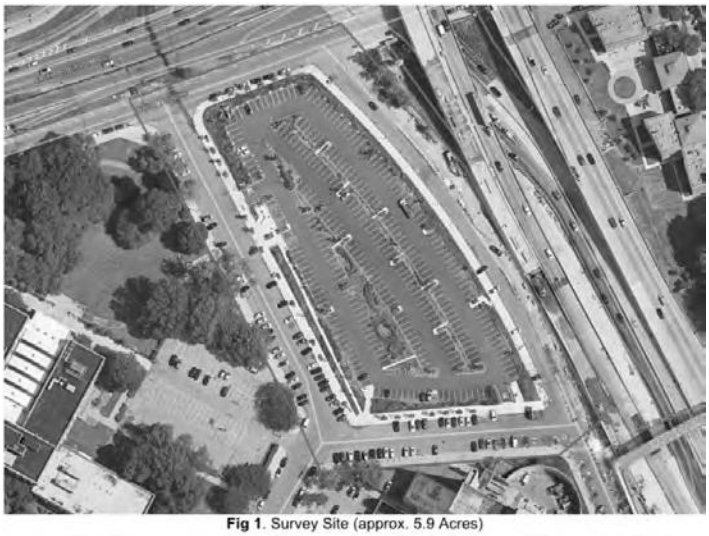


Fig 1. Survey Site (approx. 5.9 Acres)

Supplemental Environmental Phase II: Matrix New World Engineering will complete a Supplemental Environmental study. The objective of the study will be to validate the previous investigations. Previous environmental investigations included soil, groundwater and soil gas sampling. These investigations were performed as part of the Master Plan/ULURP project and more recently for the NYCDDC Borough Based Jails Project Management contract. In addition to the objective to validate the previous studies, the supplement will provide additional information to facilitate design and construction of the proposed garage and community space. The study will be focused to a depth of approximately 15' below grade to the proposed depth of the excavation. Tasks of the investigation will include:

- Preparation of a Health and Safety Plan (HASP) as per Occupational Safety and Health Administration requirements. The HASP will dictate that all site activities will be conducted in accordance with all applicable City, State and Federal regulations, including OSHA, National Institute of Occupational Safety and Health (NIOSH), New York State Department of Labor (NYSDOL) and New York City Department of Buildings (NYCDOB).
- Geophysical survey to clear boring locations
- Five soil borings in areas not previously investigated and collect up to one discrete soil sample for each boring. Boring will advance to the anticipated excavation depth. Soils will be screened for volatile organic compounds using a PID. In addition, a description of soil lithology will be classified along the vertical length of the soil column by a geologist/scientist according to the Burmister Soil Classification system.
- All work will be conducted in general accordance with the NYSDEC DER-10 "Technical Guidance for Site Investigation and Remediation." Sample analyses would consist of Target Compound List (TCL) VOCs, semivolatile organic compounds (SVOCs), pesticides and PCBs; and Target Analyte List (TAL) metals and cyanide. The VOC samples will be collected from a 2-foot interval based on field observations of contamination (PID readings, staining, odors, etc.). If no evidence of contamination is observed, the VOC sample will be collected from the first 2-foot interval of soil below the asphalt and any sub-base. The remainder of soil from the boring will be composited and submitted for analysis for the TCL SVOCs, PCBs, pesticides and TAL metals/cyanide. Additionally, one composite soil sample will also be collected from every two to three borings (two total for the Site) and analyzed for TCLP, RCRA characteristics, paint filter and diesel-range organics (DRO)/gasoline-range organics (GRO). All analyses would be conducted by a laboratory that is accredited pursuant to NYDSOH ELAP for the category of parameters analyzed. The analytical data package for all samples will be a NYSDEC ASP Category A Deliverable Package.
- An assessment of groundwater quality will be made to validate prior results. Groundwater samples will be collected from two temporary well points (TWPs) installed during the soil boring activities. The TWPs will be constructed of ¾" PVC and installed to a depth to produce sufficient water for the proposed sample collection, but no deeper than 50 feet bgs. Groundwater samples will be collected from the TWPs utilizing a peristaltic pump or dedicated Teflon sampling bailer. The groundwater samples will be analyzed for TCL+30, TAL Metals (total and dissolved) and cyanide. Upon completion of the sampling, the TWP will be removed and the borehole backfilled with drill cuttings and surface completion with concrete or asphalt as necessary.
- Matrix will collect up to two sub-slab soil gas samples from areas within the footprint of the proposed community space. The sub-slab soil gas samples will be collected from the discrete six-inch interval beneath the fill layer, in native soil, approximately 15 ft-bg, and each sample will be collected from Teflon-lined tubing inserted into a 1/2-inch diameter sample point created with a hammer drill through the asphalt. The annulus between the tubing and the temporary sample point will be sealed with non-volatile emitting and non-shrinking modeling clay. Prior to sampling, a leak test will be performed on the annular seal, utilizing a shroud, helium gas, and a gas detector, a shut-in test of the sampling train, and a minimum three volume purge on the soil gas probe and sample train. Sub-slab soil gas samples will be collected in laboratory supplied 6-liter stainless steel Summa canisters, fitted with laboratory calibrated flow controller set to achieve a flow of less than 0.2 liters per minute and a sampling duration of approximately 30 minutes.
- Following collection, samples will be labeled and properly packaged before delivery to the laboratory. Samples will be analyzed by the laboratory on a standard 2-week turnaround time for USEPA method

TO-15 for VOCs. Sampling will be completed in general accordance with the New York State Department of Health (NYSDOH) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York, NYSDEC DER-13/Strategy for Evaluating Soil Vapor Intrusion at Remedial Sites in New York, and United States Environmental Protection Agency's (USEPA) OSWER Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance).

- The results of the subsurface environmental investigation will be summarized in an environmental findings report and provided to the D-B Team. Matrix will meet with the D-B Team to discuss how the findings may impact design and construction in terms of soil handling and disposal requirements, remedial measures, and construction worker health and safety. The report will discuss the methodologies employed, sampling locations and results, and will identify contaminated/hazardous materials detected on-Site, if applicable. The report will also summarize the work accomplished, and will include (i) all laboratory data; (ii) site plans identifying the location of all samples obtained; (iii) summary tables identifying all analytical results; and (iv) a comparison of concentrations to applicable NYSDEC Soil Cleanup Objectives (SCOs) and USEPA Maximum Concentration of Contaminants for Toxicity Characteristic.
- Results of the investigation will be incorporated into a revised Remedial Action Plan (RAP), to be submitted as a draft to the D-B Team and NYCDDC and ultimately to the Mayor's Office of Environmental Coordination (MOEC) and NYCDEP. The revised RAP will address remedial measures to be implemented during construction, such as installation of a vapor barrier, sub-slab depressurization system (SSDS), importation of clean fill, etc. This proposal does not include preparation of an SSDS design, oversight during installation or operation and maintenance, if required. Matrix assumes one round of revisions to the draft RAP based on comments from NYCDDC and the D-B Team and one round of revisions based on NYCDEP comments. The RAP will include an updated Construction Health and Safety Plan (CHASP) as an attachment.

Utility mark-outs/ground penetrating radar (as required): As a supplement to the survey work, the D-B Team may opt to complete a Ground Penetrating Radar (GPR) study of the future parking garage/community space footprint, including the 30' buffer, to locate all existing utilities and below grade structures (including existing abandoned in-place foundation elements). The results of the GPR study will be mapped on to the survey document to create an accurate record of the site conditions.

Hydraulic Flow Tests: During the Site Validation phase, we will request hydraulic flow tests to determine street pressures so that the design of the plumbing and fire protection systems can be completed.

PERMITTING PLAN

The D-B Team will begin filing efforts in parallel with the Site Validation (Post NTP) to ensure construction activities can begin as soon as possible upon completion of Site Validation. This includes the development of the PDC submission as it will be critical to secure Preliminary Approval in Q1 2021 in order to confidently advance the approval process toward completion.

Our schedule includes the following DOB review and approval periods for two (2) of the more critical permits for the project.

- Excavation/Foundation: Two (2) Months from initial submission
- New Building: Five (5) Months from Initial Submission

A review and approval period longer than what is shown below will push the project beyond the 595 Calendar Day duration.

HRCG will also meet with NYCDOT to review sidewalk closing, Site Fence/Shed Permits, Curb Cuts and Lane Closure permitting. It is our intent to minimize the impact on the local community throughout the construction phase of the project. The preliminary site logistics plan reflects the closure of the existing parking lane along 126th Street, as well as the closure of the parking lane along 132nd Street (during precast & steel erection) to allow for the delivery of the precast, which will be rigged directly off of the flatbed truck and on to the building, due to the reduced lay down area on the site. Due to the variations in the existing and future elevations of the site grading, access into and out of the site will be limited to 126th Street.

Related to the Site Detention and Drainage system, the D-B Team will pursue the required submissions, calculations, and engineering support to submit to NYCDEP for the review and approval of the new site drainage system and any connections and/or impacts it will have on the City's Storm Water Management.

While the above permits are critical path items for ensure a timely mobilization, other permits throughout the project are equally critical to maintaining progress. Below is a robust, though not exhaustive list of permits required for the project:

- Site Fence (NYCDOB)
- Structural (NYCDOB)
- Mechanical (NYCDOB)
- Plumbing (NYCDOB)
- Underground Plumbing (NYCDOB)
- Sprinkler (NYCDOB)
- Temporary Standpipe (NYCDOB)
- Standpipe (NYCDOB)
- Fire Alarm (FDNY)
- Fire Alarm ARC (FDNY)
- Fire Protection Plan (FDNY)
- Fuel Storage (FDNY)
- Fuel Use (FDNY)
- After-Hour Variance (NYCDOB)

- Hydrant (NYCDEP)
- Dewatering/Discharge (NYCDEP)
- Emergency Generator (NYCDOB)
- Boiler (NYCDOB)
- Builders Paving Plan (NYCDOB)
- Curb Cut (NYCDOB)
- Light Pole Removal/Relocation (NYCDOT)
- Traffic Signal Removal/Relocation (NYCDOT)
- Bus Stop Removal/Relocation (NYCDOT)
- Phone Booth Relocation (NYCDOT)
- Tree Planting (NYCDPR)
- Work Permits (NYCDOB)
- Letters of Completion (NYCDOB/FDNY)
- Tax Lot Verification (DOB)
- Address Verification (TOPO) (BPO)
- Certificate of Occupancy (DOB)

CONSTRUCTION WASTE MANAGEMENT

The following document is a draft the Construction Waste Management Plan for the Queens Site Parking Garage. The Plan will be further developed based on any additional findings from the Site Validation period.

CONSTRUCTION WASTE MANAGEMENT PLAN
DDC QUEENS GARAGE AND COMMUNITY CENTER

1. Project Information

Project Name:	DDC Garage and Community Center	**Location:**	80-25 126 Street
Architect:	Urbahn	**Contractor:**	Hunter Roberts Construction Group
Contact:	Joshua Frankel	**CWM Contact:**	
Phone Number:	212-321-6800	**Phone Number:**	212-321-6800
Email Address:		**Email Address:**	

55 Water Street
51st Floor
New York, NY 10281

2. Waste Management Goals:

- This project will recycle or salvage for reuse 75% by weight of the waste generated on-site from the landfill by one, or a combination of the following activities:
  1. Salvage
  2. Reuse
  3. Source-Separated CDL Recycling
  4. Co-mingled CDL Recycling
- Waste reduction will be achieved through building design, and reuse and recycling efforts will be maintained throughout the construction process. As a Design Build Effort, Hunter Roberts will lead the charge in managing the design team to consider a design which results in minimum waste.

3. Communication & Education Plan:

- The General Contractor consultant will conduct an on-site pre-construction meeting with subcontractors. Attendance will be required for the subcontractor's key field personnel. The purpose of the meeting is to reinforce to subcontractor's key field employees the commitments made by their companies with regard to the project goals and requirements.

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- The General Contractor consultant will conduct an on-site pre-construction meeting with subcontractors. Attendance will be required for the subcontractor's key field personnel. The purpose of the meeting is to reinforce to subcontractor's key field employees the commitments made by their companies with regard to the project goals and requirements.

- Waste prevention and recycling activities will be discussed at the beginning of each weekly subcontractor coordination meeting to reinforce project goals and communicate progress to date.
- As each new subcontractor comes on site, the recycling coordinators will present him/her with a copy of the waste management plan.
- The subcontractor will be expected to make sure all their crews comply with the Waste Management Plan.
- Hunter Roberts is responsible for ensuring compliance by the subcontractors. Unnecessary waste shall be kept to a minimum.

4. Motivation Plan:

- The General Contractor will conduct a pre-award meeting for subcontractors'. Subcontractors under consideration will be required to attend the meeting to review project goals and requirements with the project consultant and team. Attendance will be a prerequisite for award of subcontracts. A sign-off will be required by subcontractors attending the meeting that the project goals are understood. This document will be an attachment to every subcontract. Copies of the attachment will be posted prominently at the jobsite.

5. Expected Project Waste, Disposal, and Handling:

The following chart identifies waste materials expected on this project, their disposal method, and handling procedures.

Materials	Quantity	Disposal Method	Handling Procedure
Land clearing debris	TBD	Keep separate for reuse and or wood sale.	Keep separated in designated areas on site.
Clean dimensional wood and palette wood	TBD	Keep separate for reuse by on-site construction or by site employees for either heating stoves or reuse in home projects.	Keep in designated areas on site. Place in "Clean Wood" container.
Plywood, OSB, particle board, Acoustical ceiling tiles	TBD	Reuse, landfill	Keep in designated areas on site. Place in "Trash" container.
Concrete	TBD	Recycle	
Concrete Masonry Units	TBD	Keep separate for re-use by on-site construction of by site employees	Keep in designated areas on site
	TBD		

Metals from banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, grass, and bronze.		Recycle	Keep separated in designated areas on-site.
Gypsum drywall (unpainted)	TBD	Subcontractor will recycle and submit reports to Consultant.	Keep in designated areas on site
Paint	TBD	Recycle	Keep separated in designated areas on site. Recycle through hazardous waste outlets
Insulation	TBD	Reuse, landfill	
Fluorescent lights and ballasts	TBD	Recycle	Keep in designated areas on site.
Flooring	TBD	Reuse, landfill	
Carpet and pad	TBD	Reuse or recycle with carpet manufacturer	
Glass/Plastic/Beverage/ Cardboard/Paper and news papers	TBD	Recycle	Keep in designated areas on site. Place in “Glass/Plastic bottles/Metal cans/Mixed Paper/ Cardboard” container

6. Removal of Construction Waste Materials

- Remove waste materials from project site on a regular basis. Do not allow waste to accumulate on-site.
- Transport waste materials off Owners property and legally dispose of them.
- Burning of waste is not permitted.
- Transfer plant are permitted to be used

7. Documentation Required

- Construction Waste Management Report
- Monthly Reports; Weight tickets and receipts
- Waste diverted to-date calculations
- Letter from Transfer plant stating the % of material that are recycle

8. Submittals

"LEED Consultant" will provide calculations and supporting documentation to demonstrate end of project salvage/recycling rates meeting the requirement of at least 75% diversion from landfill.

1. **"LEED Consultant"** will record and document the total weight (in tons) of all construction waste materials sent to the landfill.
2. The date the dumpsters/containers were removed from the jobsite
3. A total to date rate
4. copies of on-site logs, weight tickets and receipts. HRCG will save the original documents for the duration of the project

9. Summary- Expected C & D Waste and Diversion Rate

Total C & D Waste [x Tons] Total waste generated by construction
Total Recycled + [y Tons] Materials diverted from landfills, by salvage, reuse and recycling
Diversion Rate [y/x %] Percentage of project's waste diverted from landfills

Signed: _____

CONSTRUCTION TRAFFIC MONITORING
Hunter Roberts and its partners are responsible for the monitoring of Construction Traffic.

The goals of this program include but are not limited to the following:

- Local Traffic on adjacent routes shall not be unreasonably held up by construction activities.
- Ensure Public safety during deliveries, crane picks, and general construction traffic
- Ensure harmony between construction activities and public and pedestrian traffic

Hunter Roberts and its partners will achieve this with the following:

- All Subcontractors shall provide the DOT-required Traffic MPT plan and dedicated and qualified flags persons.
- All Crane Picks will strictly follow DOT Standards as such so that no pedestrians will be put in danger. All pedestrians shall be kept within a safe distance during such activities.
- Construction Traffic shall be coordinated so that Construction Vehicles are moved swiftly and efficiently through the jobsite. There shall be no excess traffic waiting to make deliveries on public roads.
- Lane Closure on 132nd street for delivery of precast structures will allow deliveries to be made within the jobsite, behind the site fence, and away from pedestrian and public traffic.
- Sidewalk shed located at the boundary between the surface parking lot and construction site will protect the pedestrian walkway between 132nd Street and 126th Street.
- Buffer zone of 30' between structure and site boundary with adjacent parking lot will be established.
- During steel erection for the Community Center structure, deliveries will be coordinated on 126th Street so that deliveries are made efficiently and safely to minimize the impact on the public.

CONSTRUCTION SITE SAFETY
Hunter Roberts' culture revolves around safety. Hunter Roberts empowers all employees at every level to take ownership and accountability when it comes to Construction Site Safety.

Safety starts with caring. "We Care" is not just at the end of our emails or on our website. It is the way we do business. We care how each person goes home to their family in the same condition they left their home in the morning. We care about the safety and well-being of our community members that interact with the project. We respect each other and work with our partners in such a manner.

On this project there will be a designated Site Safety Manager who is responsible to oversee and advise on critical safety conditions on the project, but safety doesn't start or stop there. Each person representing Hunter Roberts will have safety on the forefront of their mind. We start all of our meetings, from contract awards to on site pre-plans, with safety first.

Our safety requirements on the job will go above and beyond OSHA and NYC DOB. We will require 6' fall protection. This will be inclusive of all trades, even leading edge work by iron workers. If there is a risk of a fall greater than 6', we will require workers to be tied off in a proper and safe manner.

Within 30 days of Notice to Proceed, Hunter Roberts will submit a Site Safety Plan for NYCDDC review. This plan will include details on fall protection, leading edge protection, crane locations, and coordination with logistics plan, and it will continue developing to mitigate risks associated with the construction of the Garage and Community Center.

As both structures will be constructed independently, it will be critical to coordinate activities safely between each other. Overhead work will be coordinated such that no work is taking place on the top deck of the Community Center. This will include Garage façade work above the community center and structural work. There will be a dedicated set back when overhead work is ongoing.

Each subcontractor is required to submit their own health and safety plans; contractors are not authorized to be onsite until we receive and accept a project specific site safety plan. It will be required that a defined space from the leading edge be considered a Controlled Access Zone. Such Zones will require that no workers enter the area in which leading edge work will take place unless authorized and properly tied off. This will be required to be addressed in each subcontractor's project specific safety plans. Additionally, each subcontractor will be required to designate a competent person. This person is responsible for operating their crew in a safe manner. Crews will not be allowed to start work without a competent person onsite.

Our safety culture motivates us to pre-plan all high-risk activities. A Job Hazard Analysis involves a step by step description of the high-risk activity with risk analysis and mitigation techniques along the way. This will include PPE, engineering controls, and possible elimination of certain elements to reduce the risk of incident or injury.

As we strive to protect our communities, we will ensure that Construction Traffic is monitored and that our site fence and gates are operating in a safe manner. Regular inspections of the site fence will capture any deficiencies which require prompt remediation. We will install a clean and well-lit sidewalk shed for the community to safely traverse the surface parking lot at the boundary of our site.

The project site will operate under Extreme Clean requirements. This will require the project site to be well-lit and clean at all times. Slips and falls are one of the leading causes of incidents in this industry. A clean project is a

well-run project. Trades respect the workspace because you are showing their workspace respect. Properly stocked and cleaned bathrooms are essential to the well-being and morale of the workers.

Workers who fail to comply with the onsite safety requirements will be addressed in a respectful manner. Repeat or onerous offenders will be sent home, and in extreme circumstances banned from all Hunter Roberts projects. Hunter Roberts has a zero-tolerance policy for onsite alcohol and/or substance abuse. Any worker found under the influence of narcotics or alcohol will be permanently removed from all Hunter Roberts jobsites.

Hunter Roberts requires its subcontractors to include safety training for their personnel and provide all necessary PPE.

ENVIRONMENTAL COMPLIANCE

Previous environmental investigations by D-B Team member, Matrix New World, Inc (Matrix), and TRC Engineers, Inc. (TRC)—including soil, groundwater, and soil-gas sampling—were conducted at the Site as part of the prior Master Plan/ULURP project and more recently for NYCDDC under their Borough-Based Jails Project Management contract.

The results of the subsurface environmental investigation performed by TRC and summarized in the March 2020 Phase II Environmental Site Investigation (ESI) indicated the presence of historic fill to a depth of 25 ft-bgs. Historic fill was commonly used as backfill in the city to raise and level land, and these soils typically exhibit elevated concentrations of semi-volatile organic compounds (SVOCs) and metals, as well as occasional pesticides and other contaminants. Soil analytical results supported the field identification of historic fill, with detections of SVOCs, polychlorinated biphenyl compounds (PCBs), pesticides, and metals. The SVOC and metals detected in certain borings were higher than the limits provided for the General-Fill-Beneficial-Use requirements but were within the limits for Restricted-Use Fill or Limited-Use Fill as per NYSDEC's Fill Material Beneficial Use Requirements (NYCRR Part 360, Section 360.13(f), Table 2). Similarly, the detections of iron and chromium exceeding the NYSDEC Protection of Groundwater Soil Cleanup Objectives (PGWSCOs and Residential SCOs (RSCOs) were higher than the limits provided for the general fill beneficial use requirements but within the limits for Restricted-Use Fill or Limited-Use Fill.

Groundwater analytical results from temporary wells indicated regional groundwater contamination with low levels of VOCs, PCBs, SVOCs, pesticides, herbicides and metals detected in excess of the NY TOGS Class GA standards. Groundwater was encountered at depths ranging between 30 feet bgs to 47 feet bgs. Volatile organic compounds were detected in soil gas in excess of the NYSDOH soil vapor guidance levels.

Based on the results of the investigations and the proposed design of the parking lot and community space, remedial measures will need to be implemented during construction to ensure that soil handling and disposal is done in accordance with applicable regulations and in a manner that is protective of potential receptors. The D-B Team plans to excavate to approximately 15 feet below grade (ft-bg) in order to facilitate construction. Due to site constraints, the majority of excavated soil will require off-site disposal or re-use off-site in accordance with NYSDEC Solid Waste Regulations (NYCRR Part 360 et seq.). Additionally, mitigation is required to prevent exposure after construction of the facility is completed.

Recommendations for Remediation

TRC recommended remedial and environmental control measures in accordance with the Matrix-prepared and NYCDEP-approved Remedial Action Plan (RAP) (March 2019) for the Site. Matrix has proposed site validation sampling (in a separate proposal, dated July 2020) to confirm these findings.

The RAP was prepared based on the presumption that the Site would be utilized as a jail and soil analytical results were compared to the NYSDEC Part 375 Restricted Residential SCOs (RRSCOs). Based on the current proposed use, a portion of the site has a proposed use as a parking garage with a smaller portion to be used as a community space. The requirements of the RAP would remain the same for the community space portion of the site. However, they would be different for the parking garage portion of the site, as comparison of analytical results to the NYSDEC Commercial SCOs (CSCOs), less restrictive than the RRSCOs, are appropriate. There were no exceedances of the CSCOs, indicating that no remedial measures (capping, over-excavation, etc.) are required for soil left in place below the proposed parking garage.

After the site validation investigations are complete, Matrix will revise the RAP to address the appropriate remedial measures for the parking garage and community space portions of the site separately. The revised RAP would need to be resubmitted to the Mayor's Office of Environmental Coordination (MOEC) and NYCDEP for approval. The revised RAP will include an updated Construction Health and Safety Plan (CHASP) as an attachment.

As per the existing Phase II ESI and RAP, remedial actions should consist of the following site-wide:

- import of materials to be used for backfill must be in compliance with the RAP and in accordance with applicable laws,
- preparation of a Community Air Monitoring Plan (CAMP), with dust control during construction, and dust monitoring, as needed,
- transport and off-site disposal of soil/fill at permitted facilities in accordance with applicable laws/regulations,
- implementation of stormwater pollution prevention measures, and
- submission of a Remedial Closure Report (RCR).

Additional remedial actions for the community space include:

- construction and maintenance of an engineered composite cover, such as the building foundation. Where a vegetative or soil completed surface is proposed, a 1-foot minimum clean cap should be placed on top of the existing contaminated soil. A demarcation layer (orange snow fence or geotextile fabric) should be placed below any clean fill placed on top of contaminated soil remaining in place.
- installation of a vapor barrier beneath the building slab and foundation walls,
- installation of a sub-slab depressurization system (SSDS) beneath the building slab and foundation walls.

Matrix will prepare specifications governing environmental procedures; waste management; and excavation, handling and removal of contaminated soil to be followed by the construction contractor.

Recommendations for Soil Handling and Disposal
During construction, it is anticipated that excess soil will need to be exported from the Site for disposal. Matrix evaluated two avenues of disposal: at a licensed disposal facility, and as Restricted-Use Fill.

Soil may be disposed at a facility licensed to accept fill material. Based on the analytical data, soils would be considered non-hazardous contaminated material for disposal purposes. An accepting facility may require additional analytical data, depending on specific facility requirements and the volume of soils to be transported off-Site.

Based on comparison to the criteria (NYSDEC PGWSCOs and RSCOs) appropriate for Beneficial Reuse as per NYSDEC Part 360, the soil analytical results exceed the criteria for General Fill Material Use but are within the criteria for Restricted-Use Fill or Limited-Use Fill. Restricted-Use fill may be transported off-Site for use as fill for embankments, subgrade transportation corridors, or to sites where in-situ materials are confirmed to exceed Restricted-Use Fill or Limited-Use Fill criteria, as described in NYCRR Part 360, Section 360.13(f), Table 2. Soil analytical results would be required at the proposed destination site to determine in-situ characteristics and to verify if Restricted-Use Fill would be acceptable. Additional sampling of the on-Site soil would also likely be required to meet sample frequency requirements of Part 360.13, which would be based on ultimate design and include composite sampling of pre-determined soil excavation quantities.

Recommendation for Additional Soil and Groundwater Testing
As part of construction activities, Matrix recommends additional soil and groundwater sampling as required for disposal. Soil samples should be collected to meet requirements of the ultimate disposal facility and, if transporting as Restricted-Use Fill, meet sampling requirements of Part 360.13.

It is unlikely that dewatering will be needed during construction based on the groundwater depth of 30 to 47 ft-bgs and a proposed maximum excavation depth of 15 ft-bgs. If dewatering is required during construction, treatment requirements for dewatering fluids should be evaluated prior to beginning construction activities to obtain NYCDEP and NYSDEC discharge permits. Additionally, a NYSDEC Long Island Well Permit for the pumping of greater than 45 gallons per minute of groundwater during dewatering may be required. Prior to performance of dewatering, off-Site contamination should be further defined to confirm that dewatering will not draw off-Site contaminants toward the Site.

MANAGEMENT APPROACH EXECUTIVE SUMMARY

We have assembled an integrated team of highly experienced professionals. The D-B Team will be led by Joshua Frankel (Design-Build Project Manager / Design-Build Construction Project Manager) with executive level leadership provided by Sean O'Connor, PE, AICP (Project Executive) who worked on the design-build project for the New York Yankees Parking Facilities Program.

Josh will be supported by Ijeoma Iheanacho, LEED AP in the Design Integrator role. Ms. Iheanacho will serve as a critical interface between design and construction. The design team will be led by Donn Henry, AIA (Designer of Record). Mr. Henry has been working closely with the NYCDDC for nearly 30 years and has successfully completed numerous projects including the recently completed Crossroads Juvenile Center Redevelopment. Additional members of the team include Guido Hartray, AIA (Design Architect) and Stephen Szycher, PE as the Engineer of Record for the parking structure.

Graphic representation of the Management Structure is included in the 'Technical Executive Summary Tables and Charts' section.

PRELIMINARY PROJECT MANAGEMENT AND EXECUTION PLAN

Our team [see Part 1 – Tables and Charts] is committed to the NYC BBJ Program and mission. Each of the core team members firmly believes in the absolute necessity to close Rikers Island and develop four civic buildings that vastly enhance our City's jails and their surroundings. We share a desire to achieve this mission and it is integral to our team structure and management approach. We recognize that successful completion of the enabling projects – especially the Queens Site Parking Garage and Community Space – will engender the overall success of the Program and signal to the City the quality of work that can be achieved with design-build procurement.

For us, success depends on combining the "right" team with a thoughtfully managed process that will achieve all project goals within the defined budget. The key tenets of our approach include:

- Transparent communication
- Continuous engagement of senior leadership
- Streamlined communication between key team members
- Rigorous project planning
- Robust quality assurance
- Effective risk management and project tools
- Maximized M/WBE participation and workforce diversity

DESIGN AND CONSTRUCTION MANAGEMENT

We believe the key to successful project delivery is clear, transparent, and frequent communication. Key members of our team, including the Design-Build Project Manager/ Design-Build Construction Project Manager, the Design Integrator, the Design Architect, the project's lead engineer and integrated support staff (design and construction) will work from the 'Big Room'. In the best-case scenario, we want to co-locate the D-B team's key personnel with NYCDDC management to facilitate communications, but due to the limitations on in-person meetings as a result of COVID-19 this may not be a viable option. From our experience in collaborating with our design partners in this time, we have zeroed in on how to streamline our communications and are utilizing all available resources such as shared folders and regular virtual meetings to ensure continued coordination within the team. We know that we can still foster a culture of comradery that will enable the team to develop creative solutions to design, budget, and schedule challenges.

The straightforward contract structure will provide a clear line of responsibility and enable our integrated approach to leverage our cumulative expertise. Core team members fill roles at many levels of the organizational chart. We believe this strategy will promote communication across disciplines to allow the best ideas to percolate into the design and construction of the project. For instance, Lilly Chen, RA (Quality Manager: Design/UA) will report directly to our Project Executive, Sean O'Connor and D-B Project Manager, Joshua Frankel. We believe this will give Lilly the platform to deploy a formidable QA program and work directly with the Project leadership to identify issues early and contribute to solutions. Joshua Frankel, AIA, will mirror Lilly's role as the Quality Manager for Construction.

Our Project Management and Execution Plan is represented throughout this proposal as outlined in various sections.

For any complex project, but particularly for a schedule-driven design-build effort like the parking garage, a robust planning process is the critical component of the approach. We have developed a detailed workplan, as shown in our project schedule [see Part 3 – Project Schedule], that integrates design work, client reviews, estimating, community engagement, permitting, bidding, construction, and close-out activities. Our key team members, with support as needed, work from the Big Room to facilitate open communication with the NYCDDC, the PMC, and their consultants. Communication with the client agency will be as prescribed by the RFP or as directed by NYCDDC/PMC during implementation. The work plan is a dynamic document and serves as a critical guide to the D-B Team and the NYCDDC. As a complement to the workplan, commencing at the outset of the design phases, the D-B team will issue bi-weekly look-ahead schedules that identify upcoming key milestones, meetings, and a prioritized list of objectives to complete. We firmly believe that the most effective means to mitigate risk during the design and construction phase is rigorous planning, detailed communication, and a commitment from the whole team to adhere to the project planning process.

Additionally, this project requires a commitment from all stakeholders to adhere to the quality standards set forth at the beginning of the project. Our site management team along with NYCDDC and the rest of the D-B Team will establish this plan during the pre-construction phase and continually implement it throughout the construction phase.

Our project Quality Management Plan [see Part 4 - Quality Management Plan] will include:

- Database project control system – including RFI's, field directives, and meeting minutes
- Pre-work review meetings
- Weekly owner and trade coordination meetings
- Action item logs and deficiency lists
- Material and equipment approvals, tracking logs, and on-site performance verification (SAT)

- Contractor staff quality awareness training
- Executive construction reviews
- Contractor and equipment vendor installation coordination
- Daily field inspection reports with deficiency remediation sign-off
- Mock-ups for approval and establishment of quality
- Independent inspection agency reports and sign-off

All aspects of the construction process will be reviewed for quality. From subcontractor selection via our pre-qualification process to shop drawing and submittal review, our field staff will verify that all materials delivered to the site meet the project specifications and the approved submittals. In addition, our team will mandate that all materials are stored at the conditions recommended by the manufacturer.

Another critical aspect of our field Quality Control plan is the installation verification of materials and systems. This verification includes testing and inspection services for soil compaction, concrete strength testing, and pile driving. Our staff will also verify surveying data such as elevations, benchmarks, and wall layout with an independent firm to ensure the accuracy of the initial installation.

SUBCONTRACTOR ENGAGEMENT

We recognize that the City's decision to use design-build procurement is necessitated, in large part, by the demands of the schedule. The Queens Site Parking Garage and Community Center must be substantially complete 595 days following the Notice to Proceed. We also believe that it cannot simply be a utilitarian parking garage. It will be the first project completed under the program and must demonstrate that excellent design and design-build procurement are not mutually exclusive.

To meet the demands of the schedule and the design objectives while delivering best value to the City our team will carefully calibrate the timing for engaging key subcontractors. Our belief is that we can obtain best value for the City by enabling a competitive bidding process for the parking garage superstructure. The objective is to use the money saved through a competitive superstructure bid to enhance other components of the project, including public spaces and building enclosure.

During the RFP development, we have leveraged the extensive experience of TT to develop a superstructure system and details that allowed several qualified subcontractors to bid the superstructure work. TT is frequently retained directly by superstructure (structural steel and precast concrete) subcontractors to develop system details. This experience enabled our team to develop an 'open' design so that we could maintain a highly competitive process during the RFP phase. In addition, HRCG used our pre-construction estimating and purchasing group to accurately estimate the cost of the work. To be sure, we value the early input of Subcontractors and we relied on it to develop our Lump Sum cost proposal.

Although we will did not tie ourselves to a single subcontractor, we worked closely with industry leaders, like Unistress, to develop our precast garage design. We also engaged with subcontractors in other key trades including excavation/foundation, structural steel, metal panels, glass/glazing and electrical (including the PV system). If selected, we will continue these critical relationships to ensure the efficiency of the design development, cost control and initiating early work.

For a description on how the scope will be divided into packages, please refer to the Shop Drawings section [see Part 4 - Shop Drawings].

For details and further information on the Hunter Roberts approach to the following project areas, please see our links and references below:

- MEP Coordination – see Part 4 - Phasing Plan
- Schedule of Submittals – see Part 4 - Schedule of Submittals
- Scope of Work Implementation – see Part 2 - Operational Function, Efficiency, and Quality
- Construction Management Tools for Materials Management, Labor & Equipment Resource Management, Subcontractor Management, Change Management – see Part 4 - Quality Management Plan
- Coordination & Reporting – see Part 4 - NYCDDC Coordination and Communications
- Safety Management – see Part 4 - Construction Site Safety
- Internal Governance – see Part 1 – Tables and Charts
- Design & Construction Integration – see Part 1 - DBIA Best Practices
- LEED Certification – see Part 1 - LEED Gold Certification for LEED BD+C

NYCDDC COORDINATION AND COMMUNICATIONS

NYCDDC AND DESIGN-BUILDER COORDINATION AND COMMUNICATIONS

At the core of Design-Build delivery success is communication and protocol. The Queens Garage and Community Space project will benefit from a collaborative attitude by NYCDDC and the Design-Builder. Along with a solid foundation in logical and efficient coordination / communication processes, this first BBJ Program Early Works projects will be successful for the City and the D-B Team, and can help set best practices and standards for the entire NYC BBJ Design-Build Program. Hunter Roberts and the entire D-B Team recognizes that facilitation of NYCDDC's responsibility to provide oversight and inspection of the project delivery at all stages is essential for project success.

The NYCDDC standards set forth for the D-B Team in the Standard Project Requirements (ITP Volume 2), establish key communication, record keeping and document management essentials required for this Design-Build delivery. **As soon as possible after award, the D-B Team project management staff will meet with appropriate NYCDDC staff to agree on communications protocols and formats for all information exchange points between the Design-Builder and NYCDDC including:**

- Distribution
- Routing and CC's
- Approval Steps
- Authorized personnel for approvals
- Electronic filing standards

The NYCDDC needs to have ready access to all reporting, tracking, status, and project documentation. To ensure that ready access, the Design-Builder must:

- Establish direct communication lines between those D-B Team members focused on Document Management and Record Keeping;
- Understand and establish which of our counterparts at NYCDDC are focused on which documents/reports/ logs and develop all distribution and approval lists for required staff;
- Familiarize NYCDDC with each of the sample tools / documents / reports as prepared by the D-B Team;
- "Test-Run" distribution, receipt, and the ability to review and manipulate as required, all key documents/tools within the PMIS or other sharing platforms as agreed for certain documents.
- Once each tool is up and running and is readily accessible, the Design-Build Document Manager will be our key point of contact for all ongoing management of the continued information flow. In addition to addressing questions, making requested improvements throughout the course of the project, they will also be responsible for updating any changes to the distribution and approval lists as may arise to ensure that delays do not occur due to information not reaching the responsible party/individual.

The rapidly changing pace of project tracking and reporting technology coupled with recent social distancing and protective health requirements requires new projects such as this one to innovate how information (including complicated technical documents, drawings, and on-site conditions) can be shared, discussed, and clearly interpreted and reviewed. Hunter Roberts has embraced the use of video conferencing (particularly the powerful tools available in MS Teams and BlueBeam 360) not only as a substitute for in-person meetings, but as a tool for sharing field information with design team members, inspectors, and owners. In many cases, we are finding that high-quality images and live video can be presented and streamed among all key parties often resulting in greater efficiency in problem solving in the field.

Further, Hunter Roberts believes Project Closeout starts with the project kick-off meeting. Thus it is important to establish closeout documentation requirements and filing standards at the start of the Queens Garage and Community Space project to ensure that as documents are completed and filed that they are done so in a manner that makes their inclusion in Closeout documentation as seamless as possible.

For NYCDDC personnel to be able to effectively work with and provide oversight of the Design-Builder's submittal and owner approval processes, the D-B Team must:

- Establish clear lines of communication including decision making authority and signature authority for various submittal types/classes;
- Ensure a clear division between submittals that require NYCDDC input/review/approval/comment and those that are "internal" to the D-B Team and our processes, so that we are not burdening NYCDDC with items that are not in the critical flow for their oversight;
- Use the submittal process and format to clearly demonstrate to NYCDDC the current prioritization of "in-process" submittal items based upon their actual role in overall project schedule adherence;
- Provide NYCDDC with regular "look-ahead" guidance on forthcoming key submittal items that will need approval/ review to ensure continued schedule compliance;
- Note: We suggest that the RFI process similarly follow the

above guidelines, as those RFI's that involve NYCDDC or Key Stakeholder input are every bit as critical to project schedule management as is the submittal process.

There will be potential/likely areas of overlap or adjacencies between the Design-Builder's area of work with NYCDDC and its contractors, including possible adjacent road and utility work, as well as future work at the jail site (demolition and new facility construction). As noted these will be both technical and physical interfaces.

TECHNICAL INTERFACE

To ensure that NYCDDC is well-positioned to provide oversight of the areas of technical interface between the Queens Garage and Community Space and adjacent NYCDDC projects, the following process elements are important:

- Design-Builder must proactively engage NYCDDC, its design consultants, and contractors in project interface planning meetings
- NYCDDC is to be responsible to keep the Design-Builder informed of such upcoming activity
- Design-Builder is responsible to communicate all Queens Garage and Community Space project activities, schedule constraints, logistics/phasing/access considerations with NYCDDC
- Design-Builder must then review all potential impacts upon delivery of our work from the adjacent NYCDDC projects
- Design-Builder must recommend solutions to diminish or eliminate negative cost or schedule effects of coordination with those projects
- NYCDDC must ensure that selected recommended solutions are adhered to by its contractors on the interfacing projects

Further, establishing a working communication team between the Design-Builder and NYCDDC, its design consultants, and contractors with NYCDDC's guidance on establishing mutual goals is critical to the success of such technical interface for all work with this Queens civic campus.

PHYSICAL INTERFACE

We must follow up the successful technical interface process outlined above with planning for and enacting on-site coordination (physical interface) between the Queens Garage and Community Space project and adjacent NYCDDC work.

There are several process elements to which the Design-Builder and NYCDDC must adhere if smooth on-site coordination is to occur and so that NYCDDC has the ability to manage inspection and oversight on all projects at and adjacent to the Queens civic campus, including:

- Creation of a master summary schedule combining the overlapping schedule detail of each of the subject projects;
- On-site coordination meetings between NYCDDC, its contractors, Stakeholders (utilities, agencies) and the Design-Builder regarding the master schedule;
- Creation of overlapped 4 or 6 week look-ahead schedules combining the key interfacing activities of each project;
- Coordination of additional insureds coverage for areas of physical overlap;
- Establishing access agreements where needed;
- Preparing and sharing "pre-plans" for all critical and interfacing construction activities;
- Establishing call and notification lists for all pre-planned activities;
- Coordination of any and all shutdowns and service interruptions, including development of Methods of Procedures (MOPS) for all such activities.

The foremost is concern for the D-B Team during the construction phase of the project is safety. This includes the safety of all NYCDDC personnel, Key Stakeholders, authorities having jurisdiction (AHJ's), visitors, and the public.

To ensure and prepare for the safety of NYCDDC personnel when on-site providing inspection or oversight of the Work and participating in other project activities (meetings, walk-throughs, AHJ inspections, etc.) the Design-Builder must first become familiar with understand those activities for which NYCDDC personnel will likely be on-site.

There may be activities/meetings/inspections where on-site NYCDDC personnel presence is regularly scheduled and/or anticipated by the Design-Builder. There will be other on-site activities that NYCDDC may not be able to regularly predict when such visits may take place. It is important that we, the Design-Builder, set up protocols for our staff, safety professionals, and trade contractors to follow whenever any NYCDDC personnel arrive on-site, including:

- Predetermined entry/meeting locations;
- Sign-in and log-keeping processes
- Possible health attestations related to COVID-19 and as per NYC/NYS requirements
- Documentation of appropriate training certifications for access to the site
- PPE distribution and checks
- Possible on-site safety orientations as may be required by local regulations and/or specific to certain current on-site activities

Hunter Roberts reserves the right to restrict site access to individuals who are not compliant, and/or do not agree to comply with, our site safety protocols, including representative of NYCDDC. We believe that you will agree that a mutual commitment to adhere to agreed upon safety protocols is essential and in the best interest of the Design-Builder and NYCDDC.

As the owner of the property, the City/NYCDDC will be involved at all stages of both "planned" and "unplanned" environmental remedial actions. For those environmental actions that are anticipated, planned, and scheduled

integrally to the construction activities on site, NYCDDC will of course receive notifications and updates through the notification systems of the subject environmental AHJ's, as well as through regular project meetings, short-term look-ahead schedules, required log submissions and updates, as well as through monthly reporting.

Response protocols for environmental incidents are well defined by NYC, NYS and the various AHJ's providing regulatory control. Should there be any "unanticipated" environmental incident or any incident occurring during planned environmental work tasks, separate protocols from those used to manage "planned" environmental work need to be in place to ensure that NYCDDC will receive immediate/timely notification and ongoing updates related to the incident and subsequent remedial action(s). On the Queens Garage and Community Space site there are a variety of scenarios in which environmental incident could unfold, including:

- Unanticipated tank discovery(s);
- Spills;
- Unidentified or unanticipated soil, groundwater, or air contaminants;
- Occurrences related to improper storage of materials, products, gases, fuels, etc.
- Noise pollution causing public nuisance;
- Unidentified odors causing problems for on-site personnel, or public nuisance;
- Dust control issues causing problems for adjacent properties, and/or public nuisance;

As the Design-Builder, Hunter Roberts would also tie NYCDDC directly into our in-house safety incident reporting system, which strives to provide all key individuals and parties with incident notification in under 60 minutes, regardless of time-of-day or day-of-week. Including NYCDDC in our existing notification and update system can ensure that NYCDDC is aware of, and updated on, environmental incidents in as close to real-time as possible.

KEY STAKEHOLDER COORDINATION PLAN

Our D-B Team recognizes the importance of establishing a Key Stakeholder Coordination Plan. NYC is one of the most complex stakeholder environments within which navigate for large project development, even when the owner is the City itself. **As both NYCDDC and D-B Team Key Personnel share decades of experience with management and facilitation of stakeholder satisfaction and approval on major NYC projects, we jointly understand that "Active Coordination" with key stakeholders and authorities having jurisdiction (AHJ's) is among the most essential efforts required for successful project delivery.**

Particularly in the case of large public projects led by agencies such as NYCDDC, we find that it is critical for the NYCDDC Key Personnel and leadership to help establish and set the tone with all Key Stakeholders, other AHJ's, and designer and contractor leadership from Adjacent Works Component Projects. If a "shared sense of commitment to these vital public assets" can be fostered among all of the above stakeholders, as well as a deep recognition of the priority position that the BBJ Program holds within the City over the coming years, then stakeholder coordination can begin from a position of strength.

There are particular benefits of a well-developed and vigorously implemented stakeholder plan, including:

- Keeping strong, succinct lines of communication going throughout delivery;
- Being prepared and steps ahead in planning on how and when to communicate to your important stakeholders allows the team to anticipate needs of stakeholders and address them before they become issues.
- The plan (or some summary/modified version of it) can be shared among Key Stakeholders can encourage ownership and accountability.
- The plan can be adapted/modified/updated to account for new stakeholders, shifting priorities, previously unanticipated project hurdles, subsequent project phases, etc.
- The plan should be a living document that evolves throughout the project phases, not a static deliverable that sits in a folder on the PMIS or other shared project files server.

Our **Key Stakeholder Coordination Plan** will incorporate four processes:

- Identify Stakeholders
- Develop Plan Matrix
- Integrate Stakeholder Factors Into Project Schedule Tools
- Manage Stakeholder Engagement

Identify Stakeholders

Exhibit J of the RFP has identified Key Stakeholders (not repeated here for brevity). In addition, Reference also made to other BBJ contractors involved with Adjacent Works Component Projects such as the Queens Dismantle and Swing Space and the eventual construction of the Queens Detention Facility, as well as a possible operator "engaged by DOT will operate the Queens Site Parking Garage upon completion thereof".

Additional Key Stakeholders not specifically identified in Exhibit J may include AHJ's such as major utilities (ConEd, Verizon) as well as FDNY. Finally, to the extent that NYCDDC's program management advisor for BBJ (Aecom/Hill) may be engaged in the delivery of this project, they would be a Key Stakeholder. **To ensure that all Key Stakeholders having jurisdiction have been identified, the D-B Team will seek to meet with NYCDDC to review the project permitting/approval matrix and strategy.** Another important input to identification is review of all applicable existing agreements impacting the site, including easements, ROWs, etc.

Develop the Key Stakeholder Coordination Plan Matrix
The plan matrix allows the Project Team to find all essential Key Stakeholder information in one place. The matrix will provide the following information in appropriate data fields for all Key Stakeholders previously identified:

- Identification of Key Stakeholder organization/agency/firm/utility name, address, contact information for key decision makers;
- Description of the purpose/mission of Key Stakeholder, which project elements and phases over which they hold influence;
- Identification of each and every review, approval, critical decision, sign-off, permit issuance, public meeting, or other requirement/item that the subject Key Stakeholder is responsible for providing/authorizing;
- Delineation of each of the critical steps for each of the above requirements/items, typical durations, and their order of precedence as well as linkages to other matrix items (within or outside of the subject Key Stakeholder's control);
- Provision of metrics (low, medium, high) of the level of "influence/risk" that each requirement/item has upon project momentum and schedule adherence;
- Information about best practices for management of each Key Stakeholder for each requirement/item over which they hold jurisdiction (NYCDDC input here is critical since such knowledge/advice is present within Key NYCDDC Personnel);
- Tracking datafields to record actions/responses under each requirement/item.
- The matrix will regularly be updated to reflect the progression of the project through all phases and approvals.

Integrate Stakeholder Factors (Review/Permits/Decisions/Approvals) into Project Schedule Tools
As called out in the RFP all of the project's schedule tracking tools, beginning with the detailed master schedule, MUST reflect the milestones/durations associated with the critical meetings, review, approval, critical decision, sign-off, permit issuance, public meetings, or other requirements/items that the subject Key Stakeholder is responsible for providing/authorizing.

During this stage, the information contained in the Key Stakeholder Coordination Plan Matrix shall be transferred to and incorporated into the appropriate schedule tools. The schedule tools must then be updated regularly to in coordination with changes in the matrix information.

Manage Stakeholder Engagement
Key Stakeholder interactions are executed according to the Key Stakeholder Coordination Plan, and depending upon the relative success with each Key Stakeholder and each requirement/item for which they have jurisdiction, changes to the plan and approach are made as necessary.

The issues and challenges that arise in the process of coordination of Key Stakeholders' jurisdictions are related to other components of the overall Project Management Plan. The Key Stakeholder Coordination Plan is an essential part of the Project Management Plan and shares elements with the NYCDDC and Design-Builder Coordination and Communication plan outlined above. Many of the requirements/items tracked in the stakeholder plan which rate "high" on the "influence/risk" also feed directly into the Risk Management Plan and Risk Register discussed later in the proposal.

Ultimately and regardless of the fact that the Key Stakeholders are identified as agencies, organizations, firms, utilities, etc., the engagement aspect of stakeholder management will be between professionals as individuals. As with many things in the design and construction industry, success is often in part proportional to the "softer skills" of the trained technical professionals who are engaging. Thus, successful management of Key Stakeholder engagement is directly related to the following capabilities of the Key Personnel of both the Design-Builder and NYCDDC:

- Communication skills;
- Ability to run and lead efficient and focused meetings;
- Ability to process feedback and adjust approach;
- Interpersonal and team management skills;
- Negotiation experience and expertise;
- Conflict management

If success of the Key Stakeholder Coordination Plan is at least in part related to the communication and leadership abilities of the key participants, then the working partnership established between the Design-Builder and DDC is critical. As we engage with Key Stakeholders, we will need to do so together, unified in our goals.

QUALITY MANAGEMENT PLAN

Hunter Roberts Construction Group aims to **Earn Partner Satisfaction Every Day.** Our team works diligently to provide the highest quality services at every step and to noticeably differentiate ourselves from our competitors. Our QA/QC program outlines the path for our Operations Teams to follow in order to meet and exceed this standard.

The objective of the Quality Management Plan is to:

- Understand all Partners' priorities as they relate to quality.
- Understand the technical aspects needed to achieve that quality – what do the specifications require?
- Establish a responsibility matrix for tracking the path to quality implementation.
- Create a methodology for measuring and evaluating daily progress.
- Identify recording methods to document daily progress (e.g. photos, daily reports, etc.)
- Identify means to plan and schedule necessary testing. This includes identifying responsibilities to ensure that all required organizations are present and have been given the appropriate notice.
- Identify means to record deficiencies, to notify responsible contractors of the same, and to repair as required.
- Deliver the QA/QC program in accordance with plans and specifications.

This program addresses operations only. It must also be noted that this QA/QC plan does not address the specific requirements that may play into Environmental Controls. Any monitoring, inspections, or management of a Health and Safety Plan (HASP) pending approval of a Remedial Action Workplan (RAW) shall be accommodated in a project specific protocol which should be developed by the Project Team.

The overall intent is to create a proactive plan that promotes a "do it right the first time" mentality, and not a reactive "get it done, fix it later" approach.

PROJECT SUBMITTAL REQUIREMENTS
The Submittal Log is often an underused document; however, it is one of the most important tools a Project Manager or Assistant Project Manager can use in order to accomplish the following critical tasks:

- Initiate the coordination process
- Identify long lead items and plan for R.O.J. dates
- Identify critical approvals that will impact schedule
- Understand and track scope items on the job

The challenges to perform work and remain productive are apparent every day. If the material is not available because we were not as diligent as possible to ensure that it is onsite when necessary, then we have limited our capability to be efficient.

Inspection and Testing Log
To be created and managed by the Superintendent(s) responsible for the individual trades requiring inspections and/or testing. This log will assist in the following:

- Identify the steps and dates preceding the Inspections/ Testing
- Use as a distribution document for the Owner, Designers and other consultants, and HRCG team members to communicate effectively
- Use with third party consultants to manage and track their involvement as the Inspector
- Convey our understanding of the Inspection/Testing requirements, so that our other Partners can confirm its accuracy.

The final inspections and testing log shall be submitted to the Owner and Design Team for closeout documentation as proof of inspections and/or testing having taken place.

Warranties and Guarantees
Results from review of plans and specifications.

TEAM ORGANIZATION AND RESPONSIBILITIES
HRCG strongly believes in the power of working as a team and leveraging the skills of each team member to seamlessly implementing a QA/QC plan. From the onset, each construction team members will be ascribed clear responsibilities and take ownership of doing their part to ensure that the job is completed at the highest quality. They will be expected to communicate to the Project Executive and Client as concerns arise and to be proactive in mitigating issues that arise and following through to ensure that those that can't be mitigated are remedied swiftly.

The Project Managers are charged with the overall responsibility of the Quality Assurance and Control Program. They will have the authority to delegate individual responsibilities and assign duties to the person or organization that will function on behalf of the Quality Assurance and Control Program. These responsibilities include:

- Implementing & documenting quality control procedures.
- Monitoring the program to confirm that testing and inspections are performed, and quality control documents prepared and submitted in a timely manner.

- Visually inspecting critical details in the project to ensure that the QC guidelines are being followed. The Quality Assurance Review form should be used to document spot checks and track non-conformance issues.
- Supervising and reviewing the maintenance of quality control records and files
- Tracking uncorrected or non-conforming items and implementing a follow-up procedure to ensure that corrective action is taken on all issues noted
- Maintaining direct communication with the Project Team to advise on the status of approved work, specification infractions, and corrective measures
- Setting pre-planning meetings with subcontractors to review the document requirements and quality expectations
- Managing the Material Procurement and Manufacturing process. From Award to Submittal, through fabrication and testing (If Required) to delivery to the jobsite.

The Project Manager will delegate responsibilities for all field-based Quality Control activities specified by Owner and/or Architect to the Project Superintendent. Their responsibilities include:

- Providing a direct line of communication between all project personnel, contractors, material suppliers, vendors, services, and regulatory agencies to provide quality control direction and status
- Administrating and maintaining the Quality Control Program. Inherent to this is the authority to recommend acceptance or rejection of any work, materials, or equipment associated with the project.
- Checking, auditing, inspecting or otherwise verifying that construction activities and materials used are in accordance with approved drawings, samples and all contractual requirements.
- Managing any discrepancies uncovered by the Owner or A/E and brought to the attention of the Superintendent; they will deal directly with contractors, material suppliers, or vendors.
- Inspecting and approving of any/all installations
- Delegating specific trade responsibilities to the Area Superintendents in their charge, who will assist the Superintendent for all Quality Control and inspection activities in their particular area.

The Assistant Project Manager/Project Engineer will be responsible for assisting the Project Manager/ Superintendent/Area Superintendent in Quality Control Activities.

DAILY EXECUTION AND FIELD INSPECTIONS

A QA/QC plan must be regularly monitored in order to minimize items from slipping through the cracks and being overlooked. The team will conduct daily field inspections and make note of items that need to be addressed along with plan on how they will be addressed.

Projects will utilize a 3-point plan for field inspections:

- Pre-Work Meeting: Prior to any Subcontractor commencing work, a coordination meeting will be held. This shall include the PM, Supt. And any applicable Assist. Superintendents. The agenda will address safety, contract, submittals, quality control, training, testing and coordination. Meeting minutes from this meeting will be forwarded to all HR team members, as well as the subcontractor's project contacts, and a copy of the meeting minutes will be filed in the subcontract correspondence file.
- Follow up Field Inspections: These will be conducted and followed up pending daily field reviews by HRCG team.
- Completion Inspections: Design Consultants will be notified of completed areas by the Supt. Any deficiencies will be noted on the Deficiency Log for corrective action. HRCG will conduct our own/in-house field inspections and complete discovered items prior to scheduling Design Consultant inspections.

Projects will conduct material acceptance inspections at delivery. All materials and equipment entering site shall be visually checked for:

- Identification
- Compliance to approved submissions
- Damage
- Completeness
- Documentation

Project Teams are required to:

- Verify that latest approved drawings and specifications are being used and are correct.
- Verify that competent supervision and craft labor are assigned to the activity. Without adequate skilled craftsmen, proper performances are almost impossible for Building Components.
- Verify that personnel performing special processes are qualified.
- Verify that environmental conditions are conducive to quality work (i.e. temperature control, humidity control, cleanliness, etc.).
- Verify that all necessary sample installations have been completed, reviewed and approved.
- Verify that the field representative of material manufacturers and various product institutes has provided necessary instructions to the Contractor's personnel.
- Verify that all proposed substitutions have been properly approved.
- The Staff Team will inspect construction activities daily.
- The Superintendent and support staff will issue Daily Reports of their activities noting areas or items of work inspected, and their location and will indicate if such work conforms to Contract Documents.
- No construction work will be allowed to continue if there is a deviation from Contract Documents.

- If warranted, the Superintendent will initiate action to suspend operations until corrective action is initiated by the responsible party.
- All deviations will be recorded by the Superintendent in the Daily Report and further recorded by memo to the Project Manager.
- Corrections and changes to work that cannot be made to conform to drawings and specifications will not proceed without the written approval of Architect, Hunter Roberts Construction Group and/or the Owner. The Owner's approval could be subject to the requirements of approval of government agencies as might be described in other documents.
- In the case of partial or complete removal of deficient work, the Superintendents will inspect the site of removal regularly to assure complete removal and will not allow replacement work to proceed until the Architect and Owner have an opportunity to inspect the site. This will be noted by the Superintendent in the Daily Report.
- Necessary deviations to make work conform to Contract Documents will be approved by the Architect and/or owner prior to incorporation into the Work. The Owner's approval could be subject to the requirements of government agencies as might be described in other documents.
- Inspection for code requirements by governing agencies will be included and made a part of these requirements.
- Time is an essential element of quality performance. When sufficient time is not provided a workman to accomplish a task, quality will not be possible. On the other hand, too much time should not be allowed since the task often will expand to suit the time given with no change in resultant quality. The planning of adequate time and personnel is a manageable activity.
- Ensure that the working environment allows for quality installations (ie. Clean, temperature control, humidity, etc.)

ENVIRONMENTAL CONTROL:

It is HRCG's responsibility to ensure that the work environment is continuing in concert to meet OSHA requirements. It may be necessary to contract with a 3rd party consultant or to interact with the Owner's Consultant regarding air monitoring and related inspections.

It is understood that Environmental Control needs will be subject to both OSHA as well as the Owner's specific requirements. This must be identified when establishing the specific QA/QC plans. The objectives will be to:

- Abate contaminants in soil, groundwater and air in accordance with the recommendations put forth in the remedial.
- Monitor and minimize waste, recover materials and handle contaminated materials in compliance with the environmentally conscious design and regulatory requirements,
- Delineate contaminated soils and dispose of off-site based on the site-specific conditions.

These objectives will be achieved within the project specific QA/QC requirements. More specifically, these will include sampling and analyses, geo-technical investigations and testing, working with the inspector for necessary paperwork and sign-offs and monitoring of appropriate shipping and disposal manifests.

SHIPPING AND UNLOADING

- All materials and equipment will be packed, protected and preserved in such a manner that no deleterious effect will result. Supports, bracing, and lifting appurtenances will be strong enough to withstand the most vigorous of shipping and handling.
- Unloading at the site will be accomplished using only the proper equipment of the correct size and standard practice with due regard to material and personnel safety.
- All materials will be inspected before unloading and after unloading. Damage will be immediately noted and reported to the Superintendent.
- Special shipping, unloading and storage instructions by the manufacturer/vendor will be followed.

STORAGE AT SITE

- Whenever practical, the above listed materials will be stored under permanent cover from environmental elements (rain, snow, freezing temperatures).
- Provide shims to store the material level or perpendicular, as necessary, to prevent twisting forces of sufficient nature to give a permanent disfigured set.
- Cover and protect the materials sufficiently to withstand rainy gals force winds being sure all seams and joints of the protective covering will not allow intrusion of moisture.
- Protective barriers and signs will be posted to prevent damage through local operations.
- A current "bill of materials or "packing list" will be accessible to identify the material, the quantity, and owner.
- If heat is required to keep from freezing, then special arrangements will be made consistent with Contract Documents.

INSPECTION PLAN – DETAIL

Field Quality Control ('Spot Checks')

Superintendents will take a proactive approach in the field and perform "spot checks" throughout the project. Project Managers and Assistant Project Managers will be responsible for performing quality control reviews during fabrication to ensure that fabrication details are being followed, and that the correct materials and equipment will be installed upon site delivery.

- Each PM and APM will be responsible for performing Quality Assurance checks throughout the fabrication process. This includes trips to plants, factories, storage yards, etc.
- Each PM and APM will be responsible for tracking the corrective actions to be taken from any deficiencies

found during field inspections, to resolve any issues identified. Subcontractors shall complete all corrective work within one (1) week of receipt of a non-conformance or punch list, as required in the subcontract agreement.
- Each PM shall provide field superintendents reference to approved submittals for deliveries that are expected.

Subcontractor Participation in Inspection
The Subcontractor will promptly furnish, at its expense, all facilities, labor and material needed for performing such inspections and tests as may be required or specified. The Subcontractor will give Hunter Roberts Construction Group written notification of inspections and tests and Hunter Roberts Construction Group will perform, except as otherwise specifically provided, said inspections and tests in such manner as not to unreasonably delay the Work. The Subcontractor shall accommodate and allow Hunter Roberts, and/or representatives designated by Hunter Roberts at subcontractors' and vendors facilities.

Rejection of Work Done Without Inspection
Any work done without proper inspection will be subject to rejection. If any Work should be covered up without approval or consent of Hunter Roberts Construction Group, it must be uncovered for inspection and properly restored at the Contractor's expense.

Access for Inspection
To facilitate inspections and supervision; Hunter Roberts Construction Group will access the Work during construction. Work done and materials provided will be subject to hunter Roberts Construction Group's on-site and off-site inspection and approval. When Work is to be performed during hours other than during its normal schedule, the Subcontractor will so advise Hunter Roberts Construction Group in writing not less than 24 hours in advance.

Subcontractor not relieved of Obligations
Hunter Roberts Construction Group's inspection and approval of Work or materials will not relieve the Subcontractor of any of its obligations to fulfill the requirements of the Contract. Work and materials not meeting the requirements of the Contract Documents will not be incorporated into the Work are subject to rejection by Hunter Roberts, notwithstanding that such work or materials may have been previously inspected by Architect, Hunter Roberts Construction Group or owner, or that payment therefore has been included in a progress payment.

Access for Government and Utility Officials
The Subcontractor will provide access to the Work to authorized representatives of Federal, State and local governments and utilities for observing the Work associated with their respective interests.

Plant Inspection
Hunter Roberts Construction Group will inspect the production of material and the manufacture of products to be incorporated into the Project, at the manufacturer's plant. Hunter Roberts Construction Group will have free entry at all times to such parts of the plant as concern the manufacture or production of the materials. Adequate facilities will be furnished to make the necessary inspections; however, Hunter Roberts Construction Group will not be obligated to inspect materials at the source of supply. The responsibility of incorporating satisfactory materials in the Work rests entirely with the Contractor, notwithstanding any prior inspections or tests. The Subcontractor will have appropriate provisions inserted into each subcontractor agreement it enters into to provide for in-plant inspection of the manufacture or production of materials or equipment by Hunter Roberts. Hunter Roberts will review QA/QC program, production process, and quality of work ongoing and issue a report. Hunter Roberts will invite Design Team members on plant visits along with an RXR representative.

Deficiencies
If, during the course of inspection by HRCG, we become aware that installed Work, or material to be installed in the work, does not conform to the Contract Documents, Hunter Roberts Construction Group will promptly furnish to Subcontractor (with a copy to Architect and Owner), a Non-Conformance Report-HRCG. The report will include a notice of non-conformity and a preliminary recommendation as to how such non-conformity should be corrected. (Absent a need for a Change Order affecting the Contract Documents as determined by Hunter Roberts Construction Group). It will be the sole responsibility of Hunter Roberts Construction Group (with advice from the Architect) to finally determine how any such non-conformity will be corrected and to coordinate and ensure the implementation of such correction with the necessary Subcontractor. Hunter Roberts Construction Group will prepare the Non-Conformance Report-HRCG, will attach any applicable Non-Conformance Report-Architect to it, and will send both documents to the Contractor, with a copy to Owner and Architect.

When the Subcontractor has taken corrective actions, the Subcontractor will return the Non-Conformance Report to Hunter Roberts Construction Group. Hunter Roberts Construction Group will first obtain Architect's confirmation of the corrective action and then will also confirm the corrective action. When both Architect and Hunter Roberts Construction Group have confirmed the corrective action, the Non-Conformance Report will be considered resolved. A copy of the resolved Non-Conformance Report will be distributed by Hunter Roberts Construction Group to Owner, Architect, and Contractor. Hunter Roberts Construction Group will monitor the status of each non-conformance item by maintaining the Deficiency Log.

Hunter Roberts shall incorporate the use of BIM360 to facilitate this procedure. This Log will primarily be sorted so that only unresolved items may be reviewed in a more condensed version of the Log. Other available sorts will include a report listed in order of Architect's Number or Owner's Number. These logs will be subject to review at each Construction Progress Meeting and will be included in the Meeting Minutes as an exhibit.

If, during the course of inspection by the Architect, the Architect becomes aware that installed Work, or material to be installed in the work, does not conform to the Contract Documents, the Architect will promptly furnish to Hunter Roberts Construction Group, with a copy to Owner, a Non-Conformance Report –Architect. They are numbered sequentially with the suffix A. The report will include a notice of non-conformity, s specification and/or drawing reference and a preliminary recommendation as to how such non-conformity should be corrected. Absent a need for a Change Order affecting the Contract Documents as determined by Hunter Roberts Construction Group, Architect and Owner and provided such non-conformity does not require design revision, it will be the sole responsibility of Hunter Roberts Construction Group, with advice from the Architect, to finally determine how any such non-conformity will be corrected and to coordinate and ensure the implementation of such correction with the necessary Subcontractors. The further processing of the report is the same as that described in item a. above.

In the event an interpretation of the meaning and intent of the Contract Documents becomes necessary regarding non-conforming work, Hunter Roberts Construction Group will consult with Architect, obtain the interpretation in writing from Architect and transmit the same to the appropriate Subcontractor.

Any extra engineering/architectural costs or testing costs resulting from evaluating, examining, redesigning, and retesting of non-conforming work will be borne by the Subcontractor.

The Subcontractor will be responsible in its schedule for all time required to correct non-conforming work including time required for Architectural/Engineering, testing or redesign.

ONGOING PROJECT REPORTS

There are two parts to the tracking mechanisms being used on all projects. The first part is the report itself, while the second report is a measurement report that will be produced on a monthly basis to track our progress and our performance.

The four reports that apply to this performance-based methodology include:

1) Meeting Minutes

Meeting minutes for project progress are generated and produced by the Project Manager after each periodic Owner and HRCG meeting. The meeting minutes shall be written clearly, concisely, and objectively. All minutes shall:

- Be distributed within 48 hours of the meeting date.
- Identify objections and comments, action items, and responsibilities.

2) Submittals

Submittal Logs should be reviewed by Project Team (Owner, Architect, etc., on a weekly basis.

Tracking Mechanism: In addition to the log and re-submissions, HRCG should pay special attention to those items approved after 1st submission. The percentage of first-time approvals over the total is a factor we must be aware of. **This will be important documentation for evaluating any potential delay claims by subcontractors.**

- PM's and APM's are responsible for the submittal process of their respective trades.
- Submittals shall be checked for accuracy against the contract documents prior to submitting to the AE Team for approval. If errors or deviations are found, the submittal should be marked up with HR's comments, and these markups must be transferred onto each copy of that particular submittal being sent for approval. If the markups are in such a quantity that they render the submittal rejected, the PM / APM must reject the submittal and advise the Subcontractor to revise and resubmit before passing it on to the AE Team. No submittal that is anticipated to be rejected should be passed on to the AE Team by Hunter Roberts.
- Each copy of every submittal being sent for approval should include a completed "submittal coversheet", as well as a Hunter Roberts Review Stamp, with the submittal id number, date reviewed, and initials of the PM / APM who performed the review.
- A transmittal must accompany every submittal that travels out of the Hunter Roberts office, identifying who the submittal is being sent to, who has been copied, and any specific notes that need to be identified regarding the submittal.
- Upon receipt of returned submittal after AE review, the submittal should be logged into ProCore, with (1) copy sent back to the subcontractor, (1) copy sent to any adjacent trades who may need the information for coordination purposes, (1) copy to (Ijeoma Iheancho) Urbahn Architects, (1) copy to Lisa Regatti (NYCDDC), and (1) copy in the submittal file. The transmittal should be stapled to the front of the submittal, with the submittal title highlighted, as well as any notes pertaining to that submittal which HR would like to call out. It is critical to identify each subcontractor / project team member cc'd on copies of returned submittals, to verify that they have received the information with which to coordinate.
- The file copy of the submittal should also have the transmittal stapled to the front, with "file copy" highlighted, as well as highlighting the submittal title and critical notes.
- APM shall be responsible for submissions to the design team.

3) RFIs

RFI Log should be reviewed by Project Team (Owner, Architect, etc., on a weekly basis.

Tracking Mechanism: HRCG should keep track of how many RFI questions of the total we were able to solve without input

from Design Team. This factor should not discourage HRCG Operations from seeking that input when needed, but just to identify when responses are obvious enough to offer a solution.

- APM's are responsible for reviewing and answering all RFI's pertaining to their respective trades, as well as submitting any RFI's to the AE Team which Hunter Roberts cannot answer on our own.
- RFI's shall have appropriate sketches, marked up drawings, details referenced, field pictures, etc., as necessary to clearly identify the question and to facilitate a quick response.
- Responses to RFI's should be reviewed thoroughly by the APM receiving the response, before logging into CMiC and distributing to the Project Team and our Subcontractors. Sketches issued with responses should be marked on our field set of drawings, bubbling the area affected by the sketch, and noting the sketch #, RFI#, and date issued.
- A hard copy of the RFI with any sketches attached should be placed in the RFI Binder, and a copy given to the superintendents for their review.
- A hard copy of sketches issued with an RFI should also be copied in the Sketch Binder.

4) Monthly Report:
The Project Engineer is responsible for managing the monthly report updates, following up with each HRCG team member to provide their input, compiling and assembling the updated data into binders.

- The monthly report is issued no later than the 15th of the following month.
- Copies of the monthly report are transmitted to the following individuals:
  - » HRCG Senior Vice President: (1 copy)
  - » HRCG Project Executive: (1 copy)
  - » NYCDDC (2 Copies)
- The monthly report will include the following sections:
  - » Executive Summary
  - » Critical Items to resolve
  - » Project Directory
  - » Safety Report / Incident Log
  - » Project Budget
    - Budget Report (ACR)
    - Change Order Log
    - Potential Change Log
    - Budget Transfer Log
    - Contingency Log
    - Cash Flow Report
    - Procurement
    - Buy-out Log
    - Open Approval Letter Log
  - » Insurance Log
    - SDI Enrollment Log
  - » Executed Contracts Log and Attachments
  - » Construction Schedule
    - One Month Look Ahead
    - Monthly Update
    - Lost Time Report / Weather Days
    - Manpower Report
    - Manpower Report Summary
    - Copies of Daily Reports
  - » MEPS Coordination
  - » Controlled Inspections
    - Controlled Inspections Log
    - Controlled Inspections Report
  - » Material Status Report (ROJ)
  - » RFI Log
  - » Submittal Log
  - » Permit Log
  - » Project Photographs
  - » Surveys
    - Attached Foundation Survey
    - Attached Final Survey
  - » Requisition for Payment
    - CM Requisition
    - Lien Waivers
    - Subcontractor Requisition
    - General Conditions Back-up
    - Retainage Release Log
    - Off-Site Stored Material Log:
      - Inspection Report
      - Lease and Easement Agreement
      - Bill of Sales
      - Invoices
      - Insurance
      - Photographs

START-UP & TESTING / TRAINING
Our responsibilities for systems start-up testing include:

- Coordinate the testing activities with construction activities.
- Monitor and control testing schedules, providing appropriate reports to the Owner
- Provide design and construction schedules to the project team so that material delivery dates and system installation projections are known.
- Obtain and distribute all necessary documentation from subcontractors and suppliers (including but not limited to O&M manuals and "as-built" drawings.)
- Maintain files, records, test data, drawings, and manuals for transfer to the Owner upon completion of testing and verification.
- Review all procedures to assure that references to standards, testing criteria and documentation requirements are consistent with the project design documents.
- Assure availability of appropriate subcontractor personnel during onsite testing, start-up and Owner operations personnel training. Video tape all training sessions for future and reference, if required by the project construction documents.
- Identify all start-up activities on the construction schedule.
- Track start-up dates, times, attendance / sign-in, and use this tracking log for closeout documentation.

- » The MEP trades PM /APM will be responsible for creating and maintaining the start-up / testing / training log for this project.

The Start-Up, Testing and Training steps include:

- Identify Specification requirements:
  - » The MEP Project Manager must identify the start-up & testing requirements for each MEP system per the specifications and system and any additional requirements by the Owner not spelled out on the project documents.
  - » The Purchasing Manager must coordinate the purchase of the start-up & testing requirements from the Subcontractors and any required third-party testing agencies.

- Establish Start-up Plan:
  - » Project Manager to verify with the specifications the type and quantity of testing required i.e. factory acceptance tests, offsite mock-ups, site acceptance tests, etc.
  - » Project Team will create a start-up schedule identifying dates for system testing, initial start-up & Owner/A/E field verification.
  - » Project Team will develop & issue test report formats to the A/E for approval. These reports must identify equipment name, installed locations, design parameters, as tested results, and identify all required participants.
  - » Equipment Manufacturers recommended installation and start-up requirements shall be included in the scope of the installing subcontractor's work.

START-UP CHECKLIST:

The Project Team will create a start-up checklist for each piece of equipment with the Commissioning Agent. The checklist must be reviewed and verified complete prior to start-up. The list should include verification of installation quality, manufacturer's acceptance, utility connections and operational safety.

In the case of equipment and systems that require factory start up, attach a blank copy of the factory start up form. Verify that the information required by the project documents are contained within the factory start up forms.

- Start-up & Testing Process:
  - » The Start-up Testing process may include representatives of the Owner, Hunter Roberts, Equipment Manufacturers, Installing Contractors, testing and balancing contractors, and the design professional. Equipment manufacturers' representative and subcontractors will participate in the process as specified in the applicable equipment specification sections and on an as needed basis as defined in the plan.
  - » The start-up testing includes installation and operational verification checklist forms that are associated with each system. The forms identify the critical components requiring start-up.
  - » HRCG shall be responsible for performing all procedures presented in the specifications and on the contract drawings. Final sign-off shall be by the Owner via system acceptance sheets.
  - » If satisfactory results are not achieved, corrective measures shall be identified and corrective action taken before re-testing. All discrepancies and variations shall be documented on a "system deviation" report form. The components or systems shall be re-tested until the results are satisfactory.
  - » At the completion of the installation and operational verification work per system, all components, both singularly and collectively, shall be adjusted and left in a satisfactory operating condition as approved by the Owner's representative.
  - » MEP Project Manager coordinates and collects Preliminary Field Use Operation and Maintenance Manuals from each contractor and equipment manufacturer.

- Installation Verification
  - » Installation Verification activities are on-going throughout the submittal, purchasing and installation phases. The objective is to assure that all components, materials and equipment are purchased, installed and tested in accordance with the manufacturer's recommendations, design drawings, and specifications.
  - » Before systems start-up, HRCG shall verify the proper installation of each facility system by reviewing the equipment installed, using the appropriate procedures and checklists as described herein.
  - » HRCG shall document any discrepancies or variations noted during the performance of the Installation Verification on a Deficiency / Non-Conformance Report form.
  - » MEP Project Manager performs the system walk-down and lists any deficiencies found. Document the resolutions of all discrepancies and variations on a "Problem and Resolution" form. Include completed forms in System Manual.

- Completion of Critical Punchlist Items:
  - » During the Installation Verification process, HRCG will identify any outstanding punchlist items that will affect system start-up. These items will be documented as "critical punchlist" items. These items shall be corrected before system start-up proceeds.

- Manufacturer Start-up and Operational Staff Training:
  - » Start-up shall commence after Installation Verification is completed and prior to initiating Operational Verification. The objective is to assure that all components and equipment are prepared and started up safely, and in accordance with the manufacturer's instruction.
  - » HRCG and designated members of the A/E and Owner's Representatives (TBD – Garvie's Point General Manager) will witness start-up, and list all system and equipment deficiencies noted during

start-up. The Contractor shall take corrective action on all system deficiencies noted and demonstrate suitable system operation. Preliminary testing and balancing work shall commence in conjunction with system start-up. System and equipment deficiencies observed during this activity shall be noted and documented on a "Problem and Resolution" report form. The Contractor shall correct all these deficiencies.

» The Contractor and associated manufacturers' representatives shall provide the required training to the Owner's operational staff as specified in the construction specifications. The Contractor training sessions shall provide a detailed analogy of system operation and maintenance. These sessions shall be videotaped for additional personnel training and reference (where applicable).
» Specific Start-up Responsibilities (HRCG's Responsibilities):
  - Review, coordinate and confirm schedule of Contractor's work associated with system start-up activities.
  - Coordinate schedule with the A/E and Owner to allow for participation as necessary.
  - Review and approve start-up procedures.
  - Witness component and system start-up.
  - List any deficiencies found during start-up. Document the resolution of all discrepancies and variations on a "Problem and Resolution" report form. Include completed forms in the System Manual.

- Submit Operations and Maintenance, and Warranty Manuals:
  » Before the Subcontractor and Associated Equipment Representative sessions for the operations and maintenance staff, HRCG shall submit the Operations and Maintenance, and the Warranty Manuals for review.
  » The manuals shall be reviewed at the Operational Staff Training sessions. HRCG shall incorporate any comments from the training sessions and provide a final submission of the manuals to the Owner.
  » Start-up / Training Logs will be included in the O&M Manuals as documentation of Owner attendance.
  » A turnover request will be submitted to NYCDDC by HRCG upon proper start-up of equipment for ownership use and operations per the contract documents.

CLOSEOUT & SURVEYS

Closeout

The PM's and APM's are responsible for identifying the closeout documentation required for the trades which they are assigned. Closeout documentation will be included in the submittal logs for each particular trade, with dates listed for when Hunter Roberts anticipates receiving the information.

The goal of the Project Team is to close out individual trades when their work has been completed and accepted by the Owner and Architect. That does not necessarily mean at "substantial completion" of the overall project, especially in the case of superstructure trades (foundations, piles, structural steel) for example, or any other trade able to finish their scope prior to the overall completion of work in the field.

With that in mind, the Project Team must begin compiling closeout documentation as early as possible and as soon as the information is available. An outline of this process is as follows:

- As-Builts / Record Drawings – should be submitted once installation is complete.
- O&M Manuals – should be submitted immediately following approval on each piece of equipment furnished by that subcontractor.
- Warranties – should be submitted following substantial completion of that subcontractor's scope.
  » Subcontractor Warranties – on Hunter Roberts' template should be submitted at substantial completion of the subcontractor's scope.
  » Manufacturer Warranties – should be submitted upon inspection and acceptance of the material installation by the manufacturer's representative (ex: roofing).
  » Equipment Warranties – should be submitted following start-up and acceptance of the equipment.

In addition to specified closeout documentation required, the following cost control measures must be completed to close out a subcontract agreement:

- All subcontractor claims must be resolved.
- All change orders must be fully executed and invoiced.
- A subcontractor "Final Change Order" must be issued, in the amount of $0.00, with the following language in the description:
- "By signing this final change order ($0.00), [subcontractor's name] confirms that there are no outstanding claims or change orders on the NYCDDC BBJ Queens Site Parking Garage project, and this subcontract agreement can be closed."
- Pending Change Order Log must be submitted with final invoice, confirming no open claims.
- Final Lien Release must be submitted with final invoice.

Once the above closeout procedure has been satisfied, barring any specific requirements in the Hunter Roberts contract with the Owner, the subcontract should be able to be closed. A review of the Owner Agreement will be performed when available to confirm if any other closeout requirements exist.

Surveys

Hunter Roberts will employ two levels of project surveys regarding our overall on-site performance.

- Subcontractor Surveys – Concise one-page form shall be completed each month by job staff (Superintendent, PM, & Accountant). The survey shall assess the

Subcontractors' adherence to payment/billings requirements, engineering and coordination, and field execution, and shall be part of the minutes for the ORMs.

- One-Year Call Back – At 11 months past the completion of the project, the Project Executive shall forward a one-year survey to be filled out by the Owner's Representative. The Project Executive shall also schedule a one year walk-through with the individual within 30 days of the one-year survey issuance.

The purpose of this procedure is to get a periodic snapshot of HRCG's overall performance and commitment to earning partner satisfaction every day.

COMMISSIONING AND ACTIVATION PLAN

Building Commissioning is a critical activity and a key step in the process of turning over the building to the City. We have developed an initial commissioning and activation plan based on achieving LEED Gold (core and shell) for the Community Space. We also plan to pursue Parksmart certification as a potential enhancement for the parking garage. We carefully reviewed the commissioning requirements for both the MEPS systems and the Enclosure that were included in the RFP (Volume 2) and relied on both documents to formulate our plan.

Our plan starts early in the process. We firmly believe that an effective commissioning plan must include early collaboration with the design team and ownership. This process ensures that the documents conform to the Basis of Design and Performance Requirements and that the scope of work is clear and communicated to the contractors responsible for the Work. Key tasks include:

- Confirm that the documents conform to the OPR and BOD.
- Verify that the systems include all necessary components required for functional testing
- Verify that the performance information is identified and complete
- Review accessibility of necessary components
- Confirm that subcontractor commissioning work is reflected in the documents and conveyed to the subcontractors.
- Develop recommendations for improvements and refinements with a focus on operational procedures
- Provide a report identifying issues

During this initial phase we will also determine a reasonable approach for testing the exterior enclosure and review the approach with the NYCDDC. The apparent intent of the RFP is to include an off-site performance mockup that is tested and approved prior to production. Given the overall budget of the Community Space component of the project and the schedule duration for the entire project, an offsite performance mockup is neither feasible nor warranted. We will develop in-situ tests (adhering to ASTM standards) of sections of the enclosure to evaluate its performance. If necessary, design modifications will be made based on the results of the tests.

During this early phase, our Cx team member will issue a Commissioning Plan for review by the entire D-B Team and the NYCDDC. The plan will include the development of the pre-functional and functional checklists, OPR, BOD and Commissioning specifications. A critical component of the plan will be a schedule that coordinates construction team activities – clearly indicating when test will occur, the scope of each test and any project team members required to observe the test.

Our Cx team member will also lead regularly scheduled commissioning meetings to review the overall commissioning program and schedule. The frequent communication will ensure that the process advances efficiently and that all parties, the D-B Team, our subcontracting partners, the NYCDDC and the City's stakeholders are all engaged in the commissioning process. In addition to discussing testing schedules, any deficiencies will be identified and resolved.

During the initial phase of construction, our Cx team will review shop drawings and submittals from an operational perspective and validate conformance with the OPR and design drawings.

As construction proceeds, our Cx team will be present to evaluate the installation process. Site reports will be completed and submitted after each visit. Procedure during this phase will include:

- Develop construction checklists and pre-functional and functional testing forms
- Observe that equipment is installed to design specifications
- Attend construction and project meetings
- Document the construction process
- Witness hydrostatic tests, duct leakage test and any other tests required in the specification

Although the early work is critical, the key step in the process is the Systems Performance Assessment. The Systems Performance Assessment is comprised of Verification, Functional Performance Testing and Testing/Adjusting/Balancing.

Verification: This comprises a full range of checks and tests to determine that all components, equipment, systems and interfaces between systems operate in accordance with the contract documents, including operating modes, interlocks, control responses and all specified responses to abnormal or emergency conditions.

Functional Performance Testing: These tests will progress from tests of individual components of the central equipment to test of the overall systems.

Testing/Adjusting/Balancing: Our Cx team will perform a field verification of the final TAB report for all trades and directly witness and certify the results. A sample of the report

shall be selected for verification and the TAB contractor will be notified of the final verification.

In this phase we will also develop a deficiencies log that will identify when the deficiency was observed and the party responsible for its resolution.

LEED documentation will also be finalized in this phase and provided to the LEED consultant.

Maintenance, planning and Operations training is a critically important component of our plan. We will work closely the NYCDDC and its operators to make sure that the staff is well trained and ready to run the building. Our Cx team member will work with the contractors to prepare the O&M manuals and witness all training. The manuals will include the following:

- OPR
- System descriptions, capabilities and limitations
- Operational procedures
- Tolerances for adjustments
- Procedures for dealing with abnormal conditions
- Use of operating and maintenance manuals

We will also issue a final report that provides evaluates the overall performance of the facility, identifies any deficiencies that were corrected, catalogs functional test results and provides a schedule for future testing and on gong commissioning.

The final phase of the commissioning activities will be the Acceptance Phase. This phase is required for both LEED and commissioning ethics. This manual will provide information on operations with a focus on maintaining and maximizing the efficiency and sustainability of the systems. Our team will also manage the warranty period. We will document warranty issues and develop the necessary plan of action to rectify the warranty situations. This effort will also include a walk-through the 10th month with the appropriate trades to document the warranty period.

We recognize the potential benefits of a phased approach for the project. We believe that it will be possible to open the parking garage before the Community Space. With the exception of the PV system and the parking controls, the garage is a reasonably simple building from an MEP standpoint. It is also not fully enclosed. If desired by the NYCDDC, our team will modify the plan so that the commissioning tasks can be advanced for the garage to enable it to open earlier.

RISK MANAGEMENT PLAN

INTRODUCTION

Purpose:

This Queens Garage and Community Space Risk Management Plan provides the project a consistent method to manage risks to ensure best value project delivery, within budget and on schedule. Risk management is a continuous process that drives strategic decisions regarding choices for navigating the avoidance of specific project risks and regarding appropriate mitigation options for the same.

The plan delineates the process, timing, and techniques for identifying and managing risks, mitigation actions required, and organizational responsibility for monitoring and managing the risks throughout all phases of the project. The plan will distinguish between risk items that are internal to the DB Team and those that are external and require the attention of DDC, Key Stakeholders and authorities having jurisdiction (AHJ's).

Objectives:

Specific objectives of the Queens Garage and Community Space Risk Management Plan include:

- Ensure critical risks impacting scope, schedule, budget, performance requirements, and/or change management are proactively identified, communicated, mitigated, and escalated in a timely manner;
- Facilitate attention and focus onto risks impacting the Queens Garage and Community Space project;
- Produce meaningful information and analysis that allows project management to focus efforts on the "right" (e.g., high likelihood and high impact) risks with an effective coordination of effort;
- Support efficient risk mitigation by guiding risk mitigation planning and decisions at the appropriate project staffing/leadership level depending upon the risk at hand;
- Establish and confirm decision making authority from all key personnel (DDC and the Design-Builder);
- Ensure strong communications protocols with Key Stakeholders, so they are informed and, if applicable, fully participate in risk mitigation efforts;
- Provide record and audit trail of discussions, communications, actions, and planned/actual mitigation of project risks.

RISK MANAGEMENT ORGANIZATION

Process Responsibility:

The Design-Build Project Manager is responsible for the Risk Management Plan, its effective implementation throughout the project, trends and metric analysis, and training project personnel on risk management. Other DB Team project management staff will be responsible for creating and maintaining the Risk Register in coordination with the Design-Build Project Manager.

The Design-Build Project Manager has overall facilitative responsibility for the risk management process. Specific responsibilities may include the following activities:

- Develop and implement the Risk Mitigation Plan.
- Maintain the Risk Management Plan in line with configuration management procedures.
- Generate risk reports, including trends and metric analysis, for risk meetings and ad-hoc requests.
- Clarify, consolidate and document risks.
- Maintain and monitor data in the risk register.
- Monitor the status of risk mitigation.
- Communicate status to risk owners.
- Escalate communication if expected mitigation action deadlines are not met.
- Execute the risk closure process.

A risk management team will be established with representation from the Design-Builder, DDC, and Key Stakeholders as necessary. The risk management team, along with the Design Build Advisory Group (as defined in the DB Team Organizational Chart), will serve to review and manage the risks identified on the Risk Register. In particular, the Design Build Advisory Group shall act as a form of steering committee with oversight responsibility for ensuring the Risk Management Plan is executed fully. Through the design, construction, and NYC procedural experience of the members of the Design Build Advisory Group (including Hunter Roberts CEO - Jim McKenna, SVP - David Kane, P.E., AICP, our Project Executive - Sean O'Connor and the three senior leaders of the Design Team), as well as the leadership of the Risk Management Plan by our Design Build Project Manager (Joshua Frankel, AIA), the risk management process will be integrated among all activities performed by the members of the DB Team. The Design Build Advisory Group will assist with the following:

- Approval of mitigation measures for very high severity level risks.
- Support of mitigation implementation.
- Cross-organization/agency and controversial risk mitigation to include determining the involvement of senior management and other organizational resources.

Risk Ownership:

Risk ownership defines primary responsibility for mitigating individual risks as well as which group is the likely generator of the risk item. (Note: Ideally the generator of the risk would

also be the party responsible for its mitigation, however this is often not the case. A good example of this is the Public Design Commission, which is often a generator of risk for City Projects with tight budgets and schedules, but is not responsible for mitigation of the risk created). So if generation and mitigation responsibility are not aligned, the "Risk Ownership" field within the Risk Register must indicate who the respective parties are. DDC leadership and DB Team leadership will also need to be aligned for specific "severe" risks to assure adequate support.

For the Risk Register developed for the Queens Garage and Community Space project we will utilize three distinct ownership identifiers: Design-Builder, DDC, and Third Party (which may be a Key Stakeholder, AHJ, Adjacent Project contractor).

RISK MANAGEMENT PROCESS

Risk management for the Queens Garage and Community Space project will involve four major phases: risk identification, risk analysis, risk response planning and implementation, and risk monitoring and control.

Risk Identification:

Risk identification for the Queens Garage and Community Space project will begin with the DB Team's creation of the preliminary Risk Register (see the section following this one), followed by review of identified risks with DDC, Key Stakeholders, AHJ's and the Design Build Advisory Group.

Risks can have multiple causes and multiple impacts (cost, schedule, political/reputational), and a thorough risk identification process will capture both. Risks for this project should be identified by categories that are critical for this design-build delivery, given the nature of the program, location, ownership and management structure and the regulatory context of NYC. For the Queens Garage and Community Space project applicable categories and their respective subcategories are:

- ***Safety*** – safety hazards to public, workers, injuries, fire, security (vandalism, intrusion, damage, theft)
- ***Technical*** – i.e. planning, design completion, Public Design Commission approvals, Owner over-reach in design process, errors and omissions, permitting, approvals (DEP, DOT, DOB, etc.), permitted work hours variance from expected, inspections/sign-offs, bad surveys, poor utility mark-outs, utilities not where shown, unique design elements (exterior garage fins)
- ***Scope*** – program changes, scope changes, late requirements by Key Stakeholders (DEP, DOT, etc.)
- ***Environmental*** – unknown conditions, spills, tanks, traffic, noise, air pollution, weather, temperature, geotechnical, suitability of existing materials to be reused below grade, ground water, available environmental analysis incomplete/inaccurate, hazardous materials, regulation changes, archeological,
- ***Management*** – estimating, procurement, unbought scope, project management, communication with DDC, Key Stakeholders, and AHJ's, subcontractor/supplier communication/relationships,
- ***Construction*** – site access, work area restrictions varying from assumed, unknown site conditions, condition of existing storm retention, ability to temp tie-in storm retention during excavation and foundation, labor issues/shortages, labor disputes/strike, material availability, quality, performance/productivity (labor and equipment), Adjacent Project interface risks, defective work, Adjacent Project construction activities and coordination of activities, unanticipated required changes to logistics, phasing plans, work sequences,
- ***Socio/Political/Stakeholder*** – i.e. community, local considerations, public policy, BBJ program direction changes, MWBE participation, new stakeholders, political climate,
- ***Financial*** – market conditions, material costs, change management, change order negotiation and duration for approval, escalation, City Capital funding, OMB CPs, Comptroller registrations, payment delays, subcontractor insolvency or surety issues,
- ***Turn-over*** – commissioning, warranties/guaranties, training, DDC, DOCJ, DOC acceptance
- ***Force Majeure*** – natural disasters, public health emergencies,
- ***Legal / Regulator***y – changes in law, regulation, building codes or DOB requirements, approval processes, easements, access agreements, ROWs, contractual (i.e. DBA or subcontracts), dispute resolution, liens

In addition, risk identification needs to include (to the extent determinable) statement of the likely "triggering events" and "known root causes" based-upon similar experiences with such risks on other projects. This does not mean that root cause analysis must be done for each potential risk. Such analysis is typically done to analyze past, perhaps unanticipated, risk events for which the sequence and causes of occurrence are not well understood.

RISK ANALYSIS

Risk analysis for the Queens Garage and Community Space prioritize risks for subsequent ongoing management based on their likelihood of occurrence and degree of potential impact. The concept of risk is characterized by these two main factors: The likelihood/probability of a particular hazard taking place and the impact or consequences of that event upon project objectives of cost, time/schedule, quality, community/environment, safety.

Risks can be assessed qualitatively, as will be described below. Additionally, many construction project risks can also be analyzed quantitatively, for their estimated costs and time delay effects. The qualitative and quantitative analyses allow the Risk Register to be updated with:

- Established categorization and prioritization of qualitative risks from the detailed analysis;
- Projected quantitative impacts upon cost and schedule.

In addition, completion of the analysis process allows an overall probabilistic assessment of the project achieving its objectives.

Qualitative Analysis:
The qualitative grading of the risks in the Risk Register is facilitated by use of a Risk Scoring Matrix (aka, Probability and Impact Matrix). Risks are first analyzed and evaluated in terms of probability (likelihood) of occurrence and the impact (seriousness) if they should occur. The probability of the risk occurring is assessed and given defined ratings of Very Low (VL), Low (L), Medium (M), High (H), or Very High (VH) likelihood. Separately the impact upon the project if the risk were to occur is given defined ratings of Very Low (VL), Low (L), Medium (M), High (H), or Very High (VH) seriousness/severity. Then using these ratings in conjunction with the Risk Scoring Matrix, the risks can be graded to provide a measure of the Queens Garage and Community Space project's risk exposure for each.

Below is a sample of the Risk Scoring Matrix to be used to calculate gradings based upon combination of probability and impact ratings.

		Impact (Seriousness/Severity)				
		Very Low	Low	Medium	High	Very High
Probability (Likelihood)	Very High					
	High					
	Medium					
	Low					
	Very Low					

Score	Definition
High	An event that is **"extremely" or "very likely"** to occur and whose occurrence will impact the project's cost, time/schedule, quality, community/environment, safety **"severely"**. This risk should be escalated (where possible) and **reviewed frequently** until resolved.
Medium	An event that has a **"reasonable"** chance of occurring and, if it occurs, will cause **"noticeable"** impact. This risk should be reviewed on a **regular** recurring basis as appropriate.
Low	An event that is **"unlikely"** or **"very unlikely"** to occur and, if it occurs, will cause **"small"** or **"no impact"** that can be absorbed by the project without material effect.

Two (2) additional qualitative analysis tools which will be incorporated into the Risk Register are:

- An assessment of the ability to "predict" or "control" the occurrence of a given risk event. This is most definitely a "gut check" assessment that typically defies any quantitative measure (The DB Team will work with DDC, Key Stakeholders, AHJs, Adjacent Project contractors, and the Design Build Advisory Group to gather intelligence on anticipated ability to predict/control certain critical items).
- Near-Term, Mid-Term, and Long-Term assessments of the timeframe in which the risk event is most likely to occur. This provides a "second tier sort" qualitative measure against which to prioritize risks within each of the Green, Yellow, and Red categories above.

Quantitative Analysis:
Estimated cost and schedule delay impacts of many construction risks on the Queens Garage and Community Space project can be established by firing up the pre-construction resources (estimators, schedulers, logistics planning professionals) that have helped us establish budget and schedule compliant proposal to date. Each such risk event can be assessed by the project scheduler(s) for the additional time that mitigating/correcting the event will take. Such time may impact critical path items or cause come-back or out of sequence work. To assess cost, the estimators will look at costs associated with the delay (additional equipment rental, general conditions, escalation, shift work, overtime, re-work by adjacent trades, expedited shipping, etc.). Further, they will look at the possible additional costs of the mitigating solution (different equipment, material, alternative building systems, design costs, testing, inspection, means and methods). The quantitative analysis results will be posted to the Risk Register.

RISK RESPONSE PLANNING
This entire Project Team is responsible for Risk Response Planning. Though, we the Design-Builder recognize that we need to take all reasonable and actionable steps to facilitate the removal of risk, regardless of "ownership" status of each risk item, and regardless of "generator" status or "responsible for mitigation" status, in the name of meeting the overall objectives (on-time, on-budget, high value, and safe project delivery) held mutually by DDC the DB Team and all other stakeholders. We are committed to providing coordination, communication, management, encouragement, momentum, and follow-through to ensure that the Risk Register items are addressed throughout the project. Those items for which eh DB Team is responsible

to resolve and mitigate, we will, and for those items that others (DDC, et al.) hold responsibility, we will assist and support vigorously.

Management of the risks identified and recorded on the Risk Register involves determining whether the risk:

Can be accepted/absorbed

- Without compromising project objectives in a material way

Can be avoided through

- Careful planning, communication, and diligence by the Design-Builder and DDC;
- Reduction or elimination of risk likelihood through pre-event action plans
- Use of additional or innovative approaches to insurance coverage specifically addressing the risk

Can be transferred

- Does the DBA for the Queens Garage and Community Space allow for transfer of the risk to another party
- Is another party within the Project Team, or Adjacent Project contractors, AHJ's, etc. better suited, willing, contractually obligated to carry this particular risk item
- Can some portion of the risk be transferred/assigned to another party
- Can parties establish a written agreement which ensures transfer or sharing of responsibility for the impact(s) of the risk item
- Can the Design-Builder pass the risk contractually to a subcontractor or sub-consultant who is more qualified and experienced to manage the subject risk, at reasonable cost to the project budget
- Requires development of a mitigation/response plan(s)/ option(s) through -
- Detailed review of direct risk impacts, secondary impacts to other work/projects, resources available for mitigation plans
- Consultation between the Design-Builder, DDC, AHJs, Adjacent Project Contractors, and Key Stakeholders regarding potential response options
- Exploration, development, and communication of several alternative response/mitigation scenarios, ranking them by ability and likelihood of greatest recovery from the risk event (ranking will be qualitative based on relative strengths of each as determined by those who best understand and have experience with the particular risk, and will also be quantitative based upon supporting schedule and cost implications of each option)

Development of contingency/response/mitigation plans for risk items requires staffing resources and commitment from DDC and certain stakeholders as needed. The DB Team will coordinate the necessary meetings, sessions, reviews, and provide supporting analysis and materials for review and comment. We will facilitate the process of mitigation plan development, regardless of "ownership" of the risk items.

When the most effective and likely to succeed contingency/ response/mitigation plans have been agreed upon by all, the DB Team will record them in the Risk Register, along with links to appropriate backup documentation.

RISK RESPONSE IMPLEMENTATION

When DDC and the DB Team have agreed upon the selected response/mitigation plan, the DB Team will:

- Carry out the implementation should it fall within our responsibility to do so, or
- Support, monitor, and oversee implementation by others (DDC and other stakeholders) should implementation responsibility lie there.

It is important for the DB Team and DDC to recognize that as good as an implementation plan may be, resources are required to carry it out, and as such, overcommitment of management staffing or contractor resources in risk mitigation efforts have the potential to create other risks through weakening resources on otherwise low risk activities. This should be considered when making mutual decisions about the timing and importance of proceeding with particular mitigation efforts.

RISK MONITORING AND CONTROL

For the Queens Garage and Community Space project, Risk Monitoring and Control entails identifying, analyzing, and planning for newly identified or evolving risks, monitoring previously identified risks, and performing residual risk assessment after implementation of response plans.

Risk Monitoring and Control Activities will include:

- Take corrective action per approved/preferred response/ mitigation/contingency action(s) when actual risk events occur.
- Establish periodic reviews with DDC and appropriate stakeholder as needed, and schedule them.
- Ensure that all requirements of the Risk Management Plan are being implemented, and that the plan is updated and maintained as needed.
- Assess currently defined risks as defined in the Risk Register, and validate previous risk assessments (likelihood and impact).
- Validate risk mitigation strategies and alternatives.
- Track risk response/mitigation measures implemented and revise Risk Register to capture results of mitigation actions.
- Evaluate effectiveness of actions taken, and perform a risk analysis/assessment of any "residual risk" or resulting "new risk" according to the Risk Analysis methods and tools described above.
- Assess impact on the project of actions taken (cost, time, resources).
- Identify status of actions to be taken.
- Identify new risks and evolving risks.
- Establish communications with new stakeholders as appropriate.
- Communicate risk management status and risk response follow-through as appropriate to DDC and all stakeholders.

RISK REGISTER

PURPOSE
The DB Team, led by Joshua Frankel, AIA, our Design Build Project Manager will generate standard reports as part of the risk management process. In preparation for risk management meetings, the risk management team prepares the Risk Register (see the preliminary Risk Register table on the following pages) listing the risks for review, discussion, and those that require action/response decisions.

The outline Risk Register presented on the following pages reflects a format that we, the DB Team, are confident addresses the requirements of the RFP and will be utilized to build and complete the live Risk Register required in the Standard Project Requirements following award of the Queens Garage and Community Space project.

Risk Register

Hunter Roberts Construction Group

DDC - Queens Garage - Design-Build

Friday, September 18, 2020

Risk Identification							Qualitative Rating						Risk Response			
Risk ID	**Project Phase**	**Risk Type**	**Authority Having Jurisdiction (AHJ)**	**Risk Description**	**Primary Impact**	**Additional Impact**	**Probability/Likelihood**	**Seriousness / Severity**	**Risk Score**	**Risk Ranking**	**Timeline Horizon**	**Abilty to Predict / Control**	**Risk Ownership**	**Triggering Events**	**Proposed Reponse**	**Residual Risk Assessment**
Identification number for each listed Risk	Design, Site Validation, Construction, ect.	Categories of risk based on logical grouping of similar types	Agency, Key Stakeholder, other	The risk stated in a complete sentence which states the cause of the risk, the risk, and the effect that the risk causes to the project.	Categorization of risks by area of project affected, source of risk or other useful category.	Categorization of risks by area of project affected, source of risk or other useful category.	Likelihood that a risk will occur ***(on a scale from 0 to 10 with 10 being the highest)***	The impact of the risk on the project if the risk occurs **(scale from 0 to 10 with 10 being the highest)**	Determined by multiplying probability and impact ***(scale from 0 to 100)***	Piority list determined by relative ranking of the risks **(by their scores)**	***(Near-Term/ Mid-Term/ Long-Term)***	How difficult is it to anticipate the risk ***(High / Medium / Low)*** .	The team member / member firm responsible to track triggers, and manage the risk response if the risk occurs.	Something which indicates that a risk is about to occur or has already occured.	The action which is to be taken if this risk occurs.	Describe residual risk and potential impacts
SAMPLE	Design Phase	Design Completion		PDC Rejects at Preliminary Approval	Schedule	Budget	5	6	30	TBD	Near-Term	Medium	Design Builder (Design Team)	PDC Preliminary Presentation	Anticipate next PDC submission dates, DDC communitcation with PDC, address all PDC concerns as thoroughly as possibel	Compensable Delay Under Contract
1	**Design Phase**	Design Completion		Subcontractor Design Assist responsibilities	Schedule						Near-Term		Design Builder			
2	**Design Phase**	Design Completion		Completion of DOB Filing and Permitting sets	Schedule	Budget					Near-Term		Design Builder (Design Team)			
3	**Design Phase**	Design Completion		Survey inaccuracies	Schedule	Budget					Near-Term		Design Builder (Design Team)			
4	**Design Phase**	Design Completion		DCLA - % for Art Requirements / Participation	Schedule	Budget					Near-Term		Design Builder			
5	**Design Phase**	Design Completion		DDC, DOCJ, DOC program changes during design	Schedule	Budget					Near-Term		DDC			
6	**Design Phase**	Design Completion		Late added requirements by Key Stakeholders, AHJ's during Design	Schedule	Budget					Near-Term		DDC			
7	**Design Phase**	Design Completion		DCP / Community Board - Letter of Agreement	Schedule						Near-Term		DDC			
8	**Design Phase**	Design Completion		Community Board Resolution for PDC	Schedule						Near-Term		Design Builder (Design Team)			
9	**Design Phase**	Design Completion		Very Short Duration to Prepare Filing Package (90 Days from NTP)	Schedule						Near-Term		Design Builder (Design Team)			
10	**Design Phase**	Design Completion		Working / Completing Design Prior to Contract Execution	Budget	Legal					Near-Term		Design Builder			
11	**Design Phase**	Design Completion		Public Design Commission Preliminary Approval	Schedule	Budget					Near-Term		Design Builder (Design Team)			
12	**Design Phase**	Design Completion		Public Design Commission Final Approval	Schedule	Budget					Near-Term		Design Builder (Design Team)			
13	**Design Phase**	Design Completion		Design errors and ommissions	Schedule	Budget					Near-Term		Design Builder (Design Team)			
14	**Design Phase**	Design Completion		Percent for Art Elements (Integrated Art Façade)	Schedule	Budget					Near-Term		Design Builder			
15	**Design Phase**	Design Completion		BBJ Program changes / cancellation	Schedule	Budget					Near-Term		DDC			
16	**Design Phase**	Authorities Having Jurisdiction	DEP	Storm and Sanitary Connections	Schedule	Budget					Near-Term		DDC			
17	**Design Phase**	Authorities Having Jurisdiction	DOT	Authoritites Having Jurisdiction - Approvals - DOT	Schedule	Budget					Near-Term		DDC			
18	**Design Phase**	Authorities Having Jurisdiction	DOB	Early Foundation Permitting	Schedule	Budget					Near-Term		DDC			
19	**Design Phase**	Authorities Having Jurisdiction	DOB	Other Permitting	Schedule	Budget					Near-Term		DDC			
20	**Design Phase**	Authorities Having Jurisdiction	FDNY	Authoritites Having Jurisdiction - Approvals - FDNY	Schedule	Budget					Near-Term		DDC			
21	**Design Phase**	Authorities Having Jurisdiction	MTA / NYCT	Impact on MTA / NYCT Assets	Schedule	Budget					Near-Term		DDC			
22	**Design Phase**	Authorities Having Jurisdiction	MTA / NYCT	Outside Projects Division	Schedule	Budget					Near-Term		DDC			
23	**Design Phase**	Authorities Having Jurisdiction	NYPD	Late requirements	Schedule	Budget					Near-Term		DDC			
24	**Design Phase**	Authorities Having Jurisdiction	DPR	Street trees, other	Schedule	Budget					Near-Term		DDC			
25	**Design Phase**	Authorities Having Jurisdiction	ConEd	Connections, vaults, Network Protection	Schedule	Budget					Near-Term		DDC			
26	**Design Phase**	Legal / Regulatory		Easements / ROWs	Schedule						Near-Term		DDC			
27	**Design Phase**	Legal / Regulatory		Changing DOB requirements	Schedule	Budget					Near-Term		DDC			
28	**Design Phase**	Legal / Regulatory		Access Agreements	Schedule						Near-Term		DDC			
29	**Site Validation Phase**	Environmental		Dewatering Requirements	Schedule	Budget					Near-Term		Design Builder			
30	**Site Validation Phase**	Site		Unanticipated SOE requirements	Schedule	Budget					Near-Term		Design Builder			
31	**Site Validation Phase**	Site		Unanticipated Obstructions	Schedule	Budget					Near-Term		Design Builder			
32	**Site Validation Phase**	Site		Unanticipated Archeological finds	Schedule	Budget					Near-Term		Design Builder			
33	**Site Validation Phase**	Environmental		Previously unidentified tanks for removal	Schedule	Budget					Near-Term		Design Builder			
34	**Site Validation Phase**	Environmental		Suitability of existing materials to be reused below grade		Budget					Near-Term		Design Builder			
35	**Site Validation Phase**	Environmental		Regulatory changes	Schedule	Budget					Near-Term		DDC			

Risk Register

Hunter Roberts Construction Group

DDC - Queens Garage - Design-Build

Friday, September 18, 2020

Risk Identification							Qualitative Rating						Risk Response			
Risk ID	**Project Phase**	**Risk Type**	**Authority Having Jurisdiction (AHJ)**	**Risk Description**	**Primary Impact**	**Additional Impact**	**Probability/Likelihood**	**Seriousness / Severity**	**Risk Score**	**Risk Ranking**	**Timeline Horizon**	**Abilty to Predict / Control**	**Risk Ownership**	**Triggering Events**	**Proposed Reponse**	**Residual Risk Assessment**
Identification number for each listed Risk	Design, Site Validation, Construction, ect.	Categories of risk based on logical grouping of similar types	Agency, Key Stakeholder, other	The risk stated in a complete sentence which states the cause of the risk, the risk, and the effect that the risk causes to the project.	Categorization of risks by area of project affected, source of risk or other useful category.	Categorization of risks by area of project affected, source of risk or other useful category.	Likelihood that a risk will occur ***(on a scale from 0 to 10 with 10 being the highest)***	The impact of the risk on the project if the risk occurs **(scale from 0 to 10 with 10 being the highest)**	Determined by multiplying probability and impact ***(scale from 0 to 100)***	Piority list determined by relative ranking of the risks **(by their scores)**	***(Near-Term/ Mid-Term/ Long-Term)***	How difficult is it to anticipate the risk ***(High / Medium / Low)*** .	The team member / member firm responsible to track triggers, and manage the risk response if the risk occurs.	Something which indicates that a risk is about to occur or has already occured.	The action which is to be taken if this risk occurs.	Describe residual risk and potential impacts
36	**Site Validation Phase**	Environmental		Available environmental analysis incomplete/inaccurate	Schedule	Budget					Near-Term		DDC			
37	**Site Validation Phase**	Environmental		Unanticipated Hazardous Materials	Schedule	Budget					Near-Term		DDC			
38	**Site Validation Phase**	Site		Timely and complete site access	Schedule						Near-Term		DDC			
39	**Site Validation Phase**			Newly identified stakeholders during site validaton phase	Schedule	Budget					Near-Term		DDC			
40	**Site Validation Phase**	Market Risk		City Capital Funding Availability	Schedule	Budget					Near-Term		DDC			
41	**Site Validation Phase**	Market Risk		OMB CP Issuance	Schedule	Budget					Near-Term		DDC			
42	**Site Validation Phase**	Market Risk		Comptroller Registration of DBA	Schedule	Budget					Near-Term		DDC			
43	**Site Validation Phase**			DBA Contract Closing / Execution	Schedule	Budget					Near-Term		DDC			
44	**Site Validation Phase**			Receipt of NTP 1	Schedule	Budget					Near-Term		DDC			
45	**Site Validation Phase**			Receipt of NTP 2	Schedule	Budget					Near-Term		DDC			
46	**Procurement**	Unique Design Elements		Exterior Garage Fins		Budget					Mid-Term		Design Builder (Design Team)			
47	**Procurement**	Unique Design Elements		Integrated Art Façade	Schedule	Budget					Mid-Term		Design Builder (Design Team)			
48	**Procurement**			Estimate misses		Budget					Mid-Term		Design Builder			
49	**Procurement**			Missed Buys, unbought scope		Budget					Mid-Term		Design Builder			
50	**Procurement**			Poor subcontractor coverage		Budget					Mid-Term		Design Builder			
51	**Procurement**	MWBE		Difficulties with MWBE participation/success in Buy out		Budget					Mid-Term		Design Builder			
52	**Procurement**	Insurance / Bonding		Ability of certain subcontractors to be approved for Subcontractor Default Insurance (SDI) program	Schedule	Budget					Mid-Term		Design Builder			
53	**Procurement**	Insurance / Bonding		Ability of certain subcontractors to be provide required insurance limits (waivers)	Schedule	Budget					Mid-Term		Design Builder			
54	**Procurement**	Market Risk		Atypical escalation, inflation		Budget					Mid-Term		Design Builder			
55	**Construction**	Unforseen Site Conditions		Utilities not where shown, anticipated	Schedule	Budget					Long-Term		Design Builder			
56	**Construction**	Unforseen Site Conditions		Unanticpated underground geotechnical conditions	Schedule	Budget					Long-Term		Design Builder			
57	**Construction**	Unforseen Site Conditions		Unanticipated level of groundwater infiltration	Schedule	Budget					Long-Term		Design Builder			
58	**Construction**	COVID 19		Material and Shipment Delays / Travel Bans	Schedule	Budget					Long-Term		Design Builder			
59	**Construction**	COVID 19		Distancing and PPE Protocols	Schedule	Budget					Long-Term		Design Builder			
60	**Construction**	COVID 19		Potential Site Shutdowns	Schedule	Budget					Long-Term		Design Builder			
61	**Construction**	COVID 19		City / State Executive Order - Construction Stoppage	Schedule	Budget					Long-Term		DDC			
62	**Construction**			MTA / NYCT - Force Account Requirements		Budget					Long-Term		Design Builder			
63	**Construction**			DOT / NYPD - Traffic Enforcement Agents Requirements		Budget					Long-Term		Design Builder			
64	**Construction**			Late added requirements by Key Stakeholders, AHJ's during Construction	Schedule	Budget					Long-Term		DDC			
65	**Construction**	Safety		Dangers to public	Schedule						Long-Term		Design Builder			
66	**Construction**	Safety		Dangers to workers	Schedule						Long-Term		Design Builder			
67	**Construction**	Safety		Fire	Schedule	Budget					Long-Term		Design Builder			
68	**Construction**	Safety		Security (intrusion, vandalism, theft, etc.)	Schedule	Budget					Long-Term		Design Builder			
69	**Construction**			DDC, DOCJ, DOC program changes during construction	Schedule	Budget					Long-Term		DDC			
70	**Construction**	Market Risk		Available Workforce due to market conditions	Schedule	Budget					Long-Term		Design Builder			
71	**Construction**	COVID 19		Available Workforce due to COVID	Schedule	Budget					Long-Term		Design Builder			
72	**Construction**			Work area restrictions different than anticipated	Schedule	Budget					Long-Term		DDC			
73	**Construction**			Work hours restriction different than anticipated	Schedule	Budget					Long-Term		Design Builder			
74	**Construction**			Condition of existing storm detention system	Schedule	Budget					Long-Term		DDC			
75	**Construction**			Difficulty establishing bypass/temporary connections for existing storm detention system	Schedule	Budget					Long-Term		Design Builder			
76	**Construction**			Labor disputes / strikes	Schedule	Budget					Long-Term		Design Builder			
77	**Construction**			Issues with PLA	Schedule	Budget					Long-Term		DDC			

Risk Register

Hunter Roberts Construction Group

DDC - Queens Garage - Design-Build

Friday, September 18, 2020

Risk Identification							Qualitative Rating						Risk Response			
Risk ID	**Project Phase**	**Risk Type**	**Authority Having Jurisdiction (AHJ)**	**Risk Description**	**Primary Impact**	**Additional Impact**	**Probability/Likelihood**	**Seriousness / Severity**	**Risk Score**	**Risk Ranking**	**Timeline Horizon**	**Abilty to Predict / Control**	**Risk Ownership**	**Triggering Events**	**Proposed Reponse**	**Residual Risk Assessment**
Identification number for each listed Risk	Design, Site Validation, Construction, ect.	Categories of risk based on logical grouping of similar types	Agency, Key Stakeholder, other	The risk stated in a complete sentence which states the cause of the risk, the risk, and the effect that the risk causes to the project.	Categorization of risks by area of project affected, source of risk or other useful category.	Categorization of risks by area of project affected, source of risk or other useful category.	Likelihood that a risk will occur ***(on a scale from 0 to 10 with 10 being the highest)***	The impact of the risk on the project if the risk occurs **(scale from 0 to 10 with 10 being the highest)**	Determined by multiplying probability and impact ***(scale from 0 to 100)***	Piority list determined by relative ranking of the risks **(by their scores)**	***(Near-Term/ Mid-Term/ Long-Term)***	How difficult is it to anticipate the risk ***(High / Medium / Low)*** .	The team member / member firm responsible to track triggers, and manage the risk response if the risk occurs.	Something which indicates that a risk is about to occur or has already occured.	The action which is to be taken if this risk occurs.	Describe residual risk and potential impacts
78	**Construction**			Cant get quality required out of particular subcontractors/suppliers	Schedule	Budget					Long-Term		Design Builder			
79	**Construction**			performance issues with labor productivity	Schedule	Budget					Long-Term		Design Builder			
80	**Construction**			performance issues with equipment productivity	Schedule	Budget					Long-Term		Design Builder			
81	**Construction**			Adjacent Project interface issues	Schedule	Budget					Long-Term		Design Builder			
82	**Construction**			Defective work	Schedule	Budget					Long-Term		Design Builder			
83	**Construction**			Out of sequence work	Schedule	Budget					Long-Term		Design Builder			
84	**Construction**			Mock-up approval issues	Schedule						Long-Term		Design Builder			
85	**Construction**			Change Management Process issues - Change Order Approvals	Schedule	Budget					Long-Term		DDC			
86	**Construction**			Issues with Submittal Schedules	Schedule						Long-Term		Design Builder			
87	**Construction**			Owner payment delays and result payment delays to subs	Schedule						Long-Term		DDC			
88	**Construction**			Subcontractor Liens	Schedule	Budget					Long-Term		Design Builder			
89	**Construction**			Subcontractor Defaults	Schedule	LEgal					Long-Term		Design Builder			
90	**Construction**			Subcontractor Bankruptcies	Schedule	Legal					Long-Term		Design Builder			
91	**Construction**	Force Majeure		Natural disasters and related events	Schedule	Budget					Long-Term		DDC			
92	**Construction**	Force Majeure		Public Health Emergencies	Schedule	Budget					Long-Term		DDC			
93	**Construction**	Force Majeure		Industry-wide Labor Actions	Schedule	Budget					Long-Term		DDC			
94	**Post Construction**			DDC, DOCJ, DOC Acceptance	Schedule						Long-Term		Design Builder			
95	**Post Construction**			Adequacy of Training	Schedule						Long-Term		Design Builder			
96	**Post Construction**			As-Builts / Record Drawing requirements not met	Schedule						Long-Term		Design Builder			

M/WBE Partnering Approach

PART 05

M/WBE ACHIEVEMENT AND UTILIZATION PLAN

HRCG and our D-B partners believe in a culture of caring. More than a slogan, it requires us to understand the issues that keep our clients up at night, which helps us generate solutions that are comprehensive, thoughtful and sustainable.

Hunter Roberts is committed to expanding opportunities for and building meaningful relationships with Minority and Women-Owned Businesses (MWBEs). Our team champions subcontractor diversity and believes that working with MWBEs makes our team more competitive, enhances equity within the industry, and results in better project outcomes.

Hunter Roberts has a strong record of working with public agencies to achieve their MWBE participation goals. Since 2009, HRCG has served as an active partner to our public sector counterparts in brainstorming and in developing strategic solutions to maximizing MWBE subcontractor participation. We have a proven track-record of working with NYEDC and their Opportunity M/W/DBE group to expand opportunities and have built relationships with firms that we have worked with not only on NYCEDC projects with MWBE goals, but also on private sector projects with no MWBE requirements. We continuously promote those companies and support them in their growth. We believe that our approach to incorporating MWBE participation on projects aligns with that of the overall BBJ program.

Our numbers may check a box, but the continued success of our M/WBE business partners is the truest measure of the realization of our program's mission.

HRCG has conducted a comprehensive review of construction documents and has broken the drawings into bid packages and will break certain bid packages into smaller trade packages to create more opportunities for engaging MWBEs who may be smaller in size or more specialized. We have also begun to identify trades that typically have a high concentration of MWBEs and to leverage relationships within those trades to maximize participation. Trades where we see a strong potential for contracting directly with an MWBE sub include:

- BP1: Hoist, Site Fence, Sidewalk Bridging (broken up into three packages)
- BP 16: Drywall and Carpentry (broken up into several smaller packages such as Painting, Doors/Frames/Hardware, Tile, Resilient Flooring, etc.)
- BP 25: Electrical, Security, Teledata (breaking out Teledata and security)
- BP 29: Landscaping
- BP 30: Site Safety Managers, Cleaning, Security

While the above trades offer strong opportunities for MWBE engagement, achieving 30% MWBE participation will be an ambitious task given the nature of the job. A third of the project volume falls within Excavation/Foundation and Precast Concrete, two fields where there are a limited number of MWBE firms. Additionally, because the job is Design-Build, subcontractors will be expected to provide design-assist services from the onset, something that many firms are not accustomed to providing, particularly with the ambitious schedule that we are striving to meet.

While we recognize the above challenges in achieving the 30% goal, we will make our best faith efforts to maximize participation. For all trades, we will seek to utilize MWBE trucking services, rental equipment, materials and supplies as much as possible. We've detailed this strategy further in the MWBE forms but know that the strategy will continue to evolve as the project advances, and we look forward to additional input from NYCDDC.

FORM M-1 - LIST OF PROPOSED M/WBES

Complete Form M-1 Table 1 to list all proposed M/WBEs in the Proposer's team and total commitments. Complete Form M-1 Table 2 to list proposed work items of M/WBE utilization for which M/WBE firms have not yet been assigned by the Proposer, excluding M/WBE activity covered in Form M-1 Table 1.

Use additional rows / sheets as necessary.

FORM 1 Table 1 – PROPOSED LIST OF NAMED MWBE PARTICIPANTS				
PROPOSER	Hunter Roberts Construction Group, LLC			
MWBE Firm Name	**Description of Work**	**Design**	**Construction**	**% Credit Claimed**
Marvel Architects	Arch, Int., Landscape, Structural, Parking Design, EOR	20%		100%
JFK&M Consulting Group	MEP (Plumbing, FP, FA)	6%		100%
Matrix New World, Inc.	Civil, Geotech, Storm Detention	6%		100%
CBA	Vertical Transportation	1%		100%
Outsource	Expediting	2%		100%
Leni Schwendiger	Exterior Lighting	1%		100%
Future Trade Contractors	Various trades (trade contractor M/WBE awards will be added to form M-1 Table 1 upon final bidding rounds.		TBD	TBD

FORM M-1 - LIST OF PROPOSED MWBES

Use additional rows / sheets as necessary.

FORM 2 Table 2 – PROPOSED WORK M/WBE PARTICIPANTS (excluding M/WBE commitments listed on Table 1)		
Contract #		
Work Category (Design, Inspection, Materials, Construction, Trucking, etc.) **(See Note 1)**	**Description of Work**	**% Credit Claimed**
Services	Design/Engineering, professional consultant services, and other services beyond those indicated in Table 1	100%
Material Suppliers	Fireproofing, Elevator, Fire Protection, Plumbing, Electrical, Security, Teledata, Site Utilities, Wheel Stops, Bike Racks, PV Panels, Masonry, Roofing, Integrated Art Façade, Miscellaneous Metals	60%
Equipment Rental	Hoist	100%
Trucking Operations	Excavation & Foundations, Precast Concrete, Structural Steel, Cast-In-Place Concrete, Metal Panel (Fins, Louver Wall, Mechanical Screen, Opaque Façade) , Exterior Glass (Curtain Wall, Storefront, Windows)	up to 100%
Subcontractors	Site Fence, Sidewalk Bridging, Traffic Coatings, Drywall & Carpentry, OSHA, Specialties Protection, HVAC, Sitework/Hardscaping, Landscaping, Site Safety Managers, Cleaning, Security	100%

Note 1: List only 1 Work Category per row, even if it is the same M/WBE. The Description of Work shall correspond to the Work Category in the same row.
Note 2: The value of the Commitment reflects the net amount to be paid toward the goal based upon the % Credit Claimed.
Example 1: Subcontracting clearing and grubbing $50,000 @ 100% = $50,000 Commitment.
Example 2: Supply geotextile fabric $10,000 @ 80% = 6,000 Commitment.

Form M-2
M/WBE SOLICITATION LOG

Contract No. _____ County NEW YORK Proposal Due Date 9/18/2020 Date Submitted 9/18/2020 Page 1 of 4

Contractor Name / Address Hunter Roberts Construction Group, LLC Contract Name: DDC Queens Parking Garage

55 Water Street, 51st Floor E-Mail: jfrankel@hrcg.com

New York, NY 10001 Telephone No: (646) 899-5109

	Firm Name Contact	City or State Certified MWBE	Telephone No. E-Mail Address	Work Description	Date of Contact	Method(s) of Contact	MWBE Response Code(s)	Bidder Action Code(s)
1	Oliveira Contracting Inc	NYC & NY State WBE	(516) 333-6343	Foundations	8/28/2020	Phone	14	TBD
	Aziz Davranov, Estimator		aziz@oliveiracontracting.com	-	9/1/2020	Phone, Email	14	TBD
	-		-	-	9/8/2020	Phone	24	TBD
2	New York Concrete Corporation	NYC & NY State WBE	(718) 967-3720	Foundations	8/28/2020	Phone	14	TBD
	Leo McGugart, VP Chief Estimator		lmcgugart@newyorkconcrete.com	-	-	-	-	TBD
	-		-	-	-	-	-	TBD
3	Commodore Construction Corp.	NYC & NY State WBE	(914) 297-3036	Cast-In-Place Concrete	8/28/2020	Phone	14	TBD
	Chris Pezone, Senior Estimator		cpezone@commodorecc.com	-	8/31/2020	Phone	14	TBD
	-		-	-	9/11/2020	Phone	14	TBD
4	Oliveira Contracting Inc	NYC & NY State WBE	(516) 333-6343	Cast-In-Place Concrete	8/28/2020	Phone	14	TBD
	Aziz Davranov, Estimator		aziz@oliveiracontracting.com	-	9/1/2020	Phone, Email	14	TBD
	-		-	-	9/8/2020	Phone	24	TBD
5	Westchester Metal Works, Inc.	NYC WBE	(914) 376-4999	Misc. Metals	8/28/2020	Phone	14	TBD
	Dylan Russell, Estimator		dylan@westmetals.net		9/1/2020	Phone	14	TBD
	-				9/14/2020	Phone	14	TBD
6	Eurotech Construction Corporation	NYC WBE	(212) 594-7474	Fireproofing	9/14/2020	Phone	26	TBD
	Liz Nienstedt, Administrative Assistant		estimating@eurotechny.com	-	-	-	-	TBD
	-		-	-	-	-	-	TBD
7	Commodore Construction Corp.	NYC & NY State WBE	(914) 297-3036	Fireproofing	8/28/2020	Phone	26	TBD
	Chris Pezone, Senior Estimator		cpezone@commodorecc.com	-	-	-	-	TBD
	-		-	-	-	-	-	TBD
8	Commodore Construction Corp.	NYC & NY State WBE	(914) 297-3036	Exterior Glass	8/28/2020	Phone	14	TBD
	Chris Pezone, Senior Estimator		cpezone@commodorecc.com		8/31/2020	Phone	14	TBD
	-				9/2/2020	Phone	26	TBD
9	Commodore Construction Corp.	NYC & NY State WBE	(914) 297-3036	Masonry, Stone Facing	8/31/2020	Phone	14	TBD
	Chris Pezone, Senior Estimator		cpezone@commodorecc.com	-	9/11/2020	Phone	14	TBD

Form M-2
M/WBE SOLICITATION LOG

Contract No. _____ County NEW YORK Proposal Due Date 9/18/2020 Date Submitted 9/18/2020 Page 2 of 4

Contractor Name / Address Hunter Roberts Construction Group, LLC Contract Name: DDC Queens Parking Garage

55 Water Street, 51st Floor E-Mail: jfrankel@hrcg.com

New York, NY 10001 Telephone No: (646) 899-5109

	Firm Name Contact	City or State Certified MWBE	Telephone No. E-Mail Address	Work Description	Date of Contact	Method(s) of Contact	MWBE Response Code(s)	Bidder Action Code(s)
11	Job Opportunities for Women Inc.	NY State WBE	(516) 333-4414	Masonry, Stone Facing	8/31/2020	Phone, Email	26	35/36, TBD
	Sue Minucci, Owner		sue.minucci@jofw.com	-	-	-	-	TBD
	-		-	-	-	-	-	-TBD
12	Centron Enterprises LLC	NYC MBE	(908) 245-8100	Traffic Coating	8/31/2020	Phone	14	TBD
	Jay Babra		jbabra@centronllc.com	-	-	-	-	TBD
	-		-	-	-	-	-	TBD
13	Eurotech Construction Corporation	NYC WBE	(212) 594-7474	Drywall & Carpentry	9/2/2020	Phone	14	TBD
	Liz Nienstedt, Administrative Assistant		estimating@eurotechny.com	-	9/8/2020	Phone	26	TBD
	-		-	-	-	-	-	TBD
14	Curtis Partition Corporation	NYC & NY State MBE	(646) 315-6700	Drywall & Carpentry	8/31/2020	Email	26	TBD
	Michael, Estimating		bidrequests@curtispartition.com	-	-	-	-	TBD
	-		-	-	-	-	-	TBD
15	R & J Construction Corp.	NY State MBE	(516) 639-5629	Drywall & Carpentry	9/2/2020	Phone	26	35/36, TBD
	Daryn Quitoni		dquitoni@randjconstruction.com	-	9/8/2020	Phone	26	TBD
	-		-	-	-	-	-	TBD
16	Commodore Construction Corp.	NYC & NY State WBE	(914) 297-3036	Drywall & Carpentry	8/28/2020	Phone	14	TBD
	Chris Pezone, Senior Estimator		cpezone@commodorecc.com	-	8/31/2020	Phone	14	TBD
	-		-	-	9/11/2020	Phone	14	TBD
17	Robert Parchment Plumbing and Heating, Inc.	NYC & NY State MBE	(917) 299-7061	Plumbing	9/2/2020	Phone	26	TBD
	Robert Parchment, Owner		rpplunb@aol.com	-	-	-	-	TBD
	-		-	-	-	-	-	TBD
18	Cardoza Plumbing Corp.	NYC & NY State MBE	(516) 876-6900	Plumbing	9/9/2020	Phone	14	TBD
	Raymond Cardoza, President		dan@cardozaplumbing.com	-	-	-	-	TBD
	-		-	-	-	-	-	TBD
19	Premier Mechanical Services Inc.	NYC & NY State WBE	(631) 956-1112	HVAC	8/31/2020	Phone	14	TBD
	Kacie DeLuca, Assistant Estimator		kacie@premiermechanical.net	-	9/2/2020	Phone	26	TBD

Form M-2
M/WBE SOLICITATION LOG

Contract No. _____ County NEW YORK Proposal Due Date 9/18/2020 Date Submitted 9/18/2020 Page 3 of 4

Contractor Name / Address Hunter Roberts Construction Group, LLC Contract Name: DDC Queens Parking Garage

55 Water Street, 51st Floor E-Mail: jfrankel@hrcg.com

New York, NY 10001 Telephone No: (646) 899-5109

	Firm Name Contact	City or State Certified MWBE	Telephone No. E-Mail Address	Work Description	Date of Contact	Method(s) of Contact	MWBE Response Code(s)	Bidder Action Code(s)
20	Center Sheet Metal Inc.	NYC & NY State WBE	(718) 893-6700	HVAC	N/A	N/A	26	TBD
	Daniel Rosario, Estimator		daniel@centersheetmetal.com	-	-	-	-	TBD
	-		-	-	-	-	-	TBD
21	ADCO Electrical Corp.	NYC WBE	(718) 494-4400	Electrical	N/A	N/A	26	TBD
	Alicia Gonzalez, Administrative Assistance for Estimating		agonzalez@adcoonline.com	-	-	-	-	TBD
	-		-	-	-	-	-	TBD
22	Nunez Electric Corp., Inc.	NYC & NY State MBE	(718) 786-6473	Electrical	8/31/2020	Phone	14	TBD
	Raquel Nunez, Director		nunezelectric@aol.com	-	9/8/2020	Phone	26	TBD
	-		-	-	-	-	-	TBD
23	Egg Electric Inc.	NYC WBE	(212) 633-9551	Electrical	8/31/2020	Phone, Email	26	35/36, TBD
	Estimating Department		estimating@eggelectric.com	-	9/10/2020	Phone, Email	26	35/36, TBD
	-		-	-	-	-	-	TBD
24	Weltmann Lighting LLC	NYC & NY State WBE	(516) 513-1030	Lighting	9/2/2020	Phone	14	TBD
	Anna Bispat, Office Administrator		abispat@weltmannlighting.com	-	-	-	-	TBD
	-		-	-	-	-	-	TBD
25	Prima Paving Corporation	NYC & NY Sate MBE	(516) 681-8700	Work, Site Drainage, Temp. Parking	8/28/2020	Phone	14	TBD
	Zahid Khan, President		zkahn@primapaving.com	-	-	-	-	TBD
	-		-	-	-	-	-	TBD
26	Park Avenue Building & Roofing Supplies, LLC	NYC & NY Sate MBE	(718) 403-0100	Doors, Frames & Hardware	8/28/2020	Phone	14	TBD
	Peter Wu, Estimating Coordinator		peterwu@parkavebuilding.com	-	-	-	-	TBD
	-		-	-	-	-	-	TBD
27	J C Ryan Ebco - H & G LLC	NYC & NY Sate WBE	(631) 694-0008	Doors, Frames & Hardware	8/28/2020	Phone, Email	26	35/36, TBD
	Peter Chambers, Estimator		peterchambers@jcryanebco.com	-	-	-	-	TBD
	-		-	-	-	-	-	TBD
28	Director Door Industries	NYC WBE	(631) 777-7878 x100	Doors, Frames & Hardware	N/A	N/A	26	TBD
	Erika Tripoli, Sales		quotes@directordoor.com		-	-	-	TBD

Form M-2
M/WBE SOLICITATION LOG

Contract No. ______ County NEW YORK Proposal Due Date 9/18/2020 Date Submitted 9/18/2020 Page 4 of 4

Contractor Name / Address Hunter Roberts Construction Group, LLC Contract Name: DDC Queens Parking Garage

55 Water Street, 51st Floor E-Mail: jfrankel@hrcg.com

New York, NY 10001 Telephone No: (646) 899-5109

	Firm Name Contact	City or State Certified MWBE	Telephone No. E-Mail Address	Work Description	Date of Contact	Method(s) of Contact	MWBE Response Code(s)	Bidder Action Code(s)
29	Glenwood Mason Supply Co, Inc.	NYC WBE	(917) 488-0398	Masonry	9/16/2020	Phone	26	TBD
	Gina Cali, Architectural Sales Exec		gina@glenwoodmason.com	-	-	-	-	TBD
	-		-	-	-	-	-	TBD
30	CGS Rebar Inc.	NYC & NY State WBE	(516) 578-1967	Rebar	9/16/2020	Phone	26	TBD
	Michele Schaeffer		cgsrebar@optonline.net	-	-	-	-	TBD
	-		-	-	-	-	-	TBD

FORM M-3 - SCHEDULE OF PROPOSED M/WBE UTILIZATION

List proposed M/WBE Utilization by indicating percentages of the contract value that are anticipated for each 3-month interval over the duration of the contract. Total M/WBE utilization should agree with Form M-1 – Tables 1 & 2.

Use additional rows as necessary.

PROPOSER	Hunter Roberts Construction Group, LLC	
Time Interval (Beginning at Notice to Proceed)	**Work Description** (To be utilized during interval)	**Anticipated Utilization** (Proposed Participation in percentages (%))
0 – 3 months	Site Fence, Sidewalk Bridging, Excavation & Foundations, Site Utilities, OSHA protection, Site Safety Managers, Cleaning, Security	2% - 3%
4 – 6 months	Excavation & Foundations, Site Utilities, OSHA protection, Site Safety Managers, Cleaning, Security	1% - 2%
7 – 9 months	Excavation & Foundations, OSHA protection, Site Safety Managers, Cleaning, Security	1% - 2%
10 – 12 months	Excavation & Foundations, Structural Steel, CIP Concrete, Fireproofing, OSHA protection, Site Safety Managers, Cleaning, Security	2% - 3%
13 – 15 months	Precast Concrete, Structural Steel, CIP Concrete, Fireproofing, Exterior Wall, Masonry, Roofing, OSHA protection, Site Safety Managers, Cleaning, Security	1% - 3%
16 – 18 months	Precast Concrete, Hoist, Fireproofing, Exterior Wall, Integrated Art Façade, Masonry, Roofing, Drywall & Carpentry, MEP, Fire Protection, Elevators, Misc Metals, Security/Teledata, Metal Panel, Traffic Coatings, Sitework/Hardscaping, Wheel Stops, Bike Racks, OSHA protection, Site Safety Managers, Cleaning, Security	4% - 7%
19 – 21 months	Drywall & Carpentry, MEP, Parking Equipment, Elevators, Misc Metals, Fire Protection, Security/Teledata, Sitework/Hardscaping, PV Panels, OSHA protection, Site Safety Managers, Cleaning, Security	3% - 5%
22 – 24 months	MEP, Specialties, Misc Metals, Community Center Equipment, Fire Protection, Security/Teledata, Sitework/Hardscaping, Landscaping, PV Panels, OSHA protection, Site Safety Managers, Cleaning, Security	2% - 5%
25 – 27 months		
28 – 30 months		
31 – 33 months		
34 – 36 months		
Etc.		

Team and Experience PART 06

PROJECT TEAM PAST EXPERIENCE

[Use same form for 5 projects]	Name of Proposer: Hunter Roberts Construction Group, LLC
General Information:	Project Number*: 1
Project Name, Location and Size:	Name: Yankees Parking Facilities Location: Bronx, NY Size: 5,000 spaces

Original Contract Amount:	$245,857,565	Original Completion Date:	4/1/2010
Final Construction Cost:	$245,973,428	Actual Completion Date:	4/1/2010
Reason for Difference if more than 10%	N/A	Type of Facility:	Parking Structures

Proposer's Role: (Prime, Joint Venture, LLC, Integrated DB, Sub): Joint Venture

Builder (Name): Hunter Roberts Construction Group, LLC

Designer of Record (Name): Clark Caton Hintz

Project Delivery Method & RFP Type:

Private Negotiated		Construction Manager At Risk	
Design-Build w/out Bridging Docs	X	Design-Build with Bridging Docs	
Design-Bid-Build		Other	

What type of RFP documents were used for this project?

Performance Requirements	X
Prescriptive Specifications	
Bridging Drawings and Specifications	

Describe any Awards this project received:
2011 Design Award - Precast/Concrete Institute
2012 Design Award - PCI Garage A
2011 ACEC Engineering Excellence

Past Performance Reference: The City of New York reserves the right to contact this organization or person and conduct a telephone interview for references. Confirm this reference is available.

Organization:	Weill Cornell Medica Center (Formerly of NYCEDC)
Contact Person Title:	Dmitri V. Konon, P.E. Assistant Provost (Formerly AVP - Capital Program NYCEDC)
Telephone:	212-746-6815
Email:	dvk2001@med.cornell.edu
Address:	1300 York Ave, New York
City, State, Zip:	New York, NY 10065

Self-Performance

Percentage of work self-performed:

Detailed description of work self-performed:
Hunter Roberts in a joint venture partnership with Prismatic Development Corp. was responsible for the design and construction of several parking garages in the new Yankee Stadium Construction program. We engaged design architects, engineers, specialty consultants and subcontractors to take the project from performance requirements through construction completion. We self-performed all tasks relating to the pre-construction, construction management, cleaning labor and miscellaneous carpentry. Hunter Roberts utilized the onsite cleaning labor to also manage material storage, deliveries, and general logistics requirements of the project.

Describe any work you subcontracted to others:

Hunter Roberts subcontracted most of the trade work to qualified contractors after a thorough bidding and leveling process. Subcontracted work included Sitework, Excavations and Foundations, Precast structure, MEPS, and finish trades. All of these subcontractors were managed directly by Hunter Roberts on a daily basis.

List Key DB Team Members (firm and / or individual) that were critical to this project that are also proposed for the Project.

Paul Wassenbergh, Design-Build Project Manager / Design-Build Construction Project Manager
David Kane, PE participated on the project on the client side in his role as EVP of the Capital Program Division at the NYCEDC

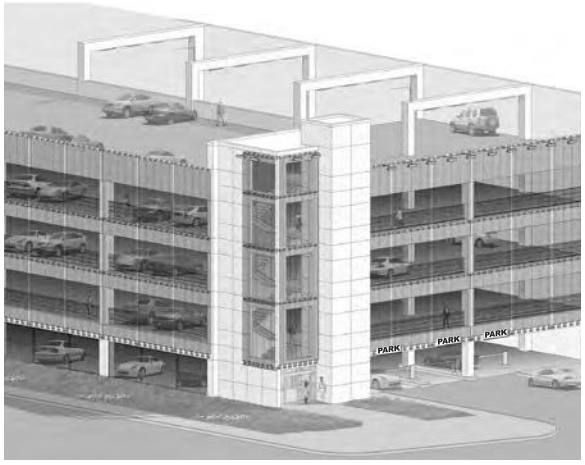
Provide a general description of the project:

Yankees Parking Garages, Bronx, NY

This parking complex for Yankee Stadium contains three garages - Garage A, Garage B, and Garage C- for a total of approximately 5,000 spaces, including appropriately-located handicapped spaces, with recreational facilities on the roof. The structure is supported by reinforced cast-in-place concrete pile caps set on concrete-filled steel pipe piles. Garage A has two below-grade levels, while Garage C has one below-grade level. Garage A was built atop a deep foundation system, including steel piles and drilled mini-piles, and, as an additional foundational element, adjoined the existing retaining wall. The structure of the garages was precast double-tees, with brick faced spandrels. Decorative stainless mesh panels were installed at the 164th Street Garage exterior to enhance the architectural vision of the garage. The exterior of this garage includes thin brick installed on the precast concrete spandrel panels on all levels. All exterior exposed precast concrete columns received a sand-blasted finish. Painted steel mesh was installed in the openings between the top of the first and second floor, and the second and third floor received precast spandrel panels. Work included interfacing with Yankee Stadium as well as a new state-of-the-art, Olympic-quality track and field with associated park improvements on top of one garage.

Project Name	**Yankees Parking Garages**

Describe only the project attributes directly applicable to the specific Tab (Tabs 1, 2, or 3) in Section 4 of the RFQ.



NYC Department of Design and Construction

Vendor Evaluation

Project Name: Yankee Stadium Parking Garages CAP Project Number (if applicable):

Hunter Roberts Construction Group / Prismatic - Joint Venture
(Contractor - Construction Manager - Builder)

Paul Wassenbergh *(Project Manager)* Pete Lodato *(Superintendent)*

Clark Caton Hintz
(Consultant - Designer)

George Hibbs / Mike Nelson *(Project Manager)* *(Construction Administration Observer (if applicable))*

New York City Economic Development Corporation *(Agency)* Dmitri Konon - Executive Vice President - Capital Program *(Agency Contact)*

This evaluation is of the: ☐ Contractor ☐ Consultant ☒ Design-Builder ☐ Other:

Please rate each of the criteria on a scale of 1 to 10, with 10 representing that you were very satisfied/in complete agreement with the statement and 1 representing that you were very unsatisfied/in disagreement with the statement. Please rate each of the criteria to the best of your knowledge. If you do not have sufficient knowledge in a particular area or it is not applicable, leave it blank.

NO	EVALUATION CRITERIA	UNIT	RATING
1	Ability to manage the project cost (minimize change orders)	(1-10)	10
2	Ability to maintain project schedule (complete on-time or early)	(1-10)	10
3	Quality of workmanship	(1-10)	9
4	Professionalism and ability to manage (includes responses and prompt payment to suppliers and subcontractors)	(1-10)	9
5	Close-out process (no punch list upon turnover, warranties, operating and maintenance manuals, etc. submitted promptly)	(1-10)	10
6	Communication, explanation of risk, and documentation	(1-10)	10
7	Ability to follow the State's and/or Agency's rules, regulations, and requirements (housekeeping, safety, etc.)	(1-10)	10
8	Overall customer satisfaction and comfort level in hiring the vendor again based on performance	(1-10)	10

Dmitri Konon *(Printed Evaluator Name)* *(Evaluator Signature)* 1-8-2020 *(Date)*

(212) 746-6815 *(Telephone Number)* dvk2001@med.cornell.edu *(Email Address)*

Assistant Vice Provost, Capital Planning *(Position/ Title)* Weill Cornell Medical College *(Agency/Firm Name)*

Comments:

The team at Hunter Roberts performed excellent work on the complex Yankee Stadium Garage Project. Their communication and responsiveness were terrific, and the coordination of work was extraordinary given the many interconnected pieces to deliver this project.

[Use same form for 5 projects]	Name of Proposer:	Hunter Roberts Construction Group, LLC

General Information: Project Number*: 2

Project Name, Location and Size: Prudential Tower
Newark, NJ
1.3 million SF

Original Contract Amount:	$444 million	Original Completion Date:	2015
Final Construction Cost:	$444 million	Actual Completion Date:	2015
Reason for Difference if more than 10%	NA	Type of Facility:	Commercial

Proposer's Role: (Prime, Joint Venture, LLC, Integrated DB, Sub): Subconsultant

Builder (Name): High Concrete Group

Designer of Record (Name): Kohn Pedersen Fox Associates PC

Project Delivery Method & RFP Type:

Private Negotiated		Construction Manager At Risk	
Design-Build w/out Bridging Docs		Design-Build with Bridging Docs	
Design-Bid-Build	X	Other	

What type of RFP documents were used for this project?

Performance Requirements	X
Prescriptive Specifications	X
Bridging Drawings and Specifications	

Describe any Awards this project received:
New Jersey Leading Infrastructure Project Award, New Jersey Alliance for Action, 2015

Past Performance Reference: The City of New York reserves the right to contact this organization or person and conduct a telephone interview for references. Confirm this reference is available.

Organization:	SJP Properties
Contact Person Title:	Vice President of Constrution
Telephone:	973.747.8496
Email:	DAllen@sjpproperties.com
Address:	655 Broad Street
City, State, Zip:	Newark, NJ.

Self-Performance

Percentage of work self-performed:

Detailed description of work self-performed:

Structural design services for a 1.3-million-square foot complex comprising of a 1,400 car garage attached to a 740,000-square-foot 20-story office building. The garage featured two below grade levels, five above grade levels and a landscaped green roof. The precast parking garage also contained two retail storefronts, roof canopies and green walls to integrate it into its urban setting. The project is located in downtown Newark across from the historic, six-acre Military Park and sets a new standard for sustainable design achieving LEED Gold certification.

Describe any work you subcontracted to others:

NA

List Key DB Team Members (firm and / or individual) that were critical to this project that are also proposed for the Project.

Steven Szycher, Thornton Tomasetti

Provide a general description of the project:

Prudential Tower, Newark, New Jersey

Thornton Tomasetti provided structural design services for a 1.3-million-square-foot complex comprising a 740,000-square-foot office building, a retail podium and parking for 1,400 cars. The office building contains a 500-seat cafeteria, 500-seat conference center and a health and wellness center. Located in downtown Newark across from the historic, six-acre Military Park, the 20-story, steel-framed building sets a new standard for sustainable design in the area with roof gardens and a green wall.

The structural systems are tied to two critical factors; schedule and cost. With these two factors in mind, in addition to the flexibility of office framing, Thornton Tomasetti recommended that the tower should be an all steel framed structure with a steel braced lateral system. This building uses steel framing as the main structural system with braced frames, composite beams, and concrete slab on metal deck. The five-story precast double-tee parking garage is a performance specification item prescribed by Thornton Tomasetti and fully designed by High Concrete Group. The main building's central, full-height atrium created a unique structural challenge for the tower's lateral system. Special diaphragm analysis and design of multistory diagonals was required to ensure proper interaction at either side of the atrium. The project achieved LEED Gold Certification.

Project Name	**Prudential Tower, Newark, NJ**

Describe only the project attributes directly applicable to the specific Tab (Tabs 1, 2, or 3) in Section 4 of the RFQ.

Thornton Tomasetti also performed a supplemental vibration study and provided a report of findings. The team recommended mitigating vibration by increasing the horizontal stiffness of the raised floor and the installation of light braces in the raised floor plenum in certain areas.

Project Name: Prudential Tower & Parking Garage CAP Project Number (if applicable):

Skanska
(Contractor - Construction Manager - Builder)

(Project Manager) *(Superintendent)*

Thornton Tomasetti
(Consultant - Designer)

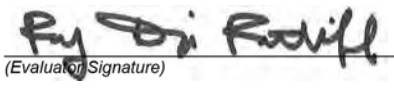
Stephen Szycher — *(Project Manager)*
N/A — *(Construction Administration Observer (if applicable))*

N/A — *(Agency)*
N/A — *(Agency Contact)*

This evaluation is of the: ☐ Contractor ☒ Consultant ☐ Design-Builder ☐ Other:

Please rate each of the criteria on a scale of 1 to 10, with 10 representing that you were very satisfied/in complete agreement with the statement and 1 representing that you were very unsatisfied/in disagreement with the statement. Please rate each of the criteria to the best of your knowledge. If you do not have sufficient knowledge in a particular area or it is not applicable, leave it blank.

NO	EVALUATION CRITERIA	UNIT	RATING
1	Ability to manage the project cost (minimize change orders)	(1-10)	N/A
2	Ability to maintain project schedule (complete on-time or early)	(1-10)	N/A
3	Quality of workmanship	(1-10)	N/A
4	Professionalism and ability to manage (includes responses and prompt payment to suppliers and subcontractors)	(1-10)	10
5	Close-out process (no punch list upon turnover, warranties, operating and maintenance manuals, etc. submitted promptly)	(1-10)	N/A
6	Communication, explanation of risk, and documentation	(1-10)	10
7	Ability to follow the State's and/or Agency's rules, regulations, and requirements (housekeeping, safety, etc.)	(1-10)	N/A
8	Overall customer satisfaction and comfort level in hiring the vendor again based on performance	(1-10)	10

Devin Ratliff — *(Printed Evaluator Name)*
 — *(Evaluator Signature)*
1/8/20 — *(Date)*

212-977-6500 — *(Telephone Number)*
dratliff@kpf.com — *(Email Address)*

Director — *(Position/ Title)*
Kohn Pedersen Fox Assoc. — *(Agency/Firm Name)*

Comments:

[Use same form for 5 projects]	Name of Proposer:	Hunter Roberts Construction Group, LLC
General Information:		Project Number*: 3

Project Name, Location and Size: Name: Pierhouse & 1 Hotel Brooklyn Bridge

Location: 60 Furman Street (Hotel) 90 and 130 Furman Street (Residential), Brooklyn, NY, USA

Size: 620k SF overall; Hotel: 160k SF; 90 Furman: 288k SF; 130 Furman 172k SF

Original Contract Amount:	$220M	Original Completion Date:	Spring 2017
Final Construction Cost:	$220M	Actual Completion Date:	Spring 2017
Reason for Difference if more than 10%		Type of Facility:	Residential, public space & hospitality

Proposer's Role: (Prime, Joint Venture, LLC, Integrated DB, Sub): Architect

Builder (Name): Hudson - Meridian

Designer of Record (Name): Guido Hartray, AIA, Founding Partner, Marvel Architects, PLLC

Project Delivery Method & RFP Type:

Private Negotiated		Construction Manager At Risk	
Design-Build w/out Bridging Docs		Design-Build with Bridging Docs	
Design-Bid-Build	X	Other	*see below

What type of RFP documents were used for this project?

Performance Requirements	
Prescriptive Specifications	X
Bridging Drawings and Specifications	

Describe any Awards this project received:
Please see the sheets that follow for a full list of National and NY design industry awards received.

Past Performance Reference: The City of New York reserves the right to contact this organization or person and conduct a telephone interview for references. Confirm this reference is available.

Organization:	Toll Brothers
Contact Person Title:	David Von Spreckelsen, President
Telephone:	212.742-0835
Email:	dvonspreckelsen@tollbrothersinc.com
Address:	75 Broad St #2100,
City, State, Zip:	New York, NY 10004

Self-Performance

Percentage of work self-performed:

Detailed description of work self-performed:

Pierhouse comprises 106 condominium units; 300-car below grade parking garage, 17,000 sf Event Space, and 195-key hotel in a 550,000 square feet complex of connected buildings ranging from four to ten stories. marvel Architects hosted community design presentations, submitted multiple options for agency review, performed architectural design services for the Pierhouse and 1 Hotel complex and interior design services for Pierhouse residential units. *from above: Project RFP type was a developer-lead, open competition.

Describe any work you subcontracted to others:

Structural Engineer: DeSimone Consulting Engineers; Mechanical, Electrical, Plumbing (MEP) Engineer: Dagher Engineering; Civil Engineer: Langan; Interior Design for Pierhouse Condo: Marvel Architects; Interior Design for 1Hotel: INC Architecture and Design; Landscape: Michael Van Valkenburgh Associates; Lighting Consultant: Lighting Workshop; Envelope Consultant: Gilsanz Murray Steficek; Acoustical Consultant: AKRF; Low Voltage Consultant: Deployed Technologies

List Key DB Team Members (firm and / or individual) that were critical to this project that are also proposed for the Project.

Guido Hartray, AIA, Founding Partner, Marvel Architects, PLLC

Provide a general description of the project:

Pierhouse & 1 Hotel Brooklyn Bridge, Brooklyn, NY

Marvel's Pierhouse and 1 Hotel project had a clear mandate to build to the highest standards of design excellence due to the project's high visibility on the Brooklyn waterfront; the site's intervening location between streetscape and public park; and the area's need for new amenities to support new visitorship as a result of the area's revitalization.

Pierhouse comprises 106 condominium units; 300-car below grade parking garage; 195-key 1Hotel Brooklyn Bridge Park; and 17,000 sf Event Space, with additional retail spaces and Park offices. The development includes three separate buildings ranging from four to ten stories. The Hotel and larger condominium building are connected by a dramatic bridge structure, while all three buildings share a continuous, below-grade parking structure.

Pierhouse performs as an extension of Brooklyn Bridge Park - a verdant backdrop recalling the high, sandy bank of pre-colonial Brooklyn Heights, screening urban noise while facilitating waterfront access. The building presents two faces: The west elevation cascades toward the Park, while the east elevation rises steeply from Furman Street, responding to the urban fabric of narrow streets and nearby expressway. This 'Janus' condition informs two, distinct facades, innovative residential floor plans, and skip-stop circulation. The residential buildings employ a repeating module of distinct duplex houses with terraces on the park and harbor views. Their double-height interior spaces and multilevel plans reinterpret the classic Brooklyn Brownstone in a multi-family structure. All residential units are floor-through with east and west exposures, providing natural ventilation that filters harbor breezes through the building from Park to Street. This porosity continues at grade, where public walkways through the building connect Furman Street and the Park. The complex respects important view corridors from the neighborhood to the Brooklyn Bridge. Its terraced forms break its imposing mass and orients each residential unit to a stunning view of the New York Harbor or the Brooklyn Bridge. Intensively planted roofs serve as the buildings' 'fifth façade'.

Starwood Capital Group's 1 Hotel is an urban threshold to the Park - with a forty-foot-tall public plaza, double-height lobby, outdoor dining, event spaces with glass walls opening directly on the Park, and roof terrace drawing the Park and its visitors into the building.

Project Name	Name: Pierhouse & 1 Hotel Brooklyn Bridge

Describe only the project attributes directly applicable to the specific Tab (Tabs 1, 2, or 3) in Section 4 of the RFQ.

An effort led by partners Jonathan Marvel and Guido Hartray, Pierhouse and 1 Hotel Brooklyn Bridge Park pursues design excellence by looking beyond the tradition limits of its typology. More than just a hotel/residence, Pierhouse creatively responded to site conditions, opportunities, and community input in order to substantively add to the public realm and materially contribute to the renewal of the waterfront and streetscape. Beyond embodying its neighborhood revitalization, Pierhouse is economically feasible, practical (completed on time and on budget), and resilient.

Marvel was tasked with stewarding the building's relationship to the public sphere from initial design mandates set by "dual" clients consisting of the developer and public agencies. Marvel's design both conformed to and expanded the possibilities of these parameters, much like a traditional design-build effort. Upon award, Marvel had a joint responsibility to developer/builder and the park and city agencies to protect public design aspects of the project as well as the development and construction needs. The building's relationship to the park, its openness to the neighborhood, connections between neighborhood and park, the scale of the building, the need to activate Furman Street, were all things that Marvel developed and preserved.

The design competition for the project included a financial model and development fee proposal to support the recently built park. Residents were concerned new buildings would obstruct views, while the greater public embraced the new park and wanted it to be well-maintained, continue to expand along the reclaimed waterfront, and provide even more amenities. The winning strategy had to secure the support of the local community with a contextual and right-sized building while generating enough income to generously compensate the park development. To mitigate view obstructions, it was agreed that building systems would be shared and concentrated at the north end of the development, with one large bulkhead housing the hotel elevators and common cooling tower and other equipment. The 300-space parking area required by the project would be concealed from view, and a continuous cellar space would accommodate shared life safety and other building systems.

The final design engages vigorously with the public domain. A grand breezeway transects the structure, opening a direct channel to the waterfront park. This breezeway acts as a public gathering spot, a nexus through which visitors can linger or go in many directions: hotel lobby, with its spaces grounded by varied-scale F&B; community spaces and amenities; a stunning new rooftop bar and lounge offering celebratory views of the skyline; or into Brooklyn Bridge Park, the construction of which was funded by Pierhouse's developer.

Ultimately, it is our hope as designers that this project, with over 1,100 feet of frontage along Furman Street, strengthens the neighborhood's connection to the waterfront and provides a model for sustainable urban living.

Pierhouse has won a variety of awards, including AIA Brooklyn-Queens Design Merit Award, ULI Award: Excellence in Hotel Development, Architizer A+ Awards for Hospitality: Hotels and Resorts, Interior Design Magazine Best of Year Award for U.S. Boutique Hotel, Building Brooklyn Awards: National Grid Award for Energy Efficiency, AIA New York State Design Award , IESNYC Lumen Award, Award of Merit, and AIA Housing Award - Multifamily Category.

Vendor Evaluation

Project Name: Pierhouse, Brooklyn Bridge Park — CAP Project Number (if applicable): NA

Hudson Meridian Construction
(Contractor - Construction Manager - Builder)

Bill Cote (owner HMC) — *(Project Manager)*
Dan Hooker — *(Superintendent)*

Marvel Architects
(Consultant - Designer)

Dennis Vermeulen — *(Project Manager)*
JS Yong — *(Construction Administration Observer (if applicable))*

Brooklyn Bridge Park Corporation — *(Agency)*
David Lowin — *(Agency Contact)*

This evaluation is of the: ☐ Contractor ☒ Consultant ☐ Design-Builder ☐ Other: _____

Please rate each of the criteria on a scale of 1 to 10, with 10 representing that you were very satisfied/in complete agreement with the statement and 1 representing that you were very unsatisfied/in disagreement with the statement. Please rate each of the criteria to the best of your knowledge. If you do not have sufficient knowledge in a particular area or it is not applicable, leave it blank.

NO	EVALUATION CRITERIA	UNIT	RATING
1	Ability to manage the project cost (minimize change orders)	(1-10)	7
2	Ability to maintain project schedule (complete on-time or early)	(1-10)	7
3	Quality of workmanship	(1-10)	7
4	Professionalism and ability to manage (includes responses and prompt payment to suppliers and subcontractors)	(1-10)	8
5	Close-out process (no punch list upon turnover, warranties, operating and maintenance manuals, etc. submitted promptly)	(1-10)	7
6	Communication, explanation of risk, and documentation	(1-10)	8
7	Ability to follow the State's and/or Agency's rules, regulations, and requirements (housekeeping, safety, etc.)	(1-10)	8
8	Overall customer satisfaction and comfort level in hiring the vendor again based on performance	(1-10)	7

DAVID VON SPRECKELSEN — *(Printed Evaluator Name)*
(Evaluator Signature)
1/2/20 — *(Date)*

212-742-0035 — *(Telephone Number)*
DVONSPRECKELSEN@POLLBROTHERS.COM — *(Email Address)*

DIVISION PRESIDENT — *(Position/ Title)*
POLL BROTHERS — *(Agency/Firm Name)*

Comments:

[Use same form for 5 projects]	Name of Proposer: Hunter Roberts Construction Group, LLC
General Information:	Project Number*: 4
Project Name, Location and Size:	Name: Jersey City Municipal Services Center Location: Jersey City, New Jersey Size: 147,000 Square Feet

Original Contract Amount:	$56 Million	Original Completion Date:	Sept., 2014
Final Construction Cost:	$59 Million	Actual Completion Date:	Sept., 2014
Reason for Difference if more than 10%	Reason: Not Applicable	Type of Facility:	Municipal Services Center

Proposer's Role: (Prime, Joint Venture, LLC, Integrated DB, Sub): Prime

Builder (Name): Terminal Construction

Designer of Record (Name): Urbahn Architects

Project Delivery Method & RFP Type:

Private Negotiated		Construction Manager At Risk	
Design-Build w/out Bridging Docs		Design-Build with Bridging Docs	
Design-Bid-Build	X	Other	

What type of RFP documents were used for this project?

Performance Requirements	
Prescriptive Specifications	X
Bridging Drawings and Specifications	

Describe any Awards this project received:
Jersey City Redevelopment Authority
"Green Award" for Sustainability

Past Performance Reference: The City of New York reserves the right to contact this organization or person and conduct a telephone interview for references. Confirm this reference is available.

Organization:	City of Jersey City
Contact Person Title:	Gregory Corrado, CMFO / Assistant Business Administrator
Telephone:	201.547.5561
Email:	greg@jcnj.org
Address:	City Hall, 280 Grove Street, Suite 112
City, State, Zip:	Jersey City, NJ 07305

Self-Performance

Percentage of work self-performed:

Detailed description of work self-performed:
Urbahn Architects - Architecture, Management, Planning, Engineering Coordination, and BIM Integration

Describe any work you subcontracted to others:
DVB Inc. - Structural Engineering / Morris, Johnson & Associates - Mechanical, Electrical, and Plumbing Engineering / Landscape Architect - Starr Whitehouse / Lighting Design - Lumen Arch / LEED Consultant - YRG

List Key DB Team Members (firm and / or individual) that were critical to this project that are also proposed for the Project.
Donald E. Henry, Jr., the Designer of Record for the D-B Team, was the Principal-In-Charge for the Jersey City Municipal Services Center project. Lillie Chen was the Design Integrator.

Provide a general description of the project:

Jersey City Municipal Services Center
Jersey City, NJ

The project transformed a former warehouse site into a multi-building complex, and is envisioned as a Gateway to Jersey City. With the vast solar photovoltaic work now complete, the project has received LEED Platinum certification and is net zero in terms of electrical consumption.

The project impetus is threefold: a public/ private land-partnership to redevelop waterfront necessitated government relocation; the City's facility consolidation program; and its designation as an exemplar of sustainable redevelopment. The program provides for three city agencies, with space for offices, hearings, vehicle repair, recycling, emergency services, and material staging, as well as extensive parking.

The site design responds to conflict between intense industrial uses, the surrounding rail lines and highways, and the City's desired welcoming green zone. The layout reconciles many determinants, such as pronounced elevation changes, existing structures, and vehicle circulation.

Three main buildings anchor distinct site regions, their interrelationships and individual formal framework echoing the unfolding site procession. Internal and external forces generate irregular geometries while their massing responds to programmatic functions and varying vehicle heights. A glazed wall at the public entrance provides an uninhibited view of the hearing room reception area. Throughout the three building clusters, employee and vehicle areas are flooded with natural light via windows, clerestories, and skylights.

Project Name	**Jersey City Municipal Services Center**

Describe only the project attributes directly applicable to the specific Tab (Tabs 1, 2, or 3) in Section 4 of the RFQ.

Greening the Architecture
The site design offered many opportunities for expressing the "green" mission of the complex, and the City's desire to be a leader in sustainable design. Use of native plant materials and best management practices that orchestrate the movement, storage, absorption and recycling of storm water creates a beautiful and significant landscape for the enjoyment of the city workers and public visitors, and has become an important landmark for the thousands of people driving by each day along the abutting highways. While the site is dominated by buildings and parking lots, over 15% of the land is dedicated to vegetated open space that handles storm water, reduces the heat island effect, creates habitats and enhance the pedestrian experience.

Green roofs and walls provided additional opportunities for vegetating and softening the

industrial landscape. The office building as well as the DPW site material storage sheds will feature low maintenance/extensive green roofs; vines grow on the steel superstructure of the existing building and on-site retaining walls; and there is a green screen covered with vines along the southern Garage wall.

The Pedestrian Experience
Paralleling this network of ecological elements is an inviting, safe and coherent pedestrian experience. People entering the site on foot from Linden Avenue make their way to the Office Building via a nature walk meandering through clumps of trees and low maintenance grasses and meadow plantings. This path is well lit and feature salvaged stone in gabion baskets as benches, and site salvaged boulders. Trees and other plantings are placed throughout the parking lots; the parking lots are lit. The entrance to the Office Building features an entry court and terrace defined by a seating/retaining wall and featuring tables, chairs, bike racks and horticultural displays. In addition to providing a welcoming entrance, the space provides a place where workers can have lunch, socialize, and have meeting and social events. The Emergency Services Unit also features a small terrace located behind the building and a dog run.

NYC Department of Design and Construction

Vendor Evaluation

Project Name: Municipal Services Complex Terminal Construction
CAP Project Number (if applicable):

(Contractor - Construction Manager - Builder)
Donald Dinallo

(Project Manager) (Superintendent)

(Consultant - Designer)
Urbahn Architects

Donald E Henry Jr AIA
(Project Manager) (Construction Administration Observer (if applicable))

Jersey City Business Administration Gregory Corrado
(Agency) (Agency Contact)

This evaluation is of the: ☐ Contractor ☒ Consultant ☐ Design-Builder ☐ Other:

Please rate each of the criteria on a scale of 1 to 10, with 10 representing that you were very satisfied/in complete agreement with the statement and 1 representing that you were very unsatisfied/in disagreement with the statement. Please rate each of the criteria to the best of your knowledge. If you do not have sufficient knowledge in a particular area or it is not applicable, leave it blank.

NO	EVALUATION CRITERIA	UNIT	RATING
1	Ability to manage the project cost (minimize change orders)	(1-10)	10
2	Ability to maintain project schedule (complete on-time or early)	(1-10)	10
3	Quality of workmanship	(1-10)	10
4	Professionalism and ability to manage (includes responses and prompt payment to suppliers and subcontractors)	(1-10)	10
5	Close-out process (no punch list upon turnover, warranties, operating and maintenance manuals, etc. submitted promptly)	(1-10)	10
6	Communication, explanation of risk, and documentation	(1-10)	10
7	Ability to follow the State's and/or Agency's rules, regulations, and requirements (housekeeping, safety, etc.)	(1-10)	10
8	Overall customer satisfaction and comfort level in hiring the vendor again based on performance	(1-10)	10

Gregory Corrado
(Printed Evaluator Name)

(Evaluator Signature)

1-6-20
(Date)

201-547-5561
(Telephone Number)

Greg@jcnj.org
(Email Address)

Assistant Business Administrator
(Position/ Title)

JC Business Administration
(Agency/Firm Name)

Comments:

Don Henry, and Urbahn Architects, did a fine job with our Municipal Services Complex and I would recommend them for your project. If you have any questions, please do not hesitate to call me.

[Use same form for 5 projects]	Name of Proposer: Hunter Roberts Construction Group, LLC
General Information:	Project Number*: 5
Project Name, Location and Size:	Name: Enhanced Station Initiative - Package 1 & 8 Location: Brooklyn, Manhattan, and Bronx, NY Size: Package 1 - 92,000 sf / Package 8 - 112,500 sf

Original Contract Amount:	$145 Million	Original Completion Date:	Nov., 2017
Final Construction Cost:	$145 Million	Actual Completion Date:	Nov., 2017
Reason for Difference if more than 10%	Not Applicable.	Type of Facility:	Transit Station

Proposer's Role: (Prime, Joint Venture, LLC, Integrated DB, Sub): Joint Venture - Design Leader

Builder (Name): Citnalta- Forte - JV

Designer of Record (Name): Urbahn Architects

Project Delivery Method & RFP Type:

Private Negotiated		Construction Manager At Risk	
Design-Build w/out Bridging Docs		Design-Build with Bridging Docs	X
Design-Bid-Build		Other	

What type of RFP documents were used for this project?

Performance Requirements	
Prescriptive Specifications	X
Bridging Drawings and Specifications	

Describe any Awards this project received:
Not Applicable.

Past Performance Reference: The City of New York reserves the right to contact this organization or person and conduct a telephone interview for references. Confirm this reference is available.

Organization:	MTA New York City Transit
Contact Person Title:	Brian Liona, RA / Design Manager
Telephone:	212.897.1408
Email:	brian.liona@nyct.com
Address:	2 Broadway
City, State, Zip:	New York, NY 10004

Self-Performance

Percentage of work self-performed:

Detailed description of work self-performed:
Urbahn Architects was the lead design consultant on the D-B Team.

Describe any work you subcontracted to others:
Civil / Structural Engineering, Mechanical, Electrical, and Plumbing Engineering, Lighting Design , and Hazardous Materials Consulting

List Key DB Team Members (firm and / or individual) that were critical to this project that are also proposed for the Project.
Ijeoma Iheanacho, LEED, the Design Integrator for the D-B Team, was the Deputy Project Manager for the Enhanced Station Initiative - Package 1 & 8 projects.

Provide a general description of the project:

Enhanced Station Initiative - Package 1 & 8
Brooklyn, Manhattan, and Bronx, NY

As part of Governor Cuomo's initiative to bring New York State's transportation infrastructure into the 21st Century, 31 subway stations were designated for fast paced modernization on a Design-Build basis. Urbahn was the lead design consultant on the D-B Team that was awarded two packages. Package 1, the first in the program, included three (3) subway stations on Brooklyn's Fourth Avenue Line. Package 8 included another three stations, one in Manhattan and two in the Bronx. The Governor's Office had established an aggressive schedule for design and construction, allowing for only 12 months from the Notice to Proceed to the final turnover of the completed stations. Unlike typical subway construction projects, the client permitted full station closure for a 5-month window, thereby allowing a high level of construction productivity. However, to meet the construction targets, our design team compressed the design timeframes of each package into a 4-month period.

The project features state-of-the-art finishes and systems, resulting in the rebranding of the stations with a focus on the customer experience.

Elements incorporated into the design include:

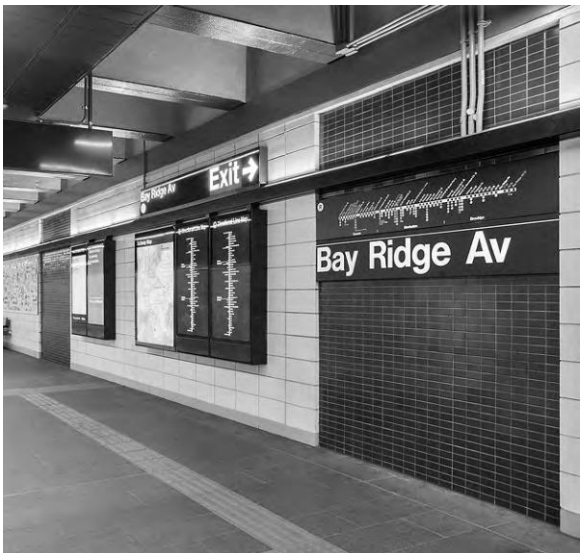
- New entry stairs and canopies
- Wayfinding signage
- Interactive information dashboards
- Energy efficient lighting
- Modern finishes throughout
- New communications systems

Project Name	**Enhanced Station Initiative**

Describe only the project attributes directly applicable to the specific Tab (Tabs 1, 2, or 3) in Section 4 of the RFQ.

Package 1	**Size**	**Cost**
Prospect Parkway:	42,500 sf	$25,750,000
53rd Street Station:	37,500 sf	$22,500,000
Bay Ridge Avenue:	38,250 sf	$23,250,000
Totals Package 1:	**118,250 sf**	**$71,500,000**

Package 8	**Size**	**Cost**
145th Street Station:	32,000 sf	$17,500,000
167th Street Station:	39,500 sf	$26,750,000
174th Street Station:	41,000 sf	$29,250,000
Totals Package 8:	**112,500 sf**	**$73,500,000**



Vendor Evaluation

Project Name: Design-Build Enhanced Station Initiative Pkgs 1 & 8 CAP Project Number (if applicable):

Citnalta-Forte Joint Venture
(Contractor - Construction Manager - Builder)

Eddie Garcia
(Project Manager)

(Superintendent)

Urbahn Architects
(Consultant - Designer)

Lawrence Gutterman / Ijeoma Iheanacho (DPM)
(Project Manager)

(Construction Administration Observer (if applicable))

New York City Transit
(Agency)

Brian Liona - Design Manager
(Agency Contact)

This evaluation is of the: ☐ Contractor ☒ Consultant ☐ Design-Builder ☐ Other:

Please rate each of the criteria on a scale of 1 to 10, with 10 representing that you were very satisfied/in complete agreement with the statement and 1 representing that you were very unsatisfied/in disagreement with the statement. Please rate each of the criteria to the best of your knowledge. If you do not have sufficient knowledge in a particular area or it is not applicable, leave it blank.

NO	EVALUATION CRITERIA	UNIT	RATING
1	Ability to manage the project cost (minimize change orders)	(1-10)	9
2	Ability to maintain project schedule (complete on-time or early)	(1-10)	9
3	Quality of workmanship	(1-10)	9
4	Professionalism and ability to manage (includes responses and prompt payment to suppliers and subcontractors)	(1-10)	10
5	Close-out process (no punch list upon turnover, warranties, operating and maintenance manuals, etc. submitted promptly)	(1-10)	9
6	Communication, explanation of risk, and documentation	(1-10)	8
7	Ability to follow the State's and/or Agency's rules, regulations, and requirements (housekeeping, safety, etc.)	(1-10)	9
8	Overall customer satisfaction and comfort level in hiring the vendor again based on performance	(1-10)	10

Brian Liona
(Printed Evaluator Name)

Brian Liona
(Evaluator Signature)

Jan. 6, 2020
(Date)

212.897.1408
(Telephone Number)

brian.liona@nyct.com
(Email Address)

Design Manager
(Position/ Title)

New York City Transit
(Agency/Firm Name)

Comments:

KEY PERSONNEL

Position/Assignment for the Project: Project Executive			
Firm Name:	Hunter Roberts Construction Group, LLC	Years of Experience:	20+
Name:	Sean O'Connor	This Firm:	14
Title:	Senior Vice President	Other Firms:	5
Degree:	B.S., Psychology & B.A., Business Management	Specialization:	Construction Management
Year Earned:	1997 / 1997	Registration:	N/A

As Project Executive, Sean O'Connor is responsible for the overall performance and successful completion of his Clients' projects. He is accountable for the budget, schedule, safety and quality of each project under his control. Sean directs and leads his teams to ensure the day-to-day construction efforts meet and exceed client expectations. He has a proven track record developing projects from pre-construction through occupancy. Sean is a seasoned construction professional with over 20 years of experience. Sean led the team for the design-build Yankee Stadium Parking Facilities. He has extensive experience in pre-construction, new construction, renovations and interior fit-outs and is well known for his strong leadership skills. Sean's market sector experience includes Higher Education, K-12, Interior Renovations, Commercial, Retail, Public Sector and he has led pre-construction teams for multiple projects. Sean has submitted his application for the DBIA Associate Design-Build Professional credential and expects to participate in the October course.

Yankee Stadium Parking Facilities, *Bronx, NY*
Design/build contract for three garages, containing approximately 5,000 parking spaces. Multiple city agency approvals. Contaminated soil removal. Reinforced cast-in-place concrete pile caps set on concrete-filled steel pipe pile foundation. Built and phased around New York Yankees seasons.

Macombs Dam Park, *Bronx, NY*
A 7.5-acre park built atop Parking Garage A at Yankee Stadium. Includes a running track, football/soccer field, grandstand, comfort station, handball courts and basketball courts, concrete planters with green roof assembly, and irrigation and sprinkler systems.

68-74 Trinity Place, *New York, NY*
Demolition of two buildings followed by the construction of a new, 28-story, structural steel, commercial mixed-use building with five floors of public space, multiple floors of mechanical space, and 22 floors of office space for commercial tenants. The building will also contain a parish hall and gymnasium. An elevated walkway, currently spanning Trinity Place between 74 Trinity and the church, will be supported and left on site to be rejoined to the new podium and link the two properties,all built along side the 1, R, and W, subway lines. Scope of the new building calls for an elaborate curtain wall system and high-end interior finishes.

Fiterman Hall, *New York, NY*
A 400,000-SF academic building for BMCC. Includes a first floor art gallery, 54 classrooms, 31 computer laboratories, 20 conference rooms, offices, a library, 12 soundproof music practice rooms, 13 art studios, a choral and ensemble room, and assembly rooms.

Pier 57, *New York, NY*
The 400,000-SF redevelopment of a Landmark pier. Consists of renovations to the existing structure and surrounding property, including marine work to expand public amenities, highway and civil alterations to reconfigure front of building and to provide new walking/bike path, and major alterations to create spaces for tenant and retail spaces. Major infrastructure components include substantial vertical transportation (new stairwells, elevators, and escalators), removal of old and installation of new MEPS systems, public rooftop park, and substantial structural package.

South Street Seaport Pier 17 Redevelopment, *New York, NY*
Transformation of Pier 17 through demolition of existing pier and building. New pier construction with increased open space. Four-story pier building with garden roof, destination stores, restaurants, and neighborhood shops.

Queens Plaza Tower, *Long Island City, NY*
A 48-story, 350,000-SF condominium residential tower with 300 units and amenity spaces. Scope also includes single-story parking garage and retail space with rooftop amenity garden.

Fulton Market Building, *New York, NY*
Gut rehabilitation of existing four-story building decimated by Superstorm Sandy. Installation of drilled mini piles, caps, grade beams, and elevator pits. Removal of existing floor slabs and structural steel, installation of structural steel trusses and slabs, and significant structural reinforcement. New elevators, escalators, exterior storefront, and MEPS systems.

Position/Assignment for the Project:			
Firm Name:	Hunter Roberts Construction Group, LLC	Years of Experience:	21
Name:	Josh Frankel, AIA	This Firm:	3
Title:	Design-Build PM/Design-Build Construction PM	Other Firms:	18
Degree:	M. Arch & B.A., English Literature	Specialization:	CM / Estimating
Year Earned:	1999 / 1994	Registration:	NYS Architecture

As Design-Build Project Manager/Design-Build Construction Project Manager, Joshua Frankel is responsible and accountable to the Design-Build Project Executive and Owner for the overall performance and success of the project. Josh will work closely with the design team to complete a design effort that exceeds the Owner's performance requirements and meets the budget. He will lead the staff in the day-to-day operations including trade procurement, coordination and submittals. Josh acts as the liaison between Hunter Roberts, the subcontractors, the design team and ownership. Josh has dedicated his 21 year career to work in the public realm for healthcare, cultural and education clients. He is a believer in the design-build procurement methodology and has completed the coursework for the Associate Design-Build Professional credential. Josh is an advocate for early and continuous collaboration between the design and construction teams. Virtually all of his projects completed over the last 15 years were executed in highly collaborative team environments - including an IPD- type project with trade management agreements for Northwell Health and an extensive pre-construction assignment for Mount Sinai South Nassau's campus revitalization.

Northwell West Wing Addition, *Manhasset, NY*
Design project manager for a proposed 250,000-SF addition to an existing hospital. Scope includes eight new operating rooms and over 40 critical care beds. Massing and design, including glazed terra cotta panels and curtainwall, was chosen to minimize impact of a large building in a residential neighborhood while maintaining a contemporary brand for Northwell. Construction total $250 million.

Museum of the City of New York Renovation & Expansion, *New York, NY*
Design project manager for a $20 million renovation and expansion project that reorganized the gallery and administrative spaces while greatly enhancing the visitor experience..

Mount Sinai Downtown Beth Israel Hospital, *New York, NY*
Design Project manager for a proposed new, 240,000-SF hospital in Lower Manhattan. Scope includes conversion of the ground floor of the existing New York Eye and Ear Care Infirmary into a new emergency department as well as a new tower with five operating rooms, 80 inpatient beds, labs, and administrative spaces.

NYU Lutheran Medical Center Ambulatory Surgery Center Expansion, *Brooklyn, NY*
Design project manager for the expansion of an existing one-story building into a new Ambulatory Surgery Center and Family Health Center. Conversion of the roof and existing HVAC equipment space into interstitial mechanical space and addition of two floors above. The first of the new floors houses the ambulatory surgery area while the upper floor contains the Family Health Center.

Montefiore Medical Center Children's Hospital Renovation & Expansion, *Bronx, NY*
Design project manager for a 300,000-SF expansion and renovation, including obstetrics, neonatal, and pediatrics medicine within a single facility. Located on a corner of the Moses Campus, the expansion requires careful planning to minimize disruptions to critical clinical programs. Total construction cost over $300 million.

South Nassau Communities Hospital, *Oceanside, NY*
On-call contract four South Nassau Communities Hospital. Includes the following projects: J-Wlng Addition / New Central Utility Plant and Electrical Infrastructure Upgrades; Emergency Department Phase II Renovation; Observation Suite; New Parking Garage; Medical Arts Pavilion.

Lycee Francais de New York, *New York, New York*
Design project manager for construction for a 17,000 SF expansion. The new wing, positioned prominently on York Avenue, creates a more public face for the school. The new building provides important new teaching and learning spaces, including new classrooms, offices, study areas, a media lab, a broadcast studio and a maker-space.

Indiana University Global & International Studies Building, *Bloomington, IN*
Design project manager for a new 165,000-SF academic building housing the School of Global and International Studies as well as other language, literature, and culture studies programs. Building includes 10 classrooms, lecture hall, academic offices, and graduate student work space. Design calls for two wings so that each professor's office has a window: the west wing follows the school's arboretum; the east wing follows an existing campus edge. Architectural style bridges between older buildings and Brutalist library, linking the campus together. Construction cost total $40 million.

Position/Assignment for the Project: Design Integrator			
Firm Name:	Urbahn Architects PLLC	Years of Experience:	19
Name:	Ijeoma Iheanacho, LEED	This Firm:	3
Title:	Project Manager	Other Firms:	16
Degree:	Bachelor of Architecture, Cornell	Specialization:	Architecture
Year Earned:	2001	Registration:	N/A

With nearly 20 years of professional experience, Ijeoma is one of the most industrious architects at Urbahn. Diligent and determined, she takes complete charge of a project's design integration right from the kick-off meeting, up until the project reaches completion. Her work has included transportation facilities, K-12 schools, residential complexes, and urban infrastructure projects. She has consistently applied her dogged approach to design management and integration, resulting in projects that meet client standards and procedures, comply with schedules and budget and achieve performance expectations. She is meticulous about documentation and communication so that all parties understand the status, issues and actions that must be taken to move the project forward and to completion. Ijeoma is conversant with Revit and has managed several projects delivered on that platform.

Ijeoma is a proponent of sustainability and progressive social and cultural initiatives. She has been a LEED Accredited Professional since 2009, and is active in several industry organizations.

Enhanced Station Initiative – Packages 1 & 8
As part of Governor Cuomo's initiative to transform New York State's transportation infrastructure into the 21st Century, 31 subway stations were designated for fast-paced modernization on a Design-Build basis. Package 1 included 3 subway stations on Brooklyn's Fourth Avenue Line - 53rd Street, Bay Ridge Avenue, and Prospect Avenue Stations - and was completed in 2017. Following the success of NYCT ESI Package 1, the D-B Team was awarded Package 8, including 145th Street Station in Manhattan, and 167th Street and 174-175th Street Stations in the Bronx. Urbahn was the lead design entity on the D-B Team for Packages 1 and 8, handling the architecture, schedule management and design integration.

Tides North Residential Complex at Arverne By The Sea, *Far Rockaway, NY*
Urbahn designed two multifamily apartment buildings as part of the Arverne By The Sea complex, an exemplar of sustainable urban development. The 6-acre site was designed to include 454 apartment units, including studios, 1-, 2-, and 3-bed apartments, with a total square footage of 550,000 sf. In addition to the residential units, the complex is designed to include 25,000 sf of retail, a club house and an outdoor swimming pool.

Accessibility Improvements at Eastern Parkway and 59th Street Stations, *Brooklyn, NY*
Urbahn was engaged by NYCT to provide full design and construction administration services to provide accessibility improvements at two Brooklyn subway stations. Urbahn is responsible for the entire consultant team, including the integration of civil, structural and MEP engineering, as well as lighting design and cost estimating. For each station Urbahn applied and adapted NYCT standard construction assemblies, including elevator equipment and elevator kiosks. Both projects are currently under construction.

PS 144Q Addition and Renovation, *Forest Hills, NY*
Urbahn is responsible for the planning and design of a major addition, as well as significant renovations to the existing 1931 school. The addition includes four stories housing 24 classrooms from Pre-K through 4th grade, with a subterranean cafeteria and full-service kitchen to serve the entire student population. Our design realigns space within the existing building to complement the full program, while providing voluntary accessibility improvements, as well as life safety, mechanical and electrical upgrades.

NYCT, World Trade Center Transportation Hub, *New York, NY*
In conjunction and coordination with the development of the replacement World Trade Center, this project involved the reimagining of the subway complex connections and environment. Design development of major design issues, attendance at client and consultant meetings, coordination of production packages, creation of construction drawings and design sketches, coordination with interoffice disciplines, correspondence with manufacturers, documentation and design integration of remaining existing conditions.

Position/Assignment for the Project: Designer of Record			
Firm Name:	Urbahn Architects PLLC	Years of Experience:	36
Name:	Donald E. Henry, Jr., AIA, LEED, CPHC®	This Firm:	30
Title:	Managing Principal	Other Firms:	6
Degree:	Bachelor of Architecture, NJIT	Specialization:	Architecture
Year Earned:	1980	Registration:	RA - New York & New Jersey

A Principal at Urbahn, Donald Henry is an experienced architect who demands the highest level of performance from all who work for him. While he commonly directs projects with large multi-disciplined staffs, he is very much a hands-on architect, frequently in the studio solving constructibility problems in design, or in the field inspecting construction progress. Throughout his diverse career, Mr. Henry has focused on public infrastructure, justice and public safety facilities, and high security projects.

Throughout Donn's career he has focused on environmental design, exploring the potential of renewable energy and use of recycled building materials. His continuing passion for sustainable design led to his early LEED accreditation in 2006. In 2008 he authored the "Green Ordinance" for the Jersey City Building Code, and was recently the recipient of the Jersey City Redevelopment Authority "Green Award" for Sustainability for his leadership in the design and construction of the LEED Silver Public Safety Center. Mr. Henry recently directed the design and construction administration for the Jersey City Municipal Services Complex, which is the first LEED Platinum project built by the city. In addition, Donn recently because a Certified Passive House Consultant.

Under Donn's leadership the Bayamon Correctional Medical Center was the recipient of the Team Award from the Healthcare Symposium. Many of Donn's projects have received recognition by industry organizations and media.

Jersey City Municipal Services Complex, *Jersey City, NJ*
The project transforms a former warehouse site to a multi-building complex, and was envisioned as a Gateway to Jersey City, and has achieved LEED Platinum certification. The project impetus was threefold: a public/private land-partnership to redevelop waterfront necessitated government relocation; the City's facility consolidation program; and its designation as an exemplar of sustainable redevelopment. The complex includes a wide range of vehicular parking, maintenance and repair structures, administrative functions, a police emergency services facility, and community amenities.
Role: Principal In Charge, Architect of Record and Project Manager
Duration: from Concept Stage to Construction Completion

Manhattan 6/6A/8 Garage, *New York, NY*
Urbahn was responsible for the planning and design of New York City Department of Sanitation's District 6/6A/8 Garage. Located between the FDR Drive and First Avenue near the East River, Urbahn's design features measures to protect the critical operations and systems within the 500-year flood zone. This 4-story garage houses 171 sanitation vehicles: refuse collection trucks, mechanical sweepers, and 120 employee cars. Working closely with DSNY, Urbahn designed the facility and its semi-transparent façade to be welcomed by the nearby residential, commercial and institutional communities. The project received approval by the NYC Public Design Commission.
Role: Principal In Charge, Architect of Record and Project Manager
Duration: from Concept Stage to Construction Documents

District 1 & 3 Sanitation Garage Complex, *Staten Island, NY*
Urbahn's scope of work included a comprehensive functional program of needs, assessment site/building conditions, environmental assessment, and the examination of a range of redevelopment strategies. The former site housed facilities to support the operations of District #3, including a large vehicle garage, a repair shop, a waste drop off area, and outdoor parking for sanitation vehicles that do not fit within the garage and employee vehicles. Based on Urbahn's study, NYCDDC is currently managing the design and construction program.
Role: Principal In Charge, Architect of Record
Duration: CPSD Study

Jersey City Public Safety Center, *Jersey City, NJ*
This building serves as the primary communications center for all emergency responders. Located on the second floor is the heart of this 25,000 sf facility: the 9-1-1 call center, a theatre of operations for the police, fire, and EMS departments. There are several critical adjacencies to the main communications theatre, including suites for groups providing research, planning and tactical support. In addition, the core program also called for a ring of support spaces. The design merges high security, anti-attack features, employee amenity, sustainable design, and community design considerations.
Role: Principal In Charge, Architect of Record and Project Manager
Duration: from Concept Stage to Construction Completion

Federal Detention Center, *Brooklyn, NY*
Urbahn designed the 1000-cell Federal Detention Center at Bush Terminal as part of the multi-phase master plan, previously developed by the firm. The new Federal Detention Center building shares a city block with the 500-bed Federal Detention Center designed, gut renovated, and occupied in the first phase of the project.
Role: Project Manager
Duration: from Concept Stage to Construction Completion

Position/Assignment for the Project: Design Architect			
Firm Name:	Marvel Architects, PLLC	Years of Experience:	31
Name:	Guido Hartray, AIA	This Firm:	7
Title:	Founding Partner, Marvel Architects, PLLC	Other Firms:	24
Degree:	Harvard GSD, Master of Architecture	Specialization:	Architectural Design
Year Earned:	1994	Registration:	Registered Architect, NY, NJ

Guido Hartray has worked with Jonathan Marvel since 1997, and is a founding Partner of Marvel Architects. He has led design teams working on a wide range of projects, including creating a streetscape vision of Union Square and integrating park and building for Pierhouse and 1 Hotel in Brooklyn Bridge Park. Under his leadership NJIT created a new campus academic center for the campus in the Central King Building. He has created workspaces that bridge digital and printed media for America Media and the American Physical Society.

Guido is dedicated to creating architecture that contributes to an environment that is greater than the individual project. Whether the context of the intervention is an urban neighborhood, a campus, or an existing building, Guido's design strategy builds from the context to develop designs that transform their surroundings. The dialogue between new and existing, project and neighborhood, infrastructure and architecture makes spaces that engage their inhabitants.
Guido was a Fulbright Scholar studying public space in Barcelona and served on Community Board 3 in Manhattan.

EDUCATION
Harvard University, Graduate School of Design, Master of Architecture 1994 Miami University, Ohio, Bachelor of Environmental Design 1989

PRACTICE
Marvel Architects, NY: 2013-Present
Rogers Marvel Architects, NY 1997-2013
Museo de Arte Contemporáneo de Barcelona, Spain,1995-1997
Curator, Architectural Association, London 1995-1997
Curator, Coderch's Barceloneta Housing AM Arquitectos, Barcelona, Spain 1996
Highrise Residential Development in Badalona, Spain, Nagle Hartray & Associates, Chicago 1993
Pica Ciamarra Associati, Naples, Italy 1989-1990

Gowanus Green Public Space Master Plan, *Brooklyn, NY*
Gowanus Green incorporates the community's visioning principles and responds to the city's call for a mixed-use extension of the Carroll Gardens neighborhood. The design features six residential buildings with approximately 950 units in a transit-rich location. It provides affordable housing serving a wide range of incomes and needs, including housing dedicated to the formerly homeless, senior and extremely low-income New Yorkers. (Guido Hartray with Marvel Architects)

Downtown Far Rockaway Housing, *Queens, NY*
In the center of Downtown Far Rockaway in Queens, Marvel has begun an ambitious project to bring 1,700 new affordable housing units to an under-utilized site between the A train terminus and the Long Island Rail Road and create more vibrant, supportive community through socially thoughtful design. (Guido Hartray with Marvel Architects)

Union Square Streetscape, *New York, NY*
Marvel worked with the Union Square Partnership to envision and plan for the future of Union Square to continue its commitment to public space. As a curator, designer, contributor, and documenter of this process Marvel studied the context and the distinct ways it is used as well as the impacts and opportunities of upcoming infrastructural changes to help achieve USP's goals and those of all of Union Square's visitors, tenants, and residents.
Guido Hartray with Marvel Architects

Bedford Courts (Bedford Union Armory), *Brooklyn, NY*
Bedford Courts is a mixed use development located in the Crown Heights neighborhood in Brooklyn, NY. It was formerly known as the Troop C Armory, and was designed in 1903 by Pilcher and Tachau. The project will add units of housing to the site while transforming the existing armory into a community hub. (Guido Hartray with Marvel Architects)

NJIT Central King Building Renovation, *Newark, NJ*
Since 2011, our team has worked with the New Jersey Institute of Technology (NJIT) to complete the renovation of the Newark, NJ Central High School, also called the CKB. Originally opened in 1912, it is a 6-story collegiate gothic building, positioned at the edge of campus. Phased renovation of the historic structure, while maintaining occupancy in part of the building spanned from 2012-2017. The Marvel-led team conducted an exhaustive survey of existing conditions, stabilized the envelope while conducting a complete gut renovation of the interior. All systems were replaced, and the interiors of this former high school were programmed to emphasize collaboration, interaction, and socialization in-between traditional educational scenarios. The complex program includes biology research and instructional labs, flexible classrooms, a 600-seat auditorium, multiple meeting and student support spaces, and an innovation lab. The entire structure and site were reconceived as part of a University master plan, with attractive new entrances on both sides underscoring the importance of this campus-edge building. Completed on time and on budget, this LEED Gold building has been called “Newark’s crown jewel” by local press. (Guido Hartray with Marvel Architects)

Hoboken Cove Community Boat House, *Hoboken, NJ*

The City of Hoboken asked Marvel to design a boathouse and resilience center, with a mandate to include community space and facilities for the local kayaking club. as part of the long-term Rebuild by Design initiative. The community was directly involved from the earliest stages to try and build up the boathouse’s potential for use. Currently, the project is pending development of the Rebuild by Design mega-berm that will protect so much of the New Jersey waterfront. When the boathouse gets built, it will have a profound impact on the North Hoboken community fabric. The area has no community center, and Superstorm Sandy showed the need for a local resiliency center. (Guido Hartray with Marvel Architects)

Pierhouse at Brooklyn Bridge Park, *Brooklyn, NY*
Pierhouse, located in the heart of Brooklyn Bridge Park between Furman Street and the East River, comprises a 106-unit condominium, 300-car below-grade parking garage, 17,000 SF event space, and 195-key hotel within a 620,000 SF complex of connected buildings ranging from four to ten stories. (Guido Hartray with Marvel Architects)

America Media Offices, *New York, NY*
America Media is a 100 year old Jesuit publication which needed a space that would support its evolution into new media while maintaining its distinct perspective. After an extensive site search we identified a space overlooking the media centers of 6th avenue but also a block from St Patricks’ Cathedral. The design builds on this location by pulling the enclosed areas to the interior of the floor plate and placing circulation and open work stations on the perimeter so that shared views over the city provide the literal embodiment of America’s perspective on world events. (Guido Hartray with Marvel Architects)

Hudson Square Streetscape Improvement Plan, *New York, NY*
Working with Mathews Nielsen Landscape Architecture and Hudson Square Connection, the business improvement district, Marvel analyzed the neighborhood’s streetscape to develop short and long-term improvements. While the heavy north-south traffic stood out as a major challenge, it is a characteristic common to many NYC neighborhoods. Our analysis of Hudson Square revealed an equally significant problem effecting the neighborhood’s quality of life: a lack of pedestrian and retail activity on the cross streets. To address this challenge we worked with the landscape architects to develop active cross-street landscapes, incentives for pop-up loading dock conversions, and active corners written into the neighborhood’s new zoning. (Guido Hartray with Marvel Architects)

Position/Assignment for the Project: Project Safety Representative			
Firm Name:	Hunter Roberts Construction Group, LLC	Years of Experience:	22
Name:	Shane Skennoto	This Firm:	13
Title:	VP, Director of Safety	Other Firms:	9
Degree:	B.S., Occupational Safety and Hygiene Mngmnt	Specialization:	
Year Earned:	1998	Registration:	N/A

Shane Skennonto is responsible for implementing the Hunter Roberts' Corporate Safety, Health, and Environmental Program & Procedures and the approved Project Safety Manual. He supports a variety of projects at the field production level and corporate team to ensure the appropriate integration and timely availability of any needed specialty safety services. He also monitors subcontractors working on behalf of the Hunter Roberts team to guarantee adherence to our corporate safety standards. He is responsible to enforce, encourage and administer all phases of the company-wide and project specific safety, security, environmental protection, and industrial hygiene programs. Shane has documented authorization from Hunter Roberts' senior management to act on behalf of Hunter Roberts in all safety matters including the stoppage of any work when the safety or occupational health of workers is compromised. Shane has over 20 years in the safety industry. Prior to his employment with Hunter Roberts in 2007, he worked as the Senior Health and Safety Specialist for Sunoco, Inc., where he coordinated contractor safety training and verification to meet standards, managed on-site safety equipment vendors for multiple locations, evaluated, and implemented training programs. Shane also managed the night shift safety effort of 20 safety professionals for a $500 million capital construction project; coordinated the intern program and supported contract administrators with field audits, training, injury follow up, and issue resolution.

NYCEDC Facilities and Construction Management Retainer Contract, *All Boroughs, NY*
Project Role: Construction Safety Oversight, Duration: Construction, Firms Involved: NYCEDC, various subcontractors
Lead a team of over forty professional staff, working closely with the Owner on projects from conception through completion. The EDC team provides Construction Management services for projects ranging from feasibility studies and estimates, through small volume short duration projects throughout New York City's five boroughs, to large scale multi-year projects with volumes ranging in the tens of millions.

Queens Plaza Park, Long Island City, NY
Project Role: Construction Safety Oversight, Duration: Construction, Firms Involved: Durst Organization, various subcontractors
A 950-unit, 1,000,000-SF residential building with a component of the units built as affordable housing. The project site also hosts a half-acre public park, a renovated entrance to the Queens Plaza subway station, and the adaptive reuse of the Landmarked Bank of Manhattan building.

Garvies Point Phase I, Glen Cove, NY
Project Role: Construction Safety Oversight, Duration: Construction, Firms Involved: RXR Development, various subcontractors
A new mixed-use community located along Hempstead Harbor. Phase I includes three residential buildings, consisting of 959,000 SF total. Two of the buildings each contain five floors of rental units while the third has six floors of condominiums. Amenities for the buildings include a green roof, parking garage and lots, swimming and spa pool, courtyard with fountain, and club house.

NYPQ EES Separation of Power, Flushing, NY
Project Role: Construction Safety Oversight, Duration: Construction, Firms Involved: NYPQ, various subcontractors
Upgrades and corrections to existing electrical system deficiencies currently present hospital-wide. Primary project objective to provide a new Type 1 Essential Electrical System (EES) to comply with NFPA 99, consisting of three electrical branches, life safety, and critical equipment, backed up with three generators as an emergency power source. Also includes new emergency electrical distribution room to house emergency ATS's and switchgear and seven new fire-protected electrical closets.

MSK Nassau Regional Cancer Center, Uniondale, NY
Project Role: Construction Safety Oversight, Duration: Construction, Firms Involved: MSK, various subcontractors
A new 105,000-SF, two-story outpatient treatment facility and pre-cast parking garage providing 450 spaces. Extensive site utility tie-ins. Programming includes radiology, lymphedema, infusion, radiation oncology with three LINACs, laboratory and quick treatment areas, office space, administration space, and public lobby/waiting areas. Targeting LEED certification.

Position/Assignment for the Project: M/WBE Coordinator			
Firm Name:	Hunter Roberts Construction Group, LLC	Years of Experience:	8
Name:	Krystin Hence	This Firm:	1
Title:	Estimator	Other Firms:	7
Degree:	M.S. City & Regional Planning, B.A. Urban Studies	Specialization:	
Year Earned:	2013/2011	Registration:	N/A

Prior to her role as an Estimator, Krystin was instrumental in implementing NYCEDC's MWBE and ConstructNYC programs, working collaboratively with Construction Managers and NYCEDC's Opportunity MWDBE Group to not only meet contractual participation goals, but to promote a culture that encourages diverse and inclusive approaches to project delivery. As Estimator, Krystin is responsible for estimating construction costs of all building systems and acts as a client liaison during pre-construction. She coordinates between owners, architects, engineers and subcontractors to orchestrate a successful pre-construction product and sets each job up for project excellence. In addition, Krystin works with the operations teams on schedules, logistics, and scopes of work to ensure operational costs are built into the estimate. Krystin has over eight years of experience in the construction industry, largely focused on the design and construction of industrial campuses and waterfront infrastructure. Throughout her varying roles within the industry, Krystin has always found opportunities to serve as champion of disadvantaged businesses in advancement of NYC/NYS goals.

South Nassau Communities Hospitals - Medical Arts Pavilion, *Oceanside, NY*
Project Role: Estimating Services, Duration: Pre-Construction, Firms Involved: HOK International
Estimating Services, Constructibility Review and consultant selection for 15,000 sq ft medical office building and associated parking lot / site-work.

NYCEDC Capital Program - Brooklyn Bridge Esplanade, *New York, NY*
Project Role: Estimating Services, Duration: Pre-Construction, Firms Involved: NYCEDC, HRCG, Starr Whitehouse Landscape Architects and Planners
1,500 linear feet of waterfront improvements to extend the East River Waterfront. Includes 12-ft walkway along the water, new pedestrian crossings and bike lanes, relocation of existing parking lot, plaza areas, seating and picnic tables, and Brooklyn Bridge viewing deck.

Made in New York Campus, *Brooklyn, NY*
Project Role: Design and Construction Management, Duration: Design/Pre-Construction/Construction,
Firms Involved: NYCEDC, Gilbane, Dewberry Companies Inc., nArchitects
Transformation of the historic Bush Terminal into a 200,000-SF garment manufacturing / 160,000-SF light industrial manufacturing hub. Scope included interior renovations and MEPS upgrades, streetscape improvements, and public realm improvements across the nine acres of the campus.

Brooklyn Army Terminal, *Brooklyn, NY*
Project Role: Design and Construction Management, Duration: Design/Pre-Construction/Construction,
Firms Involved: NYCEDC, HRCG, Mancini Duffy, WXY Architecture and Urban Design
Renovation of a 100-year-old military facility in Sunset Park, Brooklyn, transforming the campus into 55 acres of light industrial tenant space and public access to the waterfront. Scope included significant interior renovations, structural improvements, and MEPS upgrades to three large warehouse buildings; exterior façade restoration to all exteriors; new ferry shelter and ticketing space; and campus-wide sitework and landscaping improvements.

New Fulton Fish Market, *Bronx, NY*
Project Role: Design and Construction Management, Duration: Design/Pre-Construction/Construction,
Firms Involved: NYCEDC, McKissack & McKissack
Managed Capital improvements and on-going maintenance. Scope included installation of trench drains, over 1 million SF of parking lot resurfacing including concrete loading pads, retrofitting of loading docks for cold storage, façade and roof replacement, fire alarm replacement, bathroom renovations, and interior ft-out of office spaces.

Red Hook Integrated Flood Protection System, *Brooklyn, NY*
Project Role: Project Manager, Duration: Feasibility/Design, Firms Involved: NYCEDC, Dewberry Companies Inc. Coastal protection in response to Hurricane Sandy. Included feasibility study, environmental review, and design.

New York City Select Bus Service, *City-wide, NY*
Project Role: Project Coordination, Duration: Design/Pre-Construction, Firms Involved: NYCDOT, MTA-NYCT Roadway and streetscape work - including utility relocation, sidewalk reconstruction, and installation of pavement, bus shelters, traffic signals, and signage - for New York City's new rapid bus system.

PRINCIPAL PARTICIPANT HISTORY

Form H – Past Performance

For each Principal Participant, complete a copy of this Form H (all tables) covering each Principal Participant's experience for the 36 months immediately prior to the Proposer's submission of its Proposal for all of such Principal Participant's prior experience on U.S. public infrastructure projects valued at over $50 million.

Insert additional rows to any able in this Form H, if needed.

Form H – Table 1 – Schedule Delays[1]				
Name of Proposer		Hunter Roberts Construction Group, LLC		
Name of Firm		Hunter Roberts Construction Group, LLC		
Project Name	**Originally Schedule Date for Completion**	**Date of Actual Completion**	**Reason for Delay and Approach to Mitigation**	**Current Owner Details: Contact Name/Phone/Email**
NONE				

[1] Should only disclose inexcusable delays to the project schedule that were 60 days or longer.

Form H – Table 2 – Scope Change[2]				
Name of Proposer	Hunter Roberts Construction Group, LLC			
Name of Firm	Hunter Roberts Construction Group, LLC			
Project Name	**Description of Requested Claim or Scope Change**	**Estimated Cost of Requested Change (US $)**	**Description of Action Taken to Rectify the Event or Occurrence**	**Current Owner Details: Contact Name/Phone/Email**
NONE				

[2] Must only disclose scope change requests and claims for relief over $10 million in the aggregate for a particular occurrence or event.

Form H – Table 3 – Litigation & Dispute Proceedings[8]				
Name of Proposer	Hunter Roberts Construction Group, LLC			
Name of Firm	Hunter Roberts Construction Group, LLC			
Project Name	**Cause of Litigation or Dispute(s)**	**Amount in Dispute (If Applicable) (US $)**	**Summary of Outstanding Damage Claims by an Owner**	**Current Owner Details: Contact Name/Phone/Email**
NONE				

[8] Must disclose any claims brought into formal litigation or claims brought against the firm under the Federal False Claims Act.

Form H – Table 4 – Event of Default or Termination for Cause[9]			
Name of Proposer	Hunter Roberts Construction Group, LLC		
Name of Firm	Hunter Roberts Construction Group, LLC		
Project Name	**Description of Reason for Event of Default or Termination**	**Description of Action Taken to Rectify the Event or Occurrence**	**Current Owner Details: Contact Name/Phone/Email**
NONE			

[9] Must disclose any Principal Participant event of default or involuntary termination of a prior contract.

Form H – Table 5 – Disciplinary Action[10], Suspension for Cause, Safety Suspensions[11] or Failures to Pay Subcontractors[12]			
Name of Proposer	Hunter Roberts Construction Group, LLC		
Name of Firm	Hunter Roberts Construction Group, LLC		
Project Name	**Description of Event that Occurred**	**Description of Action Taken to Rectify the Event or Occurrence**	**Current Owner Details: Contact Name/Phone/Email**
NONE			

[10] Must disclose all disciplinary action, including suspensions and any circumstance where the owner had to exercise its step-in rights caused directly or indirectly by the Principal Participant and must disclose any record of any violations of any federal, state, or local statute or regulation, or any court order, addressing or governing: antitrust, public contracting, employment discrimination, false claims, fraud, extortion, bribery, bid rigging, embezzlement, or prevailing wages.

[11] Must disclose any safety suspension orders exceeding 10 Days.

[12] Must disclose any failures to pay subcontractors, including any liens against prior projects caused directly or indirectly by a Principal Participant.

HUNTER ROBERTS CONSTRUCTION GROUP

NYC DDC Department of Design and Construction

NYC BBJ Program

Queens Site Parking Garage

PIN: 8502020CR0040P-42P

Pre-Award Negotiation/Proposal Addendum

December 09, 2020

NYC BBJ Program
Queens Site Parking Garage

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Mobilization Cost Breakdown

Hunter Roberts Construction Group
Queens Parking Garage
Mobilization Cost Breakdown
December 1, 2020

HRCG MOBILIZATION COST BREAKDOWN		12/01/20
HRCG Precon Staff	$	675,077
A/E Consultant Costs	$	750,000
Expeditor / Permitting	$	20,000
Support of Excavation - Design	$	50,000
Precast Garage (Engineering/Shop drawings)	$	250,000
Scheduling Consultant	$	20,000
MOBILIZATION COST BREAKDOWN TOTAL:	$	1,765,077
P&P Bond	$	740,000
SDI	$	1,029,900
Builders Risk	$	97,378
GLI	$	1,360,600
MOBILIZATION COST W/ INSURANCE, P&P BOND:	$	4,992,955

Hunter Roberts Construction Group
Queens Parking Garage
Mobilization Cost Breakdown
December 18, 2020

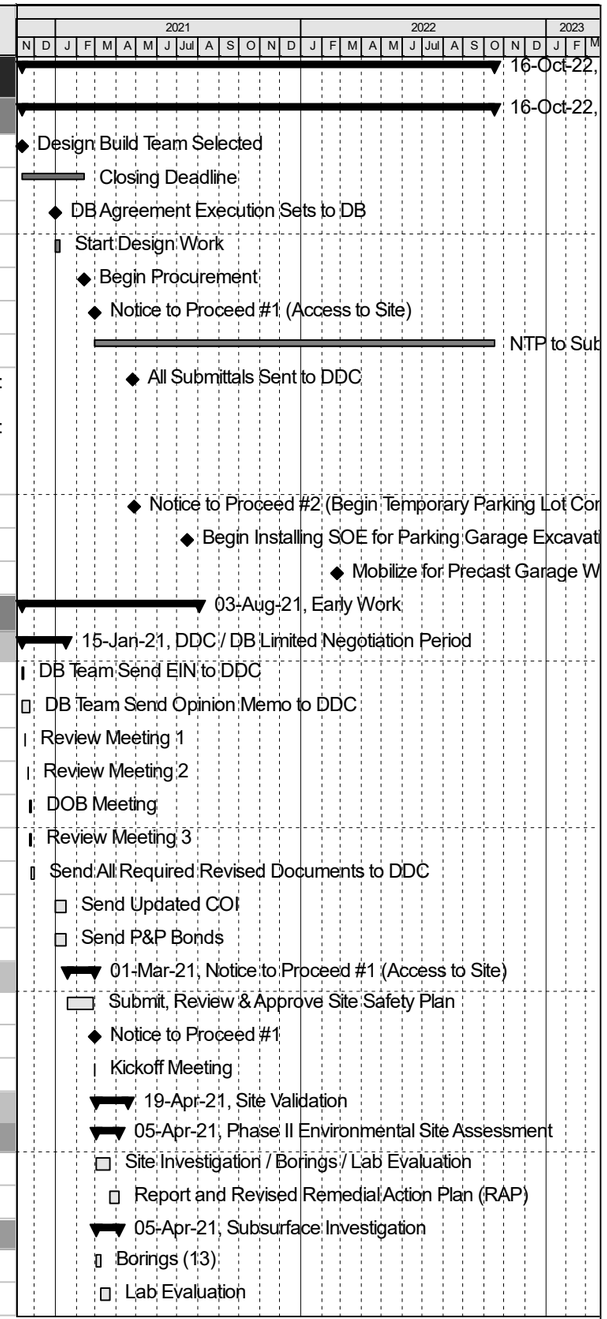
HRCG MOBILIZATION COST BREAKDOWN		12/18/20
HRCG Precon Staff	$	675,077
A/E Consultant Costs	$	750,000
Expeditor / Permitting	$	20,000
Support of Excavation - Design	$	50,000
Precast Garage (Engineering/Shop drawings)	$	250,000
Scheduling Consultant	$	20,000
Subcontractor Default Insurance	$	891,700
MOBILIZATION COST BREAKDOWN TOTAL:	$	2,656,777
P&P Bond	$	740,000
Builders Risk	$	96,200
GLI	$	1,337,000
MOBILIZATION COST W/ INSURANCE, P&P BOND:	$	4,829,977

190 Day Look Ahead Schedule

HUNTER ROBERTS
CONSTRUCTION GROUP

NYC DDC Department of Design and Construction

Activity ID	Activity Name	OD	Start	Finish	Total Float	Predecessor Details
DDC Queens Garage		480	13-Nov-20	16-Oct-22	0	
Milestones		480	13-Nov-20	16-Oct-22	0	
M-1000	Design Build Team Selected	0		13-Nov-20*	22	
M-1010	Closing Deadline	60	13-Nov-20	11-Feb-21	22	M-1000: FS, M-1000: FF 60
M-1020	DB Agreement Execution Sets to DB	0		31-Dec-20*	0	A-1060: FS
M-1030	Start Design Work	3	01-Jan-21	06-Jan-21	0	M-1020: FS
M-1040	Begin Procurement	0	12-Feb-21		20	A-1250: FS -10
M-1110	Notice to Proceed #1 (Access to Site)	0		01-Mar-21	410	A-1250: FS
M-1070	NTP to Substantial Completion	595	01-Mar-21	16-Oct-22	0	M-1110: FS, A-2710: FF
M-1050	All Submittals Sent to DDC	0		26-Apr-21	7	A-1810: FS, A-1830: FS, A-1850: FS, A-1860: FS, A-1870: FS, A-1890: FS, A-1900: FS, A-1910: FS, A-1920: FS, A-1930: FS, A-1940: FS
M-1120	Notice to Proceed #2 (Begin Temporary Parking Lot Construction)	0		27-Apr-21	369	A-2120: FS
M-1130	Begin Installing SOE for Parking Garage Excavation	0		16-Jul-21	312	A-2430: FS
M-1060	Mobilize for Precast Garage Work	0	24-Feb-22		163	A-2700: FS
Early Work		180	13-Nov-20	03-Aug-21	300	
DDC / DB Limited Negotiation Period		42	13-Nov-20	15-Jan-21	35	
A-1000	DB Team Send EIN to DDC	1	13-Nov-20	13-Nov-20	26	M-1000: FS
A-1010	DB Team Send Opinion Memo to DDC	7	13-Nov-20	23-Nov-20	22	M-1000: FS
A-1020	Review Meeting 1	1	17-Nov-20*	17-Nov-20	25	A-1000: FS
A-1030	Review Meeting 2	1	20-Nov-20*	20-Nov-20	23	A-1020: FS
A-1040	DOB Meeting	1	24-Nov-20*	24-Nov-20	22	
A-1050	Review Meeting 3	1	24-Nov-20*	24-Nov-20	22	A-1030: FS, A-1010: FS
A-1060	Send All Required Revised Documents to DDC	2	25-Nov-20	30-Nov-20	22	A-1040: FS, A-1050: FS
A-1070	Send Updated COI	10	01-Jan-21	15-Jan-21	8	M-1020: FS
A-1080	Send P&P Bonds	10	01-Jan-21	15-Jan-21	35	M-1020: FS
Notice to Proceed #1 (Access to Site)		29	19-Jan-21	01-Mar-21	7	
A-1140	Submit, Review & Approve Site Safety Plan	27	19-Jan-21	25-Feb-21	8	A-1070: FS
A-1250	Notice to Proceed #1	0	01-Mar-21*		7	A-1140: FS, A-1080: FS
A-1290	Kickoff Meeting	1	01-Mar-21	01-Mar-21	7	A-1250: FS
Site Validation		35	02-Mar-21	19-Apr-21	32	
Phase II Environmental Site Assessment		25	02-Mar-21	05-Apr-21	32	
A-1390	Site Investigation / Borings / Lab Evaluation	15	02-Mar-21	22-Mar-21	32	A-1290: FS
A-1640	Report and Revised Remedial Action Plan (RAP)	10	23-Mar-21	05-Apr-21	32	A-1390: FS
Subsurface Investigation		25	02-Mar-21	05-Apr-21	32	
A-1380	Borings (13)	5	02-Mar-21	08-Mar-21	32	A-1290: FS
A-1580	Lab Evaluation	10	09-Mar-21	22-Mar-21	32	A-1380: FS



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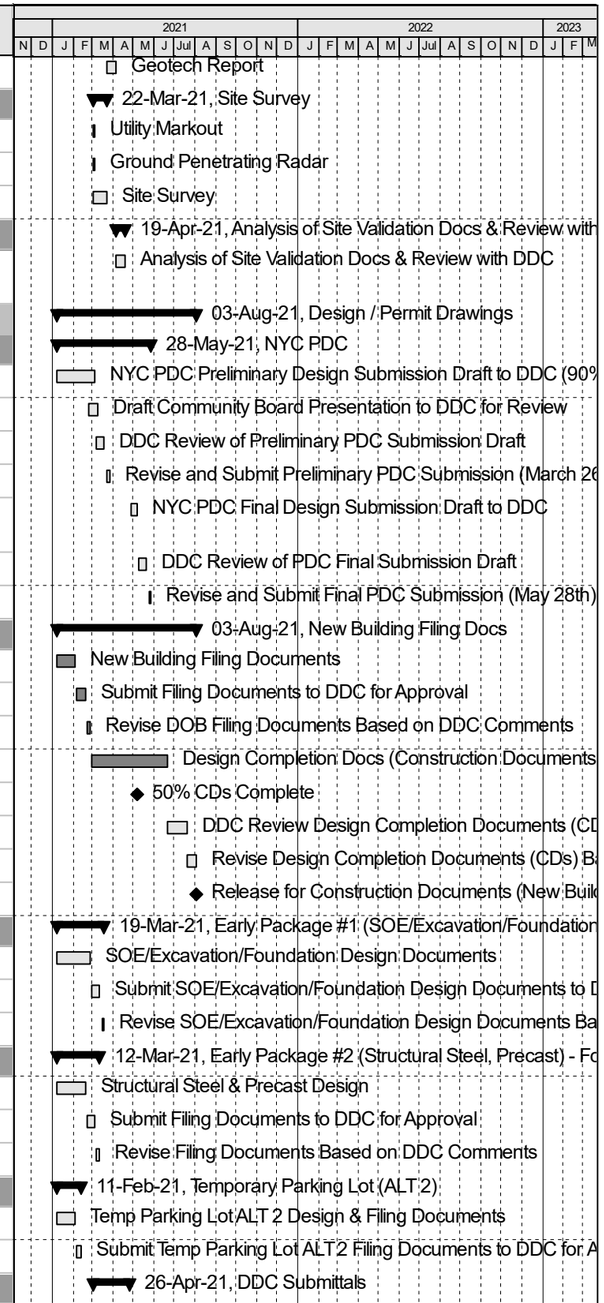
Remaining Work
Critical Remaining Work
Ciritical Remaining
Milestone

DDC Queens Garage
Preliminary Schedule (190 Day)
Edit Date: 09-Dec-20
Hunter Roberts Construction Group

HUNTER ROBERTS CONSTRUCTION GROUP

Activity ID	Activity Name	OD	Start	Finish	Total Float	Predecessor Details
A-1650	Geotech Report	10	23-Mar-21	05-Apr-21	32	A-1580: FS
Site Survey		15	02-Mar-21	22-Mar-21	42	
A-1360	Utility Markout	3	02-Mar-21	04-Mar-21	54	A-1290: FS
A-1370	Ground Penetrating Radar	3	02-Mar-21	04-Mar-21	54	A-1290: FS
A-1400	Site Survey	15	02-Mar-21	22-Mar-21	42	A-1290: FS
Analysis of Site Validation Docs & Review with DDC		10	06-Apr-21	19-Apr-21	32	
A-1730	Analysis of Site Validation Docs & Review with DDC	10	06-Apr-21	19-Apr-21	32	A-1640: FS, A-1650: FS, A-1400: FS, A-1370: FS, A-1360: FS
Design / Permit Drawings		145	07-Jan-21	03-Aug-21	300	
NYC PDC		100	07-Jan-21	28-May-21	56	
A-1590	NYC PDC Preliminary Design Submission Draft to DDC (90% Design)	40	07-Jan-21	05-Mar-21	44	M-1030: FS
A-2790	Draft Community Board Presentation to DDC for Review	10	24-Feb-21	09-Mar-21	78	A-1590: SS 32
A-1740	DDC Review of Preliminary PDC Submission Draft	10	08-Mar-21	19-Mar-21	44	A-1590: FS
A-2760	Revise and Submit Preliminary PDC Submission (March 26th)	5	22-Mar-21	26-Mar-21	44	A-1740: FS
A-1750	NYC PDC Final Design Submission Draft to DDC	9	27-Apr-21	07-May-21	56	A-1590: FS, A-1240: FS, A-1670: FS, A-2780: FF
A-2750	DDC Review of PDC Final Submission Draft	10	10-May-21	21-May-21	56	A-1750: FS
A-2770	Revise and Submit Final PDC Submission (May 28th)	5	24-May-21	28-May-21	56	A-2750: FS
New Building Filing Docs		145	07-Jan-21	03-Aug-21	26	
A-1110	New Building Filing Documents	20	07-Jan-21	04-Feb-21	0	M-1030: FS
A-1170	Submit Filing Documents to DDC for Approval	10	05-Feb-21	19-Feb-21	0	A-1110: FS
A-1240	Revise DOB Filing Documents Based on DDC Comments	5	22-Feb-21	26-Feb-21	0	A-1170: FS
A-1220	Design Completion Docs (Construction Documents) & LOD 300 BIM Model	80	01-Mar-21	21-Jun-21	0	A-1240: FS
A-2780	50% CDs Complete	0		07-May-21	56	A-1220: SS 50
A-2150	DDC Review Design Completion Documents (CDs)	20	22-Jun-21	20-Jul-21	26	A-1220: FS
A-2180	Revise Design Completion Documents (CDs) Based on DDC Comments	10	21-Jul-21	03-Aug-21	26	A-2150: FS, A-2150: FF
A-2220	Release for Construction Documents (New Building)	0		03-Aug-21	26	A-2150: FS, A-2180: FS
Early Package #1 (SOE/Excavation/Foundation) - For Filing & Procurement		50	07-Jan-21	19-Mar-21	10	
A-1100	SOE/Excavation/Foundation Design Documents	35	07-Jan-21	26-Feb-21	7	M-1030: FS
A-1160	Submit SOE/Excavation/Foundation Design Documents to DDC for Approval	10	01-Mar-21	12-Mar-21	10	A-1100: FS
A-1230	Revise SOE/Excavation/Foundation Design Documents Based on DDC Comments	5	15-Mar-21	19-Mar-21	10	A-1160: FS
Early Package #2 (Structural Steel, Precast) - For Procurement		45	07-Jan-21	12-Mar-21	35	
A-2740	Structural Steel & Precast Design	30	07-Jan-21	19-Feb-21	35	M-1030: FS
A-2720	Submit Filing Documents to DDC for Approval	10	22-Feb-21	05-Mar-21	35	M-1030: FS, A-2740: FS
A-2730	Revise Filing Documents Based on DDC Comments	5	08-Mar-21	12-Mar-21	35	A-2720: FS
Temporary Parking Lot (ALT 2)		25	07-Jan-21	11-Feb-21	420	
A-1090	Temp Parking Lot ALT 2 Design & Filing Documents	20	07-Jan-21	04-Feb-21	28	M-1030: FS
A-1150	Submit Temp Parking Lot ALT 2 Filing Documents to DDC for Approval / Revisions	5	05-Feb-21	11-Feb-21	420	A-1090: FS
DDC Submittals		40	02-Mar-21	26-Apr-21	7	



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Remaining Level of Effort
Summary
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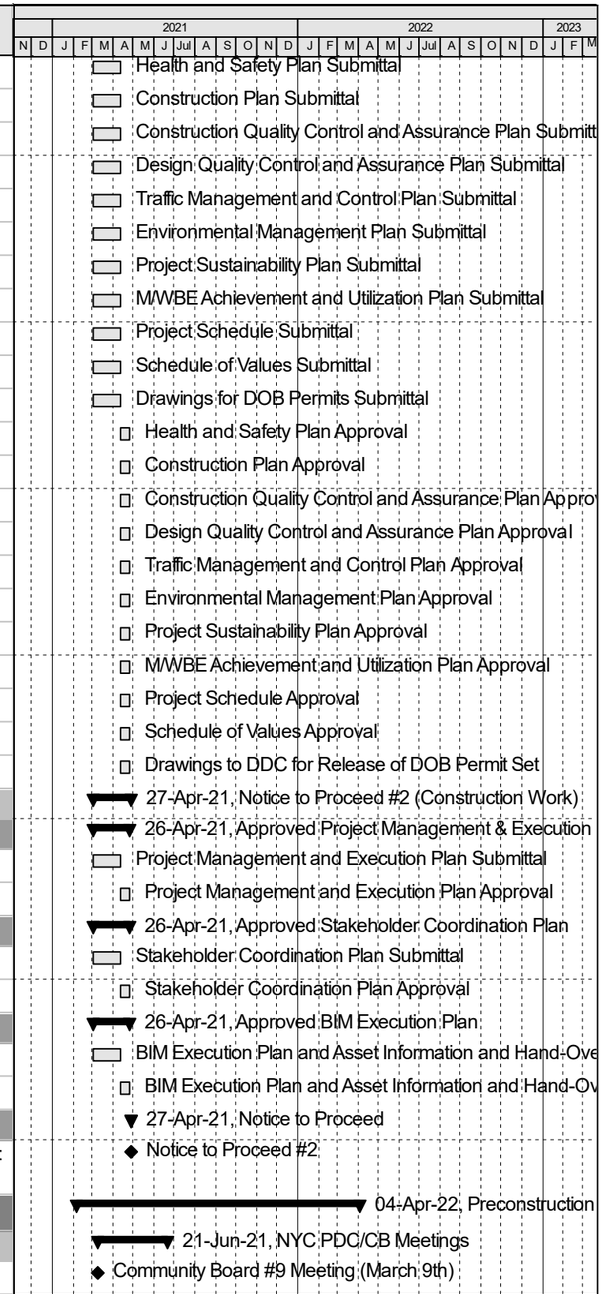
DDC Queens Garage
Preliminary Schedule (190 Day)
Edit Date: 09-Dec-20
Hunter Roberts Construction Group

HUNTER ROBERTS CONSTRUCTION GROUP

Activity ID	Activity Name	OD	Start	Finish	Total Float	Predecessor Details
A-1410	Health and Safety Plan Submittal	30	02-Mar-21	12-Apr-21	7	A-1290: FS
A-1430	Construction Plan Submittal	30	02-Mar-21	12-Apr-21	7	A-1290: FS
A-1450	Construction Quality Control and Assurance Plan Submittal	30	02-Mar-21	12-Apr-21	7	A-1290: FS
A-1460	Design Quality Control and Assurance Plan Submittal	30	02-Mar-21	12-Apr-21	7	A-1290: FS
A-1470	Traffic Management and Control Plan Submittal	30	02-Mar-21	12-Apr-21	7	A-1290: FS
A-1490	Environmental Management Plan Submittal	30	02-Mar-21	12-Apr-21	7	A-1290: FS
A-1500	Project Sustainability Plan Submittal	30	02-Mar-21	12-Apr-21	7	A-1290: FS
A-1510	M/WBE Achievement and Utilization Plan Submittal	30	02-Mar-21	12-Apr-21	7	A-1290: FS
A-1520	Project Schedule Submittal	30	02-Mar-21	12-Apr-21	7	A-1290: FS
A-1530	Schedule of Values Submittal	30	02-Mar-21	12-Apr-21	7	A-1290: FS
A-1540	Drawings for DOB Permits Submittal	30	02-Mar-21	12-Apr-21	7	A-1290: FS
A-1810	Health and Safety Plan Approval	10	13-Apr-21	26-Apr-21	7	A-1410: FS
A-1830	Construction Plan Approval	10	13-Apr-21	26-Apr-21	7	A-1430: FS
A-1850	Construction Quality Control and Assurance Plan Approval	10	13-Apr-21	26-Apr-21	7	A-1450: FS
A-1860	Design Quality Control and Assurance Plan Approval	10	13-Apr-21	26-Apr-21	7	A-1460: FS
A-1870	Traffic Management and Control Plan Approval	10	13-Apr-21	26-Apr-21	7	A-1470: FS
A-1890	Environmental Management Plan Approval	10	13-Apr-21	26-Apr-21	7	A-1490: FS
A-1900	Project Sustainability Plan Approval	10	13-Apr-21	26-Apr-21	7	A-1500: FS
A-1910	M/WBE Achievement and Utilization Plan Approval	10	13-Apr-21	26-Apr-21	7	A-1510: FS
A-1920	Project Schedule Approval	10	13-Apr-21	26-Apr-21	7	A-1520: FS
A-1930	Schedule of Values Approval	10	13-Apr-21	26-Apr-21	7	A-1530: FS
A-1940	Drawings to DDC for Release of DOB Permit Set	10	13-Apr-21	26-Apr-21	7	A-1540: FS
Notice to Proceed #2 (Construction Work)		40	02-Mar-21	27-Apr-21	7	
Approved Project Management & Execution Plan		40	02-Mar-21	26-Apr-21	7	
A-1420	Project Management and Execution Plan Submittal	30	02-Mar-21	12-Apr-21	7	A-1290: FS
A-1820	Project Management and Execution Plan Approval	10	13-Apr-21	26-Apr-21	7	A-1420: FS
Approved Stakeholder Coordination Plan		40	02-Mar-21	26-Apr-21	7	
A-1480	Stakeholder Coordination Plan Submittal	30	02-Mar-21	12-Apr-21	7	A-1290: FS
A-1880	Stakeholder Coordination Plan Approval	10	13-Apr-21	26-Apr-21	7	A-1480: FS
Approved BIM Execution Plan		40	02-Mar-21	26-Apr-21	7	
A-1440	BIM Execution Plan and Asset Information and Hand-Over Plan Submittal	30	02-Mar-21	12-Apr-21	7	A-1290: FS
A-1840	BIM Execution Plan and Asset Information and Hand-Over Plan Approval	10	13-Apr-21	26-Apr-21	7	A-1440: FS
Notice to Proceed		0	27-Apr-21	27-Apr-21	7	
A-2120	Notice to Proceed #2	0	27-Apr-21		7	A-1820: FS, A-1880: FS, A-1840: FS, M-1050: FS
Preconstruction		290	05-Feb-21	04-Apr-22	135	
NYC PDC/CB Meetings		73	09-Mar-21	21-Jun-21	56	
A-1570	Community Board #9 Meeting (March 9th)	0		09-Mar-21	78	A-1250: FS, A-2790: FS



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DDC Queens Garage

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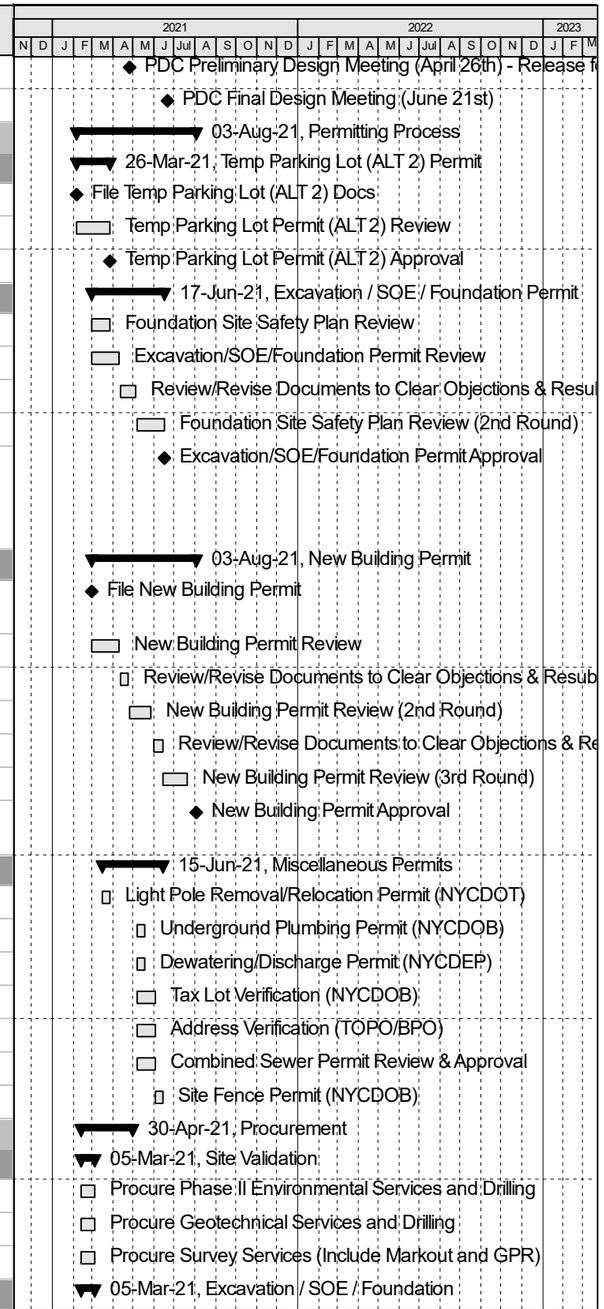
Edit Date: 09-Dec-20

Hunter Roberts Construction Group

HUNTER ROBERTS CONSTRUCTION GROUP

Activity ID	Activity Name	OD	Start	Finish	Total Float	Predecessor Details
A-1670	PDC Preliminary Design Meeting (April 26th) - Release for New Foundation Work	0		26-Apr-21	44	A-1570: FS, A-2760: FS 21
A-1760	PDC Final Design Meeting (June 21st)	0		21-Jun-21	56	A-1670: FS, A-2770: FS 15
Permitting Process		125	05-Feb-21	03-Aug-21	26	
Temp Parking Lot (ALT 2) Permit		35	05-Feb-21	26-Mar-21	28	
A-1260	File Temp Parking Lot (ALT 2) Docs	0	05-Feb-21		28	A-1090: FS
A-1350	Temp Parking Lot Permit (ALT2) Review	35	05-Feb-21	26-Mar-21	28	A-1260: FS
A-1950	Temp Parking Lot Permit (ALT2) Approval	0		26-Mar-21	28	A-1350: FS, A-1700: FS
Excavation / SOE / Foundation Permit		78	01-Mar-21	17-Jun-21	7	
A-1310	Foundation Site Safety Plan Review	20	01-Mar-21	26-Mar-21	17	A-1280: FS
A-1320	Excavation/SOE/Foundation Permit Review	30	01-Mar-21	09-Apr-21	7	A-1280: FS
A-1710	Review/Revise Documents to Clear Objections & Resubmit	18	12-Apr-21	05-May-21	7	A-1310: FS, A-1320: FS
A-2030	Foundation Site Safety Plan Review (2nd Round)	30	06-May-21	17-Jun-21	7	A-1710: FS
A-2210	Excavation/SOE/Foundation Permit Approval	0		17-Jun-21	7	A-1310: FS, A-1320: FS, A-2030: FS, A-1980: FS, A-2000: FS, A-2010: FS, A-1990: FS, A-2020: FS, A-1670: FS
New Building Permit		110	01-Mar-21	03-Aug-21	26	
A-1280	File New Building Permit	0		01-Mar-21	7	A-1250: FS, A-1240: FS, A-1100: FS
A-1340	New Building Permit Review	30	01-Mar-21	09-Apr-21	36	A-1280: FS
A-1780	Review/Revise Documents to Clear Objections & Resubmit	10	12-Apr-21	23-Apr-21	36	A-1340: FS
A-2090	New Building Permit Review (2nd Round)	25	26-Apr-21	28-May-21	36	A-1780: FS
A-2300	Review/Revise Documents to Clear Objections & Resubmit (2nd Round)	10	01-Jun-21	14-Jun-21	36	A-2090: FS
A-2390	New Building Permit Review (3rd Round)	25	15-Jun-21	20-Jul-21	36	A-2300: FS
A-2490	New Building Permit Approval	0		03-Aug-21	26	A-2390: FS, A-2220: FS, A-1760: FS
Miscellaneous Permits		66	15-Mar-21	15-Jun-21	9	
A-1700	Light Pole Removal/Relocation Permit (NYCDOT)	10	15-Mar-21	26-Mar-21	28	A-1350: SS 25
A-1980	Underground Plumbing Permit (NYCDOB)	10	06-May-21	19-May-21	27	A-1710: FS
A-1990	Dewatering/Discharge Permit (NYCDEP)	10	06-May-21	19-May-21	27	A-1710: FS
A-2000	Tax Lot Verification (NYCDOB)	20	06-May-21	03-Jun-21	17	A-1710: FS
A-2010	Address Verification (TOPO/BPO)	20	06-May-21	03-Jun-21	17	A-1710: FS
A-2020	Combined Sewer Permit Review & Approval	20	06-May-21	03-Jun-21	17	A-1710: FS
A-2340	Site Fence Permit (NYCDOB)	10	02-Jun-21	15-Jun-21	7	A-2250: FS
Procurement		55	12-Feb-21	30-Apr-21	35	
Site Validation		15	12-Feb-21	05-Mar-21	40	
A-1190	Procure Phase II Environmental Services and Drilling	15	12-Feb-21	05-Mar-21	40	M-1040: FS
A-1200	Procure Geotechnical Services and Drilling	15	12-Feb-21	05-Mar-21	40	M-1040: FS
A-1210	Procure Survey Services (Include Markout and GPR)	15	12-Feb-21	05-Mar-21	40	M-1040: FS
Excavation / SOE / Foundation		15	12-Feb-21	05-Mar-21	20	



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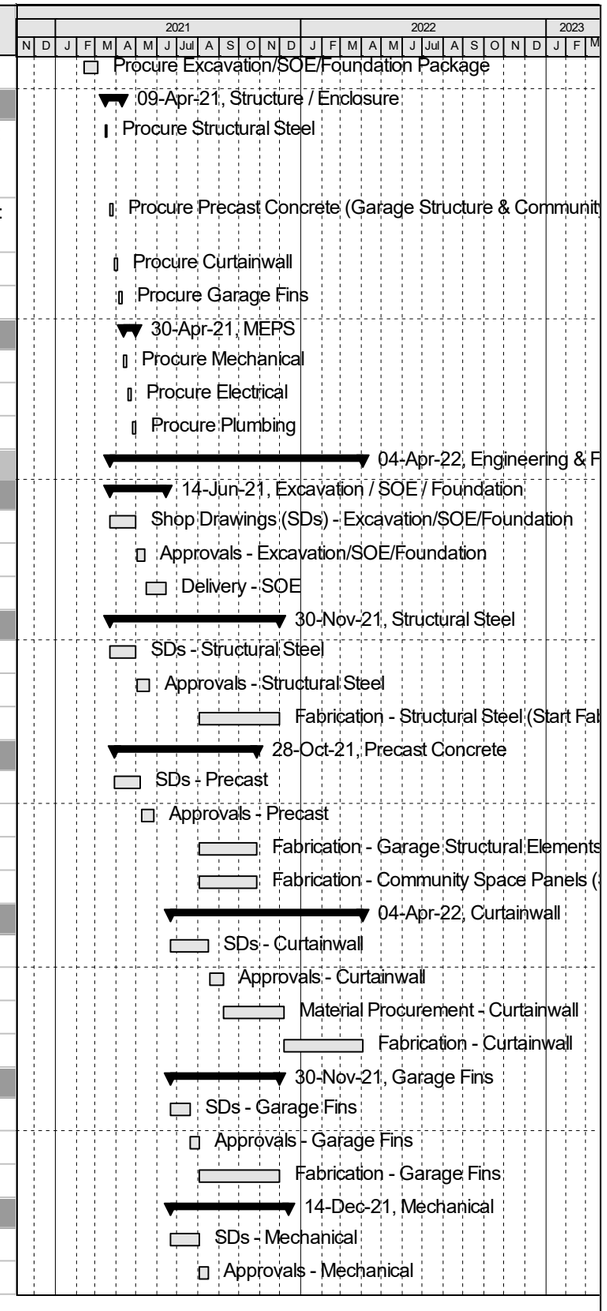
HUNTER ROBERTS CONSTRUCTION GROUP

Activity ID	Activity Name	OD	Start	Finish	Total Float	Predecessor Details
A-1180	Procure Excavation/SOE/Foundation Package	15	12-Feb-21	05-Mar-21	20	M-1040: FS
Structure / Enclosure		20	15-Mar-21	09-Apr-21	35	
A-1550	Procure Structural Steel	5	15-Mar-21	19-Mar-21	35	A-1250: FS, A-1180: FS, A-1190: FS, A-1200: FS, A-1210: FS, A-2740: FS, A-2730: FS
A-1600	Procure Precast Concrete (Garage Structure & Community Space Panels)	5	22-Mar-21	26-Mar-21	35	A-1250: FS, A-1550: FS, A-2740: FS, A-2730: FS
A-1620	Procure Curtainwall	5	29-Mar-21	02-Apr-21	35	A-1250: FS, A-1600: FS
A-1660	Procure Garage Fins	5	05-Apr-21	09-Apr-21	35	A-1250: FS, A-1620: FS
MEPS		15	12-Apr-21	30-Apr-21	35	
A-1690	Procure Mechanical	5	12-Apr-21	16-Apr-21	35	A-1250: FS, A-1660: FS
A-1770	Procure Electrical	5	19-Apr-21	23-Apr-21	35	A-1250: FS, A-1690: FS
A-1960	Procure Plumbing	5	26-Apr-21	30-Apr-21	35	A-1250: FS, A-1770: FS
Engineering & Fabrication		260	22-Mar-21	04-Apr-22	135	
Excavation / SOE / Foundation		60	22-Mar-21	14-Jun-21	10	
A-1560	Shop Drawings (SDs) - Excavation/SOE/Foundation	30	22-Mar-21	30-Apr-21	10	A-1180: FS, A-1230: FS
A-1970	Approvals - Excavation/SOE/Foundation	10	03-May-21	14-May-21	10	A-1560: FS
A-2170	Delivery - SOE	20	17-May-21	14-Jun-21	10	A-1970: FS
Structural Steel		175	22-Mar-21	30-Nov-21	220	
A-1610	SDs - Structural Steel	30	22-Mar-21	30-Apr-21	270	A-1550: FS
A-2080	Approvals - Structural Steel	15	03-May-21	21-May-21	270	A-1610: FS
A-2230	Fabrication - Structural Steel (Start Fabrication after NB Permit)	80	04-Aug-21	30-Nov-21	220	A-2080: FS, A-2490: FS
Precast Concrete		150	29-Mar-21	28-Oct-21	240	
A-1630	SDs - Precast	30	29-Mar-21	07-May-21	117	A-1600: FS
A-2160	Approvals - Precast	15	10-May-21	28-May-21	117	A-1630: FS
A-2280	Fabrication - Garage Structural Elements	60	04-Aug-21	28-Oct-21	72	A-2160: FS, A-2490: FS
A-2290	Fabrication - Community Space Panels (Start Fabrication after NB Permit)	60	04-Aug-21	28-Oct-21	240	A-2160: FS, A-2490: FS
Curtainwall		195	22-Jun-21	04-Apr-22	135	
A-1680	SDs - Curtainwall	40	22-Jun-21	17-Aug-21	135	A-1620: FS, A-1220: FS
A-2270	Approvals - Curtainwall	15	18-Aug-21	08-Sep-21	135	A-1680: FS
A-2400	Material Procurement - Curtainwall	60	09-Sep-21	07-Dec-21	135	A-2270: FS, A-2490: FS
A-2570	Fabrication - Curtainwall	80	08-Dec-21	04-Apr-22	135	A-2400: FS
Garage Fins		110	22-Jun-21	30-Nov-21	220	
A-1720	SDs - Garage Fins	20	22-Jun-21	20-Jul-21	220	A-1660: FS, A-1220: FS
A-2140	Approvals - Garage Fins	10	21-Jul-21	03-Aug-21	220	A-1720: FS
A-2240	Fabrication - Garage Fins	80	04-Aug-21	30-Nov-21	220	A-2140: FS, A-2490: FS
Mechanical		120	22-Jun-21	14-Dec-21	210	
A-1800	SDs - Mechanical	30	22-Jun-21	03-Aug-21	210	A-1690: FS, A-1220: FS
A-2260	Approvals - Mechanical	10	04-Aug-21	17-Aug-21	210	A-1800: FS



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Remaining Level of Effort
Summary
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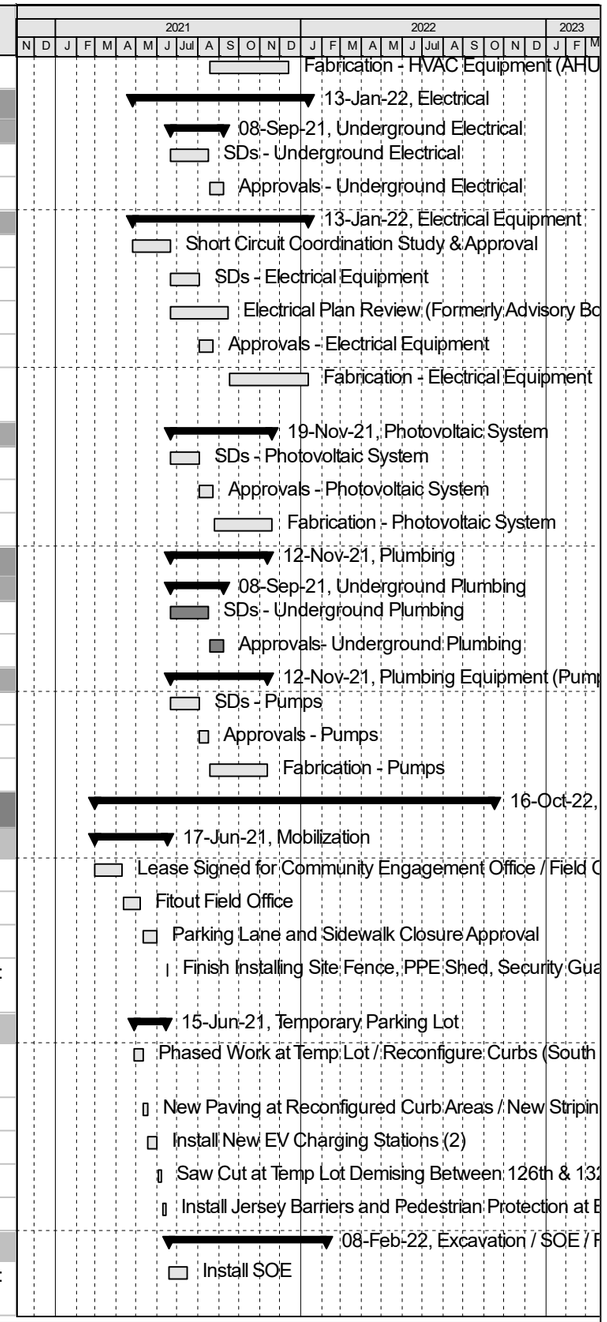
Actual Work
Remaining Work
Critical Remaining Work
Ciritical Remaining
Milestone

DDC Queens Garage
Preliminary Schedule (190 Day)
Edit Date: 09-Dec-20
Hunter Roberts Construction Group

HUNTER ROBERTS CONSTRUCTION GROUP

Activity ID	Activity Name	OD	Start	Finish	Total Float	Predecessor Details
A-2360	Fabrication - HVAC Equipment (AHUs, Fans, Unit Heaters, AC Units)	80	18-Aug-21	14-Dec-21	210	A-2260: FS, A-2490: FS
Electrical		180	26-Apr-21	13-Jan-22	190	
Underground Electrical		55	22-Jun-21	08-Sep-21	16	
A-2070	SDs - Underground Electrical	40	22-Jun-21	17-Aug-21	16	A-1770: FS, A-1220: FS
A-2380	Approvals - Underground Electrical	15	18-Aug-21	08-Sep-21	16	A-2070: FS
Electrical Equipment		180	26-Apr-21	13-Jan-22	190	
A-2060	Short Circuit Coordination Study & Approval	40	26-Apr-21	21-Jun-21	190	A-1770: FS
A-2040	SDs - Electrical Equipment	30	22-Jun-21	03-Aug-21	205	A-1770: FS, A-1220: FS
A-2410	Electrical Plan Review (Formerly Advisory Board)	60	22-Jun-21	15-Sep-21	190	A-2060: FS
A-2310	Approvals - Electrical Equipment	15	04-Aug-21	24-Aug-21	205	A-2040: FS
A-2580	Fabrication - Electrical Equipment	80	16-Sep-21	13-Jan-22	190	A-2310: FS, A-2410: FS, A-2490: FS
Photovoltaic System		105	22-Jun-21	19-Nov-21	225	
A-2050	SDs - Photovoltaic System	30	22-Jun-21	03-Aug-21	225	A-1770: FS, A-1220: FS
A-2320	Approvals - Photovoltaic System	15	04-Aug-21	24-Aug-21	225	A-2050: FS
A-2460	Fabrication - Photovoltaic System	60	25-Aug-21	19-Nov-21	225	A-2320: FS, A-2490: FS
Plumbing		100	22-Jun-21	12-Nov-21	230	
Underground Plumbing		55	22-Jun-21	08-Sep-21	0	
A-2110	SDs - Underground Plumbing	40	22-Jun-21	17-Aug-21	0	A-1960: FS, A-1220: FS
A-2440	Approvals- Underground Plumbing	15	18-Aug-21	08-Sep-21	0	A-2110: FS
Plumbing Equipment (Pumps)		100	22-Jun-21	12-Nov-21	230	
A-2100	SDs - Pumps	30	22-Jun-21	03-Aug-21	230	A-1960: FS, A-1220: FS
A-2350	Approvals - Pumps	10	04-Aug-21	17-Aug-21	230	A-2100: FS
A-2450	Fabrication - Pumps	60	18-Aug-21	12-Nov-21	230	A-2350: FS, A-2490: FS
Construction		410	01-Mar-21	16-Oct-22	0	
Mobilization		78	01-Mar-21	17-Jun-21	7	
A-1330	Lease Signed for Community Engagement Office / Field Office	30	01-Mar-21	09-Apr-21	18	A-1250: FS
A-1790	Fitout Field Office	20	12-Apr-21	07-May-21	33	A-1330: FS
A-2200	Parking Lane and Sidewalk Closure Approval	15	11-May-21	01-Jun-21	17	A-1730: FS, A-2130: FS
A-2420	Finish Installing Site Fence, PPE Shed, Security Guard, Covid/Medic Station & Turnstiles	2	16-Jun-21	17-Jun-21	7	A-2340: FS, A-2370: FS, A-2200: FS, A-1790: FS
Temporary Parking Lot		35	27-Apr-21	15-Jun-21	7	
A-2130	Phased Work at Temp Lot / Reconfigure Curbs (South Lot)	10	27-Apr-21	10-May-21	7	A-1950: FS, A-1330: FS, A-2120: FS
A-2190	New Paving at Reconfigured Curb Areas / New Striping	5	11-May-21	17-May-21	7	A-2130: FS
A-2250	Install New EV Charging Stations (2)	10	18-May-21	01-Jun-21	7	A-2190: FS
A-2330	Saw Cut at Temp Lot Demising Between 126th & 132nd Streets	5	02-Jun-21	08-Jun-21	7	A-2250: FS
A-2370	Install Jersey Barriers and Pedestrian Protection at Buffer	5	09-Jun-21	15-Jun-21	7	A-2330: FS
Excavation / SOE / Foundation		159	18-Jun-21	08-Feb-22	0	
A-2430	Install SOE	20	18-Jun-21	16-Jul-21	7	A-2210: FS, A-2370: FS, A-2420: FS, A-2170: FS



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DDC Queens Garage

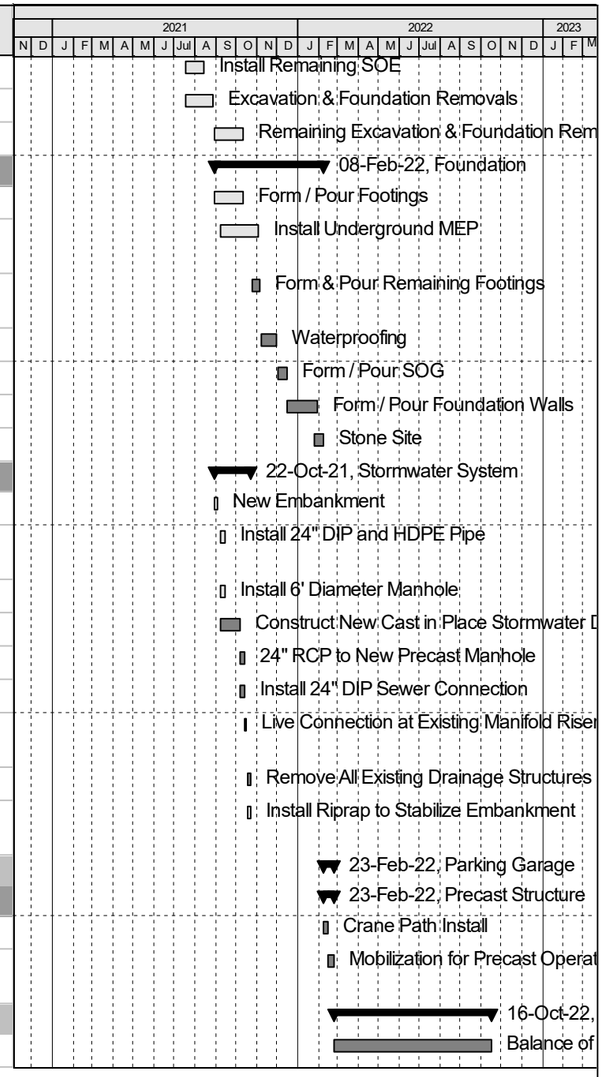
Preliminary Schedule (190 Day)

Edit Date: 09-Dec-20

Hunter Roberts Construction Group

HUNTER ROBERTS CONSTRUCTION GROUP

Activity ID	Activity Name	OD	Start	Finish	Total Float	Predecessor Details
A-2470	Install Remaining SOE	20	19-Jul-21	13-Aug-21	18	A-2430: FS
A-2480	Excavation & Foundation Removals	30	19-Jul-21	27-Aug-21	7	A-2430: SS 20, A-2430: FS
A-2530	Remaining Excavation & Foundation Removals	30	30-Aug-21	12-Oct-21	8	A-2480: FS, A-2470: FS
Foundation		109	30-Aug-21	08-Feb-22	0	
A-2520	Form / Pour Footings	30	30-Aug-21	12-Oct-21	8	A-2480: FS, A-2490: FS
A-2540	Install Underground MEP	40	09-Sep-21	04-Nov-21	16	A-2480: FS, A-2380: FS, A-2440: FS
A-2640	Form & Pour Remaining Footings	10	25-Oct-21	05-Nov-21	0	A-2530: FS, A-2520: FS, A-2620: FS
A-2650	Waterproofing	15	08-Nov-21	01-Dec-21	0	A-2520: FS, A-2640: FS
A-2660	Form / Pour SOG	10	02-Dec-21	15-Dec-21	0	A-2650: FS , A-2540: FS
A-2670	Form / Pour Foundation Walls	30	16-Dec-21	31-Jan-22	0	A-2660: FS
A-2680	Stone Site	10	26-Jan-22	08-Feb-22	0	A-2670: FS -4, A-2630: FS
Stormwater System		38	30-Aug-21	22-Oct-21	61	
A-2500	New Embankment	5	30-Aug-21	03-Sep-21	22	A-2480: FS
A-2550	Install 24" DIP and HDPE Pipe	5	09-Sep-21	15-Sep-21	20	A-2480: FS, A-2500: FS, A-2440: FS
A-2560	Install 6' Diameter Manhole	5	09-Sep-21	15-Sep-21	82	A-2500: FS, A-2440: FS
A-2510	Construct New Cast in Place Stormwater Detention Vault	20	09-Sep-21	06-Oct-21	0	A-2480: FS, A-2440: FS
A-2590	24" RCP to New Precast Manhole	5	07-Oct-21	14-Oct-21	0	A-2480: FS, A-2510: FS
A-2600	Install 24" DIP Sewer Connection	5	07-Oct-21	14-Oct-21	0	A-2480: FS, A-2510: FS
A-2610	Live Connection at Existing Manifold Riser	1	15-Oct-21	15-Oct-21	0	A-2600: FS, A-2550: FS, A-2590: FS
A-2620	Remove All Existing Drainage Structures and Pipe Within Buffer	5	18-Oct-21	22-Oct-21	0	A-2610: FS
A-2630	Install Riprap to Stabilize Embankment	5	18-Oct-21	22-Oct-21	61	A-2550: FS, A-2560: FS, A-2610: FS
Parking Garage		10	09-Feb-22	23-Feb-22	0	
Precast Structure		10	09-Feb-22	23-Feb-22	0	
A-2690	Crane Path Install	5	09-Feb-22	15-Feb-22	0	A-2680: FS
A-2700	Mobilization for Precast Operation	5	16-Feb-22	23-Feb-22	0	A-2690: FS , A-2490: FS, A-2280: FS
Remaining Construction Work (To be Expanded)		235	24-Feb-22	16-Oct-22	0	
A-2710	Balance of Construction Work	235	24-Feb-22	16-Oct-22	0	A-2700: FS



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DDC Queens Garage
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Hunter Roberts Construction Group

HUNTER ROBERTS CONSTRUCTION GROUP

PDC Work Plan and Detail Schedule

HUNTER ROBERTS CONSTRUCTION GROUP

NYC DDC Department of Design and Construction

NYCDDC / BBJ Program
Queens Garage and Community Space
Hunter Roberts Construction Group Design-Build Team
PIN:8502020CR0040P-42P

Public Design Commission Work-Plan
December 9, 2020

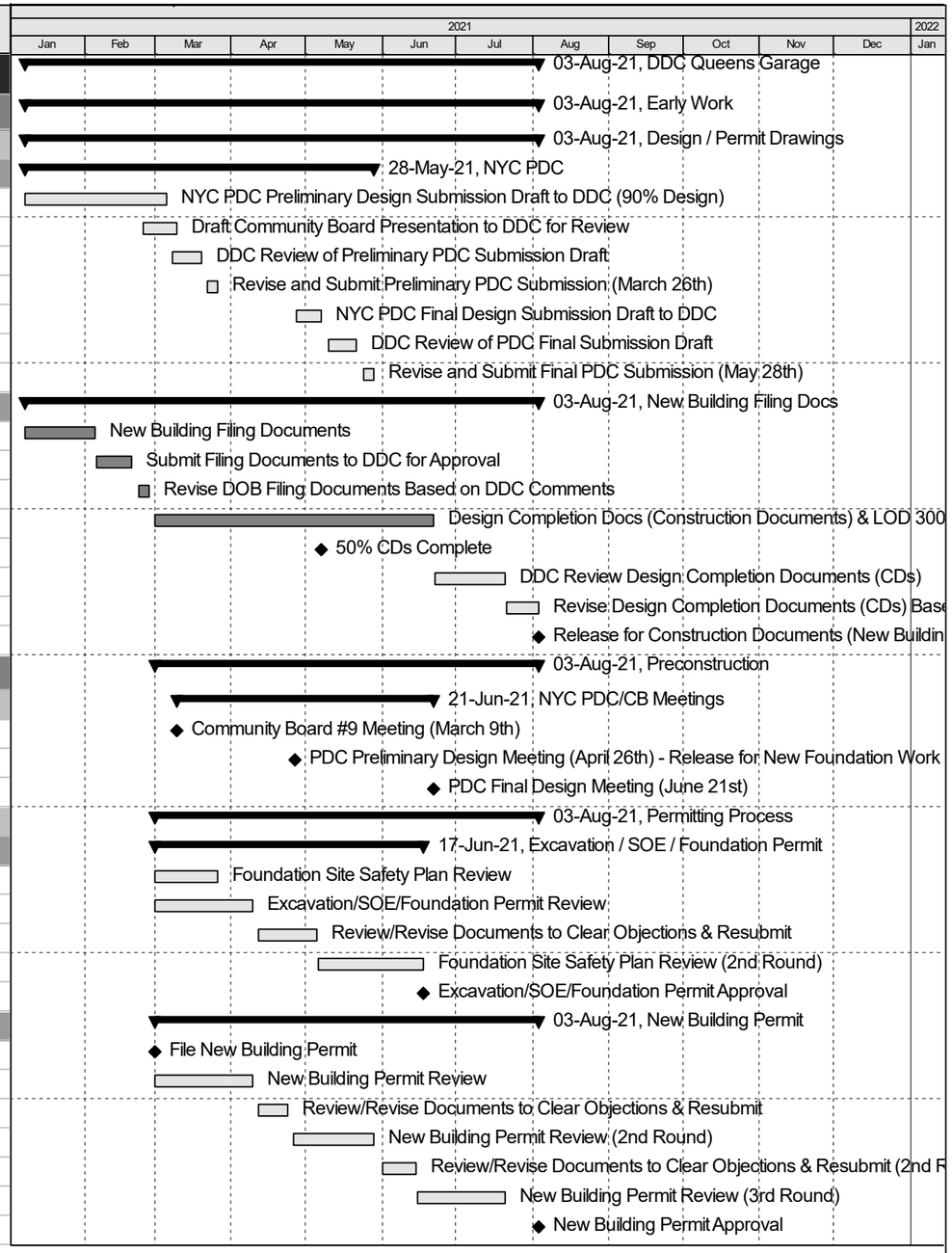
Note: See PDC & Permitting Breakout Schedule (December 9, 2020) for additional detail

The objective of the PDC work-plan is to coordinate the Hunter Roberts Design-Build team's efforts with both the DDC and the PDC to enable an efficient review and approval process.

- **Preliminary Design Submission**
  - Draft CB presentation to the DDC: February 24, 2021
  - DDC review of draft CB presentation: February 24-March 3, 2021
  - CB presentation revisions as needed: March 3-March 9, 2021
  - Issue PDC preliminary review set to the DDC (90% Design): March 5, 2021
  - **Community Board Meeting**: **March 9, 2021**
  - DDC review period: March 8-19, 2021
  - Revisions as needed: March 22-26, 2021
  - Submission to the PDC: March 26, 2021
  - **PDC Preliminary Design Meeting: April 26, 2021**
    - *DB team objective to obtain a release for SOE/Foundation DOB permit*

- **Final Design Submission**
  - Final design draft submission to the DDC: May 7, 2021
  - DDC review of final draft submission: May 10-21, 2021
  - *(50% Construction Document Milestone: May 7, 2021)*
  - Revisions as needed: May 24-28, 2021
  - Submission to the PDC: May 28, 2021
  - **PDC Final Design Meeting: June 21, 2021**

Activity ID	Activity Name	OD	Start	Finish	Total Float
DDC Queens Garage		145	07-Jan-21	03-Aug-21	26
Early Work		145	07-Jan-21	03-Aug-21	26
Design / Permit Drawings		145	07-Jan-21	03-Aug-21	26
NYC PDC		100	07-Jan-21	28-May-21	56
A-1590	NYC PDC Preliminary Design Submission Draft to DDC (90% Design)	40	07-Jan-21	05-Mar-21	44
A-2790	Draft Community Board Presentation to DDC for Review	10	24-Feb-21	09-Mar-21	78
A-1740	DDC Review of Preliminary PDC Submission Draft	10	08-Mar-21	19-Mar-21	44
A-2760	Revise and Submit Preliminary PDC Submission (March 26th)	5	22-Mar-21	26-Mar-21	44
A-1750	NYC PDC Final Design Submission Draft to DDC	9	27-Apr-21	07-May-21	56
A-2750	DDC Review of PDC Final Submission Draft	10	10-May-21	21-May-21	56
A-2770	Revise and Submit Final PDC Submission (May 28th)	5	24-May-21	28-May-21	56
New Building Filing Docs		145	07-Jan-21	03-Aug-21	26
A-1110	New Building Filing Documents	20	07-Jan-21	04-Feb-21	0
A-1170	Submit Filing Documents to DDC for Approval	10	05-Feb-21	19-Feb-21	0
A-1240	Revise DOB Filing Documents Based on DDC Comments	5	22-Feb-21	26-Feb-21	0
A-1220	Design Completion Docs (Construction Documents) & LOD 300 BIM Model	80	01-Mar-21	21-Jun-21	0
A-2780	50% CDs Complete	0		07-May-21	56
A-2150	DDC Review Design Completion Documents (CDs)	20	22-Jun-21	20-Jul-21	26
A-2180	Revise Design Completion Documents (CDs) Based on DDC Comments	10	21-Jul-21	03-Aug-21	26
A-2220	Release for Construction Documents (New Building)	0		03-Aug-21	26
Preconstruction		110	01-Mar-21	03-Aug-21	26
NYC PDC/CB Meetings		73	09-Mar-21	21-Jun-21	56
A-1570	Community Board #9 Meeting (March 9th)	0		09-Mar-21	78
A-1670	PDC Preliminary Design Meeting (April 26th) - Release for New Foundation Work	0		26-Apr-21	44
A-1760	PDC Final Design Meeting (June 21st)	0		21-Jun-21	56
Permitting Process		110	01-Mar-21	03-Aug-21	26
Excavation / SOE / Foundation Permit		78	01-Mar-21	17-Jun-21	7
A-1310	Foundation Site Safety Plan Review	20	01-Mar-21	26-Mar-21	17
A-1320	Excavation/SOE/Foundation Permit Review	30	01-Mar-21	09-Apr-21	7
A-1710	Review/Revise Documents to Clear Objections & Resubmit	18	12-Apr-21	05-May-21	7
A-2030	Foundation Site Safety Plan Review (2nd Round)	30	06-May-21	17-Jun-21	7
A-2210	Excavation/SOE/Foundation Permit Approval	0		17-Jun-21	7
New Building Permit		110	01-Mar-21	03-Aug-21	26
A-1280	File New Building Permit	0		01-Mar-21	7
A-1340	New Building Permit Review	30	01-Mar-21	09-Apr-21	36
A-1780	Review/Revise Documents to Clear Objections & Resubmit	10	12-Apr-21	23-Apr-21	36
A-2090	New Building Permit Review (2nd Round)	25	26-Apr-21	28-May-21	36
A-2300	Review/Revise Documents to Clear Objections & Resubmit (2nd Round)	10	01-Jun-21	14-Jun-21	36
A-2390	New Building Permit Review (3rd Round)	25	15-Jun-21	20-Jul-21	36
A-2490	New Building Permit Approval	0		03-Aug-21	26



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DDC Queens Garage
PDC & Permitting Breakout Schedule
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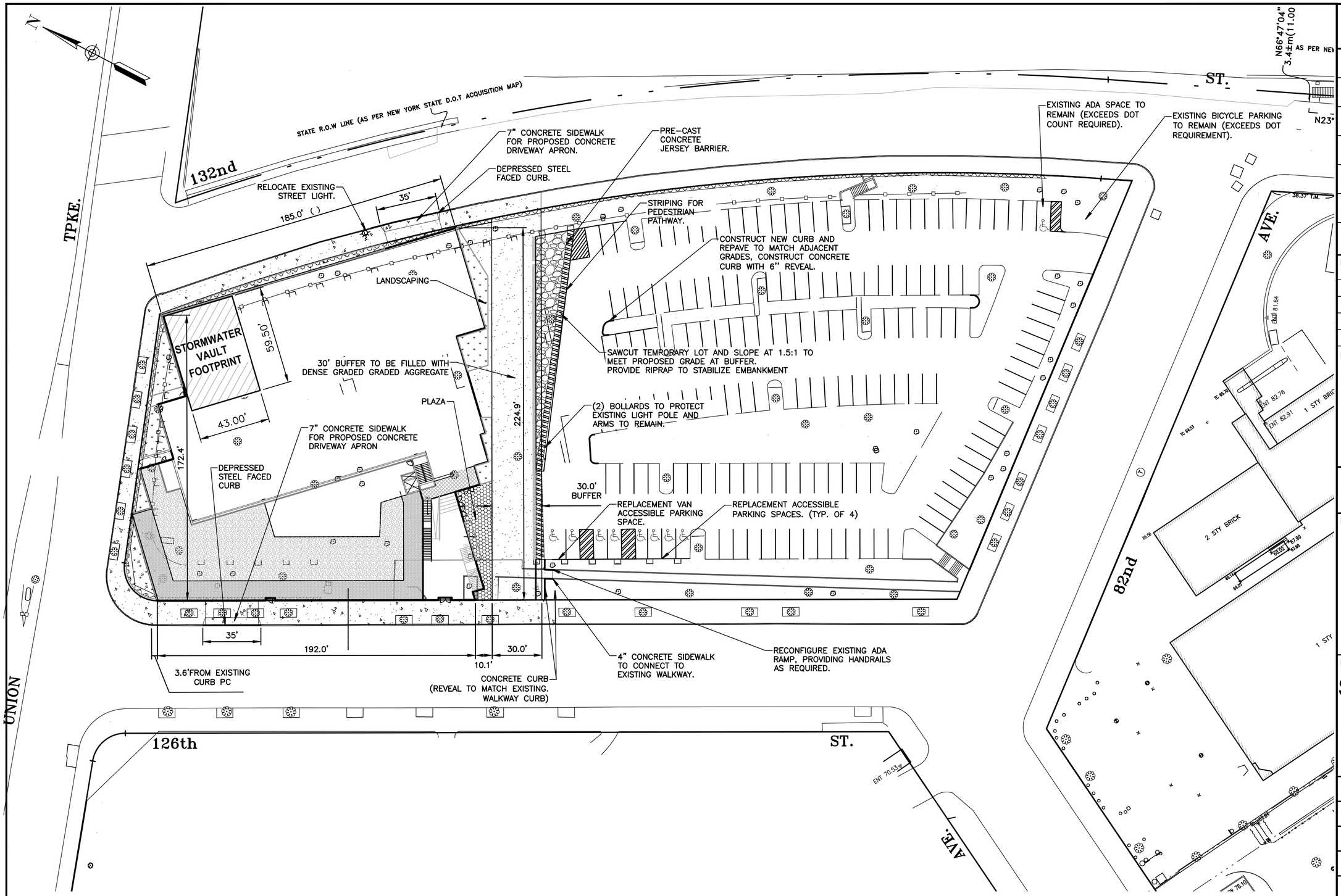
Hunter Roberts Construction Group

HUNTER ROBERTS CONSTRUCTION GROUP

Trunk Water Main/Buffer Revisions - Sketches



40 30 20 10 0 40 80 120

GRAPHIC SCALE
1 inch=40 feet

NYC BBJ	Department of Design and Construction
HUNTER ROBERTS CONSTRUCTION GROUP LLC	55 Water Street, New York, NY 10041 212.699.4749
URBAHN ARCHITECTS	306 West 37th Street, New York, NY 10018 212.239.0220
MARVEL ARCHITECTS	145 Hudson Street, New York, NY 10013 212.616.0420
THORNTON TOMASETTI	51 Madison Avenue, New York, NY 10010 917.661.7800
MATRIX NEW WORLD ENGINEERING	333 West 39th Street, New York, NY 10018 212.699.4749
JAROS, BAUM & BOLLES / LIGHTBOX STUDIOS	80 Pine Street New York, NY 10015 212.530.9300
JFK&M ENGINEERS, LLP	134 West 37th Street New York, NY 10018 212.792.8700

REVISION	DESCRIPTION	DATE

PROJECT: NYC BBJ

QUEENS GARAGE & COMMUNITY SPACE

80-25 126th St,
Kew Gardens, NY 11415

TECHNICAL DRAWINGS

KEY PLAN:

PROJECT NORTH (TRUE NORTH)

DRAWING TITLE:

SITE PLAN

SCALE: 1"=40'

DATE: SEPTEMBER 18, 2020

SEAL:

DRAWING NUMBER:

C-101

DRAWING ORDER:

EXISTING COMBINED SEWER DROP MANHOLE TO BE DEMOLISHED AFTER NEW CONNECTION TO COMBINED SEWER IS COMPLETE. EXISTING OUTLET PIPE CONNECTING TO NYCDEP COMBINED SEWER TO BE CUT AND PLUGGED PER NYCDEP REQUIREMENTS

EXISTING LIGHT POLE TO REMAIN

SAWCUT ASPHALT PAVEMENT AT LIMIT OF TEMPORARY LOT

DEMOLISH EXISITING CURB.

REMOVE EXISTING FENCE (TYP.)

REMOVE EXISTING GUIDE RAIL (TYP.).

DEMOLISH EXISTING CURB WITHIN HATCHED LIMIT OF DEMOLITION

REMOVE EXISTING TREE (TYP.)

SAWCUT NORTH ASPHALT PAVEMENT

DEMOLISH EXISTING CURB

CUT OFF EXISTING SHEET PILE WALL BELOW FINISH GRADE AFTER DRIVING TO NEW DEPTH PER SHEETS SH-101 THROUGH SH-103

EXISTING MANHOLE TO REMAIN. CONTRACTOR SHALL REMOVE CONNECTING 48" LATERALS AND CAP/PLUG PIPE STUBS

DEMOLISH EXISTING CURB

REMOVE EXISTING DRAINAGE PIPING AND STRUCTURES WITHIN LIMIT OF DEMOLITION UNLESS SPECIFIED TO REMAIN

EXISTING STREET TREES TO REMAIN AND BE PROTECTED DURING CONSTRUCTION (TYP.)

DEMOLISH EXISTING CURB WITHIN HATCHED LIMIT OF DEMOLITION

REMOVE TRAFFIC SIGNS (TYP.)

REMOVE BENCHES (TYP.)

DEMOLISH EXISTING DETENTION SYSTEM UPON COMPLETE CONSTRUCTION OF PROPOSED STORM DETENTION VAULT AND NEW CONNECTION TO COMBINED SEWER

EXISTING 15" PIPE, 12" PIPE AND DRAIN TO REMAIN

EXISTING LIGHT POLE TO REMAIN

SOUTH EDGE OF BUFFER, LIMIT OF DEMOLITION

40 30 20 10 0 40 80 120

GRAPHIC SCALE
1 inch=40 feet

HUNTER ROBERTS CONSTRUCTION GROUP LLC
55 Water Street, New York, NY 10041
212.699.4749

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REVISION	DESCRIPTION	DATE

PROJECT: NYC BBJ

QUEENS GARAGE & COMMUNITY SPACE

80-25 126th St,
Kew Gardens, NY 11415

TECHNICAL DRAWINGS

KEY PLAN:

PROJECT NORTH (TRUE NORTH)

DRAWING TITLE:

DEMOLITION PLAN

SCALE: 1"=40'

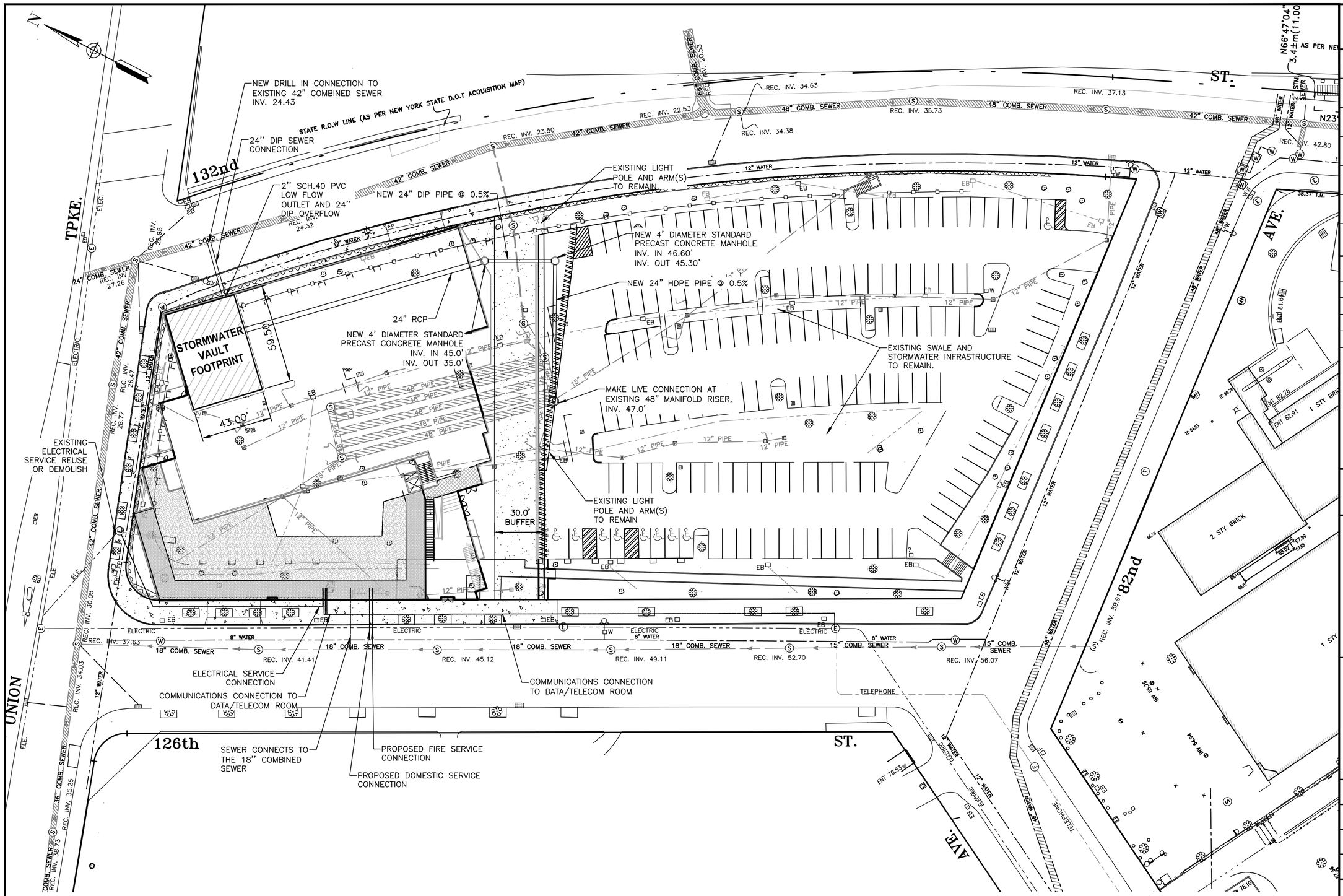
DATE: SEPTEMBER 18, 2020

SEAL:

DRAWING NUMBER:

C-102

DRAWING ORDER:



40 30 20 10 0 40 80 120

GRAPHIC SCALE
1 inch=40 feet

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REVISION	DESCRIPTION	DATE

PROJECT: NYC BBJ

QUEENS GARAGE & COMMUNITY SPACE

80-25 126th St,
Kew Gardens, NY 11415

TECHNICAL DRAWINGS

KEY PLAN:

PROJECT NORTH (TRUE NORTH)

DRAWING TITLE:

UTILITY PLAN

SCALE: 1"=40' DATE: SEPTEMBER 18, 2020

SEAL:

DRAWING NUMBER:

C-103

DRAWING ORDER:

PHASE 1:
CONSTRUCT NEW PRECAST
STORMWATER DROP MANHOLE,
INV. 28.77

PHASE 1:
CONSTRUCT NEW 24" DUCTILE
IRON SEWER PIPE AND NEW
DRILL-IN CONNECTION TO
EXISTING 42" COMBINED SEWER,
INV. 25.31

PHASE 1:
CONSTRUCT 24" RCP
CONNECTING NEW
STORMWATER VAULT TO NEW
STORMWATER MANHOLE

EXISTING COMBINED SEWER DROP
MANHOLE

PHASE 1:
CONSTRUCT 2" SCH. 40 PVC
AND 24" RCP CONNECTING STORMWATER
VAULT TO NEW COMBINED SEWER
CONNECTION

PHASE 1:
CONSTRUCT 24"
DUCTILE IRON PIPE

PHASE 1:
CONSTRUCT NEW PRECAST
STORMWATER MANHOLE

EXISTING STORMWATER
MANHOLE TO REMAIN

PHASE 1:
CONSTRUCT
STORMWATER
DETENTION VAULT

PHASE 1:
CONSTRUCT 24" HDPE PIPE

PHASE 1:
MAKE LIVE CONNECTION TO
EXISTING DETENTION SYSTEM
RISER MANHOLE

STORMWATER
VAULT
FOOTPRINT

30.0'
BUFFER

98.66'

SITE

132nd ST.

126th ST.

82nd AVE.

UNION

BLOCK 2274

2R

STATE R.O.W LINE (AS PER NEW YORK STATE D.O.T ACQUISITION MAP)

42" COMB. SEWER
48" COMB. SEWER
24" COMB. SEWER
36" COMB. SEWER
18" COMB. SEWER
15" COMB. SEWER

TELEPHONE

APPROX. LOCATION OF
UNDERGROUND TUNNEL

GRAPHIC SCALE
1 inch=40 feet
40 30 20 10 0 40 80 120

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REVISION	DESCRIPTION	DATE

PROJECT: NYC BBJ

QUEENS GARAGE & COMMUNITY SPACE

80-25 126th St,
Kew Gardens, NY 11415

TECHNICAL DRAWINGS

KEY PLAN:

PROJECT NORTH

DRAWING TITLE:

STORMWATER CONSTRUCTION PHASE-1

SCALE: 1"=40'

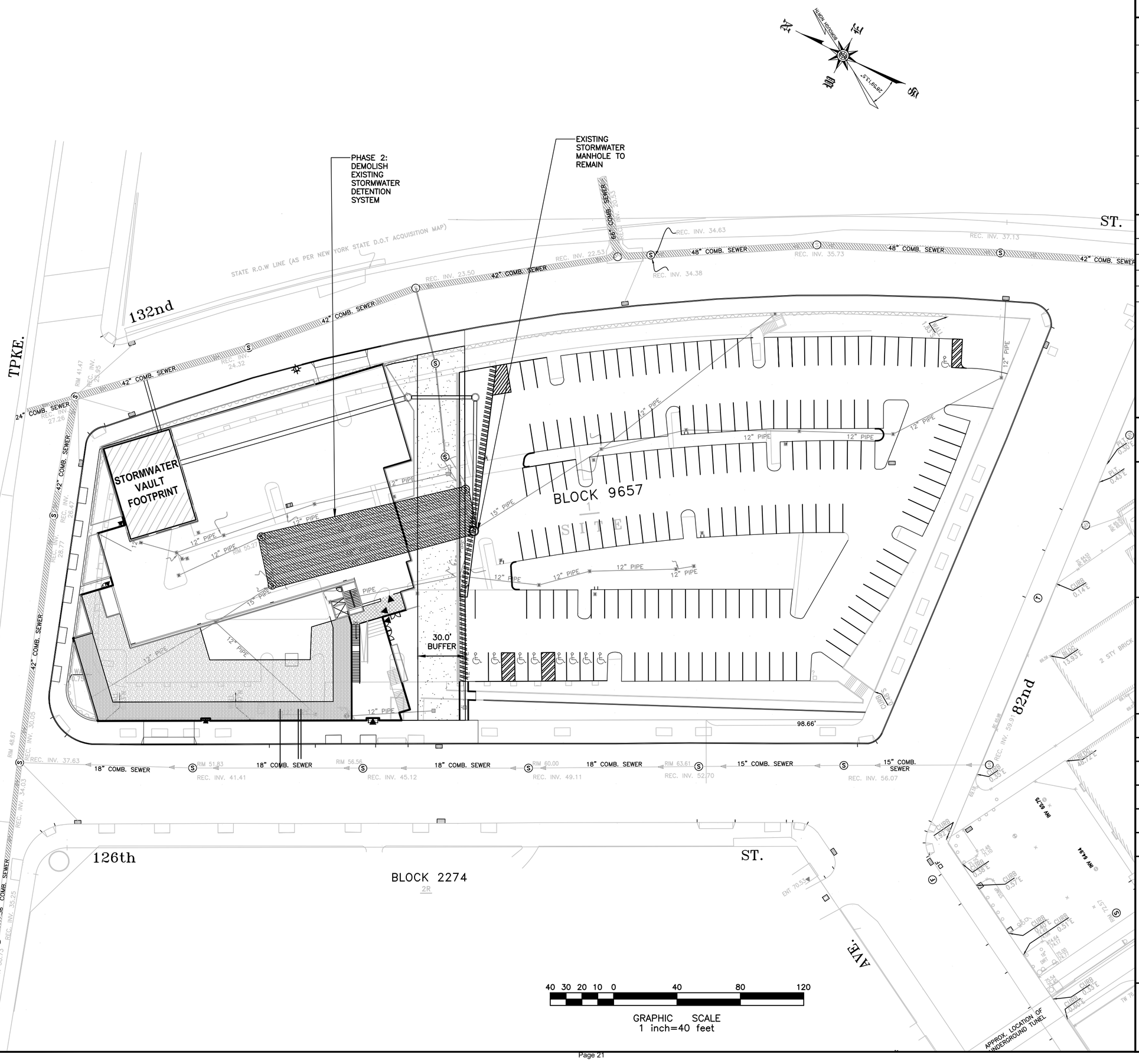
DATE: SEPTEMBER 18, 2020

SEAL:

DRAWING NUMBER:

C-200

DRAWING ORDER:



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REVISION	DESCRIPTION	DATE

PROJECT: NYC BBJ

QUEENS GARAGE & COMMUNITY SPACE

80-25 126th St,
Kew Gardens, NY 11415

TECHNICAL DRAWINGS

KEY PLAN:

PROJECT NORTH

DRAWING TITLE:

STORMWATER CONSTRUCTION PHASE-2

SCALE: 1"=40'

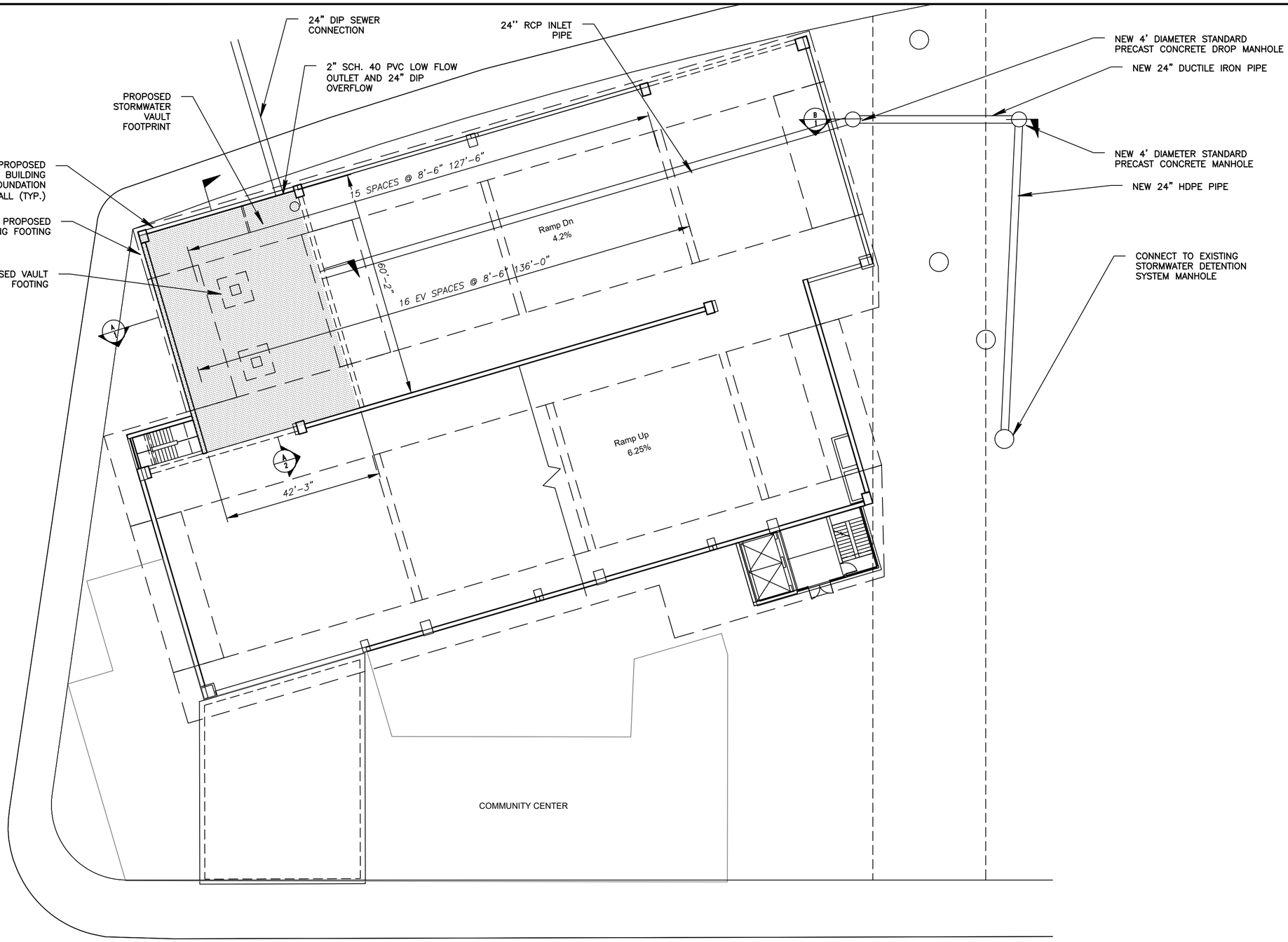
DATE: SEPTEMBER 18, 2020

SEAL:

DRAWING NUMBER:

C-201

DRAWING ORDER:



P/1 Vault Location

1" = 20'

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REVISION	DESCRIPTION	DATE

PROJECT: NYC BBJ

QUEENS GARAGE & COMMUNITY SPACE

80-25 126th St,
Kew Gardens, NY 11415

TECHNICAL DRAWINGS

KEY PLAN:

PROJECT NORTH / TRUE NORTH

DRAWING TITLE:

STORMWATER VAULT

SCALE: AS NOTED

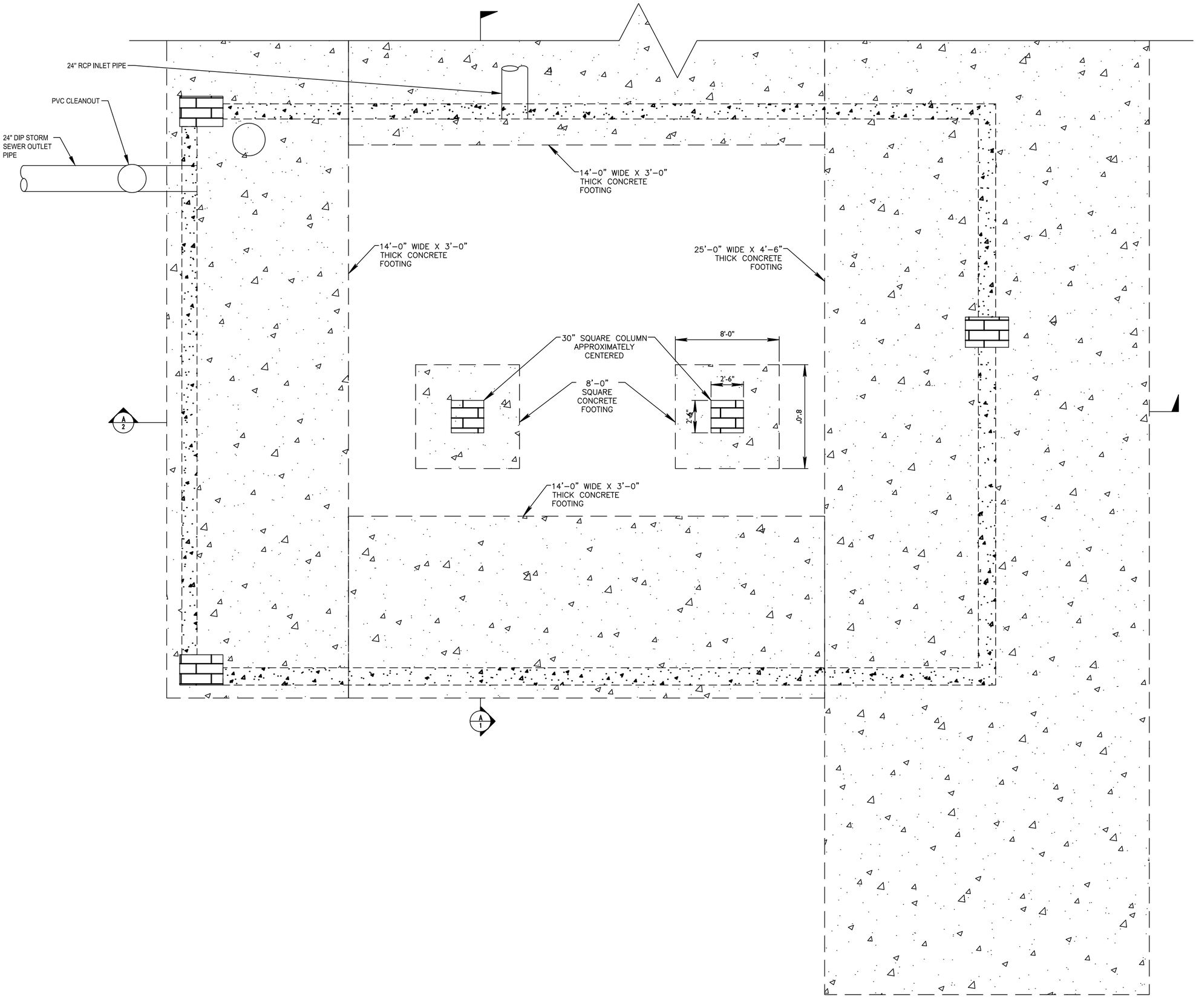
DATE: SEPTEMBER 18, 2020

SEAL:

DRAWING NUMBER:

C-300

DRAWING ORDER:



P 2 **Stormwater Vault Plan**

1" = 5'

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REVISION	DESCRIPTION	DATE

PROJECT: NYC BBJ

QUEENS GARAGE & COMMUNITY SPACE

80-25 126th St,
Kew Gardens, NY 11415

TECHNICAL DRAWINGS

KEY PLAN:

PROJECT NORTH (TRUE NORTH)

DRAWING TITLE:

STORMWATER VAULT

SCALE: AS NOTED

DATE: SEPTEMBER 18, 2020

SEAL:

DRAWING NUMBER:

C-301

DRAWING ORDER:

PROPOSED DRAINAGE AREAS

TOTAL SITE AREA: 126,550 S.F.

TRIBUTARY TO COMBINED SEWER
TOTAL GRASS/LANDSCAPED AREA: 21,742 S.F.
TOTAL IMPERVIOUS AREA: 104,808 S.F.

DRAINAGE CALCULATIONS

TRIBUTARY TO COMBINED SEWER
Q = C*A/7,320
WEIGHTED C = 0.738
A = 126,550 SF
Q = 11.858 cfs

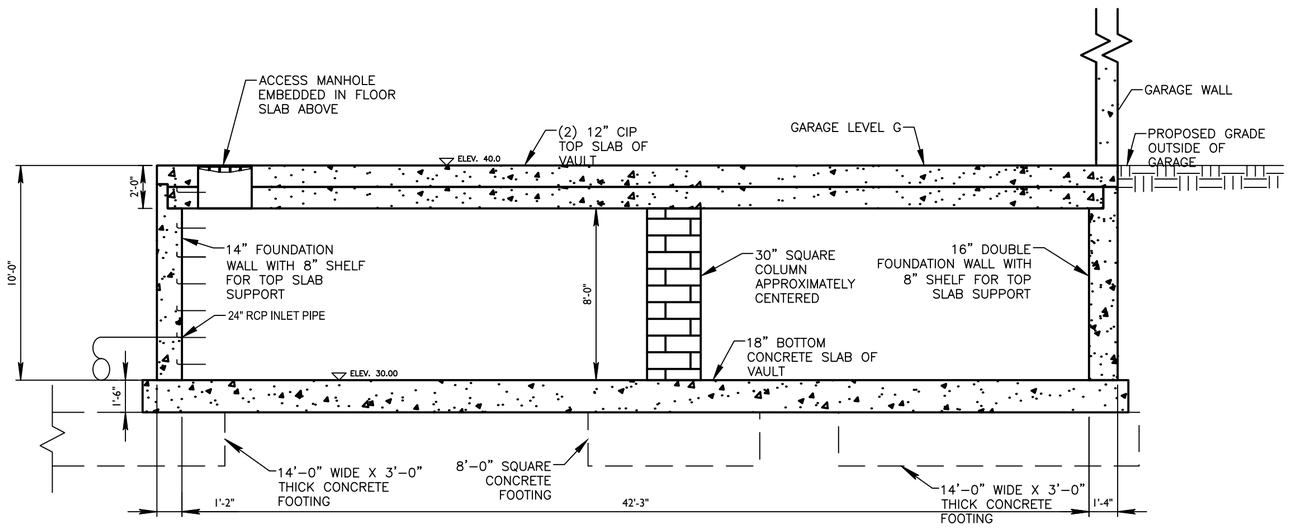
RETENTION CALCULATIONS

CONNECTION
Q = C*A/7,320
WEIGHTED C = 0.738
A = 126550 SF
Q = 11.86 CFS
QDRR = 0.29 CFS
tv = 0.27(CWT*A/QDRR)^0.5 − 15
tv (min) = 138.26
Vv = [0.19*C*A/(tv+15)−40*QDRR]*tv
Vv = 14,405 C.F.

DETENTION SYSTEM
QDRR = 0.29 CFS
Vv = 15,872 C.F.
MAX STORAGE DEPTH:
DO = 2.05 IN. (2" SCH. 40 PVC FLUSH TUBE ORIFICE)
SDR = [1,400(QDRR^2) / (DO^4)] + DO / 24
SDR = 6.79 FT.
USE 6.0' TO PROVIDE OVERFLOW CAPACITY

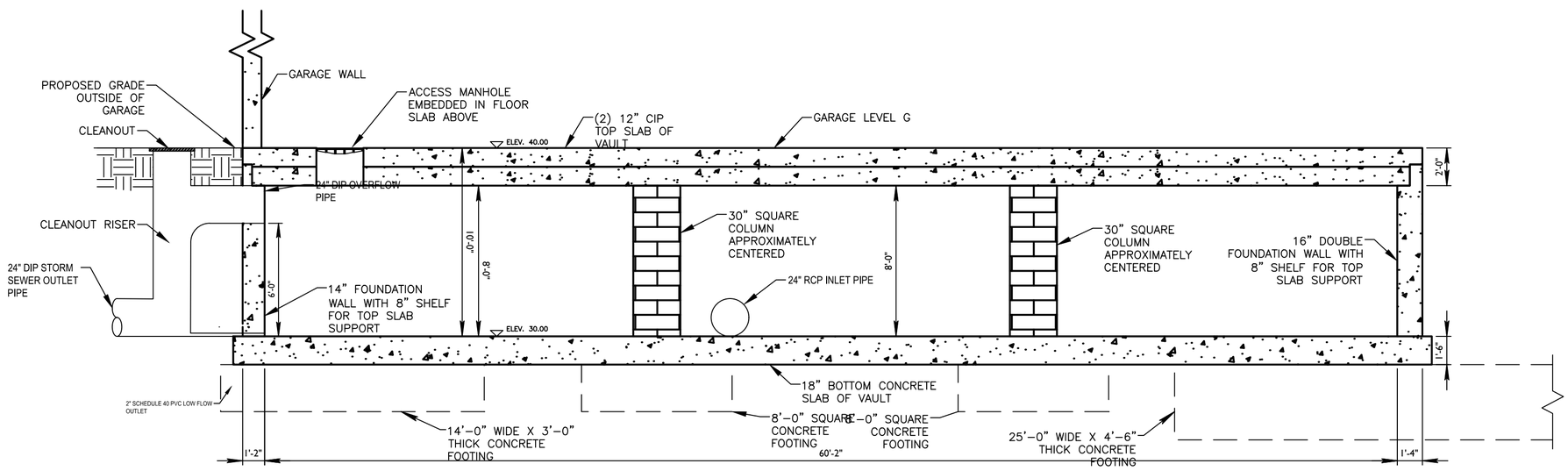
STORAGE PROVIDED:
STORMWATER VAULT – 100% VOIDS.
60'–2" X 42'–3" X 6.0' = 14,530 C.F.

TOTAL STORAGE VOLUME PROVIDED = 14,530 C.F.
QDRR @ 6.0' DEPTH = 0.273 CFS



A/1 Stormwater Vault Section

1" = 5'



A/2 Stormwater Vault Section

1" = 5'

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REVISION	DESCRIPTION	DATE

PROJECT: NYC BBJ

QUEENS GARAGE & COMMUNITY SPACE

80-25 126th St,
Kew Gardens, NY 11415

TECHNICAL DRAWINGS

KEY PLAN:

PROJECT NORTH / TRUE NORTH

DRAWING TITLE:

STORMWATER VAULT

SCALE: AS NOTED

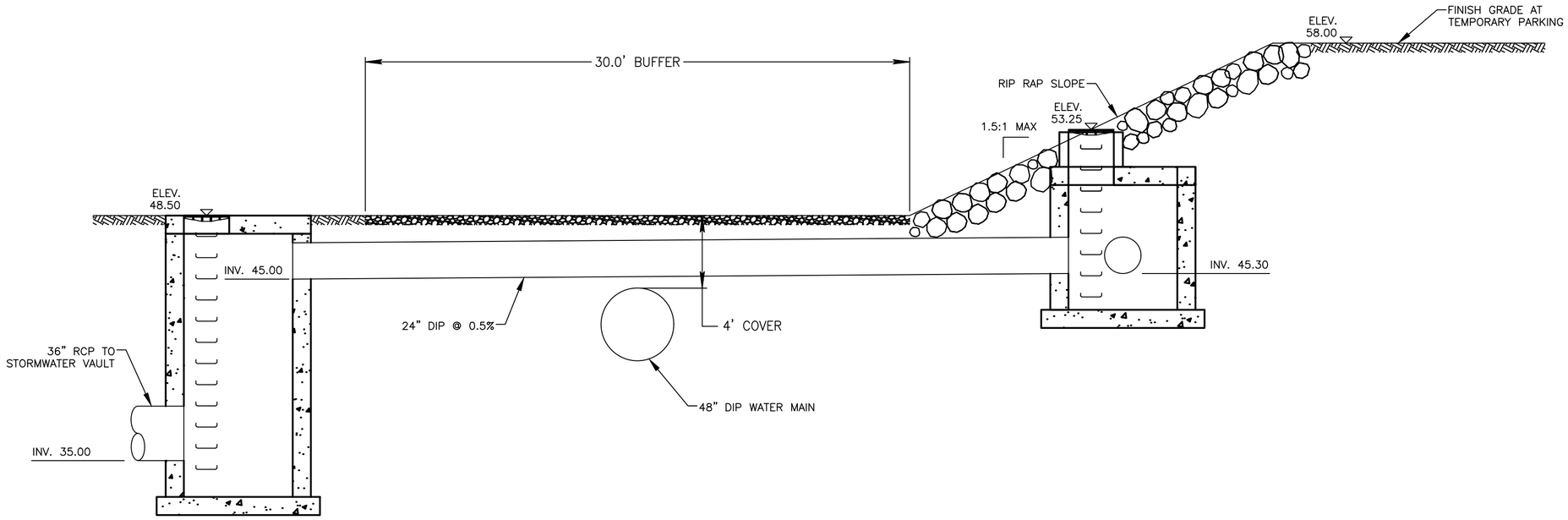
DATE: SEPTEMBER 18, 2020

SEAL:

DRAWING NUMBER:

C-302

DRAWING ORDER:



B/I TEMPORARY LOT CONNECTION

N.T.S.

Department of Design and Construction

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REVISION	DESCRIPTION	DATE

PROJECT: NYC BBJ

QUEENS GARAGE & COMMUNITY SPACE

80-25 126th St,
Kew Gardens, NY 11415

TECHNICAL DRAWINGS

KEY PLAN:

PROJECT NORTH (TRUE NORTH)

DRAWING TITLE:

SECTION VIEW TEMPORARY LOT STORM CONN. AT BUFFER

SCALE: N.T.S.

DATE: SEPTEMBER 18, 2020

SEAL:

DRAWING NUMBER:

C-303

DRAWING ORDER:

Future Electrical Service Capacity

Electrical Service Future Community Space Capacity
December 9, 2020

As discussed during the December 8, 2020 meeting with members of the Hunter Roberts Design-Build Team and the NYC Department of Design and Construction, the DB team will provide pathway to enable increasing the electrical service capacity to the Community Space in the future. The modifications are intended to serve a future commercial kitchen. Based on the DB team's email memorandum of 11/30/2020 the future increase required to serve a commercial kitchen would be approximately 1,200 amps. It should be noted that no other accommodations for a future commercial kitchen (for example: cooking equipment, HW heaters, make-up air, hoods, grease traps, below-slab infrastructure, fire suppression and trash/loading) have been provided.

The accommodations for future increase electrical capacity are being provided in lieu of the gas service RFP requirement. Although a requirement of the RFP, given the changes to the Building Code that require all-electric buildings, the DB team opted to exclude gas-service in the Proposal.

The accommodations for the potential future electrical service increase in capacity include:

- Space in the electrical service room for a new or expanded switchboard
- Empty conduits and additional points of entry from the Con Edison vaults
- Coordination with Con Edison on the appropriate vault size
- Empty conduits from the electrical service room to the ground floor of the Community Space to serve a future commercial kitchen

From: Frankel, Joshua
Sent: Monday, November 30, 2020 3:13 PM
To: 'Rigatti, Lisa M. (DDC)'
Cc: Mendoza, Nicholas (DDC); Wheat, Johnathan; 'Brendan Weiden'; O'Connor, Sean; David Kane (dkane@hrcg.com); henryd (henryd@urbahn.com)
Subject: RE: QG Question

Lisa:

The proposed electrical service for the Community Space will not be sufficient to support large cooking equipment – we presume a commercial kitchen. The proposed new service is 1,200 amps. We did a back-of the envelope calculation and determined that a 2,500 SF commercial kitchen, including additional mechanical equipment to support the kitchen program, would require a new service of 2,500 amps for the entire Community Space (25,000 GSF).

In addition to modifications for electrical equipment, a commercial kitchen will require accommodations for cooking equipment, additional HW heaters, hoods, make-up air, grease traps, drainage, below slab electrical conduit, specialized fire suppression systems, trash and loading that are not currently in the proposed scope of work.

If the DDC can provide more specific information on the type of equipment that could be required, then we can determine if the proposed (1,200 Amp) service will suffice.

Thank you,
Josh

Josh Frankel AIA
Senior Project Manager

HUNTER ROBERTS CONSTRUCTION GROUP
WE CARE. we listen. we communicate. we deliver.

Phone 212.699.4947
Cell 646.899.5109

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From: Rigatti, Lisa M. (DDC) <rigattili@ddc.nyc.gov>
Sent: Wednesday, November 25, 2020 12:26 PM
To: Frankel, Joshua <JFrankel@hrcg.com>
Cc: Mendoza, Nicholas (DDC) <MendozaNi@ddc.nyc.gov>; Wheat, Johnathan <jwheat@hrcg.com>
Subject: QG Question

Response to Meeting Agenda #4 Questions

Responses to Pre-Award Negotiation Meeting No. 4 Questions
December 1, 2020

Schedule Matters: Schedule Narrative Revisions
The revisions are based upon the updated 190-day look ahead schedule provided on December 1, 2020

PAGE 09 (September 18, 2020 Proposal)
Preliminary Baseline Schedule *(Revised December 1, 2020)*
The DB Team will work diligently to achieve substantial completion within 595 days of NTP 1. While our success in accomplishing this ambitious goal will depend upon our ability to quickly mitigate potentially disruptive site conditions, strategically sequence the work, secure early permits, and closely monitor all construction activities, we will require timely approvals on the design and building permits from all required entities.

Upon delivery of the execution contract documents (slated for early January 2020) the DB Team will immediately launch into advancing the RFP design documents and simultaneously begin to prepare submittals and early filings for the Temporary Parking Lot and the New Building filing. As discussed during the Limited Negotiation Period, to achieve the objective of meeting the schedule requirements the DB team must initiate design activities immediately following the delivery of execution contract documents – prior to NTP 1.

The primary objective of the New Building filing will be to obtain early work permits for the SOE/Excavation and Foundation work. Upon receipt of NTP 1 in early March, the team will begin Site Validation to identify any unforeseen conditions that require mitigation. We are anticipating completing the Site Validation process by late April 2021. We foresee completing early design packages for the temporary parking lot, SOE/Excavation/Foundations and Superstructure. The early packages will facilitate the filing, procurement and early work start dates.

Given the schedule requirements, our DB team intends to file with the NYC DOB for the temporary parking lot and New Building prior to completion of the Site Validation period. Timely approvals of the early filings will allow for an early start of the Temporary Parking Lot work followed immediately by SOE/Excavation/Foundation work. Of course, if the findings of the Site Validation are not consistent with the reference documents, then the DB team will be required to make amendments to the previously filed documents.

As the early work gets underway, the DB Team will focus on securing final NYCPDC and New Building approvals and completing Construction Documents by May 2021. We will also engage in final engineering and fabrication of the superstructure, community center enclosure, and MEPs/fit-out items. Along with the site-work, we envision a construction completion of August

2022 with commissioning taking place in concert, as feasible. Following a 60-day TCO period, we anticipate achieving Substantial Completion in October 2022 and Final Completion in December 2022.

PAGE 1105-1106 *(September 18, 2020 Proposal)*
Summary Schedule *(Revised December 1, 2020)*
The Project Schedule is our primary tool for monitoring progress on critical activities against milestone completion dates. The first step in establishing a project is to estimate how long each activity will take, from the time it is started until the time it is finished. This duration estimate for each activity is the time for the work to be done plus associated waiting time.

The Project Manager will perform weekly Periodic Progress Analyses (PPA) on all critical activities and bi-weekly updates on the entire schedule. This proactive approach to monitoring field progress enables us to identify potential conflicts and focus on recovery measures well before they impact the project schedule.

To develop accurate and complete information, we focus on critical input channels when building a schedule. These include: Owner requirements, subcontractor feedback, field staff, document issuances, design changes, historical data and material lead times. We use Primavera P6, which is both a project requirement and a widely used tool in the industry given its ability to track multiple critical paths (to both the project completion and progress milestones).

In addition to continuous maintenance of the Baseline Schedule, we create monthly four-week look-ahead schedules, with buy-in from all project subcontractors confirmed at weekly project coordination meetings. As part of that process, we send focused, highlighted schedules to key project personnel. We believe the use of sub-schedules improves our efficiency and enables individuals to focus on their primary spheres of responsibility. After the information is gathered and updated, we host a review session with the team to evaluate the project's status and develop strategies to resolve lagging tasks.

Additionally, daily and weekly reporting of upcoming work supports the tracking of both the Master Schedule and the four-week look-ahead schedule.

Upon Notice to Proceed, we will immediately commence Site Validation to uncover any unforeseen conditions, determine any potential hazardous materials, and to solidify the site boundaries, areas of disturbance, site layout control, and site logistic controls. Hunter Roberts identifies and tracks all long lead items through a Required-on-Job log, and tailors the schedule to prioritize those approvals and material or equipment releases accordingly.

Schedule Recovery

The key to effective project control is to measure actual progress and compare it to planned progress on a timely and regular basis and to take necessary corrective action immediately. The project schedule control process involves regularly gathering data on project performance and comparing it with the planned performance. Variance analysis will be conducted regularly throughout the project to compare planned schedule with actual performance in order to discover delays or variations in the project schedule. For example, the planned start, duration, and anticipated completion date would be compared with the actual start date, duration, and completion date for that activity.

HRCG will swiftly identify these variances and follow the below recovery plan in order to quickly mitigate delays:

- Identify Delayed Activities
- Investigate and Identify Root Causes
- Determine a Cut-off Date
- Establish Recovery Measures
- Recalculate the schedule to evaluate the efforts of the planned corrective actions.

If the planned corrective actions do not result in an acceptable schedule, these steps are repeated until the NYCDDC finds the revised plan acceptable. It is necessary to analyze the newly calculated schedule to determine whether it needs further attention.

Throughout the construction phase, our field team continuously monitors the actual work in place against the units of progress required by the project schedule.

We will focus on the critical path, long lead, and seasonally restrictive (planting, paving, concrete work, etc.) items defined by the project schedule and identify areas that require additional manpower, acceleration, or revised logic to maintain control of the schedule. This proactive approach allows the team to gain float, where possible, critical items which will act as a schedule contingency for unexpected events which may impact the completion date.

We will also investigate the potential need to fast-track the approvals process. We call this an early package Submittal Review Conference. The purpose of this conference is to assemble all the applicable design team members, subcontractor, material/equipment vendors, and Hunter Roberts' staff into a local office site facility for the purpose of reviewing and approving the long-lead item submittals. This conference will last approximately one day. The importance of expediting the submittal review process at this early stage cannot be overemphasized. This effort will enable the early release and fabrication of critical materials, possibly cutting three to

four weeks off the projected lead times. With the cooperation of the team, additional conferences may be scheduled to complete the balance of the submittal reviews.

An important step to assure the knowledge of the project's quality, safety and logistics requirements will be conducting on-site pre-work conferences with each subcontractor. These conferences will be attended by the Hunter Roberts field staff and the subcontractors' project manager and foreman responsible for on-site supervision. These meetings are used to reinforce the project-specific and trade-specific requirements, as well as addressing any special safety, coordination, or quality issues.

Throughout the construction phase, Hunter Roberts will prepare and issue remedial work lists and preliminary and final punch lists. These lists will be assembled as a result of our daily field inspections and will be reviewed at every subcontractor meeting. In addition, Hunter Roberts engages the design team early in the punch list process. The key to fast, efficient punch list resolution is early identification. All work lists and punch lists will be tracked in our ProCore project control system for tracking work completion in real-time. A final copy of completed and approved lists will be included in our turnover package.

The D-B Team has prepared a Project Schedule in accordance with Volume 2 – Article 6 of the RFP documents. Our schedule is driven by several early milestones:

- Site Validation
- Early Work Permits for the Temporary Parking Lot and the SOE/Excavation/Foundations
- PDC Approval
- DEP Approval of Stormwater/Storm Sewer
- New Building Approval

These early approvals will allow for mobilization in May 2021 which is critical to meeting Substantial Completion date.

Construction Logistics and Site/Enhancement Items:

In response to the question: If we are not getting gas, what are you giving us in lieu of

The proposed, all-electric, building is designed to meet the City's objective to eliminate fossil fuel use for buildings by transitioning to a clean source of power (electricity). In NYC, newly designed buildings that rely on gas-fired equipment will be obsolete when they open. The DB team prioritized the design of efficient electric systems that will 'future-proof' the building. Our team also prioritized important components of the design – the plaza, monumental stair and garage fins in particular – to create a distinguished building that would enhance its surroundings. Eliminating non-essential scope enabled us to provide these 'enhancements'.

In response to the question: If we are not getting a 2nd elevator for the community center what are we getting in lieu of

After a careful analysis of our proposed design, the team determined that a second elevator in the Community Space was unnecessary. As discussed, it is a two-story space that is accessible to the two elevators in the Parking Garage. Like the gas service, the elimination of the second elevator scope enabled the DB team to maintain key (and critical) elements of the design, like the monumental stair, plaza and fins.

Enhancement Clarification

The Proposal included a list of Enhancements (Technical Proposal/Page 21/see excerpt below). To clarify points from the 11/30/2020 agenda:

1. License Plate Recognition Systems (included)
2. Completely Functional Electric Charging Stations for all Vehicle Parking Spaces (not included/EV stations are included per the RFP requirements)
3. An Expedited Construction Schedule (the schedule meets the requirements of the RFP)
4. Cathodic Protection of Steel and Concrete (not included)
5. Painting of sprinkler pipes and underside of floor slabs (not included)
6. Provisions for Future Adaptability of the parking structure (included/see below)
7. Parksmart Certification (included/see below)

Enhancements Noted in the Technical Proposal (Page 21**)**

INNOVATIONS AND ENHANCEMENTS
We have provided innovations and enhancements that improve design, operations, and amenity. Some were suggested within NYCDDC's RFP, while others are of our own conception. They are as follows:

PARKING AUGMENTATION
Within the garage we have provided 12 parking spaces beyond the required 600.

CONSTRUCTION PHASE ENHANCEMENTS
Our understanding of the project scope extends beyond our conception of the ultimate building in terms of visual outcomes, functionality, and community and civic center context. We have also considered the impacts of the design during construction and have collaborated to establish a design that can be implemented in a manner that minimizes community impacts and disruption of ongoing civic center uses during all phases of BBJ implementation. Our interim parking lot design provides 25 more spaces than the 140 required and does not decrease on-street parking. Earthwork is avoided within the interim parking footprint. This will speed the process of switching over to interim lot parking operations so the balance of the municipal lot can be decommissioned and demolished to build the new Parking Garage and Community Space.

OTHER ENHANCEMENTS/BETTERMENTS TO THE PROJECT INCLUDE:

- License Plate Recognition (LPR) System via Division 28 systems
- Artwork Integral to the architecture at the Community Space Façade
- Provisions for Future Adaptability in the form of multi-modal/last mile systems buildout
- Parksmart Certification at the Bronze level, at a minimum
- Potential for NetZero at the parking garage, calculated on an aggregate, per annum basis
- Frontage to connect Community Space to the park exceeded and augmented
- Activate streetscape due to design of plaza as nexus of circulation within the civic complex
- Environmental graphics to enhance legibility and wayfinding
- 165 interim parking spaces (25 more than the 140 required)