SCHOOL FACILITIES MANAGEMENT
CONTRACT MANUAL AND SPECIFICATIONS

for the

PROJECT NAME: CONSTRUCTION OF COMMUNITY SCHOOL 35
SCHOOL NAME: COMMUNITY SCHOOL 35

BID NO. IFB - 6711

SED # 66-23-00-01-0-346-001

Contract 1 - General Construction	**Contract 2 - Plumbing Work**
Contract 3 - HVAC Work	**Contract 4 - Electrical Work**

YONKERS JOINT SCHOOLS CONSTRUCTION BOARD

Hon. Mike Spano, Mayor of the City of Yonkers

Rev. Steve Lopez, President of Yonkers Public Schools Board of Education

Dr. Edwin M. Quezada, Superintendent of Yonkers Public Schools

Roberto Rijos, Yonkers Council of PTAs Designee

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CONFORMED SPECIFICATIONS

13 January 2022

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Project Manual/Specifications

For

YONKERS JOINT SCHOOLS CONSTRUCTION BOARD

COMMUNITY SCHOOL 35
121 McLean Ave.
Yonkers, NY 10705

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SECTION 220100

GENERAL CONDITIONS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section.

1.1 GENERAL CONDITIONS

A. Before submitting a proposal, Bidders shall examine all Drawings related to this work and shall become fully informed as to the extent and character of the work required and its relation to the other work in the building.

B. Before commencing work, the Contractor will examine all conditions of the project upon which his work is in any way dependent for perfect workmanship according to the intent of this Specification. No "waiver of responsibility" for incomplete, inadequate or defective adjoining work will be considered unless notice has been filed by this Contractor and acceded to by the Owner's representative in writing before the Contractor begins any part of the work.

C. The Contractor will pay for all licenses, permits and inspection fees required by civil authorities having jurisdiction. Comply with all laws, ordinances, regulations, fire underwriters requirements applicable to work herein specified without additional expense to the Owner. (Also, local building code requirements.).

D. It is specifically intended that anything (whether material or labor) which is usually furnished as a part of such equipment as is hereinafter called for (and which is necessary for the completion and proper operation) shall be furnished as part of this Contract without additional cost the Owner, whether or not shown in detail on the Drawings or described in the Specifications.

E. When Drawings and Specifications conflict or there is a question as to the proper intent of this Contract, the Contractor shall assume the more expensive method in his pricing. All questions shall be directed to the Architect/Engineer in writing only and only up to ten (10) days prior to bidding.

F. The Drawings indicate the general runs of the piping, ductwork, etc. systems and the location of equipment and apparatus, but is shall be understood that the right is reserved by the Architect/Engineer to change the location of piping work, ductwork, equipment and apparatus to a reasonable extent as building conditions may dictate, prior to their installation without extra cost to the Owner.

G. Small scale drilling through walls and floors which may contain asbestos shall be performed by a person with a “restricted asbestos handler allied trades certificate” and shall have a copy of it in his possession at all times while working on the project.

H. Any changes from the Drawings and Specifications and any interpretation thereof shall have the prior approval of the Architect/Engineer. The Contractor shall submit in writing, at the time of signing the Contract, any items of necessary labor and materials, which, in his opinion, are lacking in requirements of the Drawings and Specifications to insure a complete job in all respects. No consideration will be granted to alleged misunderstanding of materials to be furnished, work to be done, or conditions to be complied with, it being understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying Drawings.

END OF SECTION 220100

SECTION 220125

SCOPE OF WORK

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section.

1.1 SCOPE OF WORK

A. The work under this section includes all labor, materials, equipment, tools, transportation, cutting and patching, excavation and backfill and the performance of all work necessary and required for the furnishing and installation complete of all Plumbing and Drainage work as shown on Contract Drawings, as specified herein and as otherwise required by job conditions or reasonably implied, including but not necessarily limited to the following:

1. Provide complete new and altered sanitary, storm, acid waste and vent piping from all new plumbing fixtures connecting to existing sanitary and vent system. See front end spec for bedding requirements.

2. Provide complete new and altered hot and cold water piping to all new plumbing fixtures, equipment, etc. as indicated.

3. Provide new and altered gas service, booster and piping as indicated.

4. Provide all new plumbing fixtures where indicated, complete including traps, stops, drains, strainers, tailpieces, faucets, escutcheons, etc.

5. Provide transformer and wire to auto-faucets and flush valves for complete installation. Junction box by Electrical Contractor. Select proper transformer based on number of fixtures.

6. Provide complete new piping and final connections to equipment furnished under other Divisions.

7. Provide all demolition, removal disconnecting, capping, sealing of all existing plumbing piping, apparatus, equipment, fixtures, specialties, accessories, etc. which are not included or incorporated in the new layout, including construction trailers.

8. Pipe insulation.

9. Tests and adjustments.

10. This Contractor shall obtain all permits, bonds, approvals, etc. at no additional cost to the Owner. See City of Yonkers website or additional information.

11. This Contractor shall provide all required sprinkler hydraulic calculations and corresponding drawings per all authorities having jurisdiction. Calculations and drawings to be stamped and signed by a New York State Licensed Engineer.

12. Sprinkler System, Fire Standpipe, Fire Pump etc.

13. This Contractor shall provide shop drawings for all plumbing fixtures, piping, pumps, valves, insulation, equipment, etc.

14. Furnish minimum 18" x 18" access doors for all valves, cleanouts, etc. in all inaccessible walls, ceilings, etc. Installation by General Contractor.

15. Cutting and Patching: See Front End Specifications for Trade Responsibilities.

16. Excavation and Backfill: See Front End Specifications for Trade Responsibilities.

17. Fire stopping per FM/UL and NFPA. Refer to Division 1.

B. Coordination Drawings: Attention is directed to Division 1 for coordination drawing requirements for this project. These drawings are critical to the proper execution of the work and failure to honor these requirements may become the basis for denial of any and all claims for either or both "time" and "money".

1.2 ALTERATION WORK

A. All equipment, piping, plumbing, fixtures, etc. to be removed, shall be disposed of or salvaged as directed by the Owner. They shall not be removed from the premises without Owners approval.

B. All piping to be removed shall be properly plugged or capped so that upon completion of all new work, all abandoned piping shall be concealed in finished areas.

C. No dead ends shall be left on any piping upon completion of job.

D. The existing systems shall be left in perfect working order upon completion of all new work.

E. Location and sizes of existing piping are approximate. Exact sizes and locations of all existing piping shall be verified on the job.

F. All removals shall be removed from the site.

END OF SECTION 220125

SECTION 220130

WATER SUPPLY SYSTEM

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

A. Furnish and install a complete cold-water distribution system to supply water to all new fixtures, water consuming equipment, and valved outlets for the use of other trades and connect to existing piping.

B. The water supply system shall be complete with all pipe, fittings, valves, mains, risers, branches, shock absorbers, air chambers, hangers, anchors, expansion loops, connections to existing piping, covering, tests, etc. all as shown on the Drawings, as hereinafter specified.

C. Furnish and install a complete hot water distribution system to supply water to all new fixtures and equipment requiring heated water.

PART 2 - PRODUCTS

2.1 PIPING, FITTINGS AND MATERIALS

A. All components of water supply system shall confirm to all “No Lead” requirements including NSF/ANSI-372.

B. The domestic water systems shall be of the following material and shall be in accordance with the latest ASTM and ASME Standards.

C. Domestic water piping within the buildings shall be seamless drawn or extruded tubing type "L" copper. Both shall be of Chase, Anaconda, Revere, and approved equal, hard temper ASTM B88 with solder joint sweat end fittings. Fittings for use with copper tubing shall be cast brass of Muellers "Streamlin" pattern or approved equal.

D. Joints for copper tubing shall be made with 95-5 (lead and antimony free) solder. Flanges where required shall be cast brass. Provide dielectric adapters between ferrous and non-ferrous pipe joints.

E. Underground cold water piping 3 inches or more in diameter shall be cement lined ductile iron; piping 2-1/2 inches or less in diameter shall be Type “K” copper (soft annealed) or red brass pipe. Provide proper fittings, except as otherwise shown or specified, at major changes in direction and at branch connections.

1. Ductile-iron pipe shall conform to ANSI/AWWA C151/A21.51 for Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, For Water or Other Liquids.

2. Pipe shall be thickness Class 52 plain end, cement lined, furnished in nominal 18 foot laying lengths.

3. Pipe and fittings joints shall be:

   a. Mechanical joints ANSI/AWWA C110/A21.10.

   b. Joints shall conform to ANSI/AWWA C111/A21.11 for Rubber-Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings, with a minimum pressure rating of 250 psi and similar or equal to Tyton, Fastite or Belltite.

4. Fittings for ductile-iron pipe shall conform to ANSI/AWWA C104/A21.10 for Gray-Iron and Ductile-Iron Fittings, 2 inch through 48 inch for Water and Other Liquids. Fittings shall have a minimum pressure rating of 250 psi.

5. All ductile-iron pipe and fittings shall be cement mortar lined with double thickness lining, a minimum of 1/8 inch, in accordance with ANSI/AWWA C104/A21.4 for Cement Mortar Lining for Cast-Iron Ductile and Ductile-Iron Pipe and Fittings for Water.

F. All exterior underground water piping shall have a minimum of 4 feet of cover.

2.2 VALVES

A. All shut-off valves 2” and smaller shall be ball valves equal to Apollo 70 Series or Milwaukee BA100 Series Valve. Bronze body with chrome plated trim

B. This Contractor shall furnish all valves as indicated on the Drawings, or as may be required for the proper control of the pipe lines installed under this Specification, so that any fixture, line or piece of apparatus may be cut out for repair without interference or interruption of the service to the rest of the Facility.

C. All domestic water valves shall have a minimum working pressure of 125 psig, steam rated unless otherwise noted on the Drawings or specified herein. All valves shall be of one manufacture as manufactured by Milwaukee Valve or Hammond.

D. All gate valves within the buildings shall be wedge gauge valves with painted iron wheel handles, shall have gland followers in stuffing boxes, and shall be so constructed that they may be repacked while open and under pressure. All valves shall have the name of the manufacturer and working pressure cast or stamped thereon.

E. All gate valves shall be all bronze with sweat or screwed joint ends as required by the piping system in which they are installed.

F. Globe valves shall be of all bronze with composition disc, threaded or sweat joint ends as required by piping system in which they are installed.

G. Check valves shall be all bronze swing check type with threaded or sweat joint ends. Check valves 4 inch and larger shall be iron body bronze mountings and shall be provided with screwed or flanged joint ends as required by piping system in which they are installed.

H. Drain valves, at risers and at low points, shall be 3/4 inch heavy cast brass with composition washers with male thread for hose connections.

2.3 SHOCK ABSORBERS

A. Shock absorbers shall be similar and equal to J.R. Smith 5000 series or Zurn Z1700 series with stainless steel pressurized shell sized in accordance with P.D.I. Bulletin WH-201.

B. Provide shock absorbers on all fixtures and equipment having quick closing valves whether or not indicated on the Drawings.

C. Provide access doors where shock absorbers are concealed.

2.4 VACUUM BREAKERS

A. Provide vacuum breakers on water supply piping to each fixture and equipment with submerged inlets, and on faucets and outlets, within the facility to which hose can be, or is attached forming a submerged inlet.

B. Set vacuum breakers in exposed readily accessible locations at least four inches above floor rim level of fixture, or high point of equipment.

C. Vacuum breakers shall be chrome-plated brass. "Watts" or other approved.

D. Vacuum breakers under constant pressure shall be of the continuous pressure type No. 9 "Watts" or Wilkins BFP-8CH or approved equal.

2.5 EXPANSION JOINTS, ANCHORS AND GUIDES

A. The entire piping installation shall be installed with adequate provision for expansion. No rigid connections will be permitted. Refer to Drawings for locations of expansion joints and related guides and anchors. The joints, guides and anchors shall be as manufactured by Flexonics Products, Metraflex or Flex-weld.

B. Branches shall be of sufficient length and have three elbow swings to allow for pipe expansion.

C. Any breaks in the piping within the guarantee period due to improper provision for expansion must be replaced at the expense of this Contractor, and the conditions corrected to prevent future recurrence.

D. Any damages to surrounding areas and equipment due to this failure shall also be repaired and paid for at the expense of this Contractor.

E. Joints to have 150 psi rating, ANSI-B16.5 with liner and cover.

2.6 STERILIZATION

A. The entire domestic water piping system shall be thoroughly sterilized with chlorine before acceptance for domestic operation.

B. The amount of chlorine applied shall be such as to provide a dosage of not less than 50 parts per million for 24 hours or 200 p.p.m. for one hour. The chlorinating material shall be either liquid chlorine or sodium hypochlorite solution and shall be introduced into the system and drawn to all points of the system. If possible to do so, the lines shall be thoroughly flushed before introduction of the chlorinating material. After a contact period of not less than 24 hours, the system shall be flushed with clean water until the residual content is not greater than 0.2 parts per million. All valves in the lines being sterilized shall be opened and closed several times during the contact period.

C. Sterilization and tests for purity of water in the entire piping system shall be performed by the Contractor through an approved independent testing laboratory and a certificate shall be furnished to the Architect certifying the quality of purity.

D. Per ANSI/AWWA Standard C651-05.

PART 3 - EXECUTION

3.1 INSTALLATION

A. It is the intent that each part of the plumbing system shall be complete in all details and water lines provided with all control valves as indicated on Drawings, or as may be required for the proper control of the pipe lines under this Specification so that any fixture, line or piece of apparatus may be cut out for repair without interference or interruption of the service to the rest of the facility.

B. This Contractor shall examine carefully the Architectural Drawings in detail and familiarize himself with all conditions relative to the installation of piping, particularly where same is concealed behind furring or in hung ceilings.

C. In no case shall this Contractor permit his pipes to be exposed beyond finished walls or ceilings unless specifically shown on Drawings. He shall consult with the Contractors of other trades in the building and install his piping in such a way as to least interfere with the installation of other trades.

D. The water piping shall all be installed so as to drain to a valve provided by this Contractor and branches shall not be trapped but shall have continuous pitch. Where necessary to raise or lower mains, the same shall be provided with a drip and shall be properly valved.

E. Piping shall be installed, whether indicated or not, so as to rise and/or drop to clear any and all conduits, lighting fixtures, ductwork and heating mains to maintain the desired clear heights. This Contractor shall consult with the Contractors of other trades and facilitate the erection of the equipment and piping.

F. Run piping straight and as direct as possible, in general forming right angles with or parallel to walls or other piping. Risers shall be erected plumb and true.

G. After cutting, all pipes shall be reamed out to full bore and before erection the inside of all pipes shall be thoroughly cleaned.

H. No piping or work shall be concealed or covered until all required tests have been satisfactorily completed and work has been approved by the Architect.

I. All materials shall be new and installed in a first class manner.

J. In erecting pipe, friction wrenches and vises shall be used exclusively, and any pipe cut, dented or otherwise damaged shall be replaced by this Contractor.

K. All ferrous to non-ferrous pipe connections shall be made with approved dielectric pipe or flange unions isolating joints to prevent any electrolytic action between dissimilar materials.

L. Any piece of pipe 6 inches in length or less shall be considered a nipple. All nipples with unthreaded portion 1-1/2 inch and less shall be of weight corresponding to fitting connected. Only shoulder nipples shall be used, close nipples will not be accepted.

M. Revised water service shall be in accordance with the local water supply department requirements. All water lines are to be protected from freezing. Install new piping for water service below frost line and provide concrete separations when crossing other utilities. Provide concrete thrust mass at changes of pipe direction conforming to authorities having jurisdiction.

END OF SECTION 220130

SECTION 220150

SANITARY, STORM AND ACID WASTE DRAINAGE SYSTEMS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

A. The work under this section includes all labor, materials, equipment and appliances necessary and required to completely install all drainage systems as required by the Drawings; code and as specified herein, including but not limited to the following:

B. Complete sanitary drainage and venting systems including connections to the existing sanitary drainage and venting systems.

C. Piping and final connections for equipment furnished under other Divisions.

D. Alterations and removals to existing sanitary and vent systems. (Including Construction Trailers)

E. Tests.

PART 2 - PRODUCTS

2.1 PIPING, FITTINGS AND MATERIALS

A. All indoor underground storm soil, waste and vent piping shall be service weight cast iron with fittings of bell and spigot type. All exterior underground storm soil and waste piping shall be extra heavy cast iron. Each length shall have the size, weight per foot and the manufacturer's name clearly cast or stamped thereon. Fittings and traps shall be similarly marked and of corresponding weights.

B. All aboveground storm, soil, waste and vent piping and fittings 3" and larger shall be service weight and fittings of bell and spigot type as specified in paragraph above. Above ground waste and vent piping 2" and smaller shall be galvanized steel, fittings on waste piping shall be galvanized cast iron, recessed drainage pattern, fitting on vent piping shall be galvanized cast iron, beaded pattern, screwed joints shall be made up to be perfectly tight without the use of lead or filler of any kind, except oil or graphite. Nipples for galvanized pipe shall be shoulder type. No close nipples shall be permitted.

C. Joints shall be made with compression gaskets conforming to the International Plumbing Code IPC 705.4.2. (See 2.1, E. for aboveground joint options where permitted.)

D. For the above ground sanitary, vent and storm piping the Contractor has the option of using Schedule 40 PVC piping conforming to IPC Table 702.1 with PVC fittings conforming to Table 702.4.

E. All galvanized pipe and fittings shall be galvanized with prime western spelter by hot drip process.

F. The Contractor has the option of using the following types of joints with hubless cast iron pipe only if approved by the governing agencies. These joints shall be used throughout the project. No mixing of joints shall be permitted.

1. Neoprene gasketed joints similar to Ty-Seal (for above and underground application).

2. Hubless cast iron pipe with neoprene gaskets and stainless steel clamps (by Clamp-All or equal) above ground only. All in accordance with Cast Iron Soil and Pipe Institute Standard 301 latest edition. Hangers and supports shall be in accordance with manufacturer's recommendations.

3. Copper DWV system with 50-50 tin antimony solder, DWV with solvent welded or screwed joints meeting CS-270-65.

F. Pump Discharge Piping

1. Piping: Galvanized steel pipe, Schedule 40 with marker’s name rolled into each length.

2. Fittings

a. Threaded: Galvanized malleable iron with flat band steam pattern. Cast iron drainage pattern for waste piping.
b. Mechanical Joints: Victaulic couplings style 07 for grooved piping only, with gasket.
c. Bolted flange with gasket.

3. Joints: Teflon tape for threaded, Victaulic couplings for gasket for mechanical joint.

4. Application: Schedule 40 steel for sewage ejector and sump pump discharge.

2.2 CLEANOUTS

A. Provide easily accessible cleanouts where indicated at base of vertical stacks at ends of horizontal drainage lines and at intervals not exceeding 50 ft.; at each change of direction; on handholes of running traps, and where necessary to make entire drainage system accessible for rodding. Provide at least 18" clearance to permit access to cleanout plugs.

B. Cleanouts for cast iron pipe shall consist of tarpped extra heavy cast iron ferrule caulked into cast iron fittings and extra heavy brass tapered screw plug with solid hexagonal unit. Cleanouts for wrought iron pipe shall consist of extra heavy brass screw plug in drainage fitting.

C. Cleanouts turning out through walls and up through floors shall be made by long sweep ells or "Y" and 1/8 bends with plugs and face or deck plates to conform to Architectural finish in the room. Where no definite finish is indicated on the Architectural and/or Mechanical Drawings, wall plates shall be chrome plated cast brass and floor plates shall be nickel bronze.

D. Cleanouts shall be full size at the pipe up to 6" inclusive. On larger size piping 6" size plugs shall be used.

E. Cleanout fittings in vertical stacks shall consist of tapped tees capable of receiving a rough brass raised head cleanout plug, J.R. Smith S-4730, Zurn Z1445-A-BP or approved equal.

F. All cleanout plugs shall be brass lubricated with graphite before installation.

G. Cleanouts occurring in cast iron soil pipe above floor at change of direction of pipe run and at ends of horizontal runs shall be J.R. Smith S-4425, Zurn Z1441-A-BP or approved equal with cast iron ferrule for caulk connection and fitted with a straight threaded tapered bronze plug with raised hex head.

H. Cleanout deck plates for finished areas shall be similar and equal to J.R. Smith 4020 series, Zurn ZB1400-X or approved equal with cast iron ferrule, scoriated cutoff sections, brass cleanout plus collar with brass bolts for waterproofed slabs. In tile floor areas the cleanout deck plates shall be recessed to tile.

2.3 FLASHING

A. Provide 6 lb. lead flashing extending at least 10" beyond edge of all floor drains and vents through roof and all floor sleeves in floors with waterproofing or vapor barriers. Flashing shall be held securely in by clamping devices.

B. All floor drains shall be provided with flashing rings and 24" square 6 lb. sheet lead flashing, properly flashed into flashing ring of the drain.

2.4 SANITARY DRAINAGE

A. A complete system of drainage shall be provided as shown on the Drawings. The system shall include all drains, leaders, branches, house drains with all pipe fittings, hangers, anchors, etc. to make a complete sanitary drainage system. The systems shall extend through house drains and terminate as indicated on the Drawings.

B. Piping shall be sizes as indicated on the Drawings. The sanitary drains shall have a pitch of 1/8" per ft. minimum unless otherwise noted. Branch connections to stacks and house drains shall pitch a minimum of 1/8" per ft.

2.5 PIPING AND FITTINGS

A. Provide piping of one of the following materials, of weight/class indicated. Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated.

2.6 ACID NEUTRALIZATION SYSTEM

A. Acid Neutralization System - Zurn model PH1X Acid neutralization cartridge shall be attached to each science sink. No Polypropelene piping required beyond cartridge. Connect typical cast iron pipe and fittings to cartridge and provide 2” vent and sanitary to each sink.

B. Acid System shall be installed in accordance with manufacturer's recommendations, the local Plumbing Code and good workmanlike practice. Provide where directed a sign stenciled in block letters 1" high. Sign shall read:

"IMPORTANT"

BASIN MUST BE INSPECTED FREQUENTLY AND NEUTRALIZING AGENT REPLACED WHEN NECESSARY. FAILURE TO DO SO MAY RESULT IN SERIOUS DAMAGE TO PIPING SYSTEM.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING

A. The size of soil, waste and vent piping shall be as determined by the State codes, rules and regulations for plumbing and drainage, except where specifically noted to be larger by the Specifications or Drawings and all fixed rules of installation, as set forth in the codes, rules and regulations, shall be followed as part of the Specifications.

B. This Contractor shall carefully examine the Architectural plans in detail and familiarize himself with all conditions relative to the installation of piping, particularly where same is concealed behind furring or in hung ceilings.

C. In no case shall this Contractor permit his pipes to be exposed beyond finished plaster lines unless specifically shown on Drawings. He shall consult with the Contractors of other trades in the building and install his piping in such a way as to least interfere with the installation of other trades.

D. Piping shall be installed, whether indicated or not, so to rise and/or drop to clear any and all conduits, lighting fixtures, ductwork and heating mains to maintain the desired cleat heights. This Contractor shall consult with the Contractors of other trades and facilitate the erection of the equipment and piping.

E. Run piping straight and as direct as possible in general forming right angles with or parallel to walls or other piping. Risers and stacks shall be erected plumb and true. After cutting, all pipes shall be reamed out to full bore and before erection the inside of all pipes shall be thoroughly cleaned.

F. No piping or work shall be concealed or covered until all required tests have been satisfactorily completed and work has been approved by the Architect and all other authorities having jurisdiction.

G. Branch connections shall be made with "Wye" and long "Tee-Wye" fittings, short 1/4 bends, common offsets and double hubs will not be permitted. Short "Tee-Wye" fittings are to be used in vertical piping only. All fittings shall conform to code requirements.

H. Cleanouts shall be provided at foot of all stacks, at changes of directions, at the ends of branch runs where shown and as required by code, and shall be terminated as described under cleanouts.

I. The house drains must be run at a minimum grade of 1/8" per ft. downward in the direction of flow. Wherever possible, a 1/4" per ft. pitch shall be maintained. Branch connections to stacks from fixtures shall pitch 1/4" per ft. where possible. Attention is again called to the necessity of maintaining the ceiling heights established.

J. Furnish and install complete systems of vent pipes from the various plumbing fixtures and other equipment to which drainage connections are made. Vent pipes shall be connected to the discharge of each trap and shall be carried to a point above the ultimate overflow level of the fixture before connecting with any other vent pipe; in general, this will be approximately 3'-6" above the finished floor. Branches shall be arranged to pitch back to fixtures.

K. The individual vent pipes shall be collected together in branch vent lines and connected to existing vent connections through roof.

L. Any existing vents through roof, damaged, or if flashing on roof comes loose while connecting new vent to them shall be repaired and reflashed to the roof as required to maintain waterproofing the satisfaction of the Architect.

END OF SECTION 220150

SECTION 220180

NEW GAS SERVICE, STREET CONNECTIONS AND ASSOCIATED WORK

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

A. Furnish and install a gas supply system from street main/curb box to kitchen, hot water heater and other gas-fired equipment as shown on Drawings.

B. The Contractor shall make all necessary arrangements with the local Utility Company to provide the new gas service as indicated on the Drawings.

C. Tests.

D. All work in this section shall comply with NFPA-54 and Fuel Gas Code of NY State.

E. See Con-Edison yellow book for trenching, bedding, warning tape, tracer wire and bollards.

PART 2 - PRODUCTS

2.1 GAS METER RIG AND PIPING SYSTEM

A. All piping equipment, valves, relief valves, brackets, meter, pressure reducing valves, sleeves, fencing enclosure, gates, etc. not furnished by the Utility Company and required or indicated will be furnished and installed by the Contractor.

B. New gas underground pipe shall be as directed by Utility Company. Plastic pipe: JM Eagle PE4710GD, Duraline GDB50, PP Yellowstripe 8300, Endot PE 4710.

C. Above ground gas piping 2 ½" and larger shall be welded black steel, 2" and smaller black steel.

D. Perform all required x-ray test and provide all welded x-ray documentation as required by Utility Company.

E. See front end spec for piping painting.

F. See attached service layout.

PART 3 - EXECUTION

3.1 STREET CONNECTIONS

A. Contractor shall make all necessary gas connections between the building and service lines in street, as indicated on Drawings. Contractor shall obtain street opening permit and perform all work in accordance with agencies having jurisdiction. Contractor shall pay for all costs for these service connections. See City of Yonkers and Con-Ed requirements.

B. Contractor shall be responsible for any damage caused to the work by reason of leaky, defective or broken piping connections or other appurtenances installed by him.

3.2 TESTING

A. Gas piping shall be tested with air using an air pump and mercury gauge. Tests shall be made by the Contractor with his equipment when directed by the Owner/Inspector/Construction Manager. Testing shall be done for a period of one hour, and follow Utility Company procedures and all Plumbing Code requirements. Certify and submit written test results to Architect/Engineer. Indicate that system is functioning properly, and has been installed in accordance with NFPA, and all applicable codes.

B. Encase gas piping with minimum 12” of concrete where covered by paved areas and roadways.

END OF SECTION 220180

SECTION 220200

MAGNETICALLY COUPLED PACKAGED GAS BOOSTER SYSTEM

PART 1 – GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 SYSTEM REQUIREMENTS

A. A complete skid mounted Gas Booster System is to be supplied to meet the following application. The system shall be an ETTER Engineering E101-P Series Packaged Booster System or approved equal. The factory can be reached at 860-584-8842.

1. System to be model:

a. Model E101PHC-S-NYC-PCFM-REG-GLD-TRNS, 2” inlet and outlet connections

2.	Type of Application:	gas fired RTU
3.	Total Load:	1,100 SCFH
4.	Minimum Supply Pressure:	4” wc
5.	Maximum Supply Pressure:	7” wc (assumed)
6.	Required Boost Pressure:	10” wc added, 14” wc regulated outlet pressure
7.	Minimum Flow Requirements:	100 SCFH
8.	Equipment Location:	Outdoors

1.2 CENTRIFUGAL GAS BOOSTER SYSTEM

A. Where indicated on the drawings, the contractor shall furnish a completely operational skid mounted factory tested Gas Booster System which shall be capable of delivering the required volume of Natural Gas while elevating the gas pressure as above stated. The system shall contain all the required devices in order to provide a completely automatic operating system in full accordance with the requirements of the Engineer, Owner and local Utility Company. The system must be completely assembled by the Original Equipment Manufacturer (OEM) of the gas boosters themselves for sole source responsibility. Systems built by third party suppliers such as local representatives and resales will not be accepted. The trade name “Compac” is not considered as equal.

PART 2 – COMPONENTS

A. The system shall include the following:

1. UL Listed Magnetically Coupled Gas UL Listed Booster
2. Supply Pressure Gage with petcock
3. Inlet Shut-Off Valve
4. Inlet Gas Check Valve

5. Inlet Flex Hose with bronze overbraid
6. Ventless Low Gas Pressure Cut Off Switch, Manual Reset
7. By-Pass Shut-Off Valve
8. By-Pass Gas Check Valve
9. Outlet Flex Hose with Stainless Steel overbraid
10. Lock Up Discharge Regulator
11. Outlet Shut-Off Valve
12. Discharge Pressure Gage with petcock
13. Pressure compensated flow module (PCFM) to automatically start and stop the gas booster based on flow demand from the system load equipment. The controls will be completely integrated to deliver boosted flow only when there are load demands present.
14. Gas Leak Detector mounted inside the Transclosure to provide shutdown and alarming of a detected leak. If a leak is detected the system will go into alarm mode along with closing an automated gas safety shutoff valve that is part of the gas booster system.
15. Integrated outlet pressure regulator, vent-less.
16. Outdoor Steel Transclosure.

2.1 PIPING

A. Connections: Inlet and Outlet piping connections to booster skid to be 1” NPT for the Standard E101-P and 2” NPT for the High Capacity E101-PHC

2.2 MAGNETICALLY COUPLED BOOSTER

A. The gas booster pump shall be UL Listed and of the Magnetically Coupled type. The design of the booster shall be single staged and shall have a motor that is magnetically coupled to the impeller which is housed in an air tight housing without the requirement of external shaft seals.

B. The booster shall include a 3600-rpm 1/4 hp motor which shall be capable of operating on 120V/60/1 power.

C. The booster shall operate from a Zero Flow condition to its rated maximum flow without exemplifying surging or over-heating conditions.

D. Minimum flow heat exchangers or by-passes shall not be required or permitted.

E. The entire booster system shall be approved as “indoor ventless” which includes the gas pressure regulator and any control switches.

2.3 CHECK VALVES

A. The system shall be furnished with horizontally mounted disk type check valves on the inlet suited for Natural Gas as required.

B. Check valve to be suited for Natural Gas and approved by the local gas authority.

C. Check valves shall be constructed of brass with a removable top for ease of inspection and maintenance and shall have all Aluminum trim with soft seats for Natural Gas.

2.4 GAS BOOSTER CONTROL PANEL

A. The Booster system shall be provided with an integral mounted & wired UL Labeled 508A Control Panel specific for gas booster systems. Panels must be physically labeled as UL 508A control panel. Building "in accordance" with the specification or comprised of UL Listed parts will not be acceptable to satisfy the specification. The Control Panel must be fabricated by the OEM of the boosters themselves and third party or value added representation as suppliers will not be accepted. It shall provide safe, proper automatic operation of the gas booster pump and be complete with:

1. NEMA 3R control panel
2. IEC rated non-reversing motor starters with fusing and overloads
3. Booster "Hand/Off/Auto" Station
4. Indicating lights for: "Power On", "Booster Running", "Low Gas Pressure"
5. Emergency Stop Pushbutton, Red Mushroom Type
6. Operating and interlock circuits with relays as required
7. Engraved black phenolic nameplates for all door mounted components
8. Numbered terminal strips
9. All internal components to be tagged matching electrical schematic
10. All internal and interconnecting wiring to be tagged both ends
11. Gas Leak Detector sensor and safety control circuit built into and integrated into the booster controls. Sensor to be pre-wired to the control panel and will include automated closure of a FM approved gas safety shut off valve within the system on the detection of a gas leak.
12. Panel to provide Mode G control philosophy with automated start stop based on flow demands from the generator equipment on the gas booster. If there are no flow demands on the system, the gas booster will shut off automatically after a short time delay. It will be started again based only on the presence of flow. The booster shall automatically always maintain an elevated system charge to the generator even in standby mode.

2.5 STEEL SKID ASSEMBLY

A. All equipment shall be factory mounted and supported from a skid frame

B. Skid frame shall be constructed using steel base, steel tubing or members

C. Skid shall provide adequate access to maintain the various components

D. Skid shall include mounting holes to be anchored to the concrete housekeeping pad that is to be poured by the contractor.

E. Skid and piping assembly shall be painted & complete with flow arrows.

F. All wiring shall be done with hard conduit and seal tight flexible connections.

G. Frame built using Unistrut and hardware fasteners will not be accepted as structural integrity can diminish over time.

2.6 LOW GAS PRESSURE SWITCH

A. Wired to the gas booster control system shall be a UL and FM listed low gas pressure switch which shall be set open when the inlet gas pressure to the booster falls below (3" WC).

B. When the switch opens it shall de-energize the booster motor control circuit disabling the booster while lighting the light on the panel. This switch shall be manually reset type requiring an operator to locally trouble shoot and reset the switch and system.

C. The ventless gas switch shall be an Antunes model LGP-G or approved equal.

2.7 MODE R CONTROL PHILOSOPHY

A. An outlet pressure compensated flow module is to be provided which incorporates a specialized gas pressure regulator actuator with internal switches integrated into the control scheme.

B. When the regulator opens sensing a downstream demand it will initiate the booster to start. The booster will continue to run until such a time where downstream demands from load equipment cease and the regulator closes indicating the booster may turn off. This operation is supervised using start and delay timing.

2.8 OUTDOOR STEEL TRANSCLOSURE

A. The outdoor skid mounted system shall be enclosed and protected from the weather and made tamper resistant with the supply of a Steel Transclosure. The Transclosure shall be custom made for the intended purpose and shall have multi-point pressure clamping door closures with lockable handles with two sets of keys. The equipment shall be accessible by opening the doors, and removal of large access panels as a substitute means of access is not acceptable. The doors shall include gasketing for tight weather seals. The doors shall be fully removable only in the open position for ease of access to the internal equipment. The enclosure shall include on a minimum of two sides louvered stampings to allow airflow circulation for ventilation and cooling. The entire enclosure assembly is to be enamel baked finish or powder coated for durable outdoor finish. The gas connections shall be made readily accessible with access holes or plates, including Buna Nitrile rubber gasketing seals against the piping.

2.9 COORDINATION, FIELD SERVICE AND QUALITY ASSURANCE

A. The Packaged Booster System supplier must provide a reference list of not less than 15 installations in which a similar packaged gas booster to that specified has been installed. This list shall also include a minimum of 7 units that are documented to have run & operated successfully for more than a period of 2 years Seven (7) independent letters of reference shall accompany any submittals for "approved equals".

B. In order to provide a properly operating Packaged Gas Booster system, the manufacturer shall review all aspects of the installation in advance including gas piping layout, gas control pressure requirements, and maximum/minimum load requirements for the project. Upon confirmation of all the details, the manufacturer shall provide a detailed submittal of all design data and information for review by the Engineer &/or Owner.

C. The manufacturer shall provide field service assistance for the installation supervision and start-up of the supplied equipment.

D. As part of the start-up service, upon completion, the manufacturer shall provide the Owner with a written certification that the system is operating in accordance with the design conditions. All pertinent data shall be recorded including set points of all switches.

E. A one year warranty shall be extended from the date of successful start-up on all system components.

F. The manufacturer shall submit an Annual Routine Service Plan for a period of not less than five (5) years in order to insure proper reliable future operation. This plan shall outline Service Rates that are to be held firm for the said period.

END OF SECTION 220200

SECTION 220300

PLUMBING FIXTURES AND EQUIPMENT

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

A. The work under this section shall consist of furnishing all labor, materials, equipment and appliances necessary and required to completely do all plumbing fixture work, as required by the Drawings and as specified herein, including but not limited to the following: plumbing fixtures, traps, fittings, trimmings, bra001ckets, plates, anchor, chair carriers and supports.

B. Just before the Owner's taking over the work in the building, this Contractor shall thoroughly clean all fixtures furnished and set under this Contract, leaving every fixture in perfect condition and ready for use.

C. Submit shop drawings and roughing sheets for all equipment for checking and approval.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES AND EQUIPMENT

A. All fixtures shall be free from imperfections, true as to line angles, curves and color, smooth, watertight, complete in every respect and practically noiseless in operation, Fixtures specified are given as the typical standard required as manufactured by American Standard and they or other similar approved fixtures as made by Kohler or Eljer Companies shall be furnished, set and connected in good substantial, neat workmanlike manner.

B. The letter designations hereinafter correspond with the schedule on the Drawings.

1. Water Closet - Type A1
Flush valve type, wall mounted 2856.016 "Afwall" vitreous china, siphon jet action, elongated bowl, 1-1/2" top spud, Zurn recessed hard wired 1.6 GPF low consumption flush valve, Model ZEMS 6142AV Olsonite #95 open front seat cover. Provide floor mounted carrier equal to Zurn Z1203 series or Z1204 series. Mount sensor assembly behind Zurn Model ZEMS6199 – BX17-C access panel with Vandal resistant screws. Furnish panel for general contractor installation.

2. Water Closet - Type A2 (Handicapped) Same as above except Handicapped.

3. Water Closet – Type A3
   Flush valve type, floor mounted equal to American Standard model 3461.001 “Madera 16-1/8" Universal” vitreous china, siphon jet action elongated bowl, 1-1/2" top spud, Zurn ZEMS6000-WS1-1.6 GPF hard wired low consumption flush valve, Olsonite “95 open front seat cover.

4. Water Closet – Type A4
   Flush valve type, floor mounted equal to American Standard Baby Devoro model 2282.01 vitreous china, siphon jet action elongated bowl, 1-1/2” top spud, Zurn ZEMS6000-WS1-1.6 hard wired low consumption flush valve, open front seat cover.

5. Lavatory - Type B1 (Handicapped)
   Kohler Soho Model K2084 single hole, concealed arm floor mounted support, off set grid drain adjustable trap, loose key stops and all required trim. Zurn model Z6915-XL-CWB hard wired faucet with mini junction box and mixing valve. Provide True-Bro lavatory piping guards.

6. Double Sink Unit – Type B2
   Equal to Bradley model LVRD2, 2 station express lavatory “Verge” wash station system with faucet Metro series S53-3300. Provide adapter wire AC adapter splitter kits for each fixture. Outlets installed under each sink enclosure by EC for use by P.C. “Evero” Geo series basin construction with 16 gauge support frame. P-Traps, tailpieces, supply frame connections, mixing valves, strainers, and check valves included. Provide manufacturer wall supports. Color: Antarctica, Arch to confirm in shop drawing.

7. Triple Sink Unit – Type B3 (Handicapped)
   Equal to Bradley model LVRD3, 3 station express lavatory “Verge” wash station system with Verge faucet Metro series S53-3300. Provide adapter wire AC adapter splitter kits for each fixture. Outlets installed under each sink enclosure by EC for use by P.C. “Evero” Geo series basin construction with 16 gauge support frame. P-Traps, tailpieces, supply frame connections, mixing valves, strainers, and check valves included. Provide manufacturer wall supports. Color: Antarctica, Arch to confirm in shop drawing.

8. Countertop Classroom Sink – Type B4
   Equal to Elkay model ELUHAD281655, 18 gauge, type 302 undermount, LK-35 strainer. GROHE-31-5180 Faucet with mixing valve.

9. Maker Space Sink – Type B5
   Equal to Elkay model DLR312212 18 gauge 304 stainless steel drop-in Elkay 8" center deck mount faucet Model LKD2439C, P-Trap, tailpiece, supply connections, grid drain, etc.

10. Health Suite Sink – Type B6 (Handicapped)

Equal to Elkay model LRADQ221950 18 gauge 304 stainless steel drop-in Elkay 8" center deck mount faucet Model LKD2439C, P-Trap, tailpiece, supply connections, grid drain, etc.

11. Art Sink Type - B7 (Triple) (Handicapped)
Equal to Elkay model EWMA6020SACC 14 gauge 304 stainless steel wall hung three LKB722C sensor faucet (Battery) LK188 grid drain, P-trap, tailpiece supply connections, wall hanger, etc.

12. Art Sink - Sediment Interceptor
Equal to J.R. Smith model no. 8710, Zurn Z-1180 white Duco coated cast iron body and aluminum gasketed cover and sediment strainer with removable stainless steel screens. Provide required clearance. Provide unions on each connection for easy maintenance.

13. Faculty Sink – Type – B8 (Handicapped)
Equal to Elkay model ECTSRAD25226TBG, 18 gauge
stainless steel undermount Elkay 8" center deck mount faucet model LKD2439C, P-Trap, tailpiece, supply connections, grid drain and bottom rack etc.

14. Music Room Sink – Type – B9
Equal to Elkay model BIC24X24X,18 gauge stainless steel with stainless steel legs. Elkay Model LK940AT08T4S with wrist blade handles.

15. Pre-K/Kindergarten Sink – Type – B10
Equal to Elkay model no. DRKAD-3717-R-C,18 gauge, type 302 self rimming, two bowls 6” apart, LK-1141-A, no lead Flex-Guard Bubbler, LK-35 strainer in sink, LK-8 grid strainer in fountain, LK-2439 concealed mounting mixing faucet, 45 degree restricted swing faucet with aerator.

16. Urinal - Type C
6590.501 "Washbrook" white vitreous china, siphon jet urinal, wall hanger, 3/4" top spud, Zurn recessed hard wired model ZEMS6197AV flush valve with vacuum breaker and angle stop, Josam series 17800 or Zurn Z-1222 concealed chair carrier. Mount sensor assembly behind Zurn model ZEMS6199-BX17-U access panel with Vandal resistant screws. Furnish panel for general contractor installation.

17. Single Water Cooler – Type D1 (Handicapped)
Elkay EZ H2O LZSTLR8WS bottle filling station with bubber upper unit only - no lower unit.

18. Double Electric Water Cooler – Type D2 (Handicapped)
Elkay EZH20 Bottle Filling Station with B1-Level Reverse Filtered LZ Cooler model LZSTLR8WS. Upper and lower units.

19. Double Bottle Filling Station – Type D3
Elkay LZWS(M) 8 PK recessed 1.5 GPM

20. Mop Receptor - Type E

7741.000 “Florwell” white enameled cast iron corner model with 7745.811 vinyl rim guard, 7721.038 3” drain with strainer and socket. Provide Chicago Faucet model 540-LD-897S-WXF, with vacuum breaker spout 3/4” hose threaded outlet, pail hook and wall support, WXF straight shank with flange, 8” centers, 369 handles and chrome plate.

21. Shower - Type F
“Bestbath” model 4LSS6337A75T molded single piece fiberglass with plywood backing, grab bar, pressure balancing mixing valve, soap dish, curtain, curtain rod and shower head. Coordinate with Architect and General Contractor for left/right plumbing, coordinate threshold height, provide no caulk brass drain. Folding seat, T-shaped rubber water stopping kit, and semi-permanent threshold adapter.

22. Laboratory Counter Mounted Sink - Type G1 & G2
By General Contractor, Plumber to hook-up complete.

23. Eye Wash – Type H
Guardian G1805 chrome plated brass piping fittings and swivel, chrome plated bronze ball valve with stainless steel push plate, 90^{o} locking swivel to swing over sink, plastic heads with float off covers, vandal resistant self-adjusting regulators assure even flow of 3.5 gpm under varying hydraulic conditions. Provide 11x17 sign. See floor plans for left or right mounting.

24. Combination Roof Drain and Overflow Drain:
Zurn model Z164 with cast iron domes.

25. Small Roof Drain: Watts RS – 100 Sump Receiver, under deck clamp, ductile iron low dome.

26. Overflow Drain Wall Outlet:
Josam model 25020 stainless steel scupper with rodent screen mounted 24" above grade.

27. Scupper Drain:
Watts model RD-270 with angle grate, epoxy coated cast-iron, flashing clamp.

28. Floor Drains:
Josam series 30000A or Zurn Z415 type “B” coated cast iron, two piece body with double drainage flange, flashing collar, weepholes, bottom outlet and adjustable strainer.

29. Floor Drain Trap Seal: (On every floor drain)
Zurn model Z1072 “Z-Shield” barrier trap seal device ASSE 1072.

30. Funnel Floor Drains - Same as above except with E2 series funnel or Zurn type “E” funnel.

31. Floor Sinks:

Zurn ZS-1905 Type 304 stainless steel floor sink, seepage pan, loose-set grate with 1/2" square holes and anti-splash interior dome strainer.

32. Funnel Floor Sinks - Same as above except with Type F-6 funnel.

33. Kitchen Electric Water Heater Booster:
Hubbell model J169R, ASME glass lined steel tank, 9kw, 208/3/60, 92 G.P.H. recovery at 40^{o} temperature rise. Provide ASME T&P relief valve and drain valve.

34. Wall Hydrants (Exterior): Watts Model HY-725 or approved equal. Non-freeze, cast brass, exposed, 3/4" straight nozzle, hose outlet, brass casing, solder inlet, key operated, length as required.

35. Wall Hydrants (Interior): WATTS Model HY-330, NB Box, bronze nickel plated quarter turn with 3/4" hose connection, integral vacuum breaker with vandal resistant cap and T-handle key.

36. Grade Mounted Hose Bib (Exterior): WATTS Model HY-500, Non freeze with concealed box.

37. Grease Interceptor:
"Trapzilla" T-600ECA with ECALA-TZ-18 extension collar as required. 75 GPM, 95 gallon capacity, 86.6 gallons grease capacity FTCA-22 diamond plate cover.

38. Circulators

    a. (2) Domestic Hot Water Circulator Pumps
    Furnish and install domestic water circulator as indicated on Drawings. Grundfos model no. UP-43-75-BF, 22 gpm @ 15 ft. of head, 1/6 hp, 120/1 stainless steel impeller, aluminum housing, bronze pump volute.

39. Water Meter:
Water meter shall be furnished and installed on water service main entering the building and shall be set in accordance with the regulations of all authorities having jurisdiction. Meter installations shall be complete including the necessary control valves, check valves, bypass, strainer, test tee, air chambers and approved supports. Buy from Local Water Company.

40. Ejector Pump Duplex: (One set in Academic building and one set in Gym building.) Furnish and install as shown on Drawings, B&G model 3DWS, suspended wet pit sump pump unit. Pump shall have a non-clog impeller and stainless steel shaft. Motor shall have drip-proof enclosure with drip canopy. Pumps shall be controlled by an enclosed float switch actuated by copper float, brass rod and adjustable stops. Provide built-in overload protection. Provide custom support plate by Halliday Products with access door.

    a. SP-1 pump shall be 50 gpm at 1750 rpm, 30 ft. of head and 2-HP, 208 volts, 1 phase, 60 hz.

b. Pumps shall be driven through a flexible coupling by a vertical mounted standard NEMA frame motor in an open, drip-proof housing.

c. Furnish and install a model A2D float switches. Furnish an auxiliary float switch to turn on pump if the float switch is inoperative. Each switch shall have a copper float with adjustable stops and “T” shaped float bracket. Furnish a compression tube type high water alarm actuator and a 4 inch, 110 volt alarm bell.

d. Furnish and install a magnetic starter for motor in a NEMA-1 general purpose enclosure with overload protection on each phase and a hand-off automatic selector switch in the cover.

e. Provide 2” lift out rail with 304 stainless steel pump adapter and guide bracket.

f. See detail on drawing for custom field fabricated basin, grate, etc.

41. Elevator Sump Pumps:
“Oil Minder” by Stancor Model AHS-05 with plug for outlet. Oil sensor to send signal to alarm panel and prevent operation when oil is detected. Vertical float switch 50 gpm @ 20ft. HD, 1/2 hp, 120/1/60. Type K NEMA enclosure. Mount panel in per drawing. Coordinate pit size with General Contractor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All fixtures shown on Drawings shall be set, connected and tested by the Contractor. He shall also make all water; soil, waste, vent and other service connections to fixtures as shown on Drawings or as directed and shall set, furnish, connect and test all necessary fittings.

B. All pipes at fixtures passing into walls, floors or partitions shall be provided with heavy cast brass escutcheons and security (tamperproof) set screws finished to match the pipe. No "waiving" of this section will be permitted.

C. All fittings escutcheons, faucets, traps, exposed piping etc. shall be brass, chrome plated over nickel plate with polished finish. Any visible hanger nuts shall be security (tamperproof) type and shall likewise be chrome plated over nickel plate.

D. This Contractor shall be responsible for protecting all plumbing fixtures including in these Specifications against injury from the building materials, tools and equipment. Any fixtures damaged during the construction period shall be replaced new. After all fixtures are set, this Contractor shall carefully grout all around fixtures.

END OF SECTION 220300

SECTION 220310

BACKFLOW PREVENTERS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 SUBMITTALS

A. Product Data: Manufacturers catalog sheets, specifications, and installation instructions for each type backflow preventer.

B. Approval: Local water utility company and local department of health.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements

1. Comply with the State Department of Health Sanitary Code for Cross Connection Control, and the other standards listed in Part 2 of this Section.
2. Where conflicts occur between the referenced standards, the most stringent requirements shall apply.

1.3 MAINTENANCE

A. Special Tools (as furnished or recommended by the backflow preventer manufacturer). Deliver to the Owner's Representative:

1. Test Kit B: Sight tube, of required length, for testing backflow preventer for proper operation, and printed procedure for conducting test.
2. Test must be performed by a Certified tester.

PART 2 - PRODUCTS

2.1 BACKFLOW PREVENTER

A. Double Check Valve device on fire protection service equal to Watts series LFDCDA709, conforming to ASSE Standard 1015, AWWA C-510, USC Specifications manual for Cross Connection control, and listed as acceptable in the New York State Department of Health, Environmental Health manual.

1. Performance: 150 psig and 130 degrees F, maximum working conditions.

2. Assembly: Gate valve on inlet side, gate valve on outlet side, and four test cocks, all as furnished or recommended by the backflow preventer manufacturer.

B. Reduced pressure backflow preventer on domestic water service and cold water make up line equal to Watts series LF909, with removable bronze seats, stainless steel internal parts and resilient wedge shut-off valves. Other acceptable manufacturers are Febco Inc. and Wilkins/Zurn Industries Inc.

C. Double Check Valve on playground Hose-Bib Watts Model 007 Lead Free.

D. RPZ Discharge Funnel
RPZ discharge funnel with trap J.R. Smith 3812 or approved equal Duco coated cast iron.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the work of this section in accordance with the manufacturer's printed installation instructions and local water utility co. and department of health.

B. Anchor piping to structure at each elbow to secure in the event of a pressure surge.

3.2 FIELD QUALITY CONTROL

A. Operation Test: Test kit as specified under Part 1 of this section may be used. Conduct test in the presence of the Owner’s Representative.

1. Type B Backflow Preventer: Test the device with the test kit in accordance with the manufacturer's test procedure.

B. Re-testing: Repair or replace any device failing the operation test, and repeat the test.

3.3 APPLICATION, FEES AND PERMITS

A. This Contractor shall be responsible for hiring an engineer, filing all applications, permits and filing fees with the authorities having jurisdiction over the work. Coordinate with the General Conditions of Division 1 for “Design Responsibilities” and “Permit and Fee” requirements.

B. The following list serves as the minimum filing requirements, failure to list any item does not relieve the Contractor from fulfilling that requirement.

1. Prepare and submit DOH forms with plans, Professional Engineers Report and Specifications with “Seal”.
2. Certificate of Resolution of Letter of Authorization from Owner/User to authorize licensed professional to execute design.
3. Filing fees, per device.
4. Evidence of conformance to New York State Sanitary Code, Part 5 and Chapter 873 of the Laws of Westchester County.

C. Contractor’s engineer shall verify backflow preventer’s model number appears on the latest list of approved devices by Westchester County.

END OF SECTION 220310

SECTION 220320

DOMESTIC HOT WATER GAS-FIRED HEATING EQUIPMENT

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

A. The work under this section shall consist of furnishing all labor, materials, equipment and appliances necessary and required to completely provide domestic hot water heater, as required by the Drawings and as specified herein, including but not limited to the following: equipment, fittings, trimmings, brackets, controls, carriers and supports.

B. Submit shop drawings for approval, which shall include dimension Drawings, catalog cuts, performance ratings and construction schedules.

PART 2 - PRODUCTS

2.1 GAS-FIRED HEATER

A. Water heaters shall be PVI-Conquest Model 40L 130A condensing type, or equal. Water heater(s) shall be gas-fired, equipped to burn natural gas and design certified by the American Gas Association (Canadian Gas Association) under Volume III tests for commercial heaters for delivery of 180 ^{0} F water, shall be approved by the National Sanitation Foundation and exceed requirements of ASHRAE 90.1. Heaters shall have an input rating of 399,000 and a recovery rating of 471 g.p.h. (based on 95% thermal efficiency obtained in an independent laboratory test) at a temperature rise of 100 ^{0} F with a storage capacity of 130 gallons. Maximum working pressure of 160 psi. Tank shall have ASME rating.

B. Water heater shall be equipped with an integrated control system consisting of a 180 ^{0} F adjustable thermostat with upper and lower sensing bulbs, which average the water temperatures at the top and bottom of the tank for maximum water temperature control. Heater shall be provided with a manual reset gas shutoff device, a gas pressure regulator set for the type of gas supplied, coated steel burners, an approved draft diverter, anodes for cathodic protection, flue damper and IID system. ASME rated pressure and temperature relief valve shall be furnished and installed by the factory. The heater shall be insulated with foam insulation or equal.

C. The outer jacket shall have a baked enamel finish over a bonderized undercoating. All internal surfaces of the heater exposed to water shall be glass-lined with an alkaline borosilicate, nickelous oxide composition that has been fused to steel by firing at a temperature range of 1400 degrees F to 1600 degrees F. Heater tank shall have a five (5) year limited warranty against corrosion as outlined in the written warranty. Heater shall include a fully illustrated instruction manual.

D. Provide operating thermostat, adjustable, submersed bulb, ASME pressure and temperature relief valve, temperature limiting device and a drain valve shall be factory installed.

E. Furnish and install domestic hot water circulators per Drawings and Specifications.

F. Gas-flue material and installation per manufacturer's recommendations.

G. Provide induced draft fan on flue as recommended by manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All equipment shown on Drawings shall be set, connected and tested by the Contractor. He shall also make all water and other service connections to fixtures as shown on Drawings or as directed and shall set, furnish, connect and test all necessary fittings.

B. This Contractor shall be responsible for protecting all equipment included in these Specifications against injury from the building materials, tools and equipment. Any equipment damaged during the construction period shall be replaced new.

END OF SECTION 220320

SECTION 220370

SPRINKLER SYSTEM

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

A. The work covered by this section consists of furnishing all labor, equipment, appliances, materials and performing all operations necessary for the installation of an automatic sprinkler systems all in strict conformance with NFPA, insurance regulatory agency and requirements of all authorities having jurisdiction. Provide approved hydraulically designed Drawings and calculations as required by insurance regulatory agency.

1.2 REFERENCES

A. NFPA 13 - National Fire Protection Association Standard for the Installation of Sprinkler Systems.

1.3 SYSTEM DESCRIPTION

A. Type of System: Wet System - Hydraulic.

B. Occupancy Classification: Ordinary Hazard Occupancy.

1.4 SUBMITTALS

A. Shop Drawings

1. Complete sprinkler system layout indicating the locations of sprinkler heads, devices, and accessories. Include separate details of special or not easily visualized piping arrangements and inspectors test valves and connections.

2. Hydraulic calculations shall be complete and cross referenced to the appropriate Drawing sheets per all Authorities having jurisdiction. Hydraulic calculations and sprinkler shop drawings to be stamped and signed by a Licensed NYS Professional Engineer.

3. Submit four (4) copies of Drawings to Owner’s Risk Management Group for approval.

B. Product Data: Catalog sheets, specifications, and installation instructions. Indicate UL or FM approval for each product. Include the following additional information:

1. Electrical Devices: Complete description of intended use, wiring diagrams, data plate information and, in the case of switching devices, whether normally on, or normally off. Include motor test data.

2. Mechanical Devices: Complete description of intended use, including normal operating capacities and working pressures.

3. Enclosures: Dimensions, materials, gauges of metals; type of door hinges and locks, and methods of securing the enclosure members to the building construction.

4. Hose Threads: Verify that hose threads on fire department connections match threads on equipment used by the local or servicing fire department.

C. Quality Control Submittals

1. Design Data: The portions of the sprinkler system not sized on the Contract Drawings shall be sized in accordance with NFPA requirements for Hydraulically Designed Systems. Submit Drawings and hydraulic calculations for approval.

2. Certificates: As required under Quality Assurance Article.

3. Installers Qualification Data

a. Name of each person who will be performing the Work.

b. Upon request, furnish names and addresses of the required number of similar projects that each person has worked on which meet the experience criteria.

D. Contract Closeout Submittals

1. Operation and Maintenance Data. Deliver 2 copies to the Owner’s Representative

a. Instruction manual describing the operation and maintenance of the system.

b. Parts list for each mechanical and electrical device.

c. Publication NFPA 13A, Inspection, Testing, and Maintenance of Sprinkler Systems.

1.5 QUALITY ASSURANCE

A. Qualifications: The persons employed to perform the work of this section and their supervisor shall be personally experienced in sprinkler work and shall have been regularly performing such work for a minimum of 5 years while in the employ of a company or companies engaged in the installation of sprinkler systems. Upon request, furnish to the Owner the names and addresses of five similar projects, which the foregoing people, have worked on during the past 3 years.

B. Regulatory Requirements: Materials for the work of this section shall be Underwriter's Laboratories listed, and/or Factory Mutual approved.

C. Certification: NFPA Contractor's Material and Test Certificate.

1.6 MAINTENANCE

A. Spare Parts: Furnish the following items and deliver to the Owner’s Representative for storage in spare sprinkler head cabinets:

1. Spare sprinkler heads of required temperature range as follows:

Quantity	Type
5	standard upright
5	concealed ceiling
1	side wall horizontal
1	dry type

2. One sprinkler head wrench to fit each type sprinkler head listed above.

PART 2 - PRODUCTS

2.1 VALVES AND ACCESSORIES (All Tamper Proof and Monitored)

A. Gate Valves (175 psig non-shock working pressure)

1. 3/4 inch to 2 inch: Bronze body, OS & Y indicating type; double or wedge disc with threaded ends.

2. 2-1/2 inch and larger: IBBM, OS & Y indicating type; double or wedge disc with end connections as required to suit the piping system.

B. Valve Locking Devices

1. Chain: 3/16 inch galvanized steel, welded link.
2. Padlock: Series 800 by Yale, Eaton Corp., Charlotte, NC: Key all locks alike. Furnish 2 keys for each lock.
3. Key Tags: 1-1/2 inch diameter, brass, stamped with valve number and service.
4. "S" Hooks: Brass, for securing keys to key tags.

C. Check Valves: IBBM, single clapper swing check with metal to metal or rubber faced checks, suitable for horizontal and vertical installation; end connections as required to suit the piping system; 175 psig non-shock working pressure. Ball Drip (where shown on Drawings): Brass, automatic; threaded on both ends.

D. Fire Hose Valves: 2-1/2" Fire Department valve 8 threads per inch. Provide decal "FIRE DEPT. VALVE", New York Corp outlets, finish per Architect. Obtain Local Fire Department approvals for all valves including stairwell valves. Install riser clamps to avoid trip hazard.

E. Pressure Gauges: Range of 2 times system working pressure at point where installed. Equip with gauge cock and provisions for draining.

F. Inspector's Test Connection: Cast brass, capped, sprinkler line tester fitting; Elkhart Brass Mfg. Co.'s. No. 112, or Seco Mfg., Inc.'s No. 445 or 446.

G. Dry Valve

1. Reliable Model FX with all trim accessories.
2. Provide low air pressure switch and flow switch and connect to fire alarm panel.
3. Air compressor Gast Model 4LCB-21-M450X-20 Gallon, 1/3 H.P., 120/1/60 3.1 CFM @ 40 psi.

H. Control Valves

1. 2" and smaller:

   a. OS&Y threaded bronze gate valve; 175 psi WWP class, similar to Nibco T-104-0.
   b. Brass body ball valve, threaded or grooved; 350 psi CWP, similar to Victaulic FireLock® Series 728.

2. 2-1/2" and larger:

   a. OS&Y flanged IBBM gate valve; 175 psi WWP class, similar to Nibco F-607-0.
   b. OS&Y grooved end gate valve; 200 psi CWP, similar to Victaulic Series 771.
   c. Grooved end butterfly valve; 300 psi CWP, similar to Victaulic Series 705W.

I. Pressure Reducing/Regulating Valves: UL/FM approved straight through y-type-body without obstructed flow path, stem guide, or supporting ribs, Victaulic 867-42T.

2.2 SPRINKLER HEADS AND APPURTENANCES

A. Sprinkler Heads: Brass or bronze, with standard 1/2 inch orifice, and deflector, as manufactured by Reliable Sprinkler Co., Grinnell, Fire Protection Co., or Elkhart Brass Manufacturing Co.

1. Upright or Pendent Type: (Quick Response) Provide in areas with no ceiling. Deflector designed to distribute water downward in a uniform hemispherical spray pattern. Reliable model GFR.
2. Concealed Type: (Quick Response) Provide in finished areas. All parts of sprinkler body including shank thread mounts above lower plane of finished ceiling, Reliable model G4QR.
3. Sidewall Type: (Quick Response) Equal to Reliable model GFR.
4. Markings: Stamp sprinkler type on deflector in addition to NFPA's color code requirements covering temperature classification.
5. Finish: White.

B. All sprinkler heads in skylights and boiler rooms shall be high heat type. Contractor may use swing joints to sprinkler heads where applicable.

C. Spare Sprinkler Head Cabinet: Steel, with hinged cover, constructed of minimum 20 gauge material and fitted with 16 gauge steel racks designed to hold quantities and types of spare sprinkler heads and sprinkler head wrenches. Finish shall be bright red, baked on enamel.

2.3 FIRE DEPARTMENT CONNECTION

A. Wall Type Siamese Connection: (2) 2-½" inlets with 4" back outlet, brass body with polished finish; size per local authority, 2 individual drop clapper valves, plugs and chains, and escutcheon. Provide automatic check valve and ball-drip (Reliable model C).

2.4 WATER FLOW ALARM DEVICE

A. Pressure Type Waterflow Switch - Equal to Reliable's model E having:

1. Corrosion-resistant vane.
2. Splash/dust resistant enclosure with anti-tamper switch.
3. Adjustable pneumatic retard.
4. Screw type wiring terminals.
5. Switch rated minimum 7.0 amps at 125 V ac and 0.25 amps at 125 V dc.

2.5 VALVE SUPERVISORY SWITCHES

A. Mechanically actuated, designed to close contacts and sound an alarm when supervised valve is closed and when switch cover removed.

1. For Gate Valves: Potter Electric Signal Co.'s OSYSU-A, or Grinnell's F640.
2. For Post Indicator Valves: Potter Electric Signal Co.'s PIVSU-A2, or Potter-Roemer, Inc.'s 6223.

2.6 STEEL PIPE AND FITTINGS

A. Steel Pipe for Threading: Standard weight, Schedule 40, black or galvanized; ASTM A53 or ASTM A135.

B. Cast Iron Fittings

1. Drainage Pattern, Threaded: ASME B16.12.
2. Steam Pattern, Threaded: ASME B16.4.
   a. Standard Weight: Class 125.
   b. Extra Heavy Weight: Class 250.
3. Flanged Fittings and Threaded Flanges: ASME B16.1.
   a. Standard Weight: Class 125.
   b. Extra Heavy: Class 250.

C. Unions: Malleable iron, 250 lb. class, brass to iron or brass to brass seats.

D. Couplings: Same material and pressure rating as adjoining pipe, conforming to standards for fittings in such pipe. Use taper tapped threaded type in screwed pipe systems operating in excess of 15 psig.

E. Nipples: Same material and strength as adjoining pipe, except nipples having a length of less than one inch between threads shall be extra heavy.

2.7 DUCTILE IRON PIPE AND FITTINGS

A. Water Pipe: Bitumen coated and cement-mortar lined; AWWA C151.

1. 3 and 4 Inch Sizes: Class 51.
2. 6 inch Size and Over: Class 50.

B. Fittings: Bitumen coated and cement-mortar lined; AWWA C110.

2.8 BOLTED MECHANICAL BRANCH CONNECTION

A. Victaulic Co.'s “Firelock” rigid coupling.

2.9 JOINING AND SEALANT MATERIALS

A. Thread Sealant

1. LA-CO Industries' Slic-Tite.
2. Loctite Corp.'s pipe sealant with Teflon.

B. Joint Packing

1. Oakum: FS A-A-1186.

C. Gaskets For Use With Ductile Iron Water Pipe: Synthetic rubber rings (molded or tubular): Clow Corp.'s Belltite, Tyler Pipe Industries Inc.'s Ty-Seal, or U.S. Pipe and Foundry Co.'s Tyton.

D. Flange Gasket Material

1. For Use With Cold Water: 1/16 inch thick rubber.

E. Gaskets For Use With Grooved End Pipe and Fittings: Type and materials as recommended and furnished by the fitting manufacturer, for the service of piping system in which installed.

F. Anti-Seize Lubricant: Bostik Inc.'s Never Seez or Dow Corning Corp.'s Molykote 1000.

2.10 PACKING MATERIALS FOR BUILDING CONSTRUCTION PENETRATIONS

A. Oakum: FS A-A-1186.

B. Mechanical Modular Seals: Thunderline Corp.'s Link Seal wall and floor seals designed for the service of piping system in which installed.

2.11 PIPE SLEEVES

A. Type A: Schedule 40 steel pipe.

B. Type B: No. 16 gauge galvanized sheet steel.

C. Type C: Schedule 40 steel piping with 1/4 inch steel collar continuously welded to pipe sleeve. Size steel collars as required to span a minimum of one cell or corrugation, on all sides of the rough opening through the metal deck.

D. Type D: No. 16 gauge galvanized sheet steel with 16 gauge sheet steel metal collar rigidly secured to sleeve. Size metal collars as required to span a minimum of one cell or corrugation, on all sides of the rough opening through the metal deck.

2.12 FLOOR, WALL, AND CEILING PLATES

A. Cast Brass: Polished chrome plated finish, with set screw.

1. Solid Type: Models 5 and 5T by Pegasus Mfg. Inc., Cheshire, CT; and Models 951 - 960 (inclusive) by Bridgeport Plumbing Products, Moutrie, GA.

B. Cast Iron: Solid type, unplated, with set screw; Model 395 by Grinnell Corp., Cranston, RI.

2.13 SUPPORTS, HANGERS AND ANCHORS

A. Pipe hangers, supports anchors, etc. shall be designed and fabricated to comply with NFPA Code No. 13.

B. Hangers for piping below the roof shall be supported from the roof or the building structural steel. Where hangers cannot be supported directly from the building roof of structural members, any additional steel required to support the hangers shall be furnished and erected. No drilling of or welding to, structural members shall be permitted. All structural attachments shall be beam clamps. Inserts and sleeves for supports shall be provided in concrete where necessary.

2.14 SIGNS

A. Steel with vitreous enamel finish, lettering on contrasting background to identify and indicate the function of:

1. Control valves.
2. Drain and test valves.
3. Hydraulic Design Nameplate Data: Size approx. 9 x 12 inches, inscribed with the following:
   a. SPRINKLER SYSTEM HYDRAULICALLY DESIGNED (in block letters).
   b. Location and area of hydraulically designed section.
   c. Discharge density over designed area in gallons per minute.
   d. Residual pressure at base of riser supplying water to designed section.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Unless otherwise shown or specified, install the Work of this section in accordance with NFPA 13, and the item manufacturer's installation instructions.

B. Before beginning work, Contractor shall obtain all bonds, permits, fees, etc. from all authorities having jurisdiction.

C. Locking Valves
1. Lock gate valves in open position with chain looped through handwheel and around adjacent sprinkler pipe. Secure with padlock.
2. Lock test outlet valve in closed position with padlock.

D. Spare Sprinkler Head Cabinet: Secure to building wall or other permanent structure in vicinity of main valve controlling sprinkler system, unless otherwise directed.

E. Signs: Install signs identifying the following:
1. Valves: One for each size, type and function.
2. Water Motor Alarm.
3. Hydraulically Designed System.

F. Workmanship

1. All work shall be performed in a practical and workmanlike manner by mechanics skilled in the work they are to do using the best practices of their trade.

2. No work shall be covered or hidden from view until it has been inspected and approved by the Engineer.

3. Any workmanship or materials not meeting with the requirements of the Contract Documents and/or the satisfaction of the Engineer shall be rejected. The Contractor shall immediately replace defective work and materials as required by the Engineer, at no additional cost to the Owner.

G. Cutting and Patching: Unless otherwise specified, the Contractor shall do all cutting and patching necessary for the installation of work in accordance with Division 1 of Specifications. This cutting and patching shall be done only after having obtained the Engineer's approval as to the location and extent of the cutting.

H. Drain Connections: Contractor is cautioned to arrange his permanent installation of piping in such a manner to that all or any part of the work may be completely drained. All piping shall be pitched so as to drain to the main drain.

I. As-Built Drawings: This Contractor shall keep an accurate dimensional record of all mechanical work on marked prints. The Contractor shall furnish one (1) set of As-Built, at the completion of the project and before final payment shall be made.

3.2 FIELD QUALITY CONTROL

A. Tests: Unless otherwise shown or specified, perform tests in accordance with NFPA 13.

1. Flushing: In addition to the requirements of the Standard, flush new piping before making final connection to existing systems and before performing hydrostatic test. Flush at rates of flow prescribed in the Contractor's Material and Test Certificate.

2. After making final connections, flush entire system and assure that debris is removed from piping and there are no stoppages or obstructions in the system.

3. System Tests:

   a. Test all New Work.
   b. Notify the Owner's Representative when the work of this section is ready for testing.
   c. Perform the tests when directed, and in the Owner's Representatives presence.

4. Furnish Certificate of Approval for completed system to the Owner.

END OF SECTION 220370

SECTION 220380

AUTOMATIC FIRE PUMP-COMBINATION SYSTEM STANDPIPE AND SPRINKLERS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

A. Equipment and components shall be in compliance with all standards of NFPA-20.

B. Provide one complete automatic fire pump as herein described and indicated on Drawings. The Fire Pump shall be New York BSA and Underwriters Laboratories approved complete with all accessories and controls and shall meet the following construction requirement. The pumps shall be connected to a vertical motor or an approved design.

C. Shop drawings shall include dimension drawings, catalog cuts, performance and construction schedules.

PART 2 - PRODUCTS

2.1 PUMP

A. One A-C Fire Pump Series 1580 Model 8x8x9 5F Vertical In-Line Centrifugal Pump (Quimby Equipment Co., Inc. Plainview, N.Y.) or approved equal having a capacity of 1000 gpm at a pressure boost of 90 psi. The fire pump shall be UL listed and FM approved (MEA #357-92-E Vol 2.)

B. The pump shall have bronze impeller with smooth water passages, stainless steel shaft sleeve, packed stuffing box with lantern ring and cast iron casing.

C. The pump shall furnish not less than 150% of rated capacity at a pressure not less than 65% of rate head.

D. The shutoff total head of the pump should not exceed 120% of total rated head.

2.2 ELECTRIC MOTOR

A. The fire pump shall be driven by 100 hp 3500 rpm, 280 volt, 3 phase, 60Hz standard Vertical Close-Coupled open drip-proof motor with 1.15 service factor. FLA = 273 amps.

2.3 FIRE PUMP CONTROLLER

A. The fire pump controller shall be specifically approved for fire pump service by UL and FM TornaTech GPS-GPU “electric type” primary reactor, reduced voltage soft start starting, with UL Listed Built-in Automatic Power Transfer Switch with NEMA-2 Enclosure with 100,000 AIC.

B. All equipment shall be enclosed in approved NEMA 12 drip-proof enclosure and shall be completely front accessible.

C. The Fire Pump Controller shall incorporate the following features.

1. Digital readout to safely measure the 3 phase line currents and voltages with the door closed and the motor running.

2. Status LED's visible through the door to allow anyone to quickly identify the starting demands, time delays and running conditions of the fire pump controller.

3. Long life LED light bulbs to display alarms.

4. Restart time delay to ensure that at least 3 seconds elapse between stopping and restarting the fire pump.

5. Circuit breaker test switch to verify the special locked rotor calibration requirements of NFPA-20.

6. NEMA 12 enclosure.

D. The motor control equipment shall be completely assembled, wired and tested at the factory and the assembly specifically approved for the fire pump purposes. The controller shall be enclosed in a NEMA 12 drip tight enclosure and marked "Fire Pump controller".

E. The controller shall be of the combined manual and automatic primary reactor type, reduced voltage starting, with UL Listed Built-in Automatic Power Transfer Switch for use when the normal power source is a utility and the emergency power source is a generator set. The Power Transfer Switches are listed by Underwriter's Laboratories, Inc. for transfer switch service and also as fire pump transfer switches. They are built to meet the standards of NFPA-20 Centrifugal Pumps and NFPA-70 National Electrical Code. The Automatic/manual Power Transfer Switches are listed by the Underwriters Laboratories, Inc. under UL-1008 "Transfer Switches" as well as UL-508 for "Fire Pump Service".

F. The entire package of power transfer switch controller is completely factory assembled, wired tested and shipped as a complete unit for easy field connection to the power sources and the fire pump motor.

G. Circuit breaker complying with the requirements of NFPA-20. The interrupting capacity of the circuit breaker shall be 100,000 AIC when operating on 280 volts, 60 Hz.

H. The controller shall be of the combined manual and automatic primary reactor type, reduced voltage starting.

I. The controller shall be capable of being energized automatically through the pressure switch or manually by and externally operable handle.

J. Running period timer set to keep motor in operation when started automatically for a period of ten (10) minutes.

K. Pilot lamp to indicate circuit breaker closed and power available.

L. Power availability relays, complete with alarm contact to energize an audible of visible alarm through an independent source of power to indicate circuit breaker open or power failure in any place.

M. Provision for convenient voltage and current measurement with a hand held volt-amp meter.

N. Start-stop push buttons for total manual operation.

O. The controller shall be provided with remote contacts for the following conditions.

1. Pump running - indicating when the motor current is greater than 20% of full load motor amps.
2. AC power failure.
3. Phase reversal.
4. AC voltage low - indicates when the line voltage drops more than 15% at staring, or 5% during running.

2.4 STANDARD ACCESSORIES

A. The fire pump shall be supplied with the following accessories.

1. One (1) combination 30inch Hg to 100 psi suction gauge, 4-1/2inch dial type with 1/4 inch cock and lever handle.

2. One (1) 0 to 300 psi discharge gauge, 4-1/2inch dial type with 1/4 inch cock lever and handle.

3. One (1) 3/4 inch Casing Relief Valve (300#) and one 4” main relief valve and 4x8 relief cone.

4. Fire pump test header.

2.5 JOCKEY PUMP

A. The jockey pump shall be Grundfos CR series Model CR3-9, centrifugal close-coupled vertical type, mechanically sealed, cast iron suction and discharge chambers, with stainless steel impellers, shaft and wet parts. Designed for 10 gpm, 100 psi, TDH (95 psi) 3450 rpm, complete with vertical open drip-proof motor rated for 1-1/2 hp, 3 phase, 60 cycle, 208 volt operation. Jockey Pump Controller Model JP3 by TornaTech with NEMA-2 enclosure.

PART 3 - EXECUTION

3.1 FIRE PUMP TESTING

A. Inspection of the completed installation prior to start-up including proper installation of fire pump, fittings, fire pump controller (including wiring), jockey pump and jockey pump controller. Any discrepancies shall be brought to the attention of the Sprinkler and/or Electrical Contractors and corrected under supervision of the fire pump manufacturer's representative.

B. Start-up and Adjustment: Prior to start up, the fire pump manufacturer's representative shall check the pump and make any adjustments as recommended by the pump manufacturer. All controllers will be thoroughly checked for looseness of wires and/or connections and adjustments made where necessary. The fire pump and jockey pump motors shall be "bumped" for proper rotation by the manufacturer's representative and any corrections that are necessary will be performed by the Electrical Contractor under the supervision of the pump/controller manufacturer's representative.

C. Field Test of Fire Pump: The fire pump shall be given a complete field flow test by the pump manufacturer's representative under the direction, supervision and as required by the representative of the "authority having jurisdiction".

D. Verification of pressures, voltages, amperes and rpm's shall be recorded. Flow and pressure results shall be superimposed on a factory certified performance test curve provided by the manufacturer's representative and six (6) copies shall be furnished to the Sprinkler Contractor for distribution as required.

E. Any corrections, repairs and/or modification to the equipment necessary to meet the field performance shall be accomplished at no cost to the Owner or his representative.

F. The fire pump shall be hydrostatically and performance tested prior to shipment. The hydrostatic test pressure shall be not less than one and one half times with no flow (shutoff) head of the pump's maximum diameter impeller plus the maximum allowable suction head, but in no case less than 250 psig. Characteristic curve of pump performance, efficiency and brake horsepower shall be drawn from the test results and furnished to the Consulting Engineer and Contractor.

G. The manufacturer's representative for is:
Quimby Equipment Co., Inc.
159 Express Street
Plainview, NY 11805
Tel: 516-349-5959

END OF SECTION 220380

SECTION 220420

SUPPORTS, SLEEVES AND PLATES

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

A. This Contractor shall furnish and install all plates, hangers and supports for his piping.

B. All piping shall be hung or supported from structural members only.

PART 2 - PRODUCTS

2.1 PIPING

A. All piping shall be supported from building structure in a neat and workmanlike manner wherever possible, parallel runs of horizontal piping shall be grouped together on trapeze hangers. Vertical risers shall be supported at each floor line with steel pipe clamps. Use of wire perforated metal to support pipes will not be permitted. Hanging pipes from other pipes will not be permitted.

B. Necessary structural members, hangers and supports of approved design to keep piping in proper alignment and prevent transmission of injurious thrusts and vibrations shall be furnished and installed. In all cases where hangers, brackets, etc., are supported from concrete construction, care shall be taken not to weaken concrete or penetrate waterproofing.

C. All hangers and supports shall be capable of screw adjustment after piping is erected. Hangers supporting piping expanding into loops, bends and offsets shall be secured to the building structure in such a manner that horizontal adjustment perpendicular to the run of piping supported may be made to accommodate displacement due to expansion. All such hangers shall be finally adjusted, both in the vertical and horizontal direction, when the supported piping is hot.

D. Pipe hangers shall be as manufactured by Grinnell, whose catalog numbers are given herein, or equivalent Carpenter and Paterson, or F&S Mfg. Co.

E. Piping shall be supported as follows unless otherwise indicated on the Drawings:

1. Piping: 1-1/2 inch and smaller Fig. #260 adjustable clevis hanger. 2 inch and larger Fig. #174 one-rod swivel roll hanger.

2. Two-rod hangers shall be used for piping close to the ceiling slab or where conditions prohibit use of other hanger types.

3. Anchors for hanger rods shall be Phillips "Red Head" self-drilling type. Anchors shall be placed only in vertical surfaces.

4. Spacing of pipe supports shall not exceed 6 feet for pipes up to 1-1/2 inch and 10 feet on all other piping.

5. Hangers shall pass around insulation and a 16 gauge steel protective band; 12 inch long shall be inserted between hangers and insulation.

6. All piping shall be supported to allow free movement where expanding or contracting. Pipe shall be anchored as required or directed.

7. All lateral runs of piping shall be securely supported on hangers, rolls, brackets, etc. and in a manner to allow for proper expansion and elimination of vibration.

8. 2 inch and smaller pipe, where run on walls, shall be supported on wrought iron "J" hook brackets with anchor bolts.

9. All horizontal pipe, where run overhead or on walls, shall be supported as follows unless otherwise indicated: On adjustable steel clevis type hangers suspended on hanger rods, pipe sizes up to and including 4 inch.

F. Space limitations in hung ceilings spaces and conditions in other locations may require use of other type of hangers than those specified above. Suitable and approved pipe hangers shall be provided for such job conditions.

G. All supports shall be fastened to structural members or additional steel supports furnished by this Contractor.

H. Hanger rods shall be steel, threaded with nuts and lock nuts, sizes in accordance with following schedule:

Pipe Size	Rod Size
3/4" to 2" inclusive	3/8”
2-1/2" and 3" inclusive	1/2”
4" and 5" inclusive	5/8”
6”	3/4”
8" to 12" inclusive	7/8”

I. Cast iron piping shall be supported at intervals of not more than (5) feet (at each hub) on straight runs.

PART 3 - EXECUTION

3.1 PIPING

A. Where pipes pass through masonry, concrete walls, foundations, or floors, this Contractor shall set sleeves as are necessary for passage of pipes. These sleeves shall be of sufficient size to permit insulation where required to be provided around pipe passing through. This Contractor shall be responsible for exact location of these sleeves.

B. Sleeves shall not be used in any portion of building where use of same would impair strength or construction features of the building. Inserts for supporting lateral pipes and equipment shall be placed and secured to form work, and all sleeves inserts locations shall be thoroughly checked with Architect so as not to conflict with other trades.

C. Where pipes pass through floor or walls, they shall be provided with chromium plated escutcheons.

D. Anchor horizontal piping where indicated and wherever necessary to localize expansion or prevent undue strain on branches. Anchors shall be heavy forged construction entirely separate from supports.

E. Anchor vertical piping wherever indicated and wherever necessary to prevent undue strains on offsets and branches. Anchors, unless otherwise noted shall be heavy steel clamps securely bolted and welded to pipes. Extension ends shall bear on building construction.

F. Auxiliary steel supports that may be required for all mechanical equipment shall be furnished and installed by this Contractor.

G. All operating equipment including pumps, piping, etc. shall be supported so as to produce minimum amount of noise transmission.

END OF SECTION 220420

SECTION 220430

INSULATION

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

A. The work under this section shall consist of furnishing all labor, materials, equipment and appliances necessary and required to completely do all insulation work as required by the Drawings and as specified herein including but not limited to the following: Insulation, covering, bands, tie wire.

PART 2 - PRODUCTS

2.1 INSULATION

A. The materials as specified have been selected from the catalogs of Owens-Corning Fiberglass Corp. and Johns-Manville Sales Corporation and are representative of the quality, design and finish desired. Insulation as manufactured by Gustin Bacon Co., or other approved manufacturer may be submitted for approval provided the product meets fully in all respects (such as density, moisture absorption, alkalinity, thermal-conductivity, jackets) to the materials as delineated below.

B. All insulation shall be UL rated non-combustible type classified flame spread-25, smoke-developed-50.

2.2 PIPING, FITTINGS AND VALVES

A. All insulation thickness shall be in accordance with the latest edition of the New York State Energy Conservation Construction Code.

B. Minimum pipe insulation shall be:

1. Hot water piping up to 1-1/4” - 1” insulation and piping 1-1/2” and larger - 1-1/2” insulation.

2. Cold water piping up to 1-1/2” – 1/2” insulation and piping 1-1/2” and larger - 1” insulation.

C. Domestic cold, hot water hot water return indirect waste, storm and piping aboveground. All piping shall be insulated with sectional glass fiber insulation, Owens-Corning 2 piece ASJ/SSL. Joints between sections shall be sealed with factory supplied 3 inch wide sealing strips. Sealing by means of Owens Corning self-sealing lap will also be acceptable. Install (anti-sweat) vapor barriers on all cold water piping.

D. Domestic hot and cold water valves and fittings - Fittings, valves, etc. shall be insulated with factory formed or field fabricated fiberglass covered by Johns Manville Zeston 2000 PVC covers and jacketing UV resistant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All insulation on pipes running through walls, floors, partitions and beams shall be continuous through sleeves and openings.

B. Insulation shall be installed only after all tests of the piping system have been completed.

C. All insulation shall fit snugly.

D. All surfaces shall be clean and dry when insulation is applied.

E. Longitudinal joints shall be on least conspicuous side off the pipe.

F. Valves shall be insulated up to the packing unit.

G. As specified hereinbefore, all horizontal runs of piping will be supported on adjustable clevis or group trapeze type hangers. Pipe hangers will be installed outside of the insulation. Where hangers occur, prefabricated insulation protective saddles shall be "Insul-Shield-Multi-Purpose-Saddle" as manufactured by Insul-Coustic Corp. or approved equal.

H. Hot and cold water branch piping extending through slab or knockout panels to serve equipment shall be insulated to a point 4 inch above the top of sleeve provided for pipe.

I. The use of staples shall not be permitted.

J. It is the intent of this Specification that all vapor barriers be continuous throughout. Reinstate existing piping at point of new pipe connections.

END OF SECTION 220430

SECTION 220470

TESTS AND ADJUSTMENTS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section.

1.1 TESTS AND ADJUSTMENTS

A. The Contractor shall, at his own expense, during the progress of the work or upon its completion as ordered make such tests as are specified or as required by and in the presence of the Architects, Building Inspectors, etc. At least 48 hours notice shall be given in advance of all tests.

B. The Contractors shall provide all apparatus, temporary work or other requirements necessary for all tests. He shall take all due precautions to prevent damage to the building, its contents or the work of the other Contractors, that may be incurred by all tests. This Contractors shall also be responsible for the work of other Contractors that may be damaged or disturbed by the tests or the repair or replacement of his work, and he shall without extra charges, restore to its original condition, any work of other Contractors to do the work of restoration.

C. Tests on the various systems may be conducted in sections as the work progresses or when the systems are completed.

D. No caulking of pipe joints to remedy leaks will be permitted except where joints are made with lead and oakum.

E. Each section of the sanitary, storm and vent piping tested shall have all openings tightly closed with screw plugs, or equal device. The drainage and vent systems shall be filled with water and proven tight under a 10’-0” head for a minimum of four (4) hours. Water level must remain constant through test without adding water.

F. Upon final completion of the sanitary systems and when all fixtures and appurtenances have been set and the systems are in complete working order, all traps in the systems shall be filled with water and a thick penetrating smoke shall be introduced into the entire system.

G. As smoke appears at the stack openings on the roof, such openings on the roof shall be tightly closed and a pressure equivalent to 1-1/2 inch of water shall be maintained during the test. Oils of peppermint shall be added at the smoke making machines so that any leakage is readily discernible.

H. Before any covering is applied to the domestic water piping systems, the entire domestic water piping systems shall be hydrostatically tested for eight (8) hours to a hydraulic pressure of 125 psig.

I. At the completion of the test, Contractor shall furnish the Owner with one (1) copy of test certificates as issued by the insurance company.

J. Adjustments: Tests and adjustments shall be repeated as often as necessary until the systems are tight and are to the entire satisfaction of the Plumbing Inspector, Engineers and any other authorities having jurisdiction.

1. Contractor is to thoroughly instruct the building custodian in the proper care and operation of the entire system. Contractor shall prepare for use by custodian, detailed brochures of instructions in non-technical terms, describing the maintenance and operation of all fixtures, apparatus, valves, controls etc. furnished by him.

2. Should any part of the work performed under this Contract fail to function because of cracked piping, obstructions, debris in piping, leaks in piping or any other cause, this Contractor shall disconnect, clean and reconstruct the work at his own expense and pay for any damages to adjoining work.

3. Water flow is to be balanced and adjusted to all flush valves, faucets, etc.

4. All parts of the plumbing system are to be thoroughly flushed until cleared of all grease and sediment and all dirt pockets cleaned. Repeat as often as necessary, open all cleanouts and reset in graphite.

5. All new motors shall be oiled as required.

6. All new valves are to have stuffing boxes packed and adjusted.

END OF SECTION 220470

SECTION 220480

TAGS, CHARTS AND IDENTIFICATION

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 TAGS, CHARTS AND IDENTIFICATION

A. Every valve installed under this Contract shall be tagged or labeled as follows: Tag shall be etched brass securely fastened to valve handwheels with heavy brass "S" hooks, soldered closed. At lock shield and similar type valves, tags for same shall be securely wired to valve body.

B. Charts shall be provided for each piping system, as approved and shall consist of schematic diagrams of piping layouts showing and identifying each valve and piece of equipment etc., and its use. Upon completion one (1) copy of diagrams and valve charts suitably framed under glass, shall be furnished and mounted where directed. One (1) copy of diagrams and valve charts shall be delivered to Owner.

C. This Contractor shall provide on all piping, semi-rigid, wrap around plastic identification markers equal to Seton Snap-Around and/or Seton Strap-On pipe markers.

D. Each marker background is to be appropriately color coded with a clearly printed legend to identify the contents of the pipe. Directions of flow arrows are to be included on each marker.

E. Identification of all piping shall be adjacent to each valve, at each pipe passage through wall, floor and ceiling construction and at each branch and riser take-off.

F. Identification shall be on all horizontal pipe runs, marked every 15 ft. as well as at each inlet outlet of equipment at changes in direction.

END OF SECTION 220480

SECTION 220490

GUARANTEE

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section.

1.1 GUARANTEE

A. The Contractor shall remove, replace and/or repair at his own expense and at the convenience of the Owner, any defects in workmanship, materials, ratings, capacities and/or characteristics occurring in the work within one (1) year or within such longer period as may be provided in the Drawings and/or Section of the Specifications, which guarantee period shall commence with the final acceptance of the entire Contract in accordance with provisions stated in the General Conditions, and the Contractor shall pay for all damage to the system resulting from defects in the work and all expenses necessary to remove, replace and/or repair and any other work which may be damaged in removing, replacing and/or repairing the work.

END OF SECTION 220490

SECTION 230100

GENERAL CONDITIONS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

1.1 GENERAL CONDITIONS

A. Before submitting a proposal, Bidders shall examine all related to this work and shall become fully informed as to the extent and character of the work required and its relation to the other work in the building.

B. Before commencing work, the Contractor will examine all conditions of the project upon which his work is in any way dependent for perfect workmanship according to the intent of this Specification. No "waiver of responsibility" for incomplete, inadequate or defective adjoining work will be considered unless notice has been filed by this Contractor and acceded to by the Owner's representative in writing before the Contractor begins any part of the work.

C. The Contractor will pay for all licenses, permits and inspection fees required by civil authorities having jurisdiction. Comply with all laws, ordinances, regulations, and fire underwriter’s requirements applicable to work herein specified without additional expense to the Owner. (Also building code requirements).

D. It is specifically intended that anything (whether material or labor), which is usually furnished as a part of such equipment, as is hereinafter called for (and which is necessary for the completion and proper operation) shall be furnished as part of this Contract without additional cost the Owner, whether or not shown in detail or described in the Specifications.

E. When Drawings and Specifications conflict or there is a question as to the proper intent of this Contract, the Contractor shall assume the greater quantity, the higher quality and/or the more expensive method in his pricing. All questions shall be directed to the Architect/Engineer in writing only and only up to ten (10) days prior to bidding.

F. The Drawings indicate the general runs of the piping, ductwork, etc. systems and the location of equipment and apparatus, however it shall be understood that the right is reserved by the Architect/Engineer to change the location of piping work, ductwork, equipment and apparatus to a reasonable extent as building conditions may dictate, prior to their installation without extra cost to the Owner.

G. Small scale drilling through walls and floors or cutting of piping insulation which may contain asbestos shall be performed by a person with a “restricted asbestos handler allied trades certificate” and shall have a copy of it in his possession at all times while working of the project. This shall also apply to removal of piping, ductwork or equipment insulation.

H. Any changes from the Drawings and Specifications and any interpretation thereof shall have the prior approval of the Architect/Engineer. The Contractor shall submit in writing, at the time of signing the Contract, any items of necessary labor and materials, which, in his opinion, are lacking in requirements of the Drawings and Specifications to insure a complete job in all respects. No consideration will be granted to alleged misunderstanding of materials to be furnished, work to be done, or conditions to be complied with, it being understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein or indicated on the accompanying Drawings.

END OF SECTION 230100

SECTION 230110

SCOPE OF WORK

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

1.1 SCOPE OF WORK

A. The work under this section includes all labor, materials, equipment, tools, transportation, and the performance of all work necessary and required for the furnishing and installation complete of all work as shown on the Contract Documents, including but not necessarily limited to the following:

1. Air source ductless split heat pumps and appurtenances.

2. All refrigerant and hydronic piping and associated specialties for VRF systems.

3. Exhaust fans and related appurtenances.

4. Supply air fans and related appurtenances.

5. Rooftop energy recovery air handler units and related appurtenances.

6. Ductless split systems and related appurtenances.

7. Indoor energy recovery air handler units and related appurtenances.

8. All required piping, valves, and related specialties.

9. Base mounted centrifugal pumps and related appurtenances.

10. Variable frequency drives.

11. Duct mounted hot water coils.

12. VRF type air cooled outdoor heat pump/heat recovery units.

13. VRF type indoor cooling/heating cassette and fancoil units.

14. Sheetmetal ductwork and related accessories.

15. Duct and pipe insulation.

16. Refrigerant to hot water heat exchangers and related appurtenances.

17. Fin tube baseboard and appurtenances.

18. Registers, diffusers, grilles, and dampers.

19. Hot water cabinet heaters, convectors, radiant ceiling panels, and unit heaters.

20. Electric cabinet heaters, air curtain heaters.

21. Engine exhaust vent piping and appurtenances for emergency generator.

22. Diesel fuel storage tank, piping, fill box, and appurtenances for complete fueling fill and distribution system.

23. Rigging of equipment.

24. Furnish all combination motor starter/disconnects for equipment (with the exception of starters and electric items already mounted on equipment or equipment not requiring same). Fan motor starter/disconnects shall have contacts for ATC connection and a terminal block connection for Fire Alarm fan shutdown. Starters per manufacturers recommendations. Underwriters inspection and certificate required. Coordinate with Electrical Contractor.

25. Air and Water Balancing.

26. Automatic temperature controls with complete wiring (regardless of voltage).

27. Testing, adjusting and start-up of equipment.

28. Painting and identification of all equipment and piping.

29. Firestopping per NFPA requirements (UL approved systems).

30. Operating and maintenance instructions.

31. As-Built Drawings - Refer to Division 1.

32. Cutting and Patching - Refer to Division 1.

33. Excavation and Backfill - Refer to Division 2.

B. Coordination Drawings (if applicable): Attention is directed to Division 1 for coordination drawing requirements for this project. These drawings are critical to the proper execution of the work and failure to honor these requirements may become the basis for denial of any and all claims for either or both “time” and “money”.

1.2 REMOVALS

A. Removals should be coordinated with other trades affected.

B. Piping which penetrates the construction may be cut and capped provided capping is done beneath the finished surfaces so that construction over it can be achieved.

C. Soot Removal: In connection with the dismantling of boilers, Contractor shall gather together with a vacuum-cleaning machine all accumulations of soot. He shall remove all soot from the base of the chimney.

D. All removals shall be removed from the site.

1.3 ALTERATION WORK

A. All equipment, piping, control components, etc. to be removed, shall be disposed of or salvaged as directed by the Owner. They shall not be removed from the premises without the Owner's approval.

B. All piping to be removed shall be properly plugged or capped so that upon completion of all new work, all abandoned piping shall be concealed in finished areas.

C. No dead ends shall be left on any piping upon completion of job. The existing system shall be left in perfect working order upon completion of new work.

D. Location and sizes of existing piping, ductwork, equipment, etc. are approximate. Exact sizes and locations of all existing work shall be verified on the job.

END OF SECTION 230110

SECTION 230140

DIESEL ENGINE EXHAUST

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

PART 2 - PRODUCTS

2.1 DIESEL ENGINE EXHAUST

A. Provide factory built exhaust system that is tested and listed by the Underwriters' Laboratories, Inc. for use with medium heat equipment burning liquid fuels, as described in NFPA-37 and NFPA-211, which produce exhaust flue gas temperatures not exceeding 1400ºF under continuous operating conditions. Additionally, the vent system shall be U.L. 103 positive pressure tested and listed to 60 inches internal water column pressure. Design Basis: Selkirk IPS Exhaust Pipe, or equal.

B. The U.L. listed fiber insulated exhaust system shall have skin temperatures that have been obtained by Underwriters Laboratories (UL) test procedures. The published surface temperatures shall be the result of the UL103 1000º Fahrenheit chimney test.

C. The double wall exhaust system shall have a 304 stainless steel inner liner (20 ga minimum) and an aluminized steel outer jacket (24 ga minimum). The materials and construction of the modular sections and accessories shall be as specified by the terms of the product's U.L. listing.

1. Ceramic fiber insulation between the inner liner and outer jacket shall be a nominal four (4) inches thick.

D. Aluminized steel surfaces exposed to the elements shall be protected by a minimum of one base coat of primer and one finish coat of corrosion resistant paint suitable for outer jacket skin temperatures of the given application. All primer and paint to be supplied by the installing contractor and shall be equivalent to series V2100 as manufactured by Rust-Oleum. Alternatively, an outer jacket constructed of 304 or 316 stainless steel may also be considered in lieu of painting.

E. This exhaust system shall be designed and installed to be gas tight and thus prevent leakage of combustion products into the building.

F. Inner pipe joints shall be securely connected and sealed with factory supplied over-lapping V-bands and appropriate sealant as specified in the manufacturer's installation instructions.

G. Connections to silencers and expansion joints shall be made with matching flanges. Matching flanges shall be of the same size, bolt hole spacing and pressure rating as the flanges to which the connections are made.

H. Roof penetrations shall be suitable for the specified roof construction and shall comply with the manufacturer's installation instructions.

I. The exhaust system shall be designed to compensate for all flue gas induced thermal expansion.

2.2 WARRANTY

A. The exhaust system shall be warranted against functional failure due to defects in material and manufacturer's workmanship for a period of 15 years from date of installation.

B. The inner diameter of the exhaust system shall be verified by the manufacturer's computations. The computations used shall be technically sound, follow ASHRAE calculation methods and shall incorporate the specific flow characteristics of the inner pipe. The contractor shall furnish the exact operating characteristics of the engine(s) and muffler(s) to the factory representative.

C. The manufacturer shall provide "to scale" drawings depicting the actual layout. The exhaust system shall be installed as designed by the manufacturer and in accordance with the terms of the manufacturer's warranty and in conjunction with sound engineering practices.

D. The factory built modular exhaust system shall be furnished by a vendor organization that assures design, installation and services coordination. As well as, providing "in-warranty" and "post-warranty" unified responsibility for owner, architect, consulting engineer and contractor.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Inner pipe joints shall be sealed by use of factory supplied overlapping V bands and sealant as specified in the manufacturer's installation instructions.

B. Roof penetrations shall be suitable for a noncombustible roof and shall be according to the manufacturer's detail drawings and installation instructions

C. When installed according to the manufacturer's installation instructions, the exhaust piping and its supporting system shall resist side loads at least 1.5 times greater than the weight per foot of the piping for both horizontal and vertical portions of the system.

D. The exhaust system shall be installed according to the manufacturer's installation instructions and shall conform to all applicable state and local codes.

E. Provide all supports, guides, bellows type expansion joints, pressure relief/explosion relief valves, guy sections, guy tensioners, floor and roof thimbles, roof flashings, storm collars, moisture drains, and flip top terminations as required to provide a complete system per the manufacturer's installation instructions.

F. The entire exhaust system from the muffler discharge to the termination point, including all accessories, except as noted, shall be from one manufacturer. The exhaust system shall be installed and designed by the manufacturer and in accordance with the terms of the manufacturer's warranty, and in accordance with sound engineering practices.

END OF SECTION 230140

SECTION 230190

PUMPS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

PART 2 - PRODUCTS

2.1 FLOOR MOUNTED PUMPS OR (BASE MOUNTED PUMPS)

A. The pumps shall be model series 1510 as manufactured by ITT Bell & Gossett with performances noted on the Drawing schedule.

B. The pumps shall be single stage; vertical split case design in cast iron and bronze construction. The pump's internals shall be capable of being serviced without disturbing piping connections or motor. The impeller shall be of the enclosed type, dynamically balanced and keyed to shaft and secured with a suitable locknut.

C. Pump seal shall be standard single mechanical seal with carbon seal ring and Remite (or equal) seat. A replaceable shaft sleeve shall be furnished to cover the wetted area of the shaft under the seal of packing.

D. The bearing frame assembly of the pump shall be fitted with re-greaseable ball bearings equivalent to electric motor bearing standards for quiet operation. The pump and motor shall be mounted on a common baseplate of heavy structural steel design with securely welded cross members and open grouting area.

E. The pumps shall be factory tested at the operating conditions, thoroughly cleaned and painted with one coat of machinery enamel prior to shipment. A set of installation instructions shall be included with the pump at the time of shipment.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230190

SECTION 230195

DIESEL FUEL SYSTEM

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. Provide an integrated emergency power fuel system. The specification requires the detailed system design, equipment, installation inspection, startup, and training to be the responsibility of a single specialized fuel system supplier. The specification section includes responsibility for mechanical, electrical, and control systems.

B. The system shall be in accordance with design standards and shall be designed and built to N+1 redundancy against failure.

C. Shall include:
1. Fuel storage tanks and accessories.
2. Fuel distribution pipe, valves and fittings.
3. Fuel day tank.
4. Fuel transfer and control.
5. Tank level and leak monitoring system.
6. Tank fill with spill containment.
7. Fuel filtration system.

D. All work shall be installed in accordance with all local and State codes.

1.2 RELATED SECTIONS

A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such word is specifically mentioned in this Section.

1.3 REFERENCES

A. ASME B31 - American National Standard Code for Power Piping.

B. API 650 - Welded Steel Tanks for Oil Storage.

C. API 2000 - Venting atmospheric and Low Pressure Storage Tanks.

D. NFPA 30 - Flammable and Combustible Liquids Code.

E. NFPA 70 - National Electric Code.

F. PEI/RP100- Recommended Practices for Installation of Underground Liquid Storage Systems.

G. PEI/RP200- - Recommended Practices for Installation of Aboveground Storage Systems for Motor Vehicle Fueling.

H. UL 142 - Steel Aboveground Tanks for Flammable and Combustible Liquids.

I. UL 508A - Standard for Industrial Panels of 600 V or less.

J. UL 2085 - Protected Aboveground Tanks for Flammable and Combustible Liquids.

K. Uniform Fire Code: Article 52, Article 79 and Appendix II-F.

L. BOCA Fire Prevention Code.

1.4 SUBMITTALS

A. See Section 23 01 00 and General Conditions for additional requirements.

B. Mechanical System Design: Indicate system layout, pipe sizes, and location of supports, elevations, and equipment mounting details. For fuel tanks, indicate dimensions, vent sizes and location of all accessories including pumps, fill pipe, man ways, tank supports, tank gauge, and leak sensors. Provide a piping and instrument diagram for the system including a complete bill of material/ equipment list.

C. Control System Design: Provide control system designs including job specific electrical drawings, panel physical layout, and field wiring diagrams.

D. Structural Design: Provide drawings of reinforced concrete tank foundation slabs. Provide drawings of structural steel for walkways or pipe trestles where required.

E. Calculations: Provide calculations for pump selection (if applicable), pipe sizes, and pipe support requirements. Provide calculations for size and thickness of tank hold down slab and straps.

F. Equipment Data: Provide manufacturer's information for all equipment.

G. Permit Applications: Provide copies of all permit applications.

H. Schedule: Provide a design and installation schedule.

I. Commissioning: Provide a detailed commissioning plan.

J. Project Record Documents

1. Record and submit actual location of piping system, storage tanks, wiring, conduit runs and system components.

K. Operation and Maintenance Manuals

1. Operation Data: Include installation instructions and exploded assembly views.

2. Maintenance Data: Include maintenance and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.5 SUBSTITUTIONS

A. Where items of equipment and/or materials are specifically identified herein by a manufacturer's name or model number, only such specified items may be used in the base bid. The successful contractor will be held responsible to furnish specified items under their base bid. If the contractor wishes to bid on equipment other than that specifically named in either the base bid or alternate, they must submit a request in writing, together with the full description and technical data on the equipment proposed, 7 days before opening of the bids. If such equipment is accepted as an alternate, all bidders shall be notified to allow them to include an add or deduct from the base on the accepted equipment. It is further understood that this alternate will include any and all modifications or extra cost(s), regardless of the trade(s) involved, for any changes necessary due to the alternate equipment. Submittal or shop drawings, if other than the base named equipment, must show detailed changes required by all other trades involved. The contractor shall be responsible for all additional costs involved. Under no circumstances shall the Architect or Engineer be responsible for the installation, operation, or performance of substitute materials or equipment, even though accepted; this shall be the sole responsibility of the contractor. In addition to any specific warranty in the Heating, Ventilating, Air Conditioning, Plumbing, or Electrical specifications, the manufacturers of all equipment to be supplied under any substitution shall warrant the same against all costs, including labor and material, arising out of defects in material and/or workmanship, for a period coextensive with the guarantee period provided in the contract documents.

B. The calculations for capacities, quantities, dimensions, and all other attributes are based on the pertinent data of the Base Named Manufacturers. If submitted alternate manufacturer is accepted as an alternate, it shall be the contractor's responsibility to investigate in detail the products of these other manufacturers. The contractor shall be solely responsible for all changes in design, location, dimension, function, and installation involved in selection of other than the Base Named Manufacturer. The contractor shall be responsible for, and bear all costs for, any and all changes including any required world of any and all other trades, or the owner and including all of the Architects and Engineer's redesign or evaluation of submittal costs caused directly or indirectly by the use of equipment other than that listed on the drawings or called for in the specifications.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 30 "Flammable and Combustible Liquids Code" for design and construction, installation, inspection, and testing of fuel system components and accessories.

B. Comply with NFPA 31 "Installation of Oil Burning Equipment" for the same as item A. above.

C. Comply with NFPA 70 "National Electric Code" for equipment, wiring, and conduit installed under this section.

D. For Industrial Electrical Panels, comply with UL 508A.

E. Provide equipment and accessories that are listed and labeled.

F. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

1.7 QUALIFICATIONS

A. The company shall provide evidence of professional liability and pollution liability insurance.

1.8 REGULATORY REQUIREMENTS

A. Comply with requirements of the EPA and other state and local authorities having jurisdiction. Include permitting and registering of fuel storage tank.

1.9 DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading and transporting units.

B. Protect all equipment and tariffs from damage after arrival at site.

PART 2 – PRODUCTS

2.1 ABOVEGROUND FIRE RATED FUEL TANKS

A. Acceptable manufacturers subject to compliance with the specifications:

1. Modern Welding Co, Inc.
2. Highland
3. Containment Solutions
4. Preferred Utilities

B. General

1. Provide and install an aboveground tank with secondary containment and a minimum 2-hour fire rating. The tank and its enclosure shall be listed and labeled as an assembly by Underwriters Laboratories, Inc. per U.L. 2085. The primary tank shall have a total volume as noted on the contract drawings.

C. Design Criteria

1. Primary Tank: The primary tank shall be minimum 7 gauge carbon steel approved per U.L. Standard 2085 and meeting the requirements of N.F.P.A. 30.
2. The tank shall be manufactured and labeled in strict accordance with Steel Tank Institute [STI] Fireguard Thermally Insulated Double Wall Steel Above Ground Storage Tanks standards as applied by a licensee of the STI.
3. The tank shall be warranted for 30 years by the manufacturer.
4. Secondary Containment with Leak Monitoring: Integral secondary containment shall provide at minimum 110% containment of the primary storage tank. The interstitial space shall allow liquid to migrate through it to a monitoring point. A leak detection access tube shall be located in the interstitial space between the inner tank and the secondary barrier.
5. Fire Resistance: The tank system shall be designed and tested to provide 2-hour fire protection for the primary tank. No steel members shall penetrate the concrete/thermal insulation layer between the primary tank and the secondary containment barrier to assure isolation from pool fire heat.
6. Venting: Provide properly sized emergency and standard vents to satisfy code requirements.
7. Standard vent shall terminate a minimum of 12' above the adjacent ground level. Include placing in the vent line a vent tank switch to report and alarm for any time when oil in the main tank overfills and migrates up the vent line.
8. Exterior Finish: The tank system shall include an epoxy or polyurethane exterior finish. Color of finish shall be white or as approved by the Architect.
9. Provide a minimum of 25 PSIG rating.

D. Tank Accessory Equipment

1. Acceptable manufacturers: Preferred Utilities
   The Preferred Vent Brick is to be used. The vent brick is much less unsightly and piping the vent pipe behind a wall provides less possibility for damage or otherwise disrupting the venting.
2. Vent brick: As shown on drawings, install at the vent pipe termination, a standard Preferred Utilities one piece, cast aluminum Tank Vent Brick. Vent brick shall be the full size of the pipe according to NFPA 30 Flammable and Combustible liquids Code and NFPA 31 Standard for the Installation of oil burning equipment. Vent Brick is to be an integral part of the outer face of the building wall.
3. Main Tank overfill alarm switch: Tank shall be fitted with a Preferred PLS-HLS high level oil switch. High Level Switch shall be arranged to (sound an alarm) (provide an electrical interlock) and activate the overfill alarm and the Fuel Oil Management Center PLC logic when the liquid level reaches 90 percent of tank capacity. Tank High Level Switch Unit shall be float operated, suitable for #2 oil at 150 psi, have brass and Buna N wetted parts, and be mounted in a 1 1/4" tapping in the tank top. Switch shall be hermetically sealed and fully isolated from tank contents and external atmosphere. Electrical connections shall be made externally to the tank in an explosion-proof head assembly approved by UL for Class 1, Group D applications. Switch shall be as manufactured by Preferred Utilities Mfg. Corp. Model: PLS-1.

4. Vent line shall be equipped with a vent line switch similar to Preferred Model RBS. Switch shall be monitored by Fuel Master Control Panel. Install the switch as close to the top of the tank as possible, less that one foot above the tank.
5. Emergency Vents: Emergency vents shall be equipped with aluminum vents sized to open at 8 oz pressure to provide the required capacity.
6. Overfill Prevention Valve: The tank shall have an overfill prevention valve installed in the fill pipe. The valve shall close automatically at 90% of tank capacity. The valve shall incorporate a drop tube extending to within 6& of the tank bottom. Valve shall be rated for pressurized fuel delivery. An automatically actuated motorized ball valve in the fill pipe may be provided as an alternative.
7. Access Steps and Ladders: No regular maintenance needed. Therefore, access to the tank or top of the tank is not required.
8. The tank fill system shall be equipped, as shown on drawings, with a Preferred Utilities Model 2 stainless steel recessed type spill container where the tank truck shall gravity fill fuel into the tank from this spill container. The spill container shall have a total of five U.S. gallon holding capacity, be of NEMA 4 rated construction with a neoprene gasket door seal, three point latch locking handle 2" oil fill connection dry disconnect and dust cover. The cabinet shall be 304 stainless steel 12 gauge construction and be equipped with1/2" NPT drain connection. Spill container is to be provided with an integral overfill alarm station, consisting of an explosion proof overfill alarm light(s), alarm horn, and Alarm silence pushbutton. The light and bell shall be automatically silenced in 90 seconds, or instantly when the operator selects the Alarm Silence button. Include explosion proof digital tank contents display.

2.2 FUEL DISTRIBUTION PIPE AND PIPE FITTINGS, SECONDARY CONTAINMENT

A. Acceptable manufacturers subject to compliance with the specifications:

1. Perma Pipe
2. Insul Tek
3. Ameron

B. General

1. Provide for all piping located:

   a. Underground (if applicable)
   b. Aboveground

2. All other items:

   a. Generator room.
   b. Area specifically indicated otherwise.
   c. Above ground; within building and required by local code, schedule 10 steel pipe shall be used instead of fiberglass type pipe as indicated below.

C. Above Ground in the Building

1. All secondary containment piping systems shall be an engineered and totally prefabricated DOUBLE-PIPE type containment system. Carrier pipe shall protect the environment by the use of secondary containment. The system supplier shall have at least five (5) years of experience in the manufacture of secondary contained piping systems. All straight sections, fittings and other accessories shall be factory prefabricated to job dimensions and designed to minimize the number of field connections. Secondary containment joints completed at the factory shall be 100% air-tested. The system shall be manufactured to allow the placement of the leak sensors at the low point of each floor and/or at the bottom of a riser as shown on drawings. The containment shall be drainable, dryable and air pressure testable. Contractor fabricated systems, whether built on site or off site, shall not be acceptable.

2. The secondary containment shall not be exposed to pressures which exceed the maximum for the selected containment material.

3. The secondary containment manufacturer shall supply a complete design submittal including layout drawings, leak detection routing, and catalog sheets, material data and pipe stress and end load calculations in accordance with ANSI B31.3 latest edition. The calculations shall be stamped by a registered professional engineer.

4. Carrier Pipe - Carrier pipe shall be standard weight carbon steel, ASTM A-53 Grade B ERW or seamless. All joints shall be butt welded for sizes 2 inches and greater, and socket or butt welded for 2 inches and below. Where possible, straight sections shall be supplied in 40 foot random lengths with 6 inches of piping exposed at each end for field joint fabrication.

5. Secondary Containment - The secondary containment shall be fabricated out of carbon steel in accordance with ASTM A-135 Grade B, or ASTM A-53 Grade B, to the thickness specified below:

Diameters	Minimum Thickness
3" - 5"	Schedule 40
6" - 26"	Schedule 10 or 10 Gauge

6. Carbon steel secondary containment designed for aboveground application shall be coated with red mill primer. Quality control at the manufacturing facility shall ensure that all prefabricated containment pipe joints shall be soap tested at 15 psig air. The coating shall be spray applied onto a shot blasted steel containment to a thickness of 6 mils. All field joints shall be welded and primed.

7. Pipe Supports - Supports shall be designed and factory installed by the secondary containment manufacturer. Support spacing shall be determined by the manufacturer based on pipe diameter, pipe material, and operating temperature of the product pipes. In all cases, pipes within the secondary containment shall be supported at not more than 10 foot intervals. These supports shall be designed to

allow for continuous airflow and drainage of the secondary containment in place. Leak detection devices shall be placed as indicated on drawings.

8. Subassemblies - End seals and other subassemblies shall be designed, and factory prefabricated to prevent the ingress of moisture into the system. All subassemblies shall be designed to allow for complete draining of the secondary containment.

2.3 TANK GAUGING AND LEAK MONITORING SYSTEM

A. Acceptable manufacturers subject to compliance with the specifications:

1. Preferred Utilities TG-EL-D4
2. Tidel Engineering, Inc.
3. Andover Controls/Schneider Electric

B. General

1. Provide a storage tank monitoring system capable and sensing leaks in the tank and the associated piping.

C. Design Criteria

1. Tank Level Transmitter: the system shall include a probe capable of detecting the fuel level in the tank. Provide a float type level sensor to provide accurate level monitoring that is unaffected by changes in the specific gravity of the tank liquid and is suitable for use with non-corrosive fluids and fuels up to and including No. 6 fuel oil. The level sensor shall consist of a NEMA 6P rated, 1/4" cast aluminum head, connected to a float assembly by a flexible stainless steel cable. The sensor head assembly shall mount to the tank though a standard 4" 125/150 lb. flat face flange opening, with standard bolt pattern and must be capable of operating in a submerged manhole environment without damage. The unit shall be capable of easy installation and maintenance. The unit must be able to be mounted, stand, and be subsequently removed for service with only 14" of clearance between the flange and any overhead obstructions. Vertically mounted floats that take up more height to either insert or remove shall be rejected. The sensor's operation shall be unaffected by internal tank obstructions located outside of a 14" diameter cylinder extending from the top of the tank to the bottom and centered on sensor's mount. Tank gauge calibration shall be possible at any tank fluid level (empty, paid full or full). The sensor shall include an external test mechanism to allow overfill alarm and full tariff calibration checks without removal of the sensor from the tank. Tests that electronically simulate a high tank level, instead of physically moving the float, are not acceptable. Where applicable, an ultrasound device can be substituted for the above tank float.

2. Monitoring Panel: provide a microprocessor-based tank gauging, leak detection, and overfill prevention system per NFPA 30 Flammable and Combustible Liquids Code, NFPA 31 Standard for the Installation of Oil-Burning Equipment, and NFPA 110 Standard for Emergency and Standby Power Systems. The tank gauge shall be provided complete with printer and RS485 Modbus interface to the BAS for

each storage tank indicated on the drawings. The indicator, printer, level sensors, leak sensors, and overfill alarm station shall be supplied by one manufacturer. The indicator and sensors shall be intrinsically safe for Class 1, Division 1, Group D hazardous locations as defined by the National Electric Code. The monitoring panel shall display the tank volume in gallons. The panel shall indicate alarm conditions for fuel high level, fuel low level, tank leaks and containment pipe leak. The indicator shall have a bright 4" bargraph display that is clearly visible Horn 20 foot viewing distance and shall be able to monitor either 1 or 2 tanks. All sensors signals shall be either 4-20 mA or contact closure for easy interchangeability of field devices. All leak sensors shall be automatically tested by the indicator on a daily basis with the result shown on the printed reports. Continuous sensor wiring fault detection (open or shorted) shall be provided. Automatic delivery detection logic shall trigger a printed, and data logged, report displaying the time, date, and amount delivered for delivery verification. The system shall be field upgradeable to dual sensors for higher accuracy delivery reporting and/or density shift detection in the event that delivery "shorting" is suspected. Provide idle tank theft alarming capability for standby tanks or emergency generator tanks as required.

3. The system shall be fully field configurable. The system shall be able to automatically generate a stick chart based on measured delivery flow and measured level if an accurate stick chart is not available for the tank.

4. The printer shall automatically, or manually, print:

- Current inventory
- Time/date
- Gallons of the last 7 deliveries Last 7 daily consumptions
- Last 5 weekly consumptions
- Last 10 time/date stamped alarms

2.5 OVERFILL ALARM

A. Provide and install an overfill alarm station for 1 tank that will alarm when signaled from one of the above tank gauges when an overfill condition has been reached. The overfill alarm panel shall contain a 4" weatherproof alarm horn with automatic silencing, 180 degree flashing lamp, bell silencing pushbutton, and alarm test pushbutton. Optional gallons display can be added. Alarm can be instantly silenced with the silencing pushbutton or in 90 seconds automatically if silencing pushbutton is not activated.

B. Provide and install an Overfill Caution Sign near the Overfill Alarm Station. The sign shall be 20"W by 14"H of 18 gauge steel with porcelain baked enamel finished bright yellow background and minimum 2" H black lettering. The Caution Sign shall read: CAUTION WHEN ALARM BELL SOUNDS OIL TANK FILLED TO CAPACITY. DO NOT OVERFILL.

PART 3 – EXECUTION

3.1 FUEL TANK INSTALLATION

A. Install tank in strict accordance with the manufacturer's recommendations, PEI/RP100 and PEI-RP200, and applicable fire and environmental codes. State and local permits shall be obtained prior to installation.

B. Aboveground tanks shall be clearly marked on all sides with warning signs: "FLAMMABLE" or "COMBUSTIBLE", "NO SMOKING", tank volume, product identification, and other signs as required by applicable codes.

C. Electrical work shall be in accordance with applicable codes and shall be rated for hazardous area as required. Tanks shall be electrically grounded in accordance with NFPA 78.

D. The tank installation shall be inspected and approved by the tank supplier or its certified contractor. The tank supplier shall submit a comprehensive check-list of quality and safety items critical to the system and verify that the installation has been in accordance with these standards and applicable fire and environmental codes.

3.2 ABOVEGROUND PIPING INSTALLATION

A. Install in accordance with the manufacturer's instructions and PEI/RP200-92.

B. Inspect all materials for signs of damage and confirm compliance with specifications.

C. Avoid damage to piping materials or coatings during handling, installation and testing.

D. Provide adequate support for piping on 10" centers minimum.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction so that pipe, joints, or connected equipment will not be stressed.

G. Provide clearance for access to valves and fittings.

H. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of the completed system.

I. Install unions, couplings, valves, and flexible connectors in accordance with manufacturers' recommendations.

3.3 TANK LEVEL AND LEAK MONITORING SYSTEM INSTALLATION

A. Install in strict accordance with the manufacturer's recommendations, National Electrical Code NFPA 70, and NFPA 30A.

B. Electrical work shall be rated for hazardous area as required.

C. Install the monitoring system control panel as indicated on the drawings.

D. Install the tank level transmitter and the interstitial leak probe in the proper locations in the fuel tank. Install the piping sump sensor in the piping sump.

E. Install the overfill alarm as specified and as shown in the plan.

F. The leak monitoring system installation shall be inspected and approved by the equipment supplier or its certified contractor. The leak monitoring system supplier shall submit a comprehensive check- list of quality and safety items critical to the system and verify that the installation has been in accordance with these standards and applicable fire and environmental codes.

3.4 FIELD QUALITY CONTROL

A. Test fuel distribution system according to NFPA 30. Replace leaking joints and connections with new materials.

B. Test and adjust fuel management and leak monitoring systems controls and devices. Replace damaged and malfunctioning controls and devices.

C. Submit reports of test and procedures in writing to the Engineer.

3.5 DEMONSTRATION

A. Train Owner’s maintenance personnel on procedures and schedules relates to start-up and shutdown, troubleshooting, servicing, and preventative maintenance.

B. Representatives of equipment suppliers for the fuel tanks, fuel pumps, day tanks, and leak monitoring system shall provide necessary training and technical support to the Owner so that the Owner may properly operate and maintain the systems.

3.6 COMMISSIONING

A. Before activating the system perform these steps:

1. Flush system piping with grade of fuel to be used by owner to remove any debris and foreign matter in piping prior to filling tank for the first time. Service all system filters and screens and dispose of fuel in accordance with EPA and NFPA regulations after flushing.

B. Perform a complete system commissioning in accordance with approved commission plan.

END OF SECTION 230195

SECTION 230200

HYDRONIC SPECIALTIES

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

PART 2 - PRODUCTS

2.1 AIR SEPARATOR

A. Furnish and install as shown on Drawings, an external low velocity air separator unit consisting of a steel tank with screwed piping connections and a tapping to connect the air separator directly to the compression tank with screwed piping connections and a tapping to connect the air separator directly to compression tank.

B. The unit is to be furnished with a steel base and constructed in accordance with ASME boiler pressure vessel code and stamped 125 psi working pressure. The air separator shall be ITT Bell & Gossett “Rolairtrol” or approved equal.

2.2 EXPANSION TANKS (S)

A. Furnish and install pre-charged bladder type expansion tank(s) of size and capacity as shown on Drawings. Tank shall have carbon steel shell and heavy-duty butyl rubber bladder.

B. Tank to be constructed for (125 psig) working pressure and to be guaranteed leakproof by manufacturer. Tank to be stamped with "U" symbol and Form U-1 furnished denoting compliance with paragraph U-69 for Construction of Unfired Pressure Vessels Section VIII ASME.

2.3 AIR VENTS

A. Install at all high points automatic air vents to eliminate air binding. All automatic air vents shall be approved heavy duty type equipped with petcocks and tubing for manual venting. All vents installed in coils, etc. shall be of manual key operated type.

B. All vents concealed from view shall be accessible through access doors. Vents shall be by Hoffman, Anderson or ITT Bell & Gossett, 125 psig rated.

2.4 PRESSURE GAUGES

A. Furnish and install pressure gauges on suction and discharge sides of each pump and as required to check operation of equipment; pressure gauges shall have 4-1/2"diameter dials, Ashton, Ashcroft or approved equal.

2.5 THERMOMETERS

A. Install thermometers at all locations in piping system as noted on Drawings and as required to check system performance. Thermometers shall be installed at the supply and return of coils and 3-way diverting valves as manufactured by Trerice, Weksler or Moeller, with 4-1/2 inch face, cast aluminum case, chrome plated steel ring, white background with black embossed markings, glass window, stainless steel pointer, brass movement, 316 stainless steel bulb. Provide separable, universal angle sockets for all thermometers.

2.6 TRIPLE DUTY VALVES

A. Furnish and install at each pump a nonslam check valve with a spring loaded disc and a calibrated adjustment feature permitting regulation of pump discharge flow and shut-off. Valves shall be designed to permit repacking under full line pressure.

B. Unit shall be installed on discharge side of pump in a horizontal or vertical position with the stem up. Allow for minimum clearance of valve stem. This unit shall be cast iron body construction suitable for maximum working pressure of 175 psig and maximum operating temperature of 300 degrees F.

C. All units shall be ITT Bell & Gossett Triple Duty Valve model or approved equal.

2.7 SUCTION DIFFUSERS

A. Furnish and install at each pump a suction diffuser. Units shall consist of angle type body with inlet vanes and combination Diffuser-Strainer-Orifice Cylinder with 3/16 inch diameter openings for pump protection. A permanent magnet shall be located within the flow stream and shall be removable for cleaning.

B. The orifice cylinder shall be equipped with a disposable fine mesh strainer, which shall be removed after system startup. Orifice cylinder shall have a free area equal to five times cross section area of pump suction opening. Vane length shall be no less than 2-1/2 times the pump connection diameter. Unit shall be provided with adjustable support foot to carry weight of suction piping. Each Suction Diffuser to be ITT Bell & Gossett model or approved equal.

2.8 COMBINATION BALANCING / SHUT-OFF VALVES (Circuit Sensors /Setters and Flow Meters)

A. Provide Circuit Sensor/Setter balance valves as manufactured by Bell & Gossett or approved equal.

B. Circuit Sensors: Furnish and install as shown on Drawings, a cast iron wafer-type flow meter designed for low pressure drop operation.

1. The flow meter will be equipped with brass readout valves (with integral check valve) for taking differential pressure readings across the orifice of the flow meter.

2. The flow meter shall be designed to operate at a maximum working pressure of 300 psig at 250 degrees F.

3. The flow meter must be furnished with a calibrated nameplate for determining an accurate system flow rate.

4. Each flow meter shall be ITT Bell & Gossett Circuit Sensor Flow Meter model no. OP.

C. Circuit Setters: (1/2”-3”) Furnish and install as shown on Drawings and with manufacturer's recommendations Bell & Gossett® Circuit Setter® Plus calibrated balance valve Model CB or Model MC as manufactured by Xylem.

1. Valves to be designed to allow installing Contractor to pre-set balance points for proportional system balance prior to system start-up.

2. Valve body shall be constructed out of lead-free brass.

3. Valve shall include a ball valve constructed in 304 Stainless Steel.

4. Valve shall be AB1953, and CSA certified and compliant with Vermont 152S, Maryland House Bill HB372, Senate Bill S.3874, and NSF/ANSI-372.

5. Valve body shall include two pressure/temperature ports.

6. Valve body shall include an optional drain valve port.

7. Valve shall utilize a calibrated nameplate with a memory stop.

8. Valve shall utilize a reduced port design that provides velocity head recovery.

9. Valve temperature range shall be from -4°F (-20°C) to 250°F (121°C).

10. Model CB: Valve shall have either NPTF thread or SWTF end connections.

11. Model CB**:** Valves with NPT end connections shall be rated for 400 PSIG working pressure.

12. Model CB**:** Valves with SWTF end connections shall be rated for a maximum of 300 PSIG working pressure.

13. Model MC: Valve shall be rated for 300 PSIG working pressure.

14. Model MC: Valve shall include a SWTF or NPTF fixed end connection on the discharge end and a union tailpiece adapter with choice of SWTF, NPTF thread, or NPTM thread tailpiece connection on the supply end. The union tailpiece end should include a union nut that can secure the tailpiece to the body of the valve to create a water-tight seal.

15. Valves to have memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. All valves to have calibrated nameplate to assure specific valve settings. Valves to be leak-tight at full rated working pressure. Valves 4-inch pipe size to be of cast iron body/brass vane construction with differential pressure read-out ports fitted with internal EPT insert and check valve.

16. Provide Extended Pressure/Temperature Ports and Drain Valve/Extended Drain Valve.

D. Circuit Setters: (4”-12”) Furnish and install as shown on Drawings and with manufacturer's recommendations Bell & Gossett® Circuit Setter® Plus calibrated balance valve Model CB as manufactured by Xylem.

1. Valves to be designed to allow installing Contractor to pre-set balance points for proportional system balance prior to system start-up.

2. Valve body shall be constructed out of cast iron and rated for 175 PSIG working pressure (if flanged) or constructed out of ductile iron and rated for 300 PSIG working pressure (if grooved).

3. Valve shall be a multi-turn globe style valve.

4. Valve shall include a brass disc.

5. Valve disc shall have a soft seat design made of EPDM.

6. (If Flanged) Valves shall include ANSI Class 125# flanged connections.

7. (If Grooved) Valves shall include grooved end connections.

8. Valve body shall include two pressure/temperature ports.

9. Valve shall utilize a calibrated nameplate with position indicator from 0 to 100% open.

10. Valve shall include a memory button to allow for positioning the valve to the appropriate set position after closing.

11. Valve temperature range shall be from -4°F (-20°C) to 250°F (121°C).

12. Valves to have memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. All valves to have calibrated nameplate to assure specific valve settings. Valves to be leak-tight at full rated working pressure. Valves 4-inch pipe size to be of cast iron body/brass vane construction with differential pressure read-out ports fitted with internal EPT insert and check valve.

E. Readout Meters: Provide a portable Readout Meter with provision for hanging, capable of indicating pressure differential across a system component. Unit to be complete with all necessary hoses, shut-off and vent valves, and carrying case. Reading range to be .5' to .16'. Read Out Kits to be ITT Bell & Gossett model no. RO-3.

2.9 Chemical feeding equipment

Chemical Feed System Description:

1. Provide an automatic chemical feeder for the hydronic system where shown on Drawings. The feeder shall be equal to AXIOM model no. SF100-D-P, PACKAGED HYDRONIC SYSTEM FEEDER, as manufactured by Axiom Industries Limited, 2615 Wentz Avenue, Suskatoon, SK S7K5J1. System shall include 55 gallon storage/mixing tank with cover, alternating control panel with lead/lag operation, high/low level alarm, pump suction hose with inlet strainer, two pressure pumps with thermal cutouts, integral pressure switches, integral check valve, cord and plug, pre-charged accumulator tank with EPDM diaphragm, manual diverter valve for purging air and agitating contents of tank, pressure regulating valve (adjustable 5-55 psig) complete with pressure gauge, built-in check valve, union connection, flexible connection hose with check valve, low level pump cut-out. Power supply 115 volt/60 Hz/1 Ph, 3.8 amps. Pump capacity, 1.0 gpm at 50 psig, self-priming. Unit shall be completely pre-assembled and certified by a recognized testing agency.

PART 3 – EXECUTION

3.1 INSPECTION

A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230200

SECTION 230234

INDOOR ENTHALPY WHEEL ENERGY RECOVERY UNITS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 SYSTEM DESCRIPTION

A. This specification is based on an Energy Recovery Units as manufactured by Annexair. Manufacturers of alternate equipment must be approved to bid via addendum, in writing by the specifying Engineer, at least two weeks prior to Bid time in order for their Bid to be accepted by the Contractor. If the equipment is not pre-approved, then under no circumstances shall the Contractor invest any time or money in receiving submittals or considering the equipment. Costs associated with dimensional, performance or other deviations from the specified equipment, including engineering costs to evaluate such deviations, shall be paid by the Contractor.

B. The unit(s) shall be installed in strict accordance with the specifications. Unit(s) shall be complete with all components and accessories as specified. All units shall be factory assembled, internally wired, and 100% run tested to check operation, fan and blower rotation and control sequence before leaving the factory. Wiring internal to the unit shall be numbered for simplified identification. Units shall be ETL listed and labeled, classified in accordance with ANSI-UL 1995 / CAN/CSA C22.2 No.236.

1.2 QUALITY ASSURANCE

A. All unit(s) shall be factory tested before shipping. A proof copy of the test shall be placed in the unit control panel. Unit(s) shall bear the ETL label, tested in accordance to UL 1995. Electrical components shall be UL listed; fans shall be tested in an AMCA certified laboratory; insulation shall comply with NFPA 90A; coils shall be tested in accordance to ARI 410 and filters shall be tested in accordance to ASHRAE 52. The unit manufacturer shall have an independent testing agency test the air leakage, panel deflection and sound pressure levels for a typical unit providing at minimum the supply airflow of units in question and not exceeding 20,000 CFM. The air leakage of the unit(s) shall not exceed 1% at 8” inches H_2O positive static pressure and a copy of the report must be submitted upon request. Unit shall be constructed to limit frame and panel deflection to $1/200^{th}$ of the panel length at 8” inches H_2O positive static pressure and a copy of the report must be submitted upon request. The unit shall also be tested in accordance with ANSI S12.34-1998 and instrumentation used must be in compliance with the requirements of AMCA 300 for sound readings. The sound tests conducted shall report overall sound power and pressure readings for supply air outlet, return air inlet and casing radiated.

PART 2 - PRODUCTS

2.1 HOUSING

A. The unit housing shall be constructed from a frame, base and panel assembly. Unit shall be completely factory assembled and shipped in one piece. Frame shall be made from robust aluminum die cast corners and extruded aluminum profiles shall be welded together for reinforcement. The base structure shall be fully welded galvanized with cross members specifically positioned to allow for a complete walking type floor. Base structure shall have integral lifting lugs which can be removed once the unit is installed. All panels shall be made from G-90 galvanized steel, minimum 18-gauge. Fixed panels shall be fastened from the interior and gasketed to reduce thermal transmission.

B. Access doors shall be provided to all major components to facilitate quick and easy access. Each access door shall be latched with Ventlok latches, heavy duty aluminum butt hinges and designed to open against air pressure where indicated. Access doors shall be sealed with a full “U-Shaped” gasket for superior air tightness along the door edge. Bulb type gaskets shall not be acceptable since they do not return to their original form once compressed.

C. Fixed panels shall be removable without affecting the housing integrity. All panels and access doors shall be double wall construction with (R-4.3) one-inch thick or (R-8.6) two-inch thick, minimum 1.8 PCF fiberglass insulation and lined with 20-gauge G-90 galvanized. The airflow separation wall between the outside air intake and exhaust air outlet shall be insulated with the same insulation thickness as the exterior panels when the winter design temperature is below 35 F. All roof and sidewall seams shall be positively sealed to prevent water and air leakage.

2.2 ENTHALPY WHEEL

A. Enthalpy Wheel shall recover both sensible and latent heat. The matrix shall be constructed from corrugated aluminum and specifically treated and coated with Silica Gel desiccant to assist and enhance latent heat transfer. Any other type desiccants, including 3A or 4A Molecular Sieves, will not be accepted for HVAC applications.

B. Seals shall be full contact, low bleed type, made from dual band Ultra High Molecular Weight Polyethylene. Any seal that is non-contact is not to be considered a seal and will not acceptable. Labyrinth type seals do not operate properly under different air stream pressures therefore shall not be acceptable in any circumstances.

C. Drive system shall be operated by a fractional horsepower motor (maximum 1 HP), reducing gear-box, pulley and v-belt. The wheel bearing shall be permanently sealed, and press fitted into the wheel matrix for long life operation. A double purge sector (2 x 5º) shall be factory installed to reduce cross contamination to under 0.1%.

D. Frost control prevention shall be accounted for if outdoor air temperatures are below 10 degrees F at equal airflows and return relative humidity below 30%. Frost control shall be accomplished by a variable speed drive and controlling the leaving air condition of the exhaust air. Other methods of frost control will not be considered for this application. Wheel speed shall not rotate faster than 20 rpm. Any rotational speed above 20 rpm will be unacceptable.

2.3 FANS

A. The fans shall be carefully positioned and installed at an optimal distance to respect uniform airflow across the heat exchanger and coil(s).

1. Scroll Fans: The fan housing shall be fully constructed from galvanized steel, with double width, double inlet and forward curved impellers for constant airflow applications below 3.5” TSP and airfoil impellers for VAV applications with greater than 3.5” TSP. Impeller wheels shall be staggered for reduced sound transmission. Painted housing shall not be acceptable. Fans shall be belt-driven with adjustable sheaves. Bearings shall be selected for an average life in excess of 200,000 hours at maximum cataloged operating speeds. Fan assembly shall be isolated from the unit housing and all fan wheels shall be statically and dynamically balanced for quiet operation. Fans shall be tested for Class I and II operating limits and rated in an AMCA certified laboratory.

2.4 FAN MOTORS

A. The fan motors shall meet NEMA standard dimensions and comply with the Energy policy Act of 1997. Motors shall have high efficiencies with low noise and vibration output. Motors shall be certified and built in accordance to ISO 9001 quality control system. Motors shall have Open Drip Proof enclosure with hi efficiency performance. Motors shall be designed for single speed application unless otherwise noted.

2.5 FILTERS

A. Filters shall be factory installed upstream of the heat exchanger and coils, in both airstreams. Filters shall be throwaway type with extended surface pleats to increase dust-holding capacity. Filters shall be 2`` thick, MERV 8 ASHRAE efficiency. Filters shall be placed in a completely sealed, galvanized holding frame with quick release latches for easy replacement. Maximum air velocity through filters shall be 500 FPM.

2.6 DAMPERS

A. Dampers shall be installed were shown on the drawings. Dampers shall be low leak type with rubber edges, opposed blades, and constructed in Aluminum. Damper actuators shall be 24V, two position or modulating type, with spring return mechanism and auxiliary switches.

2.7 COILS

A. Coils shall be factory installed in the unit. Primary surface shall be round seamless (5/8" O.D.) copper tube on 1½" centers, staggered in the direction of airflow. Secondary surface shall consist of rippled aluminum plate fins for higher capacity and structural strength.

B. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates.

C. Casing shall be constructed of continuous galvanized steel. Headers shall have intruded tube holes to provide a large brazing surface for maximum strength and inherent flexibility. The complete coil shall be tested with 315 pounds air pressure under warm water and be suitable for operation at 250 psig working pressures. Maximum finned coil height shall be 45" and shall not exceed 500 fpm face velocity. Stacked coils shall be provided for larger airflows and intermediate drain pans shall be provided for each coil bank.

D. Drain pans shall be stainless steel with drain connections on one side only. Pan shall be sloped in two planes. All coils shall be certified in accordance with ARI standard 410.

2.8 POWER AND CONTROL

A. The power and control center shall be integral to the unit housing and rated NEMA 4X. All wiring shall be accomplished by the manufacturer and must be tested under a high pot test. UNDER NO CIRCUMSTANCES SHALL ANY POWER WIRING OR PARTS BE FIELD INSTALLED. Panels that are externally mounted to the unit shall not be accepted, regardless of the NEMA rating they may have. A separate access door shall be provided with an approved locking device. All electrical components contained in the panel shall be UL/CSA certified and labeled. The unit shall be complete with motor starters, fuses, cascading overloads, relays, terminal interface for ON/OFF and step-down transformer.

B. All components shall be factory wired for single point power connection by the manufacturer of the unit. A non-fused safety disconnect switch shall be factory installed for on/off servicing. Any power wiring that is field installed shall not be accepted under any circumstances. IF UNITS SHOW UP AT THE JOB SITE WITHOUT WIRING BY THE MANUFACTURER, THE CONTRACTOR WILL HAVE TO SEND BACK UNITS TO THE MANUFACTURER AT THE CONTRACTORS' EXPENSE TO GET THEM FACTORY WIRED AND RE-TESTED.

C. HVAC related automatic temperature control wiring shall be field installed.

PART 3 - EXECUTION

3.1 FIELD INSPECTION

A. The manufacturer who is basis of design will reserve the right to field inspect the units, whether they are awarded the job or not, and shall provide a written report to the engineer noting any deficiencies to the bid specifications. If there are any deficiencies or missing items on the units shipped which are clearly mentioned in the bid documents, regardless of what is approved by the engineer on the submittals, the units shall be returned to the manufacturer for them to be corrected at the contractor's expense.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230234

SECTION 230235

INDOOR FIXED PLATE ENERGY RECOVERY UNITS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 SYSTEM DESCRIPTION

A. This specification is based on an Energy Recovery Units as manufactured by Annexair for greater than 1000 cfm, and Energy Wall for less than 1000 cfm. Manufacturers of alternate equipment must be approved to bid via addendum, in writing by the specifying Engineer, at least two weeks prior to Bid time in order for their Bid to be accepted by the Contractor. If the equipment is not pre-approved, then under no circumstances shall the Contractor invest any time or money in receiving submittals or considering the equipment. Costs associated with dimensional, performance or other deviations from the specified equipment, including engineering costs to evaluate such deviations, shall be paid by the Contractor.

B. The unit(s) shall be installed in strict accordance with the specifications. Unit(s) shall be complete with all components and accessories as specified. All units shall be factory assembled, internally wired, and 100% run tested to check operation, fan and blower rotation and control sequence before leaving the factory. Wiring internal to the unit shall be numbered for simplified identification. Units shall be ETL listed and labeled, classified in accordance with ANSI-UL 1995 / CAN/CSA C22.2 No.236.

1.2 QUALITY ASSURANCE

A. All unit(s) shall be factory tested before shipping. A proof copy of the test shall be placed in the unit control panel. Unit(s) shall bear the ETL label, tested in accordance to UL 1995. Electrical components shall be UL listed; fans shall be tested in an AMCA certified laboratory; insulation shall comply with NFPA 90A; coils shall be tested in accordance to ARI 410 and filters shall be tested in accordance to ASHRAE 52. The unit manufacturer shall have an independent testing agency test the air leakage, panel deflection and sound pressure levels for a typical unit providing at minimum the supply airflow of units in question and not exceeding 20,000 CFM. The air leakage of the unit(s) shall not exceed 1% at 8” inches H_2O positive static pressure and a copy of the report must be submitted upon request. Unit shall be constructed to limit frame and panel deflection to $1/200^{th}$ of the panel length at 8” inches H_2O positive static pressure and a copy of the report must be submitted upon request. The unit shall also be tested in accordance with ANSI S12.34-1998 and instrumentation used must be in compliance with the requirements of AMCA 300 for sound readings. The sound tests conducted shall report overall sound power and pressure readings for supply air outlet, return air inlet and casing radiated.

PART 2 - PRODUCTS

2.1 HOUSING

A. The unit housing shall be constructed from a frame, base and panel assembly. Unit shall be completely factory assembled and shipped in one piece. Frame shall be made from robust aluminum die cast corners and extruded aluminum profiles shall be welded together for reinforcement. The base structure shall be fully welded galvanized with cross members specifically positioned to allow for a complete walking type floor. Base structure shall have integral lifting lugs which can be removed once the unit is installed. All panels shall be made from G-90 galvanized steel, minimum 18-gauge. Fixed panels shall be fastened from the interior and gasketed to reduce thermal transmission.

B. Access doors shall be provided to all major components to facilitate quick and easy access. Each access door shall be latched with Ventlok latches, heavy duty aluminum butt hinges and designed to open against air pressure where indicated. Access doors shall be sealed with a full “U-Shaped” gasket for superior air tightness along the door edge. Bulb type gaskets shall not be acceptable since they do not return to their original form once compressed.

C. Fixed panels shall be removable without affecting the housing integrity. All panels and access doors shall be double wall construction with (R-4.3) one-inch thick or (R-8.6) two-inch thick, minimum 1.8 PCF fiberglass insulation and lined with 20-gauge G-90 galvanized. The airflow separation wall between the outside air intake and exhaust air outlet shall be insulated with the same insulation thickness as the exterior panels when the winter design temperature is below 35 F. All roof and sidewall seams shall be positively sealed to prevent water and air leakage.

2.2 FIXED PLATE HEAT EXCHANGERS

A. Fixed plates heat exchangers shall factory installed where indicated on drawings. The heat exchanger shall be a Cross flow plate-air-to-air type. The alternate layers of plate create two ducts, one for supply air and one for exhaust air. The plates shall be in pure aluminum for its characteristics of corrosion resistance, ease of manufacture, flame proof, durability and excellent heat transfer properties (option: For aggressive and corrosive applications, the plates shall be stainless steel. Minimum plate thickness shall be .008”, with positive and negative stamping for spacing and turbulence. The plates shall be sealed at air entry and exit to avoid air leakage and separate exhaust and supply air by proper seals. The plates shall be housed inside a casing composed of corner profiles and side walls. The corners of the exchanger package shall be cast and sealed into especially rigid steel extrusions in the casing with permanent elastic non acetic silicone. The side walls shall be manufactured from galvanized steel sheets welded to the extrusions. Plates shall be able to withstand up to 10” pressure differential and 400°F operating temperature when required. The fixed plate heat exchanger assembly shall be tested in accordance to ARI1060 and to ASHRAE 84-91. Access for all four sides of the heat exchanger shall be provided for cleaning and inspection. Temperature and pressure drop performance shall be equal or less than what is scheduled.

Stainless Steel drain pan shall be provided underneath the entire Fixed Plate with drain hole on each 4 sides of the heat exchanger. Drain connections protrude through the side of the unit. Note: Drain lines must be properly trapped and freeze protected in field. Frost control shall be accomplished by face & bypass damper where temperatures fall below freezing.

2.3 FANS

A. The fans shall be carefully positioned and installed at an optimal distance to respect uniform airflow across the heat exchanger and coil(s).

1. Scroll Fans: The fan housing shall be fully constructed from galvanized steel, with double width, double inlet and forward curved impellers for constant airflow applications below 3.5” TSP and airfoil impellers for VAV applications with greater than 3.5” TSP. Impeller wheels shall be staggered for reduced sound transmission. Painted housing shall not be acceptable. Fans shall be belt-driven with adjustable sheaves. Bearings shall be selected for an average life in excess of 200,000 hours at maximum cataloged operating speeds. Fan assembly shall be isolated from the unit housing and all fan wheels shall be statically and dynamically balanced for quiet operation. Fans shall be tested for Class I and II operating limits and rated in an AMCA certified laboratory.

2.4 FAN MOTORS

A. The fan motors shall meet NEMA standard dimensions and comply with the Energy policy Act of 1997. Motors shall have high efficiencies with low noise and vibration output. Motors shall be certified and built in accordance to ISO 9001 quality control system. Motors shall have Open Drip Proof enclosure with hi efficiency performance. Motors shall be designed for single speed application unless otherwise noted.

2.5 FILTERS

A. Filters shall be factory installed upstream of the heat exchanger and coils, in both airstreams. Filters shall be throwaway type with extended surface pleats to increase dust-holding capacity. Filters shall be 2`` thick, MERV 8 ASHRAE efficiency. Filters shall be placed in a completely sealed, galvanized holding frame with quick release latches for easy replacement. Maximum air velocity through filters shall be 500 FPM.

2.6 DAMPERS

A. Dampers shall be installed were shown on the drawings. Dampers shall be low leak type with rubber edges, opposed blades, and constructed in Aluminum. Damper actuators shall be 24V, two position or modulating type, with spring return mechanism and auxiliary switches.

2.7 COILS

A. Coils shall be factory installed in the unit. Primary surface shall be round seamless (5/8" O.D.) copper tube on 1½" centers, staggered in the direction of airflow. Secondary surface shall consist of rippled aluminum plate fins for higher capacity and structural strength.

B. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates.

C. Casing shall be constructed of continuous galvanized steel. Headers shall have intruded tube holes to provide a large brazing surface for maximum strength and inherent flexibility. The complete coil shall be tested with 315 pounds air pressure under warm water and be suitable for operation at 250 psig working pressures. Maximum finned coil height shall be 45" and shall not exceed 500 fpm face velocity. Stacked coils shall be provided for larger airflows and intermediate drain pans shall be provided for each coil bank.

D. Drain pans shall be stainless steel with drain connections on one side only. Pan shall be sloped in two planes. All coils shall be certified in accordance with ARI standard 410.

2.8 POWER AND CONTROL

A. The power and control center shall be integral to the unit housing and rated NEMA 4X. All wiring shall be accomplished by the manufacturer and must be tested under a high pot test. UNDER NO CIRCUMSTANCES SHALL ANY POWER WIRING OR PARTS BE FIELD INSTALLED. Panels that are externally mounted to the unit shall not be accepted, regardless of the NEMA rating they may have. A separate access door shall be provided with an approved locking device. All electrical components contained in the panel shall be UL/CSA certified and labeled. The unit shall be complete with motor starters, fuses, cascading overloads, relays, terminal interface for ON/OFF and step-down transformer.

B. All components shall be factory wired for single point power connection by the manufacturer of the unit. A non-fused safety disconnect switch shall be factory installed for on/off servicing. Any power wiring that is field installed shall not be accepted under any circumstances. IF UNITS SHOW UP AT THE JOB SITE WITHOUT WIRING BY THE MANUFACTURER, THE CONTRACTOR WILL HAVE TO SEND BACK UNITS TO THE MANUFACTURER AT THE CONTRACTORS' EXPENSE TO GET THEM FACTORY WIRED AND RE-TESTED.

C. HVAC related automatic temperature control wiring shall be field installed.

PART 3 - EXECUTION

3.2 FIELD INSPECTION

A. The manufacturer who is basis of design will reserve the right to field inspect the units, whether they are awarded the job or not, and shall provide a written report to the engineer noting any deficiencies to the bid specifications. If there are any deficiencies or missing items on the units shipped which are clearly mentioned in the bid documents, regardless of what is approved by the engineer on the submittals, the units shall be returned to the manufacturer for them to be corrected at the contractor’s expense.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230235

SECTION 230236

PACKAGED ROOFTOP ENERGY RECOVERY UNITS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 SUMMARY

A. This specification is based on an Energy Recovery model as manufactured by Annexair Inc.

B. All units shall be factory assembled, internally wired, and 100% run tested to check operation, fan/blower rotation and control sequence before leaving the factory. Wiring internal to the unit shall be numbered for simplified identification. Units shall be ETL listed and labeled, classified in accordance with ANSI-UL 1995 / CAN/CSA C22.2 No.236.

C. Equipment start-up and project inspection by qualified factory trained representative.

1.2 QUALITY ASSURANCE

A. All unit(s) shall be factory run tested before shipping.

B. Electrical components shall be UL listed.

C. Fans shall be tested in an AMCA equivalent laboratory.

D. Housing insulation shall comply with NFPA 90A.

E. Coils shall be tested in accordance to AHRI 410.

F. Energy recovery exchangers shall be tested in accordance to AHRI 1060, “Rating Air-to-Air Energy Recovery Equipment” and Eurovent standards.

G. Filters shall be tested in accordance to ASHRAE 52.

1.3 SUBMITTALS

A. Include product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes. Include rated capacities, operating weights, furnished specialties, and accessories.

B. Submit coordination drawings. Include unit details, plans, elevations, sections, details of components. Show support locations, type of support, weight and required clearances.

C. Submit wiring diagrams including power, signal, and control wiring.

1.4 EXTRA MATERIALS (OPTIONAL)

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.5 WARRANTY

A. Annexair Inc. (hereinafter referred to as “Annexair”) warrants products manufactured by it to be free of defects in material and workmanship under normal use and service for a period of twelve (12) months from start-up or eighteen (18) months from the date of invoice, whichever occurs first. Annexair’s obligation under this warranty is limited to repair or replace of any part(s) of Annexair unit’s which after Annexair’s examination shall disclose to its satisfaction to have been defective.

B. THIS WARRANTY DOES NOT COVER LABOR, DIAGNOSING (TROUBLESHOOTING), PREMIUM FOR OVERTIME, TRANSPORTATION, OR ANY OTHER COSTS ASSOCIATED WITH REMOVAL OR REPLACEMENT OF DEFECTIVE PART(S) COVERED UNDER THIS WARRANTY. THE REPLACEMENT OF A SECOND FAILURE OF THE SAME PART WILL NOT BE COVERED UNDER ANY CIRCUMSTANCE FOR THIS STANDARD AND ALL EXTENDED WARRANTIES.

C. Annexair considers equipment original start-up when the unit and/or fans are started for operation regardless of: -when the building may be ready for operation, -duct work not yet completed, -building management system (BMS) not yet completed, -unit balancing not yet completed.

D. Minimum (5) five year compressor warranty shall be provided, parts only – labor not included.

E. The installing contractor must be responsible for warranty service and maintenance after the equipment is placed into operation.

F. NOTIFICATION: Any modification to the Annexair equipment, including the controls and sequence of operation, without specific approval in writing by Annexair, will result in a violation of the equipment warranty.

1.6 REFERENCES

A All components selected for this project shall conform to the following Standards:

1. AFBMA 9: Load Ratings and Fatigue Life for Ball Bearings.

2. AMCA Standard 99: Standards Handbook.

3. AMCA /ANSI Standard 204: Balance Quality and Vibration Levels for Fans.

4. AMCA Standard 210: Laboratory Methods of Testing Fans for Ratings.

5. AMCA Standard 300: Reverberant Room Method for Sound Testing of Fans.

6. AMCA 320; Laboratory Method for Sound Testing of Fans Using Sound Intensity.

7. AMCA Standard 500:Test Methods for Louvers, Dampers and Shutters.

8. AHRI Standard 1060: Air-to-Air Energy Recovery Ventilation Equipment.

9. AHRI Standard 410: Forced-Circulation Air-Cooling and Air-Heating Coil.

10. AHRI Standard 1350: Mechanical Performance Rating of Central Station Air-handling Unit Casings.

11. ASHRAE Standard 52: Gravimetric and Dust Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

12. ASHRAE 52.2: Procedures for Testing Air Cleaning Devices Used for Removing Particulate Matter.

13. ASHRAE 84-91: Method of Testing Air-to-Air Heat Exchangers.

14. ASHRAE/ANSI Standard 111: Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.

15. ASTM A-525: Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

16. NEMA MG-1: National Electrical Manufacturers Association Motor Standards.

17. NFPA 90A: Standard for the Installation of Air Conditioning and Ventilating Systems.

18. SMACNA: Sheet Metal and Air Conditioning Contractors National Association.

19. UL Standard 1995: Heating and Cooling Equipment.

20. UL Standard 900: Test Performance of Air Filter Units.

1.7 COORDINATION

A. Coordinate location and installation of air-handling units. Revise locations and elevations to suit field conditions and to ensure proper operation.

B. Coordinate location and installation of air handling units with the electrical, mechanical, and plumbing contractors.

PART 2 - PRODUCTS

2.1 HOUSING

A. THERMO-COMPOSITE PANELS (*with thermal break frame*)

1. The unit housing shall be no-through metal with 2'' Thermo-Composite and foam panel construction - interior and exterior. or an all-aluminum 4" Foam thermal break construction - interior and exterior. Thermal break construction using a gasket to insulate two panels is not an acceptable equivalent to a no-through metal constructed casing. No-through metal construction will be inherent to all the component construction in the assembly.
2. The unit housing shall be constructed from a frame, base and panel assembly. Unit shall be completely factory assembled and shipped in one piece as shown on drawings.
3. Base structure shall be fully welded G-90, painted exterior, and have integral lifting lugs which can be removed once the unit is installed.
4. The frame shall consist of anodized extruded aluminum profiles which incorporates a thermally broken construction; welded together for reinforcement and insulated for superior thermal performance.
5. All panels and access doors shall be double wall construction with R14 foam insulation for every 2" of construction. All foam insulation must be Greenguard certified®. Any insulation incorporating CFCs or HCFCs in its construction is strictly prohibited from this application.
6. Thermo-Composite or aluminum panels shall be provided for the entire unit construction, including but not limited to, walls, doors, floors, roof, interior partitions, and electrical compartment. Panels shall be non-load bearing type.
7. Unit casing will have no exterior condensation at interior AHU temperatures down to 42.5F while unit exterior conditions are maintained at 95 F dry bulb / 85 F wet bulb. The air handling unit manufacturer shall submit a copy of the test report demonstrating the general construction of the unit housing thermal performance. The test shall include placing the housing panels in a climate chamber and exposing the unit to the conditions mentioned previously. If the manufacturer does not have access to a Climate Chamber such equipment, an independent testing agent must be hired to transport the test unit to a qualified test facility and perform the test at the expense of the manufacturer. Inability to provide this option to the engineer will make the manufacturer ineligible to bid on this project.
8. The panels shall be tested in accordance with SMACNA and ASHRAE 111 to have a deflection of no more than L/1150 at 10" (Exceeding AHRI casing deflection rating class CD1) and 1% leakage rate at 8" pressure and meet AHRI 1350 Casing Air Leakage rating Class 6.
9. Fire resistance of the panel will be in compliance with UL 94 rated at 5VA; and a flame spread / smoke development in compliance with UL 723 ASTM E84 Class 1 rating.

10. All roof and side wall seams shall be positively sealed to prevent water and air leakage. The OA compartment shall have 1.25” PVC drains extended to exterior of unit (outdoor units only).
11. Floor duct openings shall be covered with 1” fiberglass safety walk on gratings.
12. Access doors shall be provided to all major components to facilitate quick and easy access. Access doors will be made from the same material as the unit casing and shall incorporate thermal break construction. Fan access door(s) shall have Allegis type handles, with one handle interlinking multiple latches and threaded insert fastening handles for all remaining doors. If access doors do not open against unit operating pressure, provide safety latches that allow access doors to partially open after first handle movement and fully open after second handle movement. Hinges shall be Nylon hinge type designed to open 180 degrees. Removable panels provided for equipment pull out for coil(s), and air to air heat exchanger section(s) shall have key tooled threaded insert fasteners.
13. Unit shall have the entire exterior finished with a PVDF coating designed for UV resistance. Panels shall be painted Annexair standard color white gray RAL 9002. If custom color is required, please specify the associated RAL color code (per factory approval). Panels shall pass ASTM B117 3000-hour salt fog resistance test and ASTM D4585 3000-hour moisture condensation resistance test. In addition, paint must meet AAMA 620-02 standard for color, chalking, gloss retention, and abrasion resistance.
14. Outdoor units shall have a rain gutter above each access door and a watertight roof shall be provided with a white TPO UV-reflective membrane. Indoor units do not have the TPO membrane.
15. The air handler unit casing shall be provided with a lifetime warranty against corrosion under normal use.

B. WEATHER HOODS

1. The outdoor intake weather hood shall be completely constructed in aluminum for superior corrosion resistance. The hood shall ship loose for field installation by the installing contractor. Painted galvanized hoods shall not be acceptable due to its susceptibility to corrosion. The outdoor air hood shall be designed with a 4” extruded aluminum louver, bird screen and a plenum enclosure with drain holes. The louver blades shall be drainable type with a maximum 45 degree angle and curved with integral rain baffle. The louver design shall not allow more than 0.03 oz/ft2 water penetration when tested in accordance to AMCA 500. The pressure drop of the complete hood assembly shall not exceed 0.05”wc at a maximum 500 fpm face velocity.

2. A Pre-filter rack system shall be installed within the weather hood enclosure to prevent outdoor air dust and debris from entering the damper and unit casing plenum. Pre-filters installed inside the unit casing plenum and downstream of the outdoor damper will not be acceptable as this will increase overall maintenance on the damper, reduce indoor air quality and promote mold and bacteria growth. Filter access in the hood shall be accomplished via the louver that is installed with a stainless steel piano hinge and spring loaded latch. No tools or ladders shall be required to access the pre-filters in the weather hood assembly.

C. EXHAUST AIR LOUVER

1. The exhaust air outlet louvers shall be 2" extruded aluminum, with non- restricting blade design and bird screen.

2.2 HEAT RECOVERY ENTHALPY WHEEL

A. Enthalpy Wheel shall recover both sensible and latent heat. The matrix shall be constructed from corrugated aluminum and specifically treated and coated with Silica Gel desiccant to assist and enhance latent heat transfer. Any other type desiccants, including 3A or 4A Molecular Sieves, will not be accepted for HVAC applications.

B. Seals shall be full contact, low bleed type, made from dual band Ultra High Molecular Weight Polyethylene. Any seal that is non-contact is not to be considered a seal and will not acceptable. Labyrinth type seals do not operate properly under different air stream pressures therefore shall not be acceptable in any circumstances.

C. Drive system shall be operated by a fractional horsepower motor (maximum 1 HP), reducing gear-box, pulley and v-belt. The wheel bearing shall be permanently sealed, and press fitted into the wheel matrix for long life operation. A double purge sector (2 x 5º) shall be factory installed to reduce cross contamination to under 0.1%.

D. Frost control prevention shall be accounted for if outdoor air temperatures are below 10 degrees F at equal airflows and return relative humidity below 30%. Frost control shall be accomplished by a variable speed drive and controlling the leaving air condition of the exhaust air. Other methods of frost control will not be considered for this application. Wheel speed shall not rotate faster than 20 rpm. Any rotational speed above 20 rpm will be unacceptable.

2.3 FANS

A. EC-SPIDER FANS WITH PM MOTOR AND SPEED CONTROLLER (ANNEXAIR)

1. Fans shall be direct drive with non-obstructive air intake and externally mounted motor. Fans shall be compact, optimized and construction made of aluminum with 7-blade airfoil geometry protected by an epoxy powder coating.

2. To reduce vibration, the impeller shall be balanced to an admissible vibration severity of less than 3.8 mm/s (0.15in/s). Tests shall be made according to ANSI/AMCA Standard 204-05 Fan Application Category for balance and vibration: HVAC BV-3, Balance Quality Grade for rigid Rotors / Impeller: G6.3.
3. The fan and motor assembly shall be directly wall mounted without isolation.
4. Fan will require to be operated by a variable speed drive.
5. The permanent magnet motors shall have high efficiencies (up to 93%+controller) with low noise, low vibration output, compact design, longer life, increased torque at start, reduced heat losses and reduced friction between components.
6. The motor should be able to operate between -4F and +140F ambient temperature.
7. Dust and humidity protection should be IP54.
8. An insulated shaft-rotor kit will be provided to reduce shaft voltage electrical damage to motor bearings.
9. Speed controller will be used to set or regulate the fan speed and airflow for these units.
10. The speed controller shall be capable of controlling an IPM (Internal Permanent Magnet) motor to 400Hz. An auto-tuning system shall provide the ability to drive any IPM motors.
11. The efficiency of the speed controller at 100% speed and load shall not be less than 95%.
12. There shall be a regenerative avoidance function to minimize the effect of opposite rotation of another fan within the same duct and have Out-of-Range warning system to detect any potential mechanical problems.
13. The speed controller shall have momentary power-loss ride-thru capability.
14. The speed controller shall incorporate PID and Dual PID for process controls such as flow rate, air volume, or pressure.
15. The input power section shall utilize a full wave 6-pulse bridge design incorporating diode rectifiers. The diode rectifiers shall convert AC line power of fixed voltage and frequency to fixed DC voltage. This power section shall be insensitive to phase sequence of the AC line voltage.
16. The output power section shall change fixed DC voltage to adjustable frequency AC voltage. This section shall utilize insulated gate bipolar transistors (IGBT's).
17. The speed controller includes 3 sets of user adjustable skip frequencies and choice of 0-5Vdc, 0-10Vdc or 4-20mA speed reference for input and output.
18. The speed controller shall incorporate a dedicated USB port for programming.
19. The speed controller will have PWM control, RS-485 / Modbus RTU and BACnet MS/TP communication as standard, & carrier frequency up-to 14.5 KHz.
20. Control logic terminals shall be of the clamp / vibration resistant type.
21. The speed controller shall incorporate a radio filter capable of meeting product standard EN61800-3 for Second (2nd) Environment.
22. The speed controller shall have built-in PLC capable of 6k steps.
23. Speed controller shall be installed as shown on drawings with contactors, relays, and all specified accessories.

2.4 FILTERS (DAFCO FILTRATION FROUP)

A. PRE-FILTERS *(HIGH CAPACITY SERIES 400 2*" *MERV 10)*

1. Filters shall be factory installed where shown on the drawings.
2. The filters shall be Filtration Group Series 400, MERV 10.

3. Media shall be 100% synthetic, mechanical media that does not support microbial growth.

4. Frame shall be a heavy duty, high strength, moisture resistant paperboard with a cross member design that increases filter rigidity and prevents breaching. Frame shall be recyclable.
5. Filters shall have an expanded metal support grid bonded to the air-exiting side of the filter to maintain pleat uniformity and prevent fluttering. Metal support grid shall be recyclable.
6. MERV 10 model High Capacity Serie 400 filters are classified to UL 900 and tested in accordance with the ASHRAE test 52.2.
7. Filter shall have a low initial pressure drop that shall not exceed 0.17” w.g. in 2” at 500 fpm air flow, and 0.11” in 4” at 500 fpm air flow. Filters shall have a recommended final resistance of 1.0" w.g.
8. Filters shall be rated to withstand a continuous operating temperature up to 200°F.
9. Filters shall be placed in a completely sealed, galvanized holding frame with quick release latches for easy replacement.

B. FINAL FILTERS (GEOPLEAT4” MERV 13 (90-95%)

1. Filters shall be factory installed where shown on the drawings.
2. The air filters shall be Filtration Group Geopleat mini-pleat MERV15.
3. Media shall be 100% synthetic gradient dual density media that does not support microbial growth.
4. Frame shall be constructed with high-impact plastic and impervious to moisture and high humidity.
5. Media pack shall be adhered to plastic frame on all sides to prevent air by-pass.
6. Filter shall have a hot melt bead separator to maintain pleat pack stability and ensure consistent pleat spacing for optimum air flow.

7. MERV 15 model Geopleat filters are classified to UL 900 and tested in accordance with the ASHRAE test 52.2.
8. Filter shall have a low initial pressure drop that shall not exceed 0.36” w.g. in 4” at 500 fpm air flow. Filters shall have a recommended final resistance of 1.5" w.g.
9. Filters shall be rated to withstand a continuous operating temperature up to 150°F.
10. Filters shall be placed in a completely sealed, galvanized holding frame with quick release latches for easy replacement.

2.5 DAMPERS

A. AIR FOIL CONTROL DAMPER (TAMCO SERIES 1000)

1. Dampers shall be installed where shown on the drawings.
2. Dampers shall be low leak type (Leakage Class 1A at 1 in. w.g. (0.25 kPa) static pressure differential).
3. Blades are maximum 6” deep extruded aluminum air-foil profiles. All blades are symmetrically pivoted. Galvanized dampers will not be acceptable.
4. Blade seals are extruded EPDM. Frame seals are extruded silicone. Seals are secured in an integral slot within the aluminum extrusions. Blade and frame seals are mechanically fastened to prevent shrinkage and movement over the life of the

damper.

5. Dampers shall be opposed blade type and installed in the compartments (as shown on the drawings) with linkage rod for actuators, unless otherwise noted.
6. Actuators shall be 24V factory installed; two-position or modulating (please refer to the unit schedule).
7. All actuators shall have spring return mechanism and auxiliary switches. Dampers will be installed in the failed close positions unless otherwise noted.

2.6 COILS

A. DX VRF TYPE COILS

Coils shall be factory installed in the unit.

1. VRF coils (for use with remote VRF outdoor units) shall be designed with respective circuits to match the design requirements.
2. All coils shall have a distributor per circuit connection. Coils shall be circuited for counter-flow heat transfer to provide maximum mean effective temperature difference for maximum heat transfer rates.
3. Primary surface shall be round seamless (3/8” O.D.) copper tube staggered in the direction of airflow. Secondary surface shall consist of rippled aluminum plate fins for higher capacity and structural strength. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Headers shall have intruded tube holes to provide a large brazing surface for maximum strength and inherent flexibility.
4. Casing shall be constructed of continuous galvanized steel.
5. The complete coil shall be tested with 315 pounds air pressure under warm water and be suitable for operation at 250 psig working pressures. Maximum finned coil height shall be 60” and shall not exceed 500 FPM face velocity.
6. Drain pan shall be provided on cooling coils. Cooling coils shall sit on stainless steel support rails, which shall stand a minimum of (2) two inches above the highest point of the floor drain pan. Stacked coils shall be provided for larger airflows and intermediate drain pans shall be provided for each coil bank. Drain pans shall be 316 stainless steel with 1.25” MPT stainless steel drain connections on one side only. Pan shall be sloped in three planes.

A. HOT GAS REHEAT

1. Coils shall be factory installed in the unit.
2. The hot gas reheat coil shall be installed at 4” from the moisture producing DX cooling coil. A plexi glass between the two items shall be required to visually inspect the DX cooling coil surface area, and also have the ability to clean the coils when necessary.

3. A modulating valve shall be provided to control air leaving temperature for dehumidification.
4. Coils shall be designed with respective circuits to match the design requirements.
5. Primary surface shall be round seamless (3/8" O.D.) copper tube staggered in the direction of airflow. Secondary surface shall consist of rippled aluminum plate fins for higher capacity and structural strength. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Headers shall have intruded tube holes to provide a large brazing surface for maximum strength and inherent flexibility.
6. Casing shall be constructed of continuous galvanized steel.
7. The complete coil shall be tested with 315 pounds air pressure under warm water and be suitable for operation at 250 psig working pressures.

2.7 POWER AND SAFETY CONTROL

A. The power and control center shall be integral to the unit housing and rated equivalent to NEMA 4X.

B. Under no circumstances shall any wiring or parts be field installed. If units show up at the job site without wiring by the manufacturer, the contractor will have to send back units to the manufacturer at the contractors' expense to get them factory wired and re-tested.

C. Panels that are externally mounted to the unit shall not be accepted, regardless of the NEMA rating they may have.

D. Each panel should have a separate access door with an approved locking device.

E. All electrical components contained in the panel shall be UL/CSA certified and labeled. The unit shall be complete with VFDs, fuses, relays, phase protection for compressorized units, terminals for main ON/OFF and step-down transformer. All components shall be factory wired for single point power connection by the manufacturer of the unit. A non-fused safety disconnect switch shall be factory installed for ON/OFF servicing.

F. An electrical pipe chase for power and control feeding shall be provided next to the control panel.

G. The Short Circuit Current Rating (SCCR) is 5 KA (208/460 V) rms symmetrical, as noted on schedule.

H. GFI (120 V/1), lights and switches shall be factory installed and wired to a common junction box, powered by others (a separate 120V/1 required).

I. Phase loss monitor.

2.8 AIR TEMPERATURE CONTROL PACKAGE

A. The unit shall be delivered with factory installed control system. Under no circumstances shall control be provided by other than the manufacturer of the equipment. Field installed control package by the ATC will not be acceptable.

B. The control system shall consist of a microprocessor with 8-lines and 22-charaters built-in LCD display, allowing for full monitoring of all the unit equipment. Six push buttons allow for menu navigation and settings modification as required. Remote access ports also allow for potential program upgrade, operation log download and unit monitoring.

C. Refer to the Sequence of Operation and control schematic for detailed description of control logic and options.

D. Refer to control schematic for all field installed control components and control capability to and/or from others.

E. Communication Interface Card: The microprocessor shall be capable of communicating with the following protocol language: Bacnet MS/TP RS-485.

2.9 ADDITIONAL ACCESSORIES AND UNIT FEATURES

A. Dirty filter switch

B. Rotation detector (where applicable)

C. Door interlocking switch (for fan section)

D. Magnehelic gauges (Dwyer 2000 model)

E. Condensate overflow switch (for drain pans)

F. OA Air Flow Monitoring Package – IAQ-TEK
The airflow measuring station shall consist of a special probe, a transducer and a display. The probe will be designed to be accurate in turbulent airflow and will be a standard design to fit all ducts. Only the number of probes will change based on the surface area. Probes can be washed down if required. The high accuracy transducer shall be mounted inside a NEMA 4 enclosure where temperature is controlled and shall also include an auto-zero function to prevent drifting. The display will indicate airflow, temperature and alarms. It will also serve as the interface to configure the system via an internal Set-up Wizard. This Set-up Wizard will include start-up, commissioning and diagnostics functions without the use of a laptop computer or other tools. All calculations, and management operations will be done within the display unit. The accuracy shall be +/- 5% of reading between 200 and 965 ft/min and +/- 10% of reading between 75 and 200 ft/min. as per Tek-Air series IAQ-Tek.

G. Fan Airflow Monitoring Station Package
The unit shall be delivered with factory installed airflow measuring system. The airflow measuring system, consisting of a piezometer ring and transducer, shall be installed on the fan. The package consists of an inlet port on the fan inlet cone connected with flexible tubing to the transducer.

H. Fan Airflow Balancing Package – EZBALANCER
The EZBalancer controller is designed to set and monitor unit airflow of the fans without adjusting VFD settings by simply using keypad buttons. Field VFD adjustments are no longer required. Unit CFM readings are continuously displayed on the LCD screen and a 4-20 mA signal sent to others (BMS). One (1) EZBalancer is required for up to two (2) airflows even if multiple fans are used. It can be applied for constant and variable airflow applications with a 0-10Vdc signal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine ducts, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install Air Handling Unit per manufacturers' instructions.

B. Install with required clearance for service and maintenance.

3.3 TESTING

A. System verification testing is part of the commissioning process. Verification testing shall be performed by the Contractor and witnessed and documented by the Commissioning Authority. Refer to section 230485, Commissioning, for system verification tests and commissioning requirements.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Commissioning Authority. Provide competent, factory-authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the Commissioning Authority after submission and approval of formal training plans. Refer to section 230470, Commissioning, for further contractor training requirements.

B. Contact Annexair to request pricing to include factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain humidifiers.
1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
2. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
3. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
4. Schedule training with Owner, through Architect, with at least seven days advance notice.

END OF SECTION 230236

SECTION 230237

PACKAGED ROOFTOP FIXED PLATE ENERGY RECOVERY UNITS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 SUMMARY

A. This specification is based on an Energy Recovery model as manufactured by Annexair Inc.

B. All units shall be factory assembled, internally wired, and 100% run tested to check operation, fan/blower rotation and control sequence before leaving the factory. Wiring internal to the unit shall be numbered for simplified identification. Units shall be ETL listed and labeled, classified in accordance with ANSI-UL 1995 / CAN/CSA C22.2 No.236.

C. Equipment start-up and project inspection by qualified factory trained representative.

1.2 QUALITY ASSURANCE

A. All unit(s) shall be factory run tested before shipping.

B. Electrical components shall be UL listed.

C. Fans shall be tested in an AMCA equivalent laboratory.

D. Housing insulation shall comply with NFPA 90A.

E. Coils shall be tested in accordance to AHRI 410.

F. Energy recovery exchangers shall be tested in accordance to AHRI 1060, “Rating Air-to-Air Energy Recovery Equipment” and Eurovent standards.

G. Filters shall be tested in accordance to ASHRAE 52.

1.3 SUBMITTALS

A. Include product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes. Include rated capacities, operating weights, furnished specialties, and accessories.

B. Submit coordination drawings. Include unit details, plans, elevations, sections, details of components. Show support locations, type of support, weight and required clearances.

C. Submit wiring diagrams including power, signal, and control wiring.

1.4 EXTRA MATERIALS (OPTIONAL)

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.5 WARRANTY

A. Annexair Inc. (hereinafter referred to as “Annexair”) warrants products manufactured by it to be free of defects in material and workmanship under normal use and service for a period of twelve (12) months from start-up or eighteen (18) months from the date of invoice, whichever occurs first. Annexair’s obligation under this warranty is limited to repair or replace of any part(s) of Annexair unit’s which after Annexair’s examination shall disclose to its satisfaction to have been defective.

B. THIS WARRANTY DOES NOT COVER LABOR, DIAGNOSING (TROUBLESHOOTING), PREMIUM FOR OVERTIME, TRANSPORTATION, OR ANY OTHER COSTS ASSOCIATED WITH REMOVAL OR REPLACEMENT OF DEFECTIVE PART(S) COVERED UNDER THIS WARRANTY. THE REPLACEMENT OF A SECOND FAILURE OF THE SAME PART WILL NOT BE COVERED UNDER ANY CIRCUMSTANCE FOR THIS STANDARD AND ALL EXTENDED WARRANTIES.

C. Annexair considers equipment original start-up when the unit and/or fans are started for operation regardless of: -when the building may be ready for operation, -duct work not yet completed, -building management system (BMS) not yet completed, -unit balancing not yet completed.

D. Minimum (5) five year compressor warranty shall be provided, parts only – labor not included.

E. The installing contractor must be responsible for warranty service and maintenance after the equipment is placed into operation.

F. NOTIFICATION: Any modification to the Annexair equipment, including the controls and sequence of operation, without specific approval in writing by Annexair, will result in a violation of the equipment warranty.

1.6 REFERENCES

A All components selected for this project shall conform to the following Standards:

1. AFBMA 9: Load Ratings and Fatigue Life for Ball Bearings.

2. AMCA Standard 99: Standards Handbook.

3. AMCA /ANSI Standard 204: Balance Quality and Vibration Levels for Fans.

4. AMCA Standard 210: Laboratory Methods of Testing Fans for Ratings.

5. AMCA Standard 300: Reverberant Room Method for Sound Testing of Fans.

6. AMCA 320; Laboratory Method for Sound Testing of Fans Using Sound Intensity.

7. AMCA Standard 500:Test Methods for Louvers, Dampers and Shutters.

8. AHRI Standard 1060: Air-to-Air Energy Recovery Ventilation Equipment.

9. AHRI Standard 410: Forced-Circulation Air-Cooling and Air-Heating Coil.

10. AHRI Standard 1350: Mechanical Performance Rating of Central Station Air-handling Unit Casings.

11. ASHRAE Standard 52: Gravimetric and Dust Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

12. ASHRAE 52.2: Procedures for Testing Air Cleaning Devices Used for Removing Particulate Matter.

13. ASHRAE 84-91: Method of Testing Air-to-Air Heat Exchangers.

14. ASHRAE/ANSI Standard 111: Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.

15. ASTM A-525: Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

16. NEMA MG-1: National Electrical Manufacturers Association Motor Standards.

17. NFPA 90A: Standard for the Installation of Air Conditioning and Ventilating Systems.

18. SMACNA: Sheet Metal and Air Conditioning Contractors National Association.

19. UL Standard 1995: Heating and Cooling Equipment.

20. UL Standard 900: Test Performance of Air Filter Units.

1.7 COORDINATION

A. Coordinate location and installation of air-handling units. Revise locations and elevations to suit field conditions and to ensure proper operation.

B. Coordinate location and installation of air handling units with the electrical, mechanical, and plumbing contractors.

PART 2 - PRODUCTS

2.1 HOUSING

A. THERMO-COMPOSITE PANELS (*with thermal break frame*)

1. The unit housing shall be no-through metal with 2'' Thermo-Composite and foam panel construction - interior and exterior. or an all-aluminum 4" Foam thermal break construction - interior and exterior. Thermal break construction using a gasket to insulate two panels is not an acceptable equivalent to a no-through metal constructed casing. No-through metal construction will be inherent to all the component construction in the assembly.
2. The unit housing shall be constructed from a frame, base and panel assembly. Unit shall be completely factory assembled and shipped in one piece as shown on drawings.
3. Base structure shall be fully welded G-90, painted exterior, and have integral lifting lugs which can be removed once the unit is installed.
4. The frame shall consist of anodized extruded aluminum profiles which incorporates a thermally broken construction; welded together for reinforcement and insulated for superior thermal performance.
5. All panels and access doors shall be double wall construction with R14 foam insulation for every 2" of construction. All foam insulation must be Greenguard certified®. Any insulation incorporating CFCs or HCFCs in its construction is strictly prohibited from this application.
6. Thermo-Composite or aluminum panels shall be provided for the entire unit construction, including but not limited to, walls, doors, floors, roof, interior partitions, and electrical compartment. Panels shall be non-load bearing type.
7. Unit casing will have no exterior condensation at interior AHU temperatures down to 42.5F while unit exterior conditions are maintained at 95 F dry bulb / 85 F wet bulb. The air handling unit manufacturer shall submit a copy of the test report demonstrating the general construction of the unit housing thermal performance. The test shall include placing the housing panels in a climate chamber and exposing the unit to the conditions mentioned previously. If the manufacturer does not have access to a Climate Chamber such equipment, an independent testing agent must be hired to transport the test unit to a qualified test facility and perform the test at the expense of the manufacturer. Inability to provide this option to the engineer will make the manufacturer ineligible to bid on this project.
8. The panels shall be tested in accordance with SMACNA and ASHRAE 111 to have a deflection of no more than L/1150 at 10" (Exceeding AHRI casing deflection rating class CD1) and 1% leakage rate at 8" pressure and meet AHRI 1350 Casing Air Leakage rating Class 6.

9. Fire resistance of the panel will be in compliance with UL 94 rated at 5VA; and a flame spread / smoke development in compliance with UL 723 ASTM E84 Class 1 rating.

10. All roof and side wall seams shall be positively sealed to prevent water and air leakage. The OA compartment shall have 1.25" PVC drains extended to exterior of unit (outdoor units only).
11. Floor duct openings shall be covered with 1" fiberglass safety walk on gratings.
12. Access doors shall be provided to all major components to facilitate quick and easy access. Access doors will be made from the same material as the unit casing and shall incorporate thermal break construction. Fan access door(s) shall have Allegis type handles, with one handle interlinking multiple latches and threaded insert fastening handles for all remaining doors. If access doors do not open against unit operating pressure, provide safety latches that allow access doors to partially open after first handle movement and fully open after second handle movement. Hinges shall be Nylon hinge type designed to open 180 degrees. Removable panels provided for equipment pull out for coil(s), and air to air heat exchanger section(s) shall have key tooled threaded insert fasteners.
13. Unit shall have the entire exterior finished with a PVDF coating designed for UV resistance. Panels shall be painted Annexair standard color white gray RAL 9002. If custom color is required, please specify the associated RAL color code (per factory approval). Panels shall pass ASTM B117 3000-hour salt fog resistance test and ASTM D4585 3000-hour moisture condensation resistance test. In addition, paint must meet AAMA 620-02 standard for color, chalking, gloss retention, and abrasion resistance.
14. Outdoor units shall have a rain gutter above each access door and a watertight roof shall be provided with a white TPO UV-reflective membrane. Indoor units do not have the TPO membrane.
15. The air handler unit casing shall be provided with a lifetime warranty against corrosion under normal use.

B. WEATHER HOODS

1. The outdoor intake weather hood shall be completely constructed in aluminum for superior corrosion resistance. The hood shall ship loose for field installation by the installing contractor. Painted galvanized hoods shall not be acceptable due to its susceptibility to corrosion. The outdoor air hood shall be designed with a 4" extruded aluminum louver, bird screen and a plenum enclosure with drain holes. The louver blades shall be drainable type with a maximum 45 degree angle and curved with integral rain baffle. The louver design shall not allow more than 0.03 oz/ft2 water penetration when tested in accordance to AMCA 500. The pressure drop of the complete hood assembly shall not exceed 0.05"wc at a maximum 500 fpm face velocity.

2. A Pre-filter rack system shall be installed within the weather hood enclosure to prevent outdoor air dust and debris from entering the damper and unit casing plenum. Pre-filters installed inside the unit casing plenum and downstream of the outdoor damper will not be acceptable as this will increase overall maintenance on the damper, reduce indoor air quality and promote mold and bacteria growth. Filter access in the hood shall be accomplished via the louver that is installed with a stainless steel piano hinge and spring loaded latch. No tools or ladders shall be required to access the pre-filters in the weather hood assembly.

C. EXHAUST AIR LOUVER

1. The exhaust air outlet louvers shall be 2" extruded aluminum, with non- restricting blade design and bird screen.

2.2 FIXED PLATE HEAT EXCHANGER

A. Fixed plates heat exchangers shall factory installed where indicated on drawings. The heat exchanger shall be a Cross flow plate-air-to-air type. The alternate layers of plate create two ducts, one for supply air and one for exhaust air. The plates shall be in pure aluminum for its characteristics of corrosion resistance, ease of manufacture, flame proof, durability and excellent heat transfer properties (option: For aggressive and corrosive applications, the plates shall be stainless steel. Minimum plate thickness shall be .008", with positive and negative stamping for spacing and turbulence. The plates shall be sealed at air entry and exit to avoid air leakage and separate exhaust and supply air by proper seals. The plates shall be housed inside a casing composed of corner profiles and side walls. The corners of the exchanger package shall be cast and sealed into especially rigid steel extrusions in the casing with permanent elastic non acetic silicone. The side walls shall be manufactured from galvanized steel sheets welded to the extrusions. Plates shall be able to withstand up to 10" pressure differential and 400°F operating temperature when required. The fixed plate heat exchanger assembly shall be tested in accordance to ARI1060 and to ASHRAE 84-91. Access for all four sides of the heat exchanger shall be provided for cleaning and inspection. Temperature and pressure drop performance shall be equal or less than what is scheduled.

B. Stainless Steel drain pan shall be provided underneath the entire Fixed Plate with drain hole on each 4 sides of the heat exchanger. Drain connections protrude through the side of the unit. Note: Drain lines must be properly trapped and freeze protected in field. Frost control shall be accomplished by face & bypass damper where temperatures fall below freezing. Any other form of defrost shall not be acceptable

2.3 FANS

A. EC-SPIDER FANS WITH PM MOTOR AND SPEED CONTROLLER (ANNEXAIR)

1. Fans shall be direct drive with non-obstructive air intake and externally mounted motor. Fans shall be compact, optimized and construction made of aluminum with 7-blade airfoil geometry protected by an epoxy powder coating.

2. To reduce vibration, the impeller shall be balanced to an admissible vibration severity of less than 3.8 mm/s (0.15in/s). Tests shall be made according to ANSI/AMCA Standard 204-05 Fan Application Category for balance and vibration: HVAC BV-3, Balance Quality Grade for rigid Rotors / Impeller: G6.3.
3. The fan and motor assembly shall be directly wall mounted without isolation.
4. Fan will require to be operated by a variable speed drive.
5. The permanent magnet motors shall have high efficiencies (up to 93%+controller) with low noise, low vibration output, compact design, longer life, increased torque at start, reduced heat losses and reduced friction between components.
6. The motor should be able to operate between -4F and +140F ambient temperature.
7. Dust and humidity protection should be IP54.
8. An insulated shaft-rotor kit will be provided to reduce shaft voltage electrical damage to motor bearings.
9. Speed controller will be used to set or regulate the fan speed and airflow for these units.
10. The speed controller shall be capable of controlling an IPM (Internal Permanent Magnet) motor to 400Hz. An auto-tuning system shall provide the ability to drive any IPM motors.
11. The efficiency of the speed controller at 100% speed and load shall not be less than 95%.
12. There shall be a regenerative avoidance function to minimize the effect of opposite rotation of another fan within the same duct and have Out-of-Range warning system to detect any potential mechanical problems.
13. The speed controller shall have momentary power-loss ride-thru capability.
14. The speed controller shall incorporate PID and Dual PID for process controls such as flow rate, air volume, or pressure.
15. The input power section shall utilize a full wave 6-pulse bridge design incorporating diode rectifiers. The diode rectifiers shall convert AC line power of fixed voltage and frequency to fixed DC voltage. This power section shall be insensitive to phase sequence of the AC line voltage.
16. The output power section shall change fixed DC voltage to adjustable frequency AC voltage. This section shall utilize insulated gate bipolar transistors (IGBT's).
17. The speed controller includes 3 sets of user adjustable skip frequencies and choice of 0-5Vdc, 0-10Vdc or 4-20mA speed reference for input and output.
18. The speed controller shall incorporate a dedicated USB port for programming.
19. The speed controller will have PWM control, RS-485 / Modbus RTU and BACnet MS/TP communication as standard, & carrier frequency up-to 14.5 KHz.
20. Control logic terminals shall be of the clamp / vibration resistant type.
21. The speed controller shall incorporate a radio filter capable of meeting product standard EN61800-3 for Second (2nd) Environment.
22. The speed controller shall have built-in PLC capable of 6k steps.
23. Speed controller shall be installed as shown on drawings with contactors, relays, and all specified accessories.

2.4 FILTERS (DAFCO FILTRATION GROUP)

A. PRE-FILTERS *(HIGH CAPACITY SERIES 400 2" MERV 10)*

1. Filters shall be factory installed where shown on the drawings.
2. The filters shall be Filtration Group Series 400, MERV 10.

3. Media shall be 100% synthetic, mechanical media that does not support microbial growth.
4. Frame shall be a heavy duty, high strength, moisture resistant paperboard with a cross member design that increases filter rigidity and prevents breaching. Frame shall be recyclable.
5. Filters shall have an expanded metal support grid bonded to the air-exiting side of the filter to maintain pleat uniformity and prevent fluttering. Metal support grid shall be recyclable.
6. MERV 10 model High Capacity Serie 400 filters are classified to UL 900 and tested in accordance with the ASHRAE test 52.2.
7. Filter shall have a low initial pressure drop that shall not exceed 0.17” w.g. in 2” at 500 fpm air flow, and 0.11” in 4” at 500 fpm air flow. Filters shall have a recommended final resistance of 1.0" w.g.
8. Filters shall be rated to withstand a continuous operating temperature up to 200°F.
9. Filters shall be placed in a completely sealed, galvanized holding frame with quick release latches for easy replacement.

B. FINAL FILTERS (GEOPLEAT4” MERV 13 (90-95%)

1. Filters shall be factory installed where shown on the drawings.
2. The air filters shall be Filtration Group Geopleat mini-pleat MERV15.
3. Media shall be 100% synthetic gradient dual density media that does not support microbial growth.
4. Frame shall be constructed with high-impact plastic and impervious to moisture and high humidity.
5. Media pack shall be adhered to plastic frame on all sides to prevent air by-pass.
6. Filter shall have a hot melt bead separator to maintain pleat pack stability and ensure consistent pleat spacing for optimum air flow.
7. MERV 15 model Geopleat filters are classified to UL 900 and tested in accordance with the ASHRAE test 52.2.
8. Filter shall have a low initial pressure drop that shall not exceed 0.36” w.g. in 4” at 500 fpm air flow. Filters shall have a recommended final resistance of 1.5" w.g.
9. Filters shall be rated to withstand a continuous operating temperature up to 150°F.
10. Filters shall be placed in a completely sealed, galvanized holding frame with quick release latches for easy replacement.

2.5 DAMPERS

A. AIR FOIL CONTROL DAMPER (TAMCO SERIES 1000)

1. Dampers shall be installed where shown on the drawings.
2. Dampers shall be low leak type (Leakage Class 1A at 1 in. w.g. (0.25 kPa) static pressure differential).
3. Blades are maximum 6” deep extruded aluminum air-foil profiles. All blades are symmetrically pivoted. Galvanized dampers will not be acceptable.
4. Blade seals are extruded EPDM. Frame seals are extruded silicone. Seals are secured in an integral slot within the aluminum extrusions. Blade and frame seals are mechanically fastened to prevent shrinkage and movement over the life of the damper.

5. Dampers shall be opposed blade type and installed in the compartments (as shown on the drawings) with linkage rod for actuators, unless otherwise noted.
6. Actuators shall be 24V factory installed; two-position or modulating (please refer to the unit schedule).
7. All actuators shall have spring return mechanism and auxiliary switches. Dampers will be installed in the failed close positions unless otherwise noted.

2.6 COILS

A. DX VRF TYPE COILS

Coils shall be factory installed in the unit.

1. VRF coils (for use with remote VRF outdoor units) shall be designed with respective circuits to match the design requirements.

2. All coils shall have a distributor per circuit connection. Coils shall be circuited for counter-flow heat transfer to provide maximum mean effective temperature difference for maximum heat transfer rates.

3. Primary surface shall be round seamless (3/8” O.D.) copper tube staggered in the direction of airflow. Secondary surface shall consist of rippled aluminum plate fins for higher capacity and structural strength. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Headers shall have intruded tube holes to provide a large brazing surface for maximum strength and inherent flexibility.

4. Casing shall be constructed of continuous galvanized steel.

5. The complete coil shall be tested with 315 pounds air pressure under warm water and be suitable for operation at 250 psig working pressures. Maximum finned coil height shall be 60” and shall not exceed 500 FPM face velocity.

6. Drain pan shall be provided on cooling coils. Cooling coils shall sit on stainless steel support rails, which shall stand a minimum of (2) two inches above the highest point of the floor drain pan. Stacked coils shall be provided for larger airflows and intermediate drain pans shall be provided for each coil bank. Drain pans shall be 316 stainless steel with 1.25” MPT stainless steel drain connections on one side only. Pan shall be sloped in three planes.

B. HOT GAS REHEAT

1. Coils shall be factory installed in the unit.

2. The hot gas reheat coil shall be installed at 4” from the moisture producing DX cooling coil. A plexi glass between the two items shall be required to visually

inspect the DX cooling coil surface area, and also have the ability to clean the coils when necessary.

3. A modulating valve shall be provided to control air leaving temperature for dehumidification.

4. Coils shall be designed with respective circuits to match the design requirements.

5. Primary surface shall be round seamless (3/8" O.D.) copper tube staggered in the direction of airflow. Secondary surface shall consist of rippled aluminum plate fins for higher capacity and structural strength. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Headers shall have intruded tube holes to provide a large brazing surface for maximum strength and inherent flexibility.

6. Casing shall be constructed of continuous galvanized steel.

7. The complete coil shall be tested with 315 pounds air pressure under warm water and be suitable for operation at 250 psig working pressures.

2.7 POWER AND SAFETY CONTROL

A. The power and control center shall be integral to the unit housing and rated equivalent to NEMA 4X.

B. Under no circumstances shall any wiring or parts be field installed. If units show up at the job site without wiring by the manufacturer, the contractor will have to send back units to the manufacturer at the contractors' expense to get them factory wired and re-tested.

C. Panels that are externally mounted to the unit shall not be accepted, regardless of the NEMA rating they may have.

D. Each panel should have a separate access door with an approved locking device.

E. All electrical components contained in the panel shall be UL/CSA certified and labeled. The unit shall be complete with VFDs, fuses, relays, phase protection for compressorized units, terminals for main ON/OFF and step-down transformer. All components shall be factory wired for single point power connection by the manufacturer of the unit. A non-fused safety disconnect switch shall be factory installed for ON/OFF servicing.

F. An electrical pipe chase for power and control feeding shall be provided next to the control panel.

G. The Short Circuit Current Rating (SCCR) is 5 KA (208/460 V) rms symmetrical, as noted on schedule.

H. GFI (120 V/1), lights and switches shall be factory installed and wired to a common junction box, powered by others (a separate 120V/1 required).

I. Phase loss monitor.

2.8 AIR TEMPERATURE CONTROL PACKAGE

A. The unit shall be delivered with factory installed control system. Under no circumstances shall control be provided by other than the manufacturer of the equipment. Field installed control package by the ATC will not be acceptable.

B. The control system shall consist of a microprocessor with 8-lines and 22-charaters built-in LCD display, allowing for full monitoring of all the unit equipment. Six push buttons allow for menu navigation and settings modification as required. Remote access ports also allow for potential program upgrade, operation log download and unit monitoring.

C. Refer to the Sequence of Operation and control schematic for detailed description of control logic and options.

D. Refer to control schematic for all field installed control components and control capability to and/or from others.

E. Communication Interface Card: The microprocessor shall be capable of communicating with the following protocol language: Bacnet MS/TP RS-485.

2.9 ADDITIONAL ACCESSORIES AND UNIT FEATURES

A. Dirty filter switch

B. Rotation detector (where applicable)

C. Door interlocking switch (for fan section)

D. Magnehelic gauges (Dwyer 2000 model)

E. Condensate overflow switch (for drain pans)

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The airflow measuring station shall consist of a special probe, a transducer and a display. The probe will be designed to be accurate in turbulent airflow and will be a standard design to fit all ducts. Only the number of probes will change based on the surface area. Probes

can be washed down if required. The high accuracy transducer shall be mounted inside a NEMA 4 enclosure where temperature is controlled and shall also include an auto-zero function to prevent drifting. The display will indicate airflow, temperature and alarms. It will also serve as the interface to configure the system via an internal Set-up Wizard. This Set-up Wizard will include start-up, commissioning and diagnostics functions without the use of a laptop computer or other tools. All calculations, and management operations will be done within the display unit. The accuracy shall be +/- 5% of reading between 200 and 965 ft/min and +/- 10% of reading between 75 and 200 ft/min. as per Tek-Air series IAQ-Tek.

G. Fan Airflow Monitoring Station Package
The unit shall be delivered with factory installed airflow measuring system. The airflow measuring system, consisting of a piezometer ring and transducer, shall be installed on the fan. The package consists of an inlet port on the fan inlet cone connected with flexible tubing to the transducer.

H. Fan Airflow Balancing Package – EZBALANCER
The EZBalancer controller is designed to set and monitor unit airflow of the fans without adjusting VFD settings by simply using keypad buttons. Field VFD adjustments are no longer required. Unit CFM readings are continuously displayed on the LCD screen and a 4-20 mA signal sent to others (BMS). One (1) EZBalancer is required for up to two (2) airflows even if multiple fans are used. It can be applied for constant and variable airflow applications with a 0-10Vdc signal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine ducts, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install Air Handling Unit per manufacturers' instructions.

B. Install with required clearance for service and maintenance.

3.3 TESTING

A. System verification testing is part of the commissioning process. Verification testing shall be performed by the Contractor and witnessed and documented by the Commissioning Authority. Refer to section 230485, Commissioning, for system verification tests and commissioning requirements.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 TRAINING

A. Training of the Owner’s operation and maintenance personnel is required in cooperation with the Commissioning Authority. Provide competent, factory-authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the Commissioning Authority after submission and approval of formal training plans. Refer to section 230470, Commissioning, for further contractor training requirements.

1. Contact Annexair to request pricing to include factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain humidifiers.
   1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
   2. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
   3. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
   4. Schedule training with Owner, through Architect, with at least seven days advance notice.

END OF SECTION 230237

SECTION 230255

VARIABLE REFRIGERANT FLOW OUTDOOR UNITS

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 SYSTEM DESCRIPTION

A. Indoor units or outdoor air handling units are matched with heat pump or heat recovery VRF (variable refrigerant flow) outdoor unit.

1.2 DELIVERY, STORAGE AND HANDLING

A. Unit shall be ETL listed and certified to UL 1995 4th edition standard.

PART 2 - PRODUCTS

2.1 HEAT RECOVERY AND HEAT PUMP SYSTEMS

A. Product Design

1. LG Multi V heating and cooling system shall be an air cooled system allowing user to configure in the field a heat pump or a heat recovery system consisting of one to three outdoor unit modules, conjoined to make a 2-5 ton single refrigerant circuit for the Multi V S system, and 6-42 single refrigerant circuit for the Multi V 5 system.
   a. Heat recovery systems, employing three pipes, shall be connected to Heat recovery (heat recovery) unit(s) and indoor unit(s). Multi-port heat recovery units shall allow simultaneous heating and cooling of individual zone(s) at various capacities as required to satisfy their zone requirements.
   b. Heat pump systems shall require two pipes, simultaneous heating and cooling shall not be supported. The heat recovery system shall consist of three pipes, liquid, suction and hot gas pipes. Heat recovery systems operating at 0°F that cannot deliver single phase superheated refrigerant vapor at a minimum of 162°F while operating in the heating mode shall not be acceptable.

2. All three-phase VRF heat pump and heat recovery outdoor units shall be from the same product development generation. Mixing of outdoor units from different development generations is not acceptable.

B. Operating Conditions

1. Outdoor Unit shall be capable of continuous compressor operation between the following operating ambient air conditions, operation outside of these conditions are possible and may involve non-continuous operations.

2. Operating Ambient Air Conditions
   a. Cooling: 5°F DB to 122°F DB (With optional low ambient kit from -9.9°F DB to 122°F DB)
   b. Heating: -22°F WB to 61°F WB
   c. Cooling Based (ODU reversing valve in cooling position) Synchronous: 14°F DB to 81°F DB (Heat Recovery Operation Only)
   d. Heating Based (ODU reversing valve in heating position) Synchronous: 14°F WB to 61°F WB (Heat Recovery Operation Only)

C. Electrical

1. All air source heat pump and heat recovery frame(s) shall be designed and electrically protected to maintain stable continuous compressor operation when provided with 460/60/3 or 208-230/60/3 power with the following specifications:

   a. 460/60/3
      i. Voltage tolerance 414V
   b. 208-230/60/3 power and can withstand a voltage fluctuation of ± 10%
      i. Voltage tolerance between 187V to 253V
   c. Voltage imbalance of up to two percent;
   d. Power surge of up to 5kA RMS Symmetrical.

D. General Features

1. The air-conditioning system shall use R410A refrigerant.
2. Each system shall consist of one, two or three air source outdoor unit modules conjoined together in the field to result in the capacity specified elsewhere in these documents.
3. Dual and triple frame configurations shall be field piped together using manufacturer's designed and supplied Y-branch kits and field provided interconnecting pipe to form a common refrigerant circuit.
4. System shall have following frame configurations vs. capacity.
   2 to 20 ton units shall be a single frame only.
   22 to 34 ton units shall be dual frame only.
   36 to 42 ton heat recovery units shall be triple frame only
5. System shall employ self-diagnostics function to identify any malfunctions and provide type and location of malfunctions via fault alarms.
6. All outdoor units, regardless of the Heat Pump or Heat Recovery models, shall be the same generation and provide with most up to date firmware version at the time of delivery. Manufacturers commissioning agents shall assure the owner in the commissioning report that the latest software version.
7. If the specifications include both heat pump and heat recovery outdoor models, the manufacturer shall provide the most recent generation equipment only. Old stock or obsolete models will not be accepted. Products purchased over the internet and not from the manufacturer's authorized local mechanical representative or authorized distributer will not be accepted.

8. Field Provided Refrigerant Piping:
   a. The refrigerant circuit shall be constructed using field provided ACR copper, de-hydrated, refrigerant rated copper pipe, piped together with manufacturer supplied Heat recovery unit(s) and Y- branches, as may be required, connected to multiple (ducted, non-ducted or mixed combination) indoor units to effectively and efficiently control the heat pump operation or simultaneous heating and cooling operation of the heat recovery VRF system. Other pipe materials, if used, shall perform, at a minimum, as well as that specified above, shall not have any adverse reactions, for example galvanic corrosion, to any other components or materials also in use in the system and shall be installed per manufacturer's instructions.
   b. The unit shall be shipped from the factory fully assembled including internal refrigerant piping, inverter driven compressor(s), controls, temperature sensor, humidity sensor, contacts, relay(s), fans, power and communications wiring as necessary to perform both Heat Pump and Heat recovery operations.
   c. Each outdoor unit refrigeration circuit shall include, but not limited to, the following components:
      i. Refrigerant strainer(s)
      ii. Check valve(s)
      iii. Inverter driven, medium pressure vapor injection, high pressure shell compressors
      iv. Liquid refrigerant cooled inverter PCB
      v. Oil separator(s)
      vi. Accumulator /controlled volume receiver(s)
      vii. 4-way reversing valve(s)
      viii. Vapor injection valve(s)
      ix. Variable path heat exchanger control valve(s)
      x. Oil balancing control
      xi. Oil Level sensor(s)
      xii. Electronic expansion valve(s)
      xiii. Double spiral tube sub-cooler (s) and EEV
      xiv. Vapor Injection Valve(s)
      xv. High and low side Schrader valve service ports with caps
      xvi. High/low Service valves
      xvii. Threaded fusible plug
      xviii. High pressure switch

9. Field Insulation:
   a. All refrigerant pipe, y-branches, elbows and valves shall be individually insulated with no air gaps. Insulation R-value (thickness) shall not be less than the minimum called for by the local building code, local energy code or as a minimum per manufacture installation requirements. In no case shall the insulation be allowed to be compressed at any point in the system.
      i. All joints shall be glued and sealed per insulation manufactures instructions to make an air-tight assembly.

10. Microprocessor:
    a. Factory installed microprocessor controls in the outdoor unit(s), heat recovery unit(s), and indoor unit(s) shall perform functions to optimize the operation of the VRF system and communicate in a daisy chain configuration between outdoor unit and heat recovery unit(s) and indoor unit(s) via RS485 network. Controls shall also be available to control other building systems as required from the VRF control system. DIO/AIO capabilities shall be available as well as a central controller to perform operation changes, schedules and other duties as required by this specification. Addition of separate building control system shall not be required. Other control devices and sequences shall be as specified in other sections of this project specification
11. Inverter PCB Cooling:
    a. Cooling of the inverter PCB shall be conducted by way of high pressure, sub-cooled liquid refrigerant via heat exchanger attached to the inverter PCB. The full capacity flow of refrigerant shall pass though the heat exchangers to maximize the cooling effect of the PCBs and to aid in the evaporation process and capacity of the outdoor coil during the heating mode. The recovered heat of the PCBs must be used to enhance the overall heating process, other uses or dissipation of heat to ambient shall not be permitted.
12. Compressor Control:
    a. Fuzzy control logic shall establish and maintain target evaporating temperature (Te) to be constant on cooling mode and condensing temperature (Tc) constant on heating mode by Fuzzy control logic to ensure the stable system performance.
13. Initial Test Run (ITR) (Heating or Cooling) / Fault Detection Diagnosis (FDD) Code:
    a. This control mode shall monitor and display positive or negative results of system initial startup and commissioning. Heating or Cooling ITR mode will be automatically selected. It shall monitor and provide performance metrics for the following, but not be limited to, refrigerant quantity charge, auto-charge, stable operations, connection ratios, indoor unit status, error status, and number of indoor units connected. This control mode shall not replace the system error monitoring control system.
14. BMS Integration:
    a. The VRF system shall be able to integrate with Building Management Systems via BACnet™ IP gateway. This gateway converts between BACnet™ IP or Modbus TCP protocol, and RS-485 LGAP (LG Aircon protocol) allowing third party control and monitoring of the LG A/C system, or LonWorks™ gateways. See controls specification for points list.
15. Wi-Fi Communication:

    a. The outdoor unit shall be Wi-Fi enabled and capable. Wi-Fi shall allow service or maintenance personal access to the complete operating system, via LGMV mobile, without need of tools other than smart phone or tablet. Active live system review, collection of all system data for a field determined duration presented in a .csv file format or collection of all operating conditions, including all indoor units, valves, sensors, compressor speeds, refrigerant pressures, etc., by

snapshot of conditions and placing that snapshot into a power point slide to be reviewed at another time. Systems that require computers, hard wire only connection or other devices to collect, review or record operating conditions shall not be allowed.

16. Indoor Unit Connectivity:
    a. The system shall be designed to accept connection up to 64 indoor units of various configuration and capacity, depending on the capacity of the system.
17. Power and Communication Interruption:
    a. The system shall be capable of performing continuous operation when an individual or several indoor units are being serviced; communication wire cut or power to indoor unit is disconnected. Systems that alarm and/or shut down because of a lack of power to any number of indoor units shall not be acceptable.
18. Connection Ratios:
    a. The maximum allowable system combination ratio for all VRF systems shall be 130% and the minimum combination ratio shall be 50%.
19. Comfort Cooling Mode:
    a. Comfort cooling shall be initiated via a field setting at the outdoor unit during commissioning or anytime thereafter. Comfort cooling shall allow user to select all or some of the zones on a system to adjust automatically their evaporator temperatures, independent of other zones, based on the impending total loads of that zone determined by using the zone controller temperature sensor.
20. The outdoor unit refrigerant circuit shall employ for safety a threaded fusible plug.
21. Refrigerant Flow Control
    a. An active refrigerant control and multi section accumulator-receiver that dynamically changes the volume of refrigerant circulating in the system based on operating mode and operating conditions to ensure maximum system performance and efficiency.
    b. Subcooler: The VRF outdoor unit shall include a factory provided and mounted sub-cooler assembly consisting of a shell and tube-type sub-cooling heat exchanger and EEV providing refrigerant sub-cooling modulation control by fuzzy logic of EEV and by mode of operation to provide capacity and efficiency as required. Brazed plate heat exchangers shall not be allowed for this function.
    c. Smart Load Control: The air source unit shall be provided with Smart Load Control (SLC) enhanced energy saving algorithm that reduces compressor lift during off peak operation. Smart load control operation shall enhance energy savings and increase indoor comfort by monitoring the real time ambient temperature, real time weighted mean average building load, and the outdoor relativity humidity (if enabled).
        i. The SLC algorithm shall be monitoring in real time, the rate of change of the outdoor ambient air temperature, either the outdoor ambient air relative humidity or the indoor air relative humidity [field selectable], and the rate of change of the building load.

ii. The SLC algorithm shall foresee pending changes in the building load, outdoor temperature and humidity (or indoor humidity) and proactively reset head and/or suction pressure targets in anticipation of the reduction/increase in building load.

iii. The SLC algorithm shall provide no fewer than 3 field selection options to maximize the control of the VRF system operation during morning warm-up or cool-down following night-setback reset. The selection shall be set by the commissioning agent (or at any other time thereafter). Selectable algorithm choices include:

1. Maximize energy savings
2. Balance the rate of temperature change with energy consumed.
3. Quickly cool/heat the building.

22. Refrigerant Volume Management

a. Active Refrigerant Charge

i. The VRF system shall be able to operate at any and all published conditions year round in cooling or heating mode without the need of adding or removing refrigerant from the system.

ii. The air source unit shall be provided with an isolated vessel to store spare refrigerant and actively pass refrigerant to (or from) the accumulator in real time as necessary to maintain stable refrigeration cycle operation.

iii. The air source unit microprocessor shall be provided with an algorithm that monitors the VRF system head pressure, suction pressure, subcooling, superheat, compressor speed, high and low side temperatures and the load on the system to adjust the volume of refrigerant actively circulating.

b. Manual Seasonal Refrigerant Charge Adjustments

(Applicable for VRF systems without Active Refrigerant Charge)

i. Alternates: Systems that CANNOT passively and automatically modify the active refrigerant charge using the method(s) stated to maintain stable cycle operation shall clearly state so in bold capital letters in the proposal. VRF systems that cannot perform active refrigerant control may submit a proposal as an Alternate and must include as part of the equipment price the cost of to provide bi-annual refrigerant charging services for 15 years. Service shall be performed by the factory authorized agent only. Service shall include refrigerant, parts, labor, and fees necessary to analyze the current state of the system and perform the refrigerant charge adjustment. Service must occur one month before the winter season and one month before the summer season.

ii. If the VRF system requires a charge adjustment more frequently to maintain stable operation, the VRF manufacturer shall provide additional services at no additional charge.

iii. The 15 year period shall begin on the date the equipment is commissioned or the date the building occupancy permit was issued for the area(s) served by the system – whichever date is later.

iv. This service shall be underwritten, warranted, and administered by the VRF equipment manufacturer – not the local distributor or applied representative.

v. The selected service provider shall be mutually agreeable between the building owner (or owners agent) and must be licensed, insured, and trained to work on the VRF system. No third party service (subcontracted service) providers will be acceptable.

vi. If the service provider is not an employee of the VRF manufacturer, the service provider shall be reimbursed for services rendered directly from the manufacturer. Labor rate for services shall be paid at the prevailing wage rate in place at the time of service.

23. VRF Systems with Onboard Alternate Operating Mode Selection Capability

a. All VRF systems which provide field selectable Alternate Operating Modes, for example, High Heat or High Ambient Cooling, published data tables must be available to the public for all modes offered.

b. Acceptable Alternate Operating Modes must ship with all models of the VRF product offering and must be factory embedded. Custom factory or field modifications to factory provided algorithms created to meet scheduled requirements are not acceptable.

c. Provide a copy of instructions required to set the Alternate Operation Mode with the initial submittal.

d. For systems that provide field selectable Alternate Operating Modes, ALL technical data provided in the submittal data sheets showing product rated condition performance data, must also provide separate data sheets that show product performance data at each of the field selectable Alternate Operating Modes available. Capacity, power input, and acoustic performance data for each mode offered shall be reported separately. Mixing of ODU, IDU, or VRF system performance capability operating in one mode with for example the power consumption, sound power rating, or electrical requirements of the same system operating in another mode is not acceptable.

E. Field Supplied Refrigerant Piping Design Parameters

1. The outdoor unit shall be capable of operating at an elevation difference of up to 360 feet above or below the lowest or highest indoor unit respectively without the requirement of field installed subcooler or other forms of performance enhancing booster devices for the Multi V 5 Series, and 164 feet above or 131 feet below for Multi V S Series.

2. The outdoor unit shall be capable of operating with up to 3280 for the Multi V 5 Series and 984 for the Multi V S Series equivalent length feet of interconnecting liquid line refrigerant pipe in the network.

3. The outdoor unit shall be capable of operating with up to 656 actual feet for the Multi V 5 Series and 592 actual feet for the Multi V S Series or 738 equivalent length feet for the Multi V 5 Series and 574 equivalent length feet for the Multi V S Series of liquid line refrigerant pipe spanning between outdoor unit and farthest indoor unit.

4. The piping system shall be designed with pipe expansion and contraction possibilities in mind. Required expansion devices shall be field designed, supplied and installed based on proper evaluation of the proposed piping design. In addition to these requirements, the piping system installation must conform to the VRF equipment manufacturer's published guidelines.
5. The installation of pipe hangers, supports, insulation, and in general the methods chosen to attach the pipe system to the structure must allow for expansion and contraction of the piping system and shall not interfere with that movement.
6. The elevation difference between indoor units on heat pump systems shall be 131 feet for the Multi V 5 Series and 49 feet for the Multi V S Series.
7. The elevation differences for heat pump systems shall be:
   a. Heat recovery unit to connected indoor unit shall be 49 feet
   b. Heat recovery unit to heat recovery unit shall be 98 feet
   c. Indoor unit to indoor unit connected to same heat recovery unit shall be 49 feet
   d. Indoor unit to indoor unit connected to separate parallel piped heat recovery units shall be 131 feet.
8. The acceptable elevation difference between two series connected heat recovery units shall be 16 feet.

F. Defrost Operations
1. The outdoor unit(s) shall be provided with a minimum of 4 independent field adjustable defrost cycle algorithms to maximize the effectiveness of the defrost cycle to the local weather conditions. Intelligent Defrost shall melt accumulated frost, snow and ice from the outdoor unit heat exchanger. The defrost cycle length and sequence shall be based on outdoor ambient temperatures, outdoor unit heat exchanger temperature, and various differential pressure variables. Intelligent Heating Mode, when outdoor unit humidistat is engaged, shall extend the normal heating sequences by adjusting the outdoor unit coil target temperature to be above the ambient dew point temperature delaying the need for defrost operations, so long as heating demand is being met.
2. Smart Heating: This feature shall be capable of eliminating several defrost actions per day based on outdoor air temperature and humidity conditions. Smart heating shall extend the heating operation cycle by delaying the frost formation on the outdoor coil by adjusting the surface temperature to keep it above the current outdoor ambient dew point. The algorithm shall delay while maintaining indoor space temperature.
3. Defrost Mode Selection: The outdoor unit shall be provided with a minimum of three field selectable defrost operation modes: Normal, Fast, or Forced.
   a. Normal Defrost: Operation intended for use in areas of the country that experience adverse winter weather with periods of heavy winter precipitation and extremely low temperatures. This strategy shall maximize the systems heating performance and maintain operational efficiency. When the ambient temperature is either: a) above 32°F or b) below 32°F with the humidity level below 60% RH, Intelligent Defrost shall continue heating regardless of ice build-up on the coil until the quality of the heated air (i.e., discharge air temperature) decreases. At temperatures below 4°F,

a defrost cycle shall occur every two hours to optimize system heating efficiency.

b. Fast Defrost: Operation intended for use in areas of the country with mild winter temperatures and light to moderate humidity levels. The strategy minimizes defrost cycle frequency allowing frozen precipitation to build longer in between cycles. Minimum time between defrost cycles shall be 20 minutes. Intelligent Defrost shall choose between split coil/frame and full system methods based on current weather conditions to minimize energy consumption and maximize heating cycle time.

c. Forced Defrost: Operation shall be available for the service provider to test defrost operations at any weather condition and to manually clear frozen water from the outdoor coil surfaces.

4. Defrost Method Selection: The outdoor unit shall be provided with two field selectable defrost operation methods: Split Coil/Frame and Full System. Split Coil/Frame option provides continuous heating of the occupied space during defrost operation.

a. Split Coil/Frame method shall be available when Normal Defrost mode is selected. Split Coil method shall be available on all Heat Pump and Heat recovery single-frame VRF systems. Split Frame defrost shall be available on all Heat Pump and Heat recovery multi-frame outdoor units.

b. Split Coil method shall remove ice from the bottom half of the outdoor unit coil first for a maximum time of six minutes, then the top half for a maximum of six minutes. Next the bottom coil shall be heated again for an additional three minutes to remove any frozen water that may have dripped onto the lower coil during the top coil defrost operation.

c. When Split Coil/Frame method is selected, a Full System defrost shall occur every 1-9 (field selectable) defrost cycles to assure 100% of the frozen precipitation has been removed to maintain efficient performance.

d. Full System method shall be available as a field selectable option. All outdoor units located in areas of the country where large volumes of frozen precipitation are common, the commissioning agent shall be able to select the Full System only defrost method.

5. Indoor Unit Fan Operation During Defrost

a. During partial defrost operation indoor units operating in cooling or dry mode shall continue normal operation.

b. During partial defrost operation, indoor units that are commissioned with fans set for continuous operation shall maintain normal fan speed unless the leaving air temperature drops, then the fan speed will be reduced to low speed for the remainder of the defrost cycle.

c. During full system defrost operation indoor unit fans will cycle off and remain off during the remainder of the defrost cycle.

G. Oil Management

1. The system shall utilize a high pressure oil return system to ensure a consistent film of oil on all moving compressor parts at all points of operation. Oil is returned to compressor through a separate high pressure oil injection pipe directly into the

oil sump. Oil returned to the compressor via the suction port of the compressor shall not be allowed.

2. Each compressor shall be provided with a high efficiency independent centrifugal cyclone type oil separator, designed to extract oil from the oil/refrigerant gas stream leaving the compressor.
3. The system shall have an oil level sensor in the compressor to provide direct oil level sensing data to the main controller. The sensor shall provide data to main outdoor unit PCB to start oil return mode and balance oil levels between multiple compressors.
4. The system shall only initiate an oil return cycle if the sensed oil level is below oil level target values as determined by the microprocessor. The system shall display an error if the oil sensor signals low oil level for a period of 130 minutes or longer.
5. A default oil return algorithm shall automatically initiate the oil return mode if the system detects a failure of the oil sump sensor. A fault code shall be reported by the system.
6. Timed oil return operations or systems that do not directly monitor compressor oil level shall not be permitted.
7. Indoor Unit Fan Operation during Oil Return Cycle
    a. During oil return cycle indoor units operating in cooling or dry mode shall continue normal operation.
    b. During oil return, indoor units that are commissioned with fans set for continuous operation shall maintain normal fan speed unless the leaving air temperature drops, then the fan speed will be reduced to low speed for the remainder of the oil return cycle.
    c. During oil return cycle indoor unit fans will cycle off and remain off during oil return cycle while operating in all modes.

H. Fan and Motor Assembly

1. 6 ton frames shall be equipped with one direct drive variable speed propeller fan with Brushless Digitally Controlled (BLDC) motor with a vertical air discharge Heat Pump ARUN024GSS4 unit shall be equipped with one direct drive, variable speed, and axial flow fan with a horizontal air discharge. The motors shall be Brushless Digitally Controlled (BLDC), variable speed, inverter driven motors.
2. 8 to 20 ton frames shall be equipped with two direct drive variable speed propeller fan(s) with BLDC motor(s) with a vertical air discharge. Heat Pump ARUN038GSS4~ARUN060GSS4 and Heat Recovery unit ARUB060GSS4 shall be equipped with two direct drive variable speed axial flow fan(s) with a horizontal air discharge. Each fan shall be provided with an independent dedicated Brushless Digitally Controlled (BLDC), variable speed, inverter driven motors.
3. The fan(s) blades shall be made of Acrylonitrile Butadiene Styrene (ABS) material and incorporate biomimetic technology to enhance fan performance and reduce fan generated noise.
4. The fan(s) motor shall be equipped with permanently lubricated bearings.
5. The fan motor shall be variable speed with an operating speed range of 0-1150 RPM cooling mode and 0-1150 RPM heating mode. The fan assembly(s) shall have a minimum operating speed range from 0 RPM to 850 RPM in cooling mode and heating mode.

6. The fan shall have a guard to help prevent contact with moving parts.
7. The cabinet shall have option to redirect the discharge air direction from vertical to
8. The fan controller shall have a DIP switch setting to raise external static pressure of the fan up to 0.32 inch of W.C. to accommodate ducted installations.
9. The fan control shall have a function setting to remove excess snow automatically.
10. The fan control shall have a function setting to remove access dust and light debris from the outdoor unit and coil.

I. Cabinet

1. Outdoor unit cabinet shall be made of 20 gauge galvanized steel with a weather and corrosion resistant enamel finish. Outdoor unit cabinet finish shall be tested in accordance with ASTM B-117 salt spray surface scratch test (SST) procedure for a minimum of 1000 hours.
2. Cabinet weights and foot prints shall vary between 430 lbs., 7.61 sq. ft. (1.27 sq. ft. per ton), for 6 ton cabinet to 666 lbs., 10.14 sq. ft. (.51 sq. ft. per ton), for 20 ton cabinet for single cabinet configurations. The front panels of the outdoor units shall be removable type for access to internal components.
3. A smaller service access panel, not larger than 7” x 7” and secured by a maximum of (2) screws, shall be provided to access the following
   a. Service tool connection
   b. DIP switches
   c. Auto addressing
   d. Error codes
   e. Main microprocessor
   f. Inverter PCB
4. The cabinet shall have piping knockouts to allow refrigerant piping to be connected at the front, right side, or through the bottom of the unit.
5. The cabinet shall have a factory installed coil guard and shall have a baked enamel finish.

J. Outdoor Unit Coil

1. Outdoor unit coil shall be designed, built and provided by the VRF outdoor unit manufacturer.
2. The outdoor unit coil for each cabinet shall have lanced aluminum fins with a maximum fin spacing of no more than 17 Fins per Inch (FPI). All the outdoor unit coils shall be a 2 or 3 rows consisting of staggered tubes for efficient air flow across the heat exchanger.
3. Outdoor unit coil shall be comprised of aluminum fins mechanically bonded to copper tubing with inner surfaces having a riffling treatment to expand the total surface of the tube interior
4. The aluminum fin heat transfer surfaces shall have factory applied corrosion resistant Black Fin coating. The copper tubes shall have inner riffling to expand the total surface of the tube interior.
   a. ISO 21207 Salt Spray Test Method B – 1500 hours
   b. ASTM B-117 Acid Salt Test – 900 hours

c. The Black Fin coating shall be certified by Underwriters Laboratories and per ISO 21207. The above conditions shall establish the minimum allowable performance which all alternates must comply.

5. Variable Path Heat Exchanger: System shall have a variable flow and path outdoor heat exchanger function to vary the refrigerant flow and volume and path. Control of the variable path circuits shall be based on system operating mode and operating conditions as targeted to manage the efficiency and minimize or maximize the circulating volume of the operating fluids of the system. This feature allows MV 5 to maintain system head pressure that delivers “gas-furnace leaving air temperature” from the indoor unit at moderate and low ambient outdoor air temperatures. The outdoor unit coil, all indoor units and pipe network shall be field tested to a minimum pressure of 550 psig.

K. Compressor(s)

1. Compressor shall be designed and assembled by the VRF manufacturer specifically for use in the air source VRF product line. Third party manufactured, branded, or designed to the VRF system’s OEM specifications by a third party manufacturer shall not be acceptable.

2. Compressor shall be a hermetic, high-side shell (HSS), commercial grade, compliant scroll direct-drive design.

a. Compressor Design: The compressor design shall be of the high pressure shell scroll type where the internal pressure below the suction valves of the compressor shall be at the same high pressure and high temperature. The motor shall be cooled by high pressure gas at temperatures above saturation conditions and minimize the mixing of refrigerant liquid with oil in the sump. The system shall employ a high pressure oil return method returning recovered oil from the oil separator directly into the oil sump of the compressor; oil shall not be allowed to return via the suction line. Bearing surfaces are continually coated with oil. The compressor shall employ an Aero-bearing constructed with high lubricity materials increasing operation time in case of low sump oil level. Compressor shall have a nominal operating range from 12Hz to 150 Hz.

3. The fixed and oscillating compressor scroll components shall be made of high grade (GC25) or denser steel material. All scrolls shall be heat treated and tempered.

4. The oscillating scroll shall be finely machined and polished. PVE refrigerant oil shall be used as the sole liquid used to maintain a seal between the high and low sides of the compression chamber. Compressors that require the use of any type of mechanical or wearable sealant material between the moving surfaces of the compression chamber is NOT ACCEPTABLE.

5. Vapor Injection: System shall have a medium pressure gas vapor injection function employed in the heating and cooling modes to increase system capacity when the outdoor ambient temperatures are low and lower compressor lift when temperatures are high. The compressor vapor injection flow amount shall be controlled by the vapor injection sub-cooling algorithm reset by discharge gas temperatures of the compressor.

6. Bearing surfaces shall be coated with Teflon® equal. Bearings shall be lubricated using a constant flow of PVE refrigerant oil to the bearing surfaces the film of oil separating the crankshaft journals and bearing surfaces shall be consistent at all

times the crankshaft is in motion and shall be maintained irrelevant of crankshaft rotational speed.

7. An internal, integrated, mechanically driven gear pump shall draw oil from the compressor sump reservoir, pressurize the oil and inject the oil directly to the crankshaft journals maintaining a consistent film of oil between all moving parts. Auxiliary, indirect, or electronically driven pumps are not acceptable.

8. The viscosity property of the PVE oil in the compressor sump shall be maintained irrelevant or compressor operation and the surrounding ambient temperature.
   a. The compressor shall be equipped with an external thermally protected electric crankcase heater that is automatically activated only when the ambient temperature is below freezing, and the compressor is not running to maintain the temperature of the oil in the sump above the refrigerant boiling point.
   b. During stable operation, irrelevant of ambient air temperature outside the water source unit, the temperature of refrigerant vapor in contact with the surface of the oil in the compressor sump shall be maintained above 140°F to prevent foaming and to eliminate refrigerant from mixing with the oil degrading the viscosity of the oil in the sump.
   c. Low side shell (LSS) type compressors that use suction vapor to cool the compressor motor shall not be acceptable.

9. The compressor motor shall be designed to operate at high temperatures.
   a. The motor winding insulation shall be designed to operate continuously at a minimum temperature of 180°F without deterioration.
   b. The motor cooling system shall be designed to maintain acceptable operational temperature at all times and in all conditions using high pressure, hot refrigerant vapor as motor coolant.
   c. Low side shell and compressors that use low pressure, low temperature refrigerant gas to cool the motor are not acceptable.

10. Inverter Compressor Controller(s)
   a. Each compressor shall be equipped with a dedicated inverter compressor drive. The control of multiple compressors using a single drive is not acceptable.
   b. The inverter drive shall vary the speed of the compressor crankshaft between zero (0) Hz and 140 Hz.
   c. The inverter driver controller shall be matched with the physical properties of the compressor. The drive shall be manufactured by the VRF air source unit manufacturer. The inverter drive and matching compressor shall have been thoroughly tested as a matched pair. The inverter drive shall be programmed to avoid operating the compressor at any speed that results in harmonic vibration, nuisance noise, or mechanical damage to either the driver or the compressor with power provided that is within the tolerance specification.
   d. The compressor inverter drive assembly and software must be designed, manufactured, and supplied by the VRF product manufacturer. Third party branded inverter driver hardware and/or driver software or inverter driver hardware and/or software provided by a third party manufacturer to meet

OEM specifications of the VRF water source manufacturer will not acceptable.

e. All inverter drive hardware or software manufactured in, is a product of, or sourced from China, or using a broker or third party provider as an intermediary that obtains the product from CHINA shall not be acceptable.

11. Compressor(s)
    a. Each 6, 8, 10 ton frames shall be equipped with a single hermetically sealed, inverter driven, High Side Shell (HSS) scroll compressor.
    b. 12, 14, 16, 18 and 20 ton frames shall be equipped with dual hermetically sealed, inverter driven, High Side Shell (HSS) scroll compressors.
    c. Each inverter driven, HSS scroll compressor shall be capable of operating from 12 Hz up to 150 Hz in any and all modes (cooling, heating or simultaneous modes).
    d. The compressor shall be designed for a separate port for oil to be directly returned to the compressor oil sump.
    e. The compressor bearing(s) shall have Teflon™ coating and shall be an aero type design using High lubricity materials.
    f. The compressor(s) shall be protected with:
        i. High Pressure switch
        ii. Over-current /under current protection
        iii. Oil sump sensor
        iv. Phase failure
        v. Phase reversal
        vi. Compressor shall be capable of receiving injection of medium pressure gas at a point in the compression cycle where such injection shall allow a greater mass flow of refrigerant at lower outdoor ambient and achieving a higher heating capability. The VRF outdoor unit shall have published performance data for heating mode operation down to -13°F on both heat pump and heat recovery systems.
    g. Standard, non-inverter driven compressors shall not be permitted nor shall a compressor without vapor injection or direct sump oil return capabilities.

12. Heat Pump models:
    a. The compressor shall be a high efficiency high-side shell rotary hermetic design. Bearing shall be manufactured using high lubricity material. Compressor shall be factory charged with Polyvinyl Ether (PVE) oil. Single or dual speed compressors charged with oil (POE) shall not be acceptable. Compressor inverter drive shall Polyolester allow modulation from 20Hz to 90Hz with control in 1.0 Hz increments depending on the nominal capacity. (ARUN060GSS4) The compressor shall be a high-side shell hermetic scroll design. Oil sump area and chamber housing the motor shall be operated at the same temperature and pressure of the gas leaving the compressor chamber to ensure that the low temperature low pressure refrigerant returning to the compressor does not mix with the oil in the sump. Bearing shall be manufactured using high lubricity material. Compressor shall be factory charged with Polyvinyl Ether (PVE) oil. Single or dual speed compressors charged with Polyolester oil (POE) oil shall not

be acceptable. Compressor motor shall be designed to operate at a frequency range of 0Hz to 160Hz. Compressor inverter drive shall allow modulation from 12Hz to 110Hz.

13. Heat Recovery models:

a. The compressor design shall be of the high pressure shell scroll type where the internal pressure below the suction valves of the compressor shall be at the same high pressure and high temperature. The motor shall be cooled by high pressure gas at temperatures above saturation conditions and minimize the mixing of refrigerant liquid with oil in the sump. The system shall employ a high pressure oil return method returning recovered oil from the oil separator directly into the oil sump of the compressor; oil shall not be allowed to return via the suction line. Bearing surfaces are continually coated with oil. The compressor shall employ an Aero-bearing constructed with high lubricity materials increasing operation time in case of low sump oil level. Compressor shall have a nominal operating range from 12Hz to 110 Hz.

L. Operational Sound Levels

1. Each single frame outdoor unit shall be rated with an operational sound pressure level not to exceed as listed on below chart when tested in an anechoic chamber under ISO 3745 standard at the highest field selectable heating operating modes available. Such documentation shall be presented in all submittals, manufactures who elect to rate their equipment at other than tested in an anechoic chamber under ISO 3745 standard at the highest field selectable heating operating modes available and the highest field selectable conditions shall not be allowed.

2. A field setting shall be available to program the outdoor unit to reduce sound levels at night, when desired, to a selectable level while still able to meet building load requirement. This mode is available in both cooling and heating modes.

M. Sensors

1. Each outdoor unit module shall have:

a. Suction temperature sensor
b. Discharge temperature sensor
c. Oil level sensor
d. High Pressure sensor
e. Low Pressure sensor
f. Outdoor temperature sensor
g. Outdoor humidity sensor
h. Outdoor unit heat exchanger temperature sensors

N. Wind Load Installations for Outdoor Units

1. LG FL Wind load Installation Drawings meet the requirements of the 2017 Florida Building Code, 6th Edition and ASCE Standard 7-2010.

O. Seismic Installations

1. Provide OSHPD Special Seismic Certification Preapproval (OSP) documents for certified product list of VRF equipment to be installed in high seismic risk areas. Provide LG supplemental installation documents in conformance with CBC 2013, 2016 and 2019 California Building Code and IBC 2012, 2015 and 2018 International Building Code.

P. Warranty

1. Limited Warranty Period
   a. STANDARD ONE-YEAR PARTS WARRANTY FOR A QUALIFIED SYSTEM - The Part(s) of a qualified System, including the compressor, are warranted for a period (the “Standard Parts Warranty Period”) ending on the earlier to occur of one (1) year after the date of original installation, or eighteen (18) months from the date of manufacture.
   b. ADDITIONAL SIX (6) YEAR COMPRESSOR PART WARRANTY - The Compressor is warranted for an additional six (6) year period after the end of the applicable Standard Part Warranty Period (the “Compressor Warranty Period”).
2. Extended Warranty
   a. The Standard Warranty Period and the Compressor Warranty Period are extended to a total of ten (10) years (the “Extended Warranty Period”) for qualified Systems that have been (a) commissioned by a party that has completed the current Training Requirements, (b) such commissioning is pursuant to LG’s current published instructions, and (c) the System commissioning results and supporting documents are entered correctly into LG’s online commissioning system. Commissioning of a System requires one (1) hour of LG Monitoring View (LGMV) data. Commissioning results must be entered into LG’s online commissioning system within sixty (60) days of System startup.

2.2 EEV KIT

A. General

1. Unit shall be manufactured by LG.
2. Unit shall be factory assembled and wired unit shall be designed to be installed indoors only, when installed outdoors provide NEMA weatherproof enclosure.
3. Unit shall be capable to be installed with heat pump or heat recovery VRF system.
4. Unit requires one communication kit to provide power and control signals.
5. Connects liquid line piping from outdoor unit to any AHU coil.

B. Electrical

1. Six conductor, 18 GA shielded and stranded field supplied wiring for 12 volt (low voltage) power and control signal from communication kit.

2.3 AHU COMMUNICATION KIT PAHCMR00 (RETURN AIR CONTROL)

A. General

1. Unit shall be manufactured by LG.
2. Unit shall be factory assembled and wired.
3. Unit shall be designed to be installed for indoor or outdoor.
4. Unit shall be capable to be installed with heat pump or heat recovery VRF system.
5. Allows communication between third party air handling unit (AHU) and LG Multi V air-source or water-source outdoor units with combination ratio between 50% to 100%.
6. Requires one EEV kit to control the flow of refrigerant from Multi V outdoor unit to AHU coil.

B. Electrical:

1. The unit electrical power shall be 208-230/1/60 (V/Ph/Hz).

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230255

SECTION 230260

DUCTLESS SPLIT SYSTEMS

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 SYSTEM DESCRIPTION

A. Outdoor-mounted, air-cooled split system outdoor section suitable for rooftop installation. Unit shall consist of a hermetic reciprocating, scroll, or rotary compressor, an air-cooled coil, propeller-type blow-thru out-door fans, reversing valve, accumulator, holding refrigerant charge heating mode metering device, and control box. Unit shall discharge air horizontally as shown on the contract drawings. Units shall function as the outdoor component of an air-to-air cooling and heating system.

B. Indoor, in-the-ceiling-mounted or wall mounted direct-expansion fan coil to be matched with the commercial heat pump unit.

1.2 QUALITY ASSURANCE

A. Unit construction shall comply with ANSI/ASHRAE 15, latest revision, and with the NEC.

B. Unit shall be rated (when matched with appropriate outdoor unit) per ARI Standard 210/240. Units shall be certified by UL and CSA.

C. Units shall be constructed in accordance with UL standards.

D. Units shall be listed in the CEC directory.

E. Unit cabinet shall be capable of withstanding Federal Test Standard No. 141 (method 6061) 500-hour salt spray test.

F. Air-cooled condenser coils shall be leak tested at 350 psig air pressure with the coil submerged in water.

1.3 DELIVERY, STORAGE AND HANDLING

A. Units shall be shipped in one piece and shall be stored and handled per unit manufacturer’s recommendations.

PART 2 - PRODUCTS

2.1 OUTDOOR HEAT PUMP CONDENSING UNIT

A. Factory assembled, single piece, air-cooled outdoor unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, compressor, charge of R-410A refrigerant and special features required prior to field start-up.

B. Unit Cabinet

1. Unit cabinet shall be constructed of galvanized-steel, bonderized and coated with a baked-enamel finish.
2. Unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fan, and control components.
3. Outdoor compartment shall be isolated and have an acoustic lining to assure quiet operation.

C. Fans

1. Outdoor fans shall be direct-drive propeller type and shall discharge air horizontally. Fans shall blow air through the outdoor coil.

2. Outdoor fan motors shall be totally enclosed, single-phase motors with class B insulation and permanently lubricated sleeve bearings. Motor shall be protected by internal thermal overload protection.

3. Shaft shall have inherent corrosion resistance.

4. Fan blades shall be corrosion resistant and shall be statically and dynamically balanced.

5. Outdoor fan openings shall be equipped with PVC coated protection grille over fan and coil.

D. Compressor

1. Compressor shall be fully hermetic reciprocating or scroll type.

2. Compressor shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from over temperature and over current. Scroll compressors shall also have high discharge gas temperature protection if required.

3. Motor shall be NEMA rated class F, suitable for operation in a refrigerant atmosphere.

4. Reciprocating compressors shall be equipped with crankcase heaters to minimize liquid refrigerant accumulation in compressor during shutdown and to prevent refrigerant dilution of oil.

5. Compressor assembly shall be installed on rubber vibration isolators and shall have internal spring isolation.

6. Compressors shall be single phase or 3-phase as specified on the Contract Drawings.

E. Outdoor Coil: Coil shall be constructed of aluminum fins mechanically bonded to internally enhanced, seamless copper tubes that are cleaned, dehydrated, and sealed.

F. Refrigeration Components: Refrigerant circuit components shall include brass external liquid line service valve with service gage port connections, suction line service valve with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader-type fittings with brass caps, accumulator, bi-flow filter drier, pressure relief, reversing valve, and heating mode metering device.

G. Controls and Safeties - Operating controls and safeties shall be factory selected, assembled, and tested. The minimum control functions shall include the following:

1. Controls
   a. Time delay restart to prevent compressor reverse rotation on single-phase scroll compressors.
   b. Automatic restart on power failure.
   c. Safety lockout if any outdoor unit safety is open.
   d. A time delay control sequence is also provided standard through the fan coil board, thermostat, or controller.
   e. High-pressure and liquid line low-pressure switches.
   f. Automatic outdoor-fan motor protection.
   g. Start capacitor and relay (single-phase units without scroll compressors).

2. Safeties
   a. System diagnostics.
   b. Compressor motor current and temperature overload protection.
   c. High pressure relief.
   d. Outdoor fan failure protection.

H. Electrical Requirements

1. Unit shall operate on a 208-v or 230-v, 60 Hz power supply as specified on the equipment schedule.

2. Unit shall operate on three-phase, 60 Hz power at 208/230 v or 460 v, as specified.

3. Unit electrical power shall be a single point connection.

4. Unit control voltage to the indoor-fan coil shall be 24 v.

5. All power and control wiring must be installed per NEC and all building codes.

6. Unit shall have high- and low-voltage terminal block connections.

I. Special Features (Field Installed)

1. Low-Ambient Kit: Control shall regulate fan-motor cycles in response to saturated condensing pressure of the unit. The control shall be capable of maintaining a condensing temperature of 100 F ±10 F with outdoor temperatures to –20 F. Installation of kit shall not require changing the outdoor-fan motor.

2. Liquid Solenoid Valve: This electronically operated shutoff valve shall close and open in response to compressor operation. The valve should be used with all long-lines applications (over 100 ft).

3. Crankcase Heater (units with scroll compressors only): Unit shall be shipped with a clamp-on compressor oil sump heater.

2.2 WALL MOUNT INDOOR UNIT

A. Indoor, direct-expansion, fan coil. Unit shall come complete with cooling/heating coil, electric heater, fan, fan motor, piping connectors, electrical controls, condensate pump, and hanging brackets.

B. Unit cabinet shall be constructed of zinc-coated steel. Fully insulated discharge and inlet grilles shall be attractively styled, high-impact polystyrene. Cabinet shall have filter tracks and cleanable filters which shall be accessible from below with a 1/4 -turn fastener. Adjacent room cooling to be provided by a simple knock-out in the cabinet side panel, and cabinet shall have provisions to accommodate a limited amount of ductwork, if desired.

C. Fan shall be a centrifugal, direct-drive blower type with air intake in center of the unit and discharge on the perimeter. Air louvers shall be adjustable for 2, 3, or 4-way discharge.

D. Coil:
Coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins will be bonded to the tubes by mechanical expansion. A drip pan under the coil shall have a factory-installed condensate pump and drain connection for hose attachment to remove condensate.

E. Motors:
Motor shall be totally enclosed and permanently lubricated with inherent protection. Fan motor shall be 3-speed.

F. Controls:
Controls shall be 24V and shall be easily operated by the user from a wall-mounted control unit. Float control shall be in the condensate sump to shut unit down in case of pump malfunction. A wall-mounted electromechanical thermostat with 3 fan-speed selections and an auto/manual switch shall be supplied for field installation. Automatic changeover from cooling to heating modes and selectable 2 or 4 minute start-up delay shall be included. The R-22 refrigerant shall be controlled with a piston-type refrigerant metering device, and evaporator coil freeze protection shall be provided.

G. Filters:
Unit shall have filter track with factory-supplied cleanable filters.

H. Electrical Requirements:
Unit shall operate on a 208-v or 230-v, 60 Hz power supply as specified on the equipment schedule.

I. Operating Characteristics: (See Drawing Schedule)

J. Special Features (Field Installed)

1. Power Ventilation Kit: Kit shall allow ventilation of the conditioned space with outdoor air. The kit shall include filter, booster fan, and controls.

2. Electronic Programmable Thermostat: Thermostat shall be commercial grade and shall provide 7-day, 4-event scheduling. Integral subbase shall be included. Thermostat shall also provide 3-speed fan switchover capability, air sweep auto changeover, and shall not require a battery to retain memory.

3. Fresh Air Intake Kit: Kit shall include filter and duct connections to provide for outdoor ventilation air.

2.3 AIR CONDITIONING CONDENSATE PUMP

(PROVIDE IN ALL CASES WHERE CONDENSATE CANNOT DRAIN BY GRAVITY)

A. Pump shall be equal to “Little Giant” model no. VCMA-15ULS–554401. Automatic, 15 ft. shut-off, 1/2 gallon tank, safety switch check valve, 6 ft. power cord power cord with plug.

B. Provide 3/8” copper tubing discharge piping installed per manufacturer’s recommendations.

C. For roof discharge applications provide pitch pocket, rigid 3/8” copper discharge piping and gooseneck turned down 12 inches above roof. Provide splash block and remove pump check valve before installation.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230260

SECTION 230265

VARIABLE REFRIGERANT FLOW INDOOR UNITS

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 SYSTEM DESCRIPTION

A. Indoor units are matched with heat pump or heat recovery VRF (variable refrigerant flow) outdoor unit.

1.2 DELIVERY, STORAGE AND HANDLING

A. Units shall be stored and handled per unit manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 CEILING CASSETTE – 4 WAY

1. Unit shall be manufactured by LG.
2. Unit shall be designed to be installed for indoor application.
3. Unit shall be designed to mount recessed in the ceiling and has a surface mounted grille on the bottom of the unit.
4. The unit shall be available in both nominal 2’ x 2’ and 3’ x 3’ chassis.

B. Casing/Panel

1. Unit case shall be manufactured using galvanized steel plate.
2. The unit panel shall be provided with an off-white or black Acrylonitrile Butadiene Styrene (ABS) polymeric resin grille.
3. The grille shall have a tapered trim edge, and a hinged, spring clip (screw-less) return air filter-grille door.
4. Unit shall be provided with metal ears designed to support the unit weight on four
5. Ears shall have pre-punched holes designed to accept field supplied all thread rod hangers.
6. Unit shall be supplied with snap off access panels to facilitate leveling of unit without removing the grille.

C. Cabinet Assembly

1. Unit shall have four supply air outlets and one return air inlet.
2. The supply air outlet shall be through four directional slot diffusers each equipped with independent oscillating motorized guide vanes designed to change the airflow direction.

3. The grille shall have a discharge range of motion of 40° in an up/down direction with capabilities of locking the vanes.
4. The unit shall have a guide vane algorithm designed to sequentially change the predominant discharge airflow direction in counterclockwise pattern.
5. Guide vanes shall provide airflow in all directions.
6. Unit shall be equipped with factory installed temperature thermistors for:
   a. Return air
   b. Refrigerant entering coil
   c. Refrigerant leaving coil
7. Unit shall have a factory assembled, piped and wired electronic expansion valve (EEV) for refrigerant control.
8. Unit shall have a built-in control panel to communicate with other indoor units and to the outdoor unit.
9. The unit shall have factory designated branch duct knockouts on the unit case.
10. The unit shall have provision of fresh air ventilation through a knock-out on the cabinet.
11. The branch duct knockouts shall have the ability to duct up to 1/2 the unit airflow capacity.
12. The branch duct cannot be ducted to another room.
13. Unit shall have the following functions as standard:
    a. Self-diagnostic function
    b. Auto addressing
    c. Auto restart function
    d. Auto changeover function (Heat Recovery system only)
    e. Auto operation function
    f. Child lock function
    g. Forced operation
    h. Dual thermistor control
    i. Sleep mode
    j. Dual set point control
    k. Multiple aux heater applications
    l. Filter life timer
    m. External on/off input
    n. Wi-Fi compatible
    o. uto fan operation
    p. Leak detection logic

D. Fan Assembly

1. The unit shall have a single, direct-drive turbo fan made of high strength ABS HT-700 polymeric resin.
2. The fan impeller shall be statically and dynamically balanced.

3. The fan motor is Brushless Digitally commutated (BLDC) with permanently lubricated and sealed ball bearings.
4. The fan motor shall include thermal, overcurrent and low RPM protection.
5. The fan/motor assembly shall be mounted on vibration attenuating rubber grommets.
6. The fan speed shall be controlled using microprocessor based direct digitally controlled algorithm that provides a minimum of four pre-programed fan speeds in the heating mode and fan only mode and five speeds in the cooling mode. The fan speed algorithm provides a field selectable fixed speed.
7. A field setting shall be provided to vary air throw pattern to compensate for high ceiling installations.
8. In cooling mode, the indoor fan shall have the following settings: Low, Med, High, Super high, Power Cool, and Auto.
9. In heating mode, the indoor fan shall have the following settings: Low, Med, High, Super high and auto.
10. Unit shall have factory installed motorized louver to provide flow of air in up and down direction for uniform airflow.

E. Filter Assembly

1. The return air inlet shall have a factory supplied removable, washable filter.
2. The unit shall have the capability to accept a field provided MERV 1 to MERV 10 filter.
3. The filter access shall be from the bottom of the unit without the need for tools.
4. The nominal 3’x3’ cabinet unit shall have provision for an optional auto-elevating grille kit designed to provide motorized ascent/descent of the return air grille/pre filter assembly.
    a. The ascent/descent of the return air grille shall be up to a distance of 14-3/4 feet allowing access to remove and clean the filter.
    b. The auto-elevating grille shall have a control algorithm to accept up, down and stop control commands from the controller.
    c. The auto-elevating grille shall have a control to stop the descent automatically if a contact is made with any obstacle.

F. Coil Assembly

1. Unit shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
2. The copper tubing shall have inner grooves to expand the refrigerant contact surface for high efficiency heat exchanger operation.
3. Unit shall have a minimum one or two row coil 18-19 fins per inch.
4. Unit shall have a factory supplied condensate drain pan below the coil constructed of EPS (expandable polystyrene resin).
5. Unit shall include an installed and wired condensate drain lift pump capable of providing minimum 27.5 inch lift from bottom surface of the unit.

6. The drain pump shall have a safety switch to shut off the unit if condensate rises too high in the drain pan.
7. Unit shall have provision of 45° flare refrigerant pipe connections.
8. The coil shall be factory pressure tested at a minimum of 550 psig.
9. All refrigerant piping from outdoor unit to indoor unit shall be field insulated. Each pipe should be insulated separately. Thickness and heat transfer characteristics shall be determined by the design engineer and shall meet all code requirements

4. Safeties - The following safety devices shall be part of the condensing unit:

   a. High pressure switch
   b. Fuses
   c. Crankcase heater
   d. Fusible plug
   e. Over current relay for the compressor
   f. Thermal protectors for compressor and fan motor
   g. Compressor time delay
   h. Oil Recovery system
   i. Oil level sensor
   j. Over-current sensor
   k. Compressor suction and discharge temperature sensor
   l. Compressor suction and discharge pressure sensor

G. Microprocessor Control

1. The unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system.
2. The unit shall be able to communicate with other indoor units and the outdoor unit using a field supplied minimum of 18 AWG, two core, stranded, twisted and shielded communication cable.
3. The unit controls shall operate the indoor unit using one of the five operating modes:
   a. Auto changeover (Heat Recovery System only)
   b. Heating
   c. Cooling
   d. Dry
   e. Fan only
4. The unit shall be able to operate in either cooling or heating mode for testing and/or commissioning.
5. The unit shall be able to operate with the fan turned off during system cooling thermal off.
6. The unit shall have adjustable, multi-step cooling and heating mode thermal on/off temperature range settings.
7. The system shall include a product check function to access and display indoor unit type and capacity from a wired programmable thermostat controller.

8. Unit shall have a field settable method to choose auto fan speed change operation based on mode of operation, on/off fan operation based on mode of operation, or continuous minimum set fan speed operation.

H. Electrical
1. The unit electrical power shall be 208-230/1/60 (V/Ph/Hz).
2. The unit shall be capable of operating within voltage limits of +/- 10% of the rated voltage.

I. Controls: Unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over an RS-485 daisy chain.

J. Seismic Installations: Provide OSHPD Special Seismic Certification Preapproval (OSP) documents for certified product list of VRF equipment to be installed in high seismic risk areas. Provide LG supplemental installation documents in conformance with CBC 2013, 2016 and 2019 California Building Code and IBC 2012, 2015 and 2018 International Building Code.

K. Warranty: Please refer to the respective outdoor unit for applicable warranty.

2.2 WALL MOUNTED – STANDARD

A. General
1. Unit shall be manufactured by LG.
2. Unit shall be designed to be installed for indoor application.
3. Unit shall be attached to an installation plate/bracket that secures unit to the wall.
4. The depth of the unit shall not exceed 8.25 inches.

B. Casing/Panel
1. Unit case shall be manufactured using Acrylonitrile Butadiene Styrene (ABS) polymeric resin and has a pearl white finish designed for mounting on a vertical surface and includes an installation mounting template and hanging bracket.

C. Cabinet Assembly
1. Unit shall have one supply air outlet and one return air inlet with a manual or motorized sweeping guide vane that automatically changes the direction of airflow from side-to-side and up-and-down.
2. Unit shall be equipped with factory installed temperature thermistors for:
   a. Return air
   b. Refrigerant entering coil
   c. Refrigerant leaving coil
3. Unit shall have a factory assembled, piped and wired electronic expansion valve (EEV) for refrigerant control.

4. Unit shall have a built-in control panel to communicate with other indoor units and to the outdoor unit.
5. Unit shall have the following functions as standard:
    a. Self-diagnostic function
    b. Auto addressing
    c. Auto restart function
    d. Auto changeover function (Heat Recovery system only)
    e. Auto operation function
    f. Auto clean function
    g. Child lock function
    h. Forced operation
    i. Dual thermistor control
    j. Sleep mode
    k. Dual set point control
    l. Filter life timer
    m. External on/off control input
    n. Wi-Fi compatible
    o. Auto fan operation
    p. Leak detection logic
6. Unit shall be capable of refrigerant piping in four different directions.
7. Unit shall be capable of drain piping in two different directions.

D. Fan Assembly
1. The unit shall have a single, direct driven crossflow tangential Sirocco fan made of high strength ABS BSN-7530 polymeric resin.
2. The fan impeller shall be statically and dynamically balanced.
3. The fan motor is Brushless Digitally commutated (BLDC) with permanently lubricated and sealed ball bearings.
4. The fan motor shall include thermal, overcurrent and low RPM protection.
5. The fan/motor assembly shall be mounted on vibration attenuating rubber grommets.
6. The fan speed shall be controlled using microprocessor based direct digitally controlled algorithm that provides a minimum of three pre-programed fan speeds in the heating mode and fan only mode and four speeds in the cooling mode. The fan speed algorithm provides a field selectable fixed speed.
7. In cooling mode, the indoor fan shall have the following settings: Low, Med, High, Power Cool, and Auto.
8. In heating mode, the indoor fan shall have the following settings: Low, Med, High, and Auto.
9. Unit shall have factory installed motorized louver to provide flow of air in up and down direction for uniform airflow.
10. Unit shall have factory installed motorized guide vane to control the direction of flow of air from side to side.

E. Filter Assembly

1. The return air inlet shall have a factory supplied removable, washable filter.
2. The unit shall have the capability to accept a field provided MERV 1 to MERV 10 filter.
3. The filter access shall be from the bottom of the unit without the need for tools.
4. The nominal 3'x3' cabinet unit shall have provision for an optional auto-elevating grille kit designed to provide motorized ascent/descent of the return air grille/pre filter assembly.
   a. The ascent/descent of the return air grille shall be up to a distance of 14-3/4 feet allowing access to remove and clean the filter.
   b. The auto-elevating grille shall have a control algorithm to accept up, down and stop control commands from the controller.
   c. The auto-elevating grille shall have a control to stop the descent automatically if a contact is made with any obstacle.

F. Coil Assembly

1. Unit shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
2. The copper tubing shall have inner grooves to expand the refrigerant contact surface for high efficiency heat exchanger operation.
3. Unit shall have a minimum one or two row coil 18-19 fins per inch.
4. Unit shall have a factory supplied condensate drain pan below the coil constructed of EPS (expandable polystyrene resin).
5. Unit shall include an installed and wired condensate drain lift pump capable of providing minimum 27.5 inch lift from bottom surface of the unit.
6. The drain pump shall have a safety switch to shut off the unit if condensate rises too high in the drain pan.
7. Unit shall have provision of 45° flare refrigerant pipe connections.
8. The coil shall be factory pressure tested at a minimum of 550 psig.
9. All refrigerant piping from outdoor unit to indoor unit shall be field insulated. Each pipe should be insulated separately. Thickness and heat transfer characteristics shall be determined by the design engineer and shall meet all code requirements.

G. Microprocessor Control

1. The unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system.
2. The unit shall be able to communicate with other indoor units and the outdoor unit using a field supplied minimum of 18 AWG, two core, stranded, twisted and shielded communication cable.
3. The unit controls shall operate the indoor unit using one of the five operating modes:
   a. Auto changeover (Heat Recovery System only)
   b. Heating
   c. Cooling

d. Dry
e. Fan only

4. The unit shall be able to operate in either cooling or heating mode for testing and/or commissioning.
5. The unit shall be able to operate with the fan turned off during system cooling thermal off.
6. The unit shall have adjustable, multi-step cooling and heating mode thermal on/off temperature range settings.
7. The system shall include a product check function to access and display indoor unit type and capacity from a wired programmable thermostat controller.
8. Unit shall have a field settable method to choose auto fan speed change operation based on mode of operation, on/off fan operation based on mode of operation, or continuous minimum set fan speed operation.

H. Electrical

1. The unit electrical power shall be 208-230/1/60 (V/Ph/Hz).
2. The unit shall be capable of operating within voltage limits of +/- 10% of the rated voltage.

I. Controls: Unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over an RS-485 daisy chain.

J. Seismic Installations: Provide OSHPD Special Seismic Certification Preapproval (OSP) documents for certified product list of VRF equipment to be installed in high seismic risk areas. Provide LG supplemental installation documents in conformance with CBC 2013, 2016 and 2019 California Building Code and IBC 2012, 2015 and 2018 International Building Code.

K. Warranty: Please refer to the respective outdoor unit for applicable warranty.

2.3 FAN COIL DUCTED – HIGH STATIC

A. General

1. Unit shall be manufactured by LG.
2. Unit shall be designed to be installed for indoor applications.
3. Ducted high Static- Unit shall be a low profile design with a maximum height of twelve inches.
4. Unit shall be designed to mount fully concealed above the finished ceiling.
5. Unit shall have opening to supply air from front horizontal and a dedicated rear horizontal return.
6. The supply air shall be flanged for field installed ductwork that shall not exceed the external static pressure limitation of the unit.

B. Casing/Panel

1. Unit case shall be manufactured using galvanized steel plate.
2. The cold surfaces of the unit shall be covered internally with a coated polystyrene insulating material.
3. Unit shall be provided with hanger brackets designed to support the unit weight on four corners.
4. Hanger brackets shall have pre-punched holes designed to accept field supplied, all thread rod hangers.

C. Cabinet Assembly

1. Unit shall have horizontal supply air discharge outlets and a return air inlet
2. Unit shall be equipped with factory installed temperature thermistors for:
   a. Return air
   b. Refrigerant entering coil
   c. Refrigerant leaving coil
3. Unit shall have a factory assembled, piped and wired electronic expansion valve (EEV) for refrigerant control.
4. Unit shall have a built-in control panel to communicate with other indoor units and to the outdoor unit.
5. Unit shall have the following functions as standard:
   a. Self-diagnostic function
   b. Auto addressing
   c. Auto restart function
   d. Auto changeover function (Heat Recovery system only)
   e. Auto operation function
   f. Child lock function
   g. Forced operation
   h. Dual thermistor control
   i. Sleep mode
   j. External static pressure (ESP) control
   k. Dual set point control
   l. Multiple aux heater applications
   m. Filter life timer
   n. External on/off input
   o. Wi-Fi compatible
   p. Auto fan operation
   q. Leak detection logic

D. Fan Assembly

1. The unit shall have two direct drive Sirocco fans made of high strength ABS GP-2200 polymeric resin.
2. The fan impeller shall be statically and dynamically balanced.
3. The fans shall be mounted on a common shaft.
4. The fan motor is Brushless Digitally commutated (BLDC) with permanently lubricated and sealed ball bearings.
5. The fan motor shall include thermal, overcurrent and low RPM protection.
6. The fan/motor assembly shall be mounted on vibration attenuating rubber grommets.

7. The fan speed shall be controlled using microprocessor based direct digitally controlled algorithm that provides a minimum of three pre-programed fan speeds, each setting is also adjustable by field setting to compensate for a limited amount of additional resistance to airflow by adjusting the RPM of the fan motor.
8. In cooling mode, the indoor fan shall have the following settings: Low, Med, High, and Auto.
9. In heating mode, the indoor fan shall have the following settings: Low, Med, High, and Auto.
10. Each of the settings can be field adjusted from the factory setting (RPM/ESP).
11. Unit shall be designed for high speed air volume against an external static pressure of up to 0.98", model dependent.

E. Filter Assembly

1. The return air inlet shall have a factory supplied accessory MERV 13 filter rack.
2. The filter access shall be from the side of the unit.

F. Coil Assembly

1. Unit shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
2. The copper tubing shall have inner grooves to expand the refrigerant contact surface for high efficiency heat exchanger operation.
3. Unit shall have a minimum two to three row coil, 18-21 fins per inch.
4. Unit shall have a factory supplied condensate drain pan below the coil constructed of HIPS (high impact polystyrene resin).
6. Unit shall include an installed and wired condensate drain lift pump capable of providing minimum 27.5 inch lift from bottom surface of the unit. The unit drain pan is supplied with a secondary drain port/plug allowing the pan to be gravity drained and serviced.>
7. The drain pump shall have a safety switch to shut off the unit if condensate rises too high in the drain pan, model dependent.
8. Unit shall have provision of 45° flare refrigerant pipe connections.
9. The coil shall be factory pressure tested at a minimum of 550 psig.
10. All refrigerant piping from outdoor unit to indoor unit shall be field insulated. Each pipe should be insulated separately. Thickness and heat transfer characteristics shall be determined by the design engineer and shall meet all code requirements.

G. Microprocessor Control

1. The unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system with or without the use of a wall mounted controller. The unit shall have a factory mounted return air thermistor for use as a space temperature control device. All operating parameters except scheduling shall be stored in non-volatile memory resident on the microprocessor. The microprocessor shall provide the following functions, self-diagnostics, auto re-start after a power failure and a test run mode.

2. The unit shall be able to communicate with other indoor units and the outdoor unit using a field supplied minimum of 18 AWG, two core, stranded, twisted, and shielded communication cable (RS-485).The unit shall be able to communicate with the BMS system. Provide all software and hardware as required.
3. The unit controls shall operate the indoor unit using one of the five operating modes:
   a. Auto changeover (Heat Recovery System only)
   b. Heating
   c. Cooling
   d. Dry
   e. Fan only
4. The unit shall be able to operate in either cooling or heating mode for testing and/or commissioning.
3. The unit shall be able to operate with the fan turned off during system cooling thermal off.
4. The unit shall be able to operate with a continuous fan setting.
5. The unit shall have adjustable, multi-step cooling and heating mode thermal on/off temperature range settings.
6. The system shall include a product check function to access and display indoor unit type and capacity from a wired programmable thermostat controller.

H. Electrical

1. The unit electrical power shall be 208-230/1/60 (V/Ph/Hz).
   a. The unit shall be capable of operating within voltage limits of +/- 10% of the rated voltage.

2.4 BMS INTEGRATION:

A. The VRF system shall be able to integrate with Building Management Systems via BACnet™ IP gateway. This gateway converts between BACnet™ IP or Modbus TCP protocol, and RS-485 LGAP (LG Aircon protocol) allowing third party control and monitoring of the LG A/C system, or LonWorks™ gateways. See controls specification for points list.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching

any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230265

SECTION 230270

VRF REFRIGERANT TO WATER HEAT EXCHANGERS

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 SYSTEM DESCRIPTION

A. Indoor units are matched with heat pump or heat recovery VRF (variable refrigerant flow) outdoor unit.

1.2 DELIVERY, STORAGE AND HANDLING

A. Units shall be stored and handled per unit manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 HYDRO KIT

A. Hydro Kit is designed for indoor application to work with LG's Multi V product line and shall be available in two capacities each uniquely designed for providing hot or chilled water.

1. The Hydro Kit shall be used in conjunction with Multi V 5 Heat Pump and Heat Recovery Outdoor Units.

2. Multi V Systems consists of an outdoor air source unit , one or more indoor units or Hydro Kits, integrated system controls, and interconnecting field-provided refrigerant pipe network containing various fittings including Y-Branch kits and Header kits supplied by LG.

B. Product Design

1. LG Hydro Kit Heating/Cooling model shall provide hot water to use for hydronic heating applications. The medium temperature heating model shall use a 1-stage refrigerant to water heat exchanger to transfer heat generated during a cooling operation or cooling generated during a heating operation of a Multi V system.

2. The medium Temperature heating Hydro kit shall be capable of operating with 208/230V, 60Hz, 1 phase power with phase to phase and phase to ground imbalance up to 3% and a voltage fluctuation of +/- 10%.

C. Operating Conditions

1. Hydro Kit Heating model shall be capable of continuous operation at the following conditions.

2. Hydro Kit Inlet water temperature: 50°F to 95°F

a. Multi V 5 Air Source Heat Pump and Recovery System
   - Ambient temperature: 23°F DB to 109°F DB

b. Multi V S Air Source Heat Pump and Recovery System
   - Ambient temperature: 23°F DB to 109°F DB

c. Multi V Water IV (Heat Pump and Heat Recovery Series)
   - Hydro Kit Inlet water temperature: 50°F to 95°F
   - Entering water range temperature: 59°F to 113°F

3. Heating operation – Leaving water temperature up to 122°F
   a. With Multi V Air Source Heat Pump
      - Hydro Kit Inlet water temperature: 59°F to 113°F
      - Ambient temperature: -13°F(WB) to 95°F(WB)
   b. With Multi V Air Source Heat Recovery
      - Hydro Kit Inlet water temperature: 59°F to 113°F
      - Ambient temperature (Heating Operation): -13°F (WB) to 95°F(WB)
      - Ambient temperature (Simultaneous Operation): 95°F (DB) to 109°F (DB)
   c. With Multi V Water Source Heat Pump and Heat Recovery
      - Hydro Kit Inlet water temperature: 59°F to 122°F
      - Condenser circuit water temperature: 50°F to 113°F

D. General

1. The system shall use R410A refrigerant
   a. Hydro Kit shall work in conjunction with:
      - Either a Multi V air source, single phase or three phase or water source single phase or three phase system(s).
      - Secondary third party solar heating systems using Solar heating interface

2. Refrigerant circuit for Hydro Kit:
   a. The refrigerant pipe connections shall be accessible from the front right side of the unit.
   b. The refrigerant circuit shall be installed using field provided copper pipe connected to either a Multi V outdoor unit or water source unit together with manufacturer supplied y-branches and/or header fittings.
   c. Each refrigerant pipe, y-branch, header, elbows and valves shall be field insulated with a minimum of ½" Armaflex/Rubatex, or equivalent pipe insulation. All joints shall be glued and sealed air tight.

3. Water circuit for Hydro Kit
   a. All water pipe connections shall be accessible from the front right side of Hydro Kit.

   b. The Hydro Kit shall be capable of using waste heat generated during cooling operations and waste cooling generated during heating operation to use in hydronic heating/cooling applications including but not limited to:
      - Domestic water heating

- Radiant floor heating
- Hydronic wall fin heating
- Historic radiators
- 2-pipe fan coil cooling/heating
- Preheat/ Precool coils
- Reheat coils
- Dual Source water heating – VRF and Solar

4. All water piping accessories, piping specialties shall be supplied and installed by the installing contractor.

5. Flow of water shall be monitored by an internal factory installed flow switch connected to water source unit safety controls to prevent operation of the water source unit when there is insufficient water flow through heat exchanger.

6. Solar Heating Interface kit shall consist of a PCB microprocessor, a hot water heating tank sensor/well. Any Control valves required shall be field provided.

7. The Heating/Cooling Hydro Kit unit shall be provided with a power module designed to close field provided valves to prevent the heat exchanger from freezing in the event of a power failure during Multi V defrost or oil return operations.

E. Cabinet

1. The Hydro kit casing shall have 14 gauge coated metal frame construction with 20-gauge sheet metal panels.

2. Frame and panels shall have a weather resistant baked enamel finish.

3. The front panel shall be easily removable and allow access to all major components and control devices.

4. All pipe connections shall be from the front right end of the cabinet.

5. Service access shall be from front side of the unit. Unit designs that require service access from the top or back panels will not be acceptable.

6. A removable panel shall be provided for heat exchanger removal without disassembling the unit cabinet.

F. Hydro Kit Refrigerant to Water Heat Exchanger

1. The Hydro Kit unit shall be provided with a 316 stainless steel plate type heat exchanger.

2. The heat exchanger shall remove/add heat between refrigerant and water.

3. Refrigerant/water plate heat exchanger shall be designed to operate at a maximum working pressure of 640 psig.

4. Heat exchanger waterside volume shall not exceed 0.58 US gallons.

5. The heat exchanger shall be protected with a factory provided and field installed (50-Mesh or finer) strainer on the water inlet connection.

6. The unit controller shall have:
   a. Heat exchanger freeze protection algorithm
   b. Overheating protection algorithm

G. Sound Levels

1. The Heating/Cooling Hydro Kit (K2 chassis) unit shall have an open path sound pressure level rating of 26 dB(A) or lower when tested in an anechoic chamber using ISO Standard 3745 test protocol.

H. Microprocessor Controller

1. The Hydro Kits shall be provided with an internal microprocessor based controller and a wall mounted Hydro Kit Control Panel.

2. The Hydro Kits shall accommodate an optional Wi-Fi module as an additional accessory to allow monitoring and control through a smart device with the LG Smart ThinQ© application.

3. Operation shall be auto changeover or field selected based on maintaining leaving water or hot water tank temperature at a field adjustable set-point.

4. Entering and leaving water pipe temperature sensors

5. Hot Water Tank Sensor

6. The Hydro Kit operation may be optionally controlled by sensing the conditioned space air temperature using an LG provided, Remote Temperature Sensor (sold separately) or a field provided manual changeover conventional thermostat.

I. External Control Component Connectivity

1. The Hydro Kit shall be equipped with a factory mounted terminal block with screw type connectors provided to connect waterside control devices and accessories including:
   a. The K2 chassis shall be provided with field supplied and installed 208-230V Pump on/off control interface.
   b. The K2 chassis shall be provided with both power and control terminals to connect to a field provided and installed conventional 208-230 VAC or mechanical type conditioned space temperature sensing thermostat with a manual changeover subbase.
   c. The Heating/Cooling Hydro Kit shall also be provided with both power and control terminals to connect a field provided and installed conventional

manual changeover 24VAC Heating/Cooling thermostat (Heat pump model not applicable).

d. The K2 chassis shall be provided with terminals to power and control a field provided and installed:
   - 3-way valve to switch between hot water heating and space conditioning.
   - 2-way valve to isolate the flow of water to a portion of the hydronic heating circuit where condensation may present a problem while the Hydro Kit is producing chilled water.

e. The K2 chassis shall be provided with an algorithm that monitors and minimizes the potential for condensation formation on the floor of a radiant floor heating circuit.

f. The controller shall have the capability of interfacing with an existing standalone secondary or solar hydronic heating circuit. The optional Hydro Kit solar heating system control interface and sensor(s) shall be provided by LG and purchased separately. (Valves are provided by others).
   - They shall be provided with field supplied and installed solar heating circuit water pump on/off control.

J. External Control Component Connectivity

1. The Hydro Kit remote mounted Hydro Kit controller shall have the following attributes and functions:
   a. Display: Degrees Fahrenheit or Celsius
   b. Manual/Auto restart
   c. User override - Enable/Disable water tank heating
   d. Set priority - water tank or conditioned space heating
   e. Leaving water heating temperature set-point
   f. Leaving water heating dead-band
   g. Conditioned space heating temperature set-point
   h. Conditioned space heating dead-band
   i. Adjustable water tank heating cycle schedule (duration on / duration off)
   j. Water tank heating temperature set-point
   k. Water tank heating dead-band
   l. Water tank freeze protection temperature set-point
   m. Outdoor air temperature (or building water with water source) based Hot water temperature reset
   n. Water circuit pump on/off control
   o. Emergency operation (external sensor failure override)
   p. Group Control (Up to 16 Hydro Kits may be controlled by a single Hydro Kit Controller)
   q. Water pump test run cycle
   r. Self diagnostics
   s. Child lock
   t. Outdoor air temperature based chilled water temperature reset (K2 Chassis)
   u. Leaving chilled water temperature set-point (K2 Chassis)
   v. Leaving chilled water dead-band (K2 Chassis)

K Warranty

1. Please refer to the respective outdoor unit for applicable warranty.

2.2 BMS INTEGRATION:

A. The VRF system and hydro units shall be able to integrate with Building Management Systems via BACnet™ IP gateway. This gateway converts between BACnet™ IP or Modbus TCP protocol, and RS-485 LGAP (LG Aircon protocol) allowing third party control and monitoring of the LG A/C system, or LonWorks™ gateways. See controls specification for points list.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230270

SECTION 230280

VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.2 DESCRIPTION

A. This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use with a standard NEMA Design B induction motor.

B. The drive manufacturer shall supply the drive and all necessary options as herein specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of twenty years. VFD's that are manufactured by a third party and "brand labeled" shall not be acceptable. All VFDs installed on this project shall be from the same manufacturer.

1.3 QUALITY ASSURANCE

A. Referenced Standards

1. Institute of Electrical and Electronic Engineers (IEEE)
   a. Standard 519-1992, IEEE Guide for Harmonic Content and Control.

2. Underwriters laboratories
   a. UL508C

3. National Electrical Manufacturer's Association (NEMA)
   a. ICS 7.0, AC Adjustable Speed Drives

4. IEC 16800 Parts 1 and 2

5. National Electric Code (NEC)
   a. NEC 430.120, Adjustable-Speed Drive Systems

6. International Building Code (IBC)
   a. IBC 2006 Seismic – referencing ASC 7-05 and ICC AC-156

B. Qualifications

1. VFDs and options shall be UL listed as a complete assembly. VFD's that require the customer to supply external fuses for the VFD to be UL listed are not acceptable. VFDs with red label UL stickers, requiring additional branch circuit protection are not acceptable. The base VFD shall be UL listed for 100 KAIC without the need for input fuses.

2. CE Mark – The VFD shall conform to the European Union ElectroMagnetic Compatibility directive, a requirement for CE marking. The VFD shall meet product standard EN 61800-3 for the First Environment restricted level.

3. The entire VFD enclosure, including the bypass shall be seismically certified and labeled as such in accordance with the 2006 International Building Code (IBC):

   a. VFD manufacturer shall provide Seismic Certification and Installation requirements at time of submittal.

   b. Seismic importance factor of 1.5 rating is required and shall be based upon actual shake test data as defined by ICC AC-156.

   c. Seismic ratings based upon calculations alone are not acceptable. Certification of Seismic rating must be based on testing done in all three axis of motion.

4. Acceptable Manufactures

   a. ABB ACH Series.

   b. Alternate manufacturer's requests must be submitted in writing to the Engineer for approval at least 20 working days prior to bid. Approval does not relieve the supplier of specification requirements.

5. The VFD manufacturer shall have available a comprehensive, HVAC Drive Computer Based Training (CBT) product. The CBT product shall include detailed, interactive sections covering VFD unpacking, proper mechanical and electrical installation, and programming. The CBT product shall allow the user to provide just-in-time training to new personnel or refresher training for maintenance and repair personnel on the user's site. The CBT product shall be repeatable, precise and shall include record keeping capability. The CBT product shall record answers to simulations and tests by student ID number. The CBT product must be professionally produced and have interactive sections, student tests, and include video clips of proper wiring and installation.

1.4 SUBMITTALS

A. Submittals shall include the following information:

1. Outline dimensions, conduit entry locations and weight.

2. Customer connection and power wiring diagrams.

3. Complete technical product description includes a complete list of options provided. Any portions of this specification not met must be clearly indicated or the supplier and contractor shall be liable to provide all additional components required to meet this specification.

4. Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).

   a. The VFD manufacturer shall provide calculations; specific to this installation, showing total harmonic voltage distortion is less than 5%. Input filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519. All VFD's shall include a minimum of 5% impedance reactors, no exceptions.

PART 2 - PRODUCTS

2.1 VARIABLE FREQUENCY DRIVES

A. The VFD package as specified herein shall be enclosed in a UL Listed Type enclosure, exceeding NEMA enclosure design criteria (enclosures with only NEMA ratings are not acceptable), completely assembled and tested by the manufacturer in an ISO9001 facility. The VFD tolerated voltage window shall allow the VFD to operate from a line of +30% nominal, and -35% nominal voltage as a minimum.

   1. Environmental operating conditions: VFDs shall be capable of continuous operation at 0 to 50^0 C (32 to 122^0 F) ambient temperature as per VFD manufacturers documented/submittal data or VFD must be oversized to meet these temperature requirements. Not acceptable are VFD's that can only operate at 40° C intermittently (average during a 24 hour period) and therefore must be oversized. Altitude 0 to 3300 feet above sea level, less than 95% humidity, non-condensing. All circuit boards shall have conformal coating.

   2. Enclosure shall be rated UL Type 1 and shall be UL listed as a plenum rated VFD. VFD's without these ratings are not acceptable. NEMA only type 1 enclosures are not acceptable (must be UL Type 1).

   3. Provide NEMA 3R enclosures where exposed to outside weather or wet conditions.

B. All VFDs shall have the following standard features:

   1. All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.

   2. The keypad shall include Hand-Off-Auto selections and manual speed control. The drive shall incorporate "bumpless transfer" of speed reference when switching between "Hand" and "Auto" modes. There shall be fault reset and "Help" buttons on the keypad. The Help button shall include "on-line" assistance for programming and troubleshooting.

   3. There shall be a built-in time clock in the VFD keypad. The clock shall have a battery backup with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. If the

battery fails, the VFD shall automatically revert to hours of operation since initial power up. Capacitor back-up is not acceptable. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output Form-C relays. The VFD shall have a digital input that allows an override to the time clock (when in the off mode) for a programmable time frame. There shall be four (4) separate, independent timer functions that have both weekday and weekend settings.

4. The VFD's shall utilize pre-programmed application macro's specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time. The VFD shall have two user macros to allow the end-user to create and save custom settings.

5. The VFD shall have cooling fans that are designed for easy replacement. The fans shall be designed for replacement without requiring removing the VFD from the wall or removal of circuit boards. The VFD cooling fans shall operate only when required. To extend the fan and bearing operating life, the VFD shall cycle the cooling fans on and off as required.

6. The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to set point without tripping or component damage (flying start).

7. The VFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.

8. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430.250 for 4-pole motors.

9. The VFD shall have internal 5% impedance reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5% impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors. VFD's with only one DC reactor shall add an AC line reactor.

10. The input current rating of the VFD shall be no more than 3% greater than the output current rating. VFD's with higher input current ratings require the upstream wiring, protection devices, and source transformers to be oversized per NEC 430.120. Input and output current ratings must be shown on the VFD nameplate.

11. The VFD shall include a coordinated AC transient surge protection system consisting of 4-120 joule rated MOV's (phase to phase and phase to ground), a capacitor clamp, and 5% impedance reactors.

12. The VFD shall provide a programmable loss-of-load (broken belt / broken coupling) Form-C relay output. The drive shall be programmable to signal the loss-of-load condition via a keypad warning, Form-C relay output, and / or over the serial communications bus. The loss-of-load condition sensing algorithm shall include a programmable time delay that will allow for motor acceleration from zero speed without signaling a false loss-of-load condition.

13. The VFD shall have user programmable underload and overload curve functions to allow user defined indications of broken belt or mechanical failure / jam condition causing motor overload

14. The VFD shall include multiple “two zone” PID algorithms that allow the VFD to maintain PID control from two separate feedback signals (4-20mA, 0-10V, and / or serial communications). The two zone control PID algorithm will control motor speed based on a minimum, maximum, or average of the two feedback signals. All of the VFD PID controllers shall include the ability for “two zone” control.

15. If the input reference (4-20mA or 2-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, Form-C relay output and / or over the serial communication bus.
16. The VFD shall have programmable “Sleep” and “Wake up” functions to allow the drive to be started and stopped from the level of a process feedback signal.

17. Provide drive with circuit breaker option and remote panel mounting kit.

C. All VFDs to have the following adjustments:

1. Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed. The lockout range must be fully adjustable, from 0 to full speed.

2. Two (2) PID Set point controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed-loop control. The VFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID set point shall be adjustable from the VFD keypad, analog inputs, or over the communications bus. There shall be two independent parameter sets for the PID controller and the capability to switch between the parameter sets via a digital input, serial communications or from the keypad. The independent parameter sets are typically used for night setback, switching between summer and winter set points, etc.

3. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain the set point of an independent process (i.e., valves, dampers, etc.). All set points, process variables, etc. to be accessible from the serial communication network.

4. Two (2) programmable analog inputs shall accept current or voltage signals.

5. Two (2) programmable analog outputs (0-20ma or 4-20 ma). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, Active Feedback, and other data.

6. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices. All digital inputs shall be programmable to initiate upon an application or removal of 24VDC or 24VAC.

7. Three (3) programmable, digital Form-C relay outputs. The relay outputs shall include programmable on and off delay times and adjustable hysteresis. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating of 2 amps RMS. Outputs shall be true Form-C type contacts; open collector outputs are not acceptable.

8. Run permissive circuit - There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, input contact closure, time-clock control, or serial communications), the VFD shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD digital input and allows VFD motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close. The keypad shall display “start enable 1 (or 2) missing”. The safety input status shall also be transmitted over the serial communications bus.

9. The VFD control shall include a programmable time delay for VFD start and a keypad indication that this time delay is active. A Form C relay output provides a contact closure to signal the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates. The time delay shall be field programmable from 0 – 120 seconds. Start delay shall be active regardless of the start command source (keypad command, input contact closure, time-clock control, or serial communications), and when switching from drive to bypass.

10. Seven (7) programmable preset speeds.

11. Two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable time ramps.

12. The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise. The VFD shall have selectable software for optimization of motor noise, energy consumption, and motor speed control.

13. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows higher carrier frequency settings without derating the VFD.

14. The VFD shall include password protection against parameter changes.

D. The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable). All VFD faults shall be displayed in English words. The keypad shall include a minimum of 14 assistants including:
   1. Start-up assistant
   2. Parameter assistants
      a. PID assistant
      b. Reference assistant
      c. I/O assistant
      d. Serial communications assistant
      e. Option module assistant
      f. Panel display assistant
      g. Low noise set-up assistant
   3. Maintenance assistant
   4. Troubleshooting assistant
   5. Drive optimizer assistants

E. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):
   1. Output Frequency
   2. Motor Speed (RPM, %, or Engineering units)
   3. Motor Current
   4. Motor Torque
   5. Motor Power (kW)
   6. DC Bus Voltage
   7. Output Voltage

F. The VFD shall include a fireman's override input. Upon receipt of a contact closure from the fire / smoke control station, the VFD shall operate in one of two modes: 1) Operate at a programmed predetermined fixed speed ranging from -500Hz (reverse) to 500Hz (forward). 2) Operate in a specific fireman's override PID algorithm that automatically adjusts motor speed based on override set point and feedback. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands), except customer defined safety run interlocks, and force the motor to run in one of the two modes above. "Override Mode" shall be displayed on the keypad. Upon removal of the override signal, the VFD shall resume normal operation, without the need to cycle the normal digital input run command.

G. Serial Communications

1. The VFD shall have an EIA-485 port as standard. The standard protocols shall be Modbus, Johnson Controls N2, Siemens Building Technologies FLN, and BACnet. Optional protocols for LonWorks, Profibus, EtherNet, BACnet IP, and DeviceNet shall be available. Protocol provided shall match ATC system in Building. Each individual drive shall have the protocol in the base VFD. The use of third party gateways and multiplexers is not acceptable. All protocols shall be "certified" by the governing authority (i.e., BTL Listing for BACnet). Use of non-certified protocols is not allowed.

2. The BACnet connection shall be an EIA-485, MS/TP interface operating at 9.6, 19.2, 38.4, or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:

   a. Data Sharing – Read Property – B.
   b. Data Sharing – Write Property – B.
   c. Device Management – Dynamic Device Binding (Who-Is; I-Am).
   d. Device Management – Dynamic Object Binding (Who-Has; I-Have).
   e. Device Management – Communication Control – B.

3. If additional hardware is required to obtain the BACnet interface, the VFD manufacturer shall supply one BACnet gateway per drive. Multiple VFDs sharing one gateway shall not be acceptable.

4. Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible.

5. Serial communication in bypass shall include, but not be limited to; bypass run-stop control, the ability to force the unit to bypass, and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the DDC to monitor feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The DDC shall also be capable of monitoring the bypass relay output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible.

6. The VFD / bypass shall allow the DDC to control the drive and bypass digital and analog outputs via the serial interface. This control shall be independent of any VFD function. The analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive and bypass' digital (Form-C relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive and bypass' digital inputs shall be capable of being monitored by the DDC system. This allows for remote monitoring of which (of up to 4) safeties are open.

7. The VFD shall include an independent PID loop for customer use. The independent PID loop may be used for cooling tower bypass value control, chilled water value / hot water valve control, etc. Both the VFD PID control loop and the independent PID control loop shall continue functioning even if the serial communications connection is lost. As default, the VFD shall keep the last good set point command and last good DO & AO commands in memory in the event the serial communications connection is lost and continue controlling the process.

H. EMI / RFI filters. All VFD's shall include EMI/RFI filters. The onboard filters shall allow the VFD assembly to be CE Marked and the VFD shall meet product standard EN 61800-3 for the First Environment restricted level with up to 100 feet of motor cable. No Exceptions. Certified test reports shall be provided with the submittals confirming compliance to EN 61800-3, First Environment.

I. All VFD's through 75HP at 480 V shall be protected from input and output power mis-wiring. The VFD shall sense this condition and display an alarm on the keypad. The VFD shall not sustain damage from this power mis-wiring condition.

J. OPTIONAL FEATURES – Optional features shall be furnished and mounted by the drive manufacturer. All optional features shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label.

1. Door interlocked, pad-lockable disconnect switch that will disconnect all input power from the drive and all internally mounted options. Disconnect option shall be available with or without systems requiring bypass.

2. Field-bus adapters - Protocols such as BACnet IP shall be a plug in modules.

K. Bypass

1. A complete factory wired and tested bypass system consisting of a door interlocked, pad-lockable circuit breaker, output contactor, bypass contactor, and fast acting VFD input fuses. UL Listed motor overload protection shall be provided in both drive and bypass modes.

2. The bypass enclosure door and VFD enclosure must be mechanically interlocked such that the disconnecting device must be in the "Off" position before either enclosure may be accessed.

3. The VFD and bypass package shall have a UL listed short circuit current rating (SCCR) of 100,000 Amps and this rating shall be indicated on the UL data label.

4. The drive and bypass package shall be seismic certified and labeled to the IBC:
   a. Seismic importance factor of 1.5 rating is required and shall be based upon actual shake table test data as defined by ICC AC-156.

5. Drive Isolation Fuses - To ensure maximum possible bypass operation, fast acting fuses, exclusive to the VFD, shall be provided to allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection. This maintains bypass operation capability in the event of a VFD failure. Bypass designs which have no such fuses, or that incorporate fuses common to both the VFD and the bypass, will not be accepted. Third contactor "isolation contactors" are not an acceptable alternative to fuses, as contactors could weld closed and are not an NEC recognized disconnecting device.

6. The bypass shall maintain positive contactor control through the voltage tolerance window of nominal voltage +30%, -35%. This feature is designed to avoid contactor coil failure during brown out / low line conditions and allow for input single phase operation when in the VFD mode. Designs that will not allow input single phase operation in the VFD mode are not acceptable.

7. Motor protection from single phase power conditions - the bypass system must be able to detect a single phase input power condition while running in bypass, disengage the motor in a controlled fashion, and give a single phase input power indication. Bypass systems not incorporating single phase protection in bypass mode are not acceptable.

8. The bypass system shall be designed for stand-alone operation and shall be completely functional in both Hand and Automatic modes even if the VFD has been removed from the system for repair / replacement. Serial communications shall remain functional even with the VFD removed. Bypass systems that do not maintain full functionality with the drive removed are not acceptable.

9. Serial communications – the bypass shall be capable of being monitored and / or controlled via serial communications. On-board communications protocols shall include ModBus RTU; Johnson Controls N2; Siemens Building Technologies FLN (P1); and BACnet MS/TP.
   a. Serial communication capabilities shall include, but not be limited to: bypass run-stop control, the ability to force the unit to bypass, and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the BAS to monitor feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The BAS shall also be capable of monitoring the bypass relay output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible. The following additional status indications and settings shall be transmitted over the serial communications bus and / or via a Form-C relay output – keypad "Hand" or "Auto" selected, bypass selected, and broken belt indication. The BAS system shall also be able to monitor if the motor is running in the VFD mode or bypass mode over serial communications. A minimum of 50 field serial communications points shall be capable of being monitored in the bypass mode.

b. The bypass serial communications shall allow control of the drive/bypass (system) digital outputs via the serial interface. This control shall be independent of any bypass function or operating state. The system digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. All system analog and digital I/O shall be capable of being monitored by the BAS system.

10. There shall be an adjustable motor current sensing circuit for the bypass and VFD modes to provide proof of flow (broken belt) indication. The condition shall be indicated on the keypad display, transmitted over the BAS and / or via a Form-C relay output contact closure. The broken belt indication shall be programmable to be a system (drive and bypass) indication. The broken belt condition sensing algorithm shall be programmable to cause a warning or system shutdown.

11. The digital inputs for the system shall accept 24VAC or 24VDC. The bypass shall incorporate an internally sourced power supply and not require an external control power source. The bypass power board shall supply 250 mA of 24 VDC for use by others to power external devices.

12. There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad command, time-clock control, digital input, or serial communications) the bypass shall provide a dry contact closure that will signal the damper to open before the motor can run. When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a bypass system input and allows motor operation. Up to four separate safety interlock inputs shall be provided. When any safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close. This feature will also operate in Fireman’s override / smoke control mode.

13. The bypass control shall monitor the status of the VFD and bypass contactors and indicate when there is a welded contactor contact or open contactor coil. This failed contactor condition shall be indicated on the bypass LCD display, programmed to activate a Form-C relay output, and / or over the serial communications protocol.

14. The bypass control shall include a programmable time delay bypass start including keypad indication of the time delay. A Form C relay output commands the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates at full speed in the bypass mode. The time delay shall be field programmable from 0 – 120 seconds.

15. There shall be a keypad adjustment to select manual or automatic transfer to bypass. The user shall be able to select via keypad programming which drive faults will result in an automatic transfer to bypass mode and which faults require a manual transfer to bypass. The user may select whether the system shall automatically transfer from drive to bypass mode on the following drive fault conditions:

    a. Over current
    b. Over voltage
    c. Under voltage
    d. Loss of analog input

16. The following operators shall be provided:

    a. Bypass Hand-Off-Auto
    b. Drive mode selector
    c. Bypass mode selector
    d. Bypass fault reset

17. The bypass shall include a two line, 20 character LCD displays. The display shall allow the user to access and view:

    a. Energy savings – in US dollars
    b. Bypass motor amps
    c. Bypass input voltage– average and individual phase voltage
    d. Bypass power (kW)
    e. Bypass faults and fault logs
    f. Bypass warnings
    g. Bypass operating time (resettable)
    h. Bypass energy (kilowatt hours – resettable)
    i. I/O status
    j. Parameter settings / programming
    k. Printed circuit board temperature

18. The following indicating lights (LED type), or keypad display indications shall be provided. A test mode or push to test feature shall be provided.

    a. Power-on (Ready)
    b. Run enable
    c. Drive mode selected
    d. Bypass mode selected
    e. Drive running
    f. Bypass running
    g. Drive fault
    h. Bypass fault
    i. Bypass H-O-A mode
    j. Automatic transfer to bypass selected
    k. Safety open
    l. Damper opening
    m. Damper end-switch made

19. The Bypass controller shall have six programmable digital inputs, and five programmable Form-C relay outputs. This I/O allows for a total System (VFD and Bypass) I/O count of 24 points as standard. The bypass I/O shall be available to the BAS system even with the VFD removed.

20. The on-board Form-C relay outputs in the bypass shall be programmable for any of the following indications.

    a. System started
    b. System running
    c. Bypass override enabled
    d. Drive fault
    e. Bypass fault
    f. Bypass H-O-A position
    g. Motor proof-of-flow (broken belt)
    h. Overload
    i. Bypass selected
    j. Bypass run
    k. System started (damper opening)
    l. Bypass alarm
    m. Over temperature

21. The bypass shall provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in VFD or Bypass mode. The remote start/stop contact shall operate in VFD and bypass modes. The terminal strip shall allow for independent connection of up to four (4) unique safety inputs.

22. The bypass shall include a supervisory control mode. In this bypass mode, the bypass shall monitor the value of the VFD's analog input (feedback). This feedback value is used to control the bypass contactor on and off state. The supervisory mode shall allow the user to maintain hysteresis control over applications such as cooling towers and booster pumps even with the VFD out of service.

23. The user shall be able to select the text to be displayed on the keypad when an external safety opens. Example text display indications include "FireStat", "FreezStat", "Over pressure" and "Low suction". The user shall also be able to determine which of the four (4) safety contacts is open over the serial communications connection.

24. Smoke Control Override Mode (Override 1) – The bypass shall include a dedicated digital input that will transfer the motor from VFD mode to Bypass mode upon receipt of a dry contact closure from the Fire / Smoke Control System. The Smoke Control Override Mode action is not programmable and will always function as described in the bypass User's Manual documentation. In this mode, the system will ignore low priority safeties and acknowledge high priority safeties. All keypad control, serial communications control, and normal customer start / stop control inputs will be disregarded. This Smoke Control Mode shall be designed to meet the intent of UL864/UUKL.

25. Fireman's Override Mode (Override 2) – the bypass shall include a second, programmable override input which will allow the user to configure the unit to acknowledge some digital inputs, all digital inputs, ignore digital inputs or any combination of the above. This programmability allows the user to program the bypass unit to react in whatever manner the local Authority Having Jurisdiction (AHJ) requires. The Override 2 action may be programmed for "Run-to-Destruction". The user may also force the unit into Override 2 via the serial communications link.

26. Class 10, 20, or 30 (programmable) electronic motor overload protections shall be included.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive in accordance with the recommendations of the VFD manufacturer as outlined in the VFD installation manual.

B. Power wiring shall be completed by the electrical contractor, to NEC code 430.122 wiring requirements based on the VFD input current. Caution: VFDs supplied without internal reactors have substantially higher input current ratings, which may require larger input power wiring and branch circuit protection. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

3.2 START-UP

A. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.

3.3 PRODUCT SUPPORT

A. Factory trained application engineering and service personnel that are thoroughly familiar with the VFD products offered shall be locally available at both the specifying and installation locations. A toll free 24/365 technical support line shall be available.

B. A computer based training CD or 8-hour professionally generated video (VCR format) shall be provided to the owner at the time of project closeout. The training shall include installation, programming and operation of the VFD, bypass and serial communication.

3.4 WARRANTY

A. The VFD Product Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of shipment. The warranty shall include all parts, labor, travel time and expenses. A toll free 24/365 technical support line shall be available.

END OF SECTION 230280

SECTION 230290

DUCT MOUNTED COILS

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

PART 2 - PRODUCTS

2.1 DUCT MOUNTED COILS – HOT WATER

A. Coils shall be with aluminum plate fins, have collars drawn, belled, and firmly bonded to copper tubes by mechanical expansion of tubes. No soldering or tinning used in the bonding process.

B. Coils have galvanized steel casing and are mounted pitched in the unit casing. Coils are to be removable in duct flanges.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230290

SECTION 230300

FANS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

PART 2 - PRODUCTS

2.1 FANS

A. Furnish and install fans of the type, models, size and capacity indicated on the Drawings. Models indicated are as manufactured by Carnes Company. ACME or Greenheck, with equivalent characteristics will be considered.

B. Refer to Drawing schedule for required accessories and related appurtenances.

2.2 ROOF EXHAUST FANS

A. All roof exhaust fans shall be centrifugal roof exhausters of aluminum rustproof construction.

B. Units shall be direct connected with full ball-bearing motor. Power unit shall be isolated against vibration by means of oil resistant rubber or spring steel mounting.

C. Provide square insulated curb cap of aluminum with aluminum liner as an integral part of the unit. Each unit shall be equipped with a back draft or automatic damper, disconnect switch for the motor and birdscreens.

2.3 IN-LINE FANS

A. Construction: Unit exterior shall be constructed of heavy gauge galvanized steel. The fan housing shall be square in shape and readily attachable to building ductwork. Unit side panels shall be removable for easy access for maintenance and service. The power assembly shall be removable as a complete module.

B. Wheel: Wheels shall be of the centrifugal backward inclined type. Wheels shall be constructed of aluminum and contain a matching inlet venturi for optimum performance. Wheels shall be statically and dynamically balanced.

C. Shaft: Fan shafts shall be precision ground and polished. Shafts shall have a first critical speed of at least 125% of the fan’s maximum operating speed.

D. Bearings: Bearings shall be of the one piece, cast iron, pillow block type with relubricable zerk fittings. Bearings shall be designed for final system balancing.

E. Drive: Drives shall be sized for a minimum of 150% of driven horsepower. Machined, cast iron motor sheaves shall be adjustable for final system balancing.

F. Motor: Motor shall be heavy duty ball bearing type, closely matched to the fan load. All motors shall be listed by UL and/or CSA. A disconnect switch shall be factory installed and wired to the fan motors as standard. Motors shall be mounted on the outside of the unit isolated from the airstream. The belt and pillow block ball bearings shall be protected from the airstream by an enclosure.

G. Backdraft Damper: When no motorized damper is indicated on Drawings at discharge of fan, provide gravity backdraft damper.

H. Fans shall bear the AMCA ratings seal for Sound and Air performance. Fans shall carry the UL and/or CSA listing mark. Fans shall bear a permanently attached nameplate displaying model and serial number of the unit for future identification.

2.3 KITCHEN HOOD EXHAUST FANS

A. Up-blast exhaust ventilators shall be of the centrifugal belt driven type. The motor compartments shall be construed of aluminum mounted on an independent support structure. The outer shroud shall have a rolled bead for added strength. The wheel and spun inlet venturi shall be a centrifugal design of non-sparking construction. For maximum performance and quiet, efficient operation, the wheel shall overlap the inlet venturi and have backward inclined blades. The wheel shall be dynamically balanced to assure smooth and vibration-free rotation under maximum loading. The complete drive assembly, including the motor and the wheel, shall be mounted on vibration isolators. Motors and drives shall be factory mounted. All fans shall be test run prior to shipment.

B. Motor and drives shall be isolated from the exhaust air stream. Air for cooling the motor shall be supplied to the internal motor compartments through a vent tube from a location free from discharge contaminants. Motors shall be of the heavy duty type with permanently lubricated, sealed ball bearings. Motors shall be readily accessible for maintenance. The wheel shaft shall be ground, polished, coated with a rust inhibitive finish and mounted in heavy duty, permanently sealed pillow block ball bearings which are capable of 200,000 hours of life, average operation. The drives shall be sized at a minimum of 165% of driven horsepower. Drive belts shall be oil-resistant, non-static and be capable of 25,000 hours of life, average operation. Sheaves shall be fully machined cast iron or pressed steel, keyed and securely attached to the shafts. Variable pitch motor sheaves shall be standard.

C. The motor shall be factory wired to the disconnect switch which shall be mounted in a junction box located on the fan plate inside the motor compartment. Wiring connected to the switch will travel through rigid conduit to a weatherproof junction box mounted on the exterior of the unit. Wiring shall not pass through the motor compartment vent tube. Horsepower and noise levels shall not exceed the published values and oversized motors will not be acceptable. Performance ratings shall be AMCA licensed for air and sound. Centrifugal power up-blast ventilators for commercial kitchen applications shall be Carnes Company model VRBK, belt driven, sizes 06 through 48, as manufactured by Carnes Company or Verona, Wisconsin or approved equal.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230300

SECTION 230310

HOT WATER CABINET HEATERS

PART 1 - GENERAL

Applicable provisions of the Conditions *of* the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

PART 2 - PRODUCTS

2.1 HOT WATER CABINET HEATERS

A. Furnish and install where indicated on the Drawings hot water cabinet heaters as manufactured by Sterling Co. of model, capacity and performance noted on the Drawing schedule.

B. The cabinet shall be 16 gauge steel, four side overlap front panels, with M-shaped stiffener running entire panel length as standard. Integral, stamped, inlet and outlet insulated over entire coil section.

C. Front panel removed with two tamperproof screws and shall be of finish as selected by Architect. Unit to be equipped with factory mounted fan cycling thermostat. Fans are forwardly curved double-inlet centrifugal of aluminum construction and are modular in design.

D. The water coil is constructed of copper tubing mechanically expanded into aluminum fins. All joints are brazed with high temperature silver alloy. Water coils have a plugged drain tube and vent tube extended into the unit end compartment. Automatic air vent fittings shall be provided. Coils are field reversible.

E. Filters are removable by removing front panel. 1" woven glass filters standard to be used.

F. Provide factory finished trim flange for all semi-recessed applications.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230310

SECTION 230320

HOT WATER UNIT HEATERS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

PART 2 - PRODUCTS

2.1 HOT WATER UNIT HEATERS

A. Furnish and install where shown on the Drawings model as manufactured by Sterling Co. or approved equal and shall be of sizes noted on the Drawing.

B. Casing shall be 20 gauge die-formed steel. Casing substrates shall be prepared for finishing with a hot wash, iron phosphatizing clear rinse, chromic acid rinse and oven drying. Paint finish shall be of lead-free, chromate-free, alkyd melamine resin base and applied with an electrostatic two-pass system.

C. Coil elements and headers shall be of heavy wall drawn seamless copper tubing. Element tubes shall be brazed into extruded header junctions. Pipe connection saddles shall be of cast bronze. Aluminum fins shall have drawn collars to assure permanent bond with expanded element tubes and exact spacing.

D. Motors shall be totally enclosed, resilient mounted with class B windings. All motors shall be designed for horizontal mounting.

E. Fans shall be of the aluminum blade, steel hub type designed and balanced to assure maximum air delivery, low motor horsepower requirements and quiet operation. Blades are spark proof. Fan guards shall be welded steel, zinc plated or painted.

F. Units shall be equipped with horizontal, individually adjustable louvers. Vertical louvers for 4-way air control shall be available as an optional extra.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230320

SECTION 230325

CEILING RADIANT PANEL HEATERS

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

PART 2 – PRODUCTS

2.1 RADIANT PANELS HEATERS

A. Furnish and install Panels as manufactured by Sterling Co., or others considered equal as indicated on the Drawings. Type and size as noted on Drawing. Unit shall be installed in a neat and workmanlike manner in accordance with the Specifications and manufacturer's recommendations.

B. The aluminum planks shall incorporate a tube saddle channel as an integral part of the profile which can be integrated into a suspended ceiling to provide overhead radiant heating. A non-hardening heat paste between the tubing and the aluminum face plate shall ensure even heat distribution to the active face, providing overall thermal efficiency. The panels' planks shall be tongue and groove to provide a clean joint longitudinally. They shall be held together using a special clipping system.

C. The system can be used with hot water at various temperatures; insulation blankets with a heat reflecting foil backing are utilized to maintain heating efficiency.

D. The panels are fabricated from 18 gauge aluminum sheet to which a heating coil is mechanically fastened. Thermal contact between the coil and panel is maintained by an aluminum heat saddle fastened with welded aluminum or steel studs. The coil is clipped to the heat saddle using cadmium plated steel clips where heat transfer paste is used at the interface between the aluminum heat saddle and both the face of the panel and the tubing.

E. Dimensions and Weight

1. Linear panels shall be available in a variety of lengths of up to 16 ft. and widths in multiples of 6".

2. The working weight for the aluminum panels is approximately 2.0 lb./ft^2.

F. Materials of Construction

1. Pipework: Panel shall have its own serpentine pipe coil of 5/8" O.D. tubing.

2. Panels: Extruded aluminum planks.

3. Paint Finish: Standard finish is white polyester powder coating.

4. Contact Strips: Aluminum heat saddle bolted to the back of the panel using steel or aluminum studs which are welded to the panel.

5. Insulation: Minimum of 1” thick foil back batt insulation by this contractor.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230325

SECTION 230330

CONVECTORS

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

PART 2 - PRODUCTS

2.1 CONVECTORS

A. Furnish and install Convectors as manufactured by Sterling Co., Airtherm Co. and American Air Filer Co. considered equal as indicated on the Drawings. Type and size as noted on Drawing. Unit shall be installed in a neat and workmanlike manner in accordance with the Specifications and manufacturer's recommendations.

B. Convector element shall be constructed of copper tubes expanded and rolled into cast iron headers with contact further strengthened by brass bushings, aluminum fins, ribbed steel side plates and fin tube supports.

C. Cabinet shall have a one piece 14 gauge steel front panel. Front panel shall be held in place by camlock fasteners.

D. Dampers shall be factory mounted on the element to reduce heating capacity up to 70% when closed. Key operated damper-tamperproof. Baked enamel finish shall be provided in standard manufacturer's colors as selected by the Architect. Unit shall have (camlock) access doors to provide access to valves.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230330

SECTION 230340

FIN TUBE RADIATION

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

PART 2 - PRODUCTS

2.1 FIN TUBE RADIATION

A. Furnish and install fin-tube heating elements and enclosures, indicated on Drawings, together with required mounting components and accessories.

B. Materials shall be as manufactured by Sterling Radiator Co., Vulcan Radiator Co. or Standard Fin-Pipe Radiator Corp.

C. Heating Elements

1. Various lengths and assemblies are indicated on the plan together with their pipe sizes, fin sizes and spacing. Elements shall be completely independent of and shall not touch enclosures to assure low surface temperature.

2. Heating elements shall consist of full-hard aluminum plate fins not less than .20" thick, permanently bonded to copper seamless drawn tube and guaranteed for working pressure at 300 degrees F not less than 200 psi for 1-1/4" tube. Fins shall be actually embedded in the copper tube.

D. Enclosure and Accessories

1. Enclosures and accessories shall be of style and dimensions indicated on our Drawings and shall be fabricated from zinc-coated steel. Enclosures shall be 16 gauge. On wall-to-wall applications, enclosures shall be furnished in one piece up to a maximum of 10’ - 10" enclosure length for rooms or spaces measuring a maximum of 10' - 10" wall length, using a 6" end trim each end. Enclosures shall be furnished in two or more lengths for wall lengths exceeding 10' - 10".

2. Left end of all enclosures shall have spot-welded back-up angles. The mating right end shall be fastened securely with screws. End enclosures shall have same method of joining.

3. End trims, furnished with roll-flanged edges, shall be used between ends of enclosures and walls on wall-to-wall applications. End trims to be 6" maximum length and shall be attached without visible fasteners. End enclosures shall be furnished where indicated, shall be same gauge as enclosures, and be factory-welded to enclosures.

4. Enclosures shall be supported at top and bottom by means of heavy gauge mounting channel and allow installation and removal of enclosures without scraping walls or disturbing paint lines. Enclosures are securely fastened to the bottom support.

5. Access doors shall be provided where noted on Drawings. Doors shall be 8" x 8" and shall be located directly in the enclosures. Doors shall be hinged. Where radiation is located behind casework coordinate access door locations with casework vendor.

6. Provide vertical and horizontal enclosure for pipe risers and runouts which are exposed above/below/adjacent to radiation enclosure. Riser enclosure shall be of same gauge and finish as radiation enclosure. Provide wall plate which enclosure shall snap onto without exposed fasteners. Sterling model PCH (V).

7. Enclosure finish shall be as selected by Architect (and shall match unit ventilator finish when unit ventilators are also specified for the project).

E. Enclosure Brackets and Element Hangers

1. Enclosure bracket and element hangers shall be installed not farther than 4' apart. Brackets shall be die-formed from 3/16" thick stock, 1-1/2" wide, and shall be lanced to support and position lower flange of enclosure. Enclosures shall be firmly attached to brackets by set screws, operated from under the enclosure. Devices, which do not provide positive fastening of enclosures, are not acceptable. Brackets shall be inserted in pre-punched slots in mounted channel to insure correct alignment and shall be fastened securely to wall at bottom.

2. Sliding saddles shall support heating elements and provide positive positioning of element in enclosure to insure maximum heating efficiency while preventing any possibility of fin impingement on brackets or enclosure joints during expansion or contraction. Element supports shall be a double saddle design fabrication from 16 gauge zinc-coated steel.

3. Saddle shall slide freely on saddle support arm bolted to support bracket. Support arm shall allow 1-1/2" height adjustment for pinch. The element support saddle shall allow 1-5/8" lateral movement for expansion and contraction of heating element. Rod or wire hangers not acceptable.

4. Submit shop drawings of all heating elements and enclosures. Enclosure measurements and accessories are not to be fabricated until after verified measurements have been taken at the site.

F. Piping Enclosures: Where concealed piping in ceilings and wall of finished spaces is not possible, provide vertical or horizontal metal piping enclosures equal to “Sterling” model PCH (horizontal) or PCHV (vertical). Provide all required hangers, supports, corners, brackets, etc. color per Architect.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230340

SECTION 230343

AIR CURTAINS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements shall govern work in this section. Submit shop drawings for checking and approval.

1.1 SYSTEM DESCRIPTION

A. Air curtains, electric heated.

B. Air curtain designed for commercial entry doors, direct drive, quiet operation.

1.2 DELIVERY, STORAGE AND HANDLING

A. Deliver air curtains in factory labeled packages.

B. Store and handle in strict compliance with manufacturer’s written instructions and recommendations.

C. Protect from damage due to weather, excessive temperature, and construction operations.

1.3 WARRANTY

A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of air curtains that fail in materials or workmanship within specified warranty period.

1. Two-year limited warranty for heated units.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. Basis-of-Design Manufacturer: The design for air curtains is based on products manufactured by VTS Wing.

B. Substitutions will be considered.

2.2 AIR CURTAINS

A. Acceptable Products: High Performance Electric Heated.

B. Construction: Provide factory-assembled units of sufficient structural strength to be supported from ends without intermediate support. Ship units completely assembled.

C. Cabinet:

1. Material and Finish: Minimum 16-gage aluminized steel base frame with welded construction, powder coated finish.

2. Dimensions: Not to exceed 12.25 in (31.1) high by 22 in (55.9 cm) deep.

3. Mounting: Provide for suspended mounting.

4. Service Access: Removable screen and hinged bottom access panel.

D. Motors: 1/2-HP, 1680 RPM, single phase, 3-speed, ODP, direct drive, resilient mounted, continuous duty, with internal thermal-overload protection and permanently lubricated sealed ball bearings.

E. Fans: Balanced forward curved type, double inlet, mounted in matched fan housings with aerodynamically formed air inlet venturis. Manufacture wheels and housings from galvanized steel.

F. Discharge Nozzles:

1. Provide uniform velocity across width of air curtain.

2. Aperture: 2.5 in (6.4 cm) slot by width of air curtain.

G. Vanes: 1.5 in (3.8 cm) minimum height; constructed of airfoil-shaped aluminum extrusions; adjustable plus or minus 20 degrees to deflect airflow.

H. Air Inlet Filter: Flat faced fire-rated re-cleanable aluminum with integral filter bracket.

1.2 HEATING ELEMENTS

A. Electric Heating Coil: UL-approved, factory-mounted, factory-wired, thermally-protected, in galvanized steel frame.

1. Venturi mounted helical coil with point suspended elements, [single] [three] phase circuit.

2. Thermal Cutout: Locks out electric heater when prolonged abnormal over-temperature conditions exist.
3. Factory mount coil within blower fan venturi inlet.

1.3 CONTROLS

A. Controller:

1. UL listed, industrial type, pre-wired, with solid-state control switch.

2. Factory-mounted and wired Intelliswitch™ digital programmable controller with the following features:

   a. 5 volt DC output for control circuit.
   b. Lock and unlock tamperproof feature.
   c. Motor and switching suitable for 10 fan speed settings.
   d. Programmable fan start, and fan stop time with provisions to set the start and stop times for any of the week.
   e. Programmable settings for all user controlled options.
   f. Adjustable time delay from 0 to 10 minutes.
   g. Five (5) preset and three (3) customizable programs - On, Off, Automatic, Deluxe, Comfort Plus, Program 1, Program 2, and Program 3.
   h. Fan fail lockout.
   i. Built-in capillary style thermostat for heated units with temperature settings of 34 degrees F to 90 degrees F (one (1) degree C to 32 degrees C).
   j. Two (2) heating modes, one (1) call for heat and one (1) call for fan and heat.
   k. Emergency stop.
   l. Clock with lighted display.
   m. Ability to be operated via Mobile App with Wi-Fi Controller option.

3. Unit mounted display.

B. Wi-Fi and BLE Communication: Native Wi-Fi and Bluetooth wireless networking included with the Intelliswitch™ digital programmable controller for use with Berner Air mobile app to allow for remote control of air curtain via BACnet client.

1. Supply BACnet client connection: via CAT 5 cable connected to air curtain.

C. Thermostat: For remote mounted sensing to prevent the operation of heater when inside air temperature exceeds desired temperature.

D. Disconnect Switch: Provide lockable factory mounted non-fused toggle disconnects based on number of power supplies required.

2.5 MOUNTING ACCESSORIES

A. Provide brackets and other mounting accessories as required to permit installation and proper functioning of air curtain to meet project conditions of use.

1. Brackets: galvanized steel.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that door frame and adjacent construction are installed correctly and are ready to receive work of this Section.

B. Verify that utilities are in correct location and are of correct capacities for specified products.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install air curtains, where indicated on Drawings and accordance with shop drawings and manufacturer's instructions. Provide clearance to permit servicing and maintenance.

B. Securely install air curtains plumb, level, and as close as practical to top of opening and face of wall.

3.3 CONNECTIONS

A. Connect air curtain to utilities as specified in Division 26 sections.

3.4 FIELD QUALITY CONTROL

A. Provide a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Test and operate air curtain to be sure that it performs as intended.

3.5 ADJUSTING

A. Adjust fan speed to prepare installed products to perform properly.

B. Adjust discharge nozzles to deflect air outward.

3.6 CLEANING

A. Clean air curtain prior to commissioning.

B. Repair or repaint damage to finishes on exposed-to-view surfaces.

3.7 SYSTEM STARTUP

A. Test and operate air curtains to ensure that they perform as intended.

3.8 DEMONSTRATION

A. Demonstrate for Owner's maintenance personnel how to adjust, operate, and maintain air curtains.

END OF SECTION 230343

SECTION 230400

SHEETMETAL WORK AND RELATED ACCESSORIES

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements shall govern work in this section. Submit shop drawings for checking and approval.

PART 2 - PRODUCTS

2.1 SHEETMETAL DUCTWORK

A. Contractor shall furnish and install all sheet-metal ducts as shown on the Drawings. While the Drawings shall be adhered to as closely as possible, the Engineer reserves the right to vary the run and size to meet the field conditions. Any duct size not shown shall be sized in proportion to the air carried at the same resistance in similar ductwork, or of size as directed.

B. All ductwork shall be constructed of galvanized steel gauges in accordance with the latest edition of the ASHRAE/SMACNA Guide. Bracing angles for ductwork shall be hot dipped galvanized for steel ductwork and appropriate gauge for aluminum ductwork. All ducts 18" and over in width shall be cross broken to prevent flutter. Duct pressure class shall be 2” w.g.

C. Ducts shall be braced as follows:

1. All ducts not exceeding 24" on one side shall be assembled with airtight slip joints.

2. 25" to 40" larger dimension 1" x 1" x 1/8" angles.

3. 41" to 60" larger dimension 1-1/2" x 1-1/2" x 1/8" angles.

4. All bracing angles shall be a minimum of 4' apart along the length of the duct.

5. Furnish and install all angles and frames for all registers, diffusers, grilles and louvers.

6. Support horizontal ducts with hangers spaced not more than 8' apart. Place hangers at all changes in direction. Use strap hangers for cuts up to 30" wide.

D. Comply with all State and Local regulations regarding fire stopping and fireproofing. Provide fusible link fire dampers as required by State, local and Underwriter authorities and where indicated on the Drawings. Each fire damper shall be installed in such a manner as to permit ready access for inspection and maintenance purposes.

E. Provide splitter and butterfly dampers, deflecting vanes for control of air volume and direction and for balancing systems, where indicated, specified, directed and as required for the proper operation of the systems. Dampers shall be of the same material as the duct, at least one gauge heavier that the duct, reinforced where indicating quadrant and locking device for adjusting damper and locking in position.

F. Where ducts fewer than 100 square inches penetrate a rated wall, steel ductwork system of a minimum 0.0127 inch thickness shall be used.

G. All elbows shall have a minimum center line radius of 150% of duct width. If the radius is smaller, turning vanes shall be used: Turning vanes shall be double thickness, fitted into slide strips and screwed or riveted to duct below.

H. Contractor shall furnish and install all access doors in ducts as required. Access doors shall be of the pan type 1" thick and shall be provided with two galvanized hinges and suitable latched. Access doors insulated with same thickness material as duct and shall be double casing construction.

I. Rigid spiral ductwork within Gymnasium shall be double wall type.

2.2 REGISTERS AND DIFFUSERS

A. Registers and diffusers shall be installed where shown on the Drawings and shall be of the sizes specified and the type indicated on the drawing schedule.

B. All registers and diffusers shall be installed in accordance with manufacturer's recommendations.

C. Registers and diffusers shall be as manufactured by Anemostat Co., Carnes or Hart and Cooley.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be

taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230400

SECTION 230405

UNDERGROUD DUCTWORK

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements shall govern work in this section. Submit shop drawings for checking and approval.

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:

1. Underground Ducts

1.3 ACTION SUBMITTALS

A. Provide Product Data: For each type of the following products, furnished specialties and accessories.

1. Underground Ducts

2. Sealants and Gaskets

B. Shop Drawings: For underground ducts. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Burial and supports, including methods for duct burial and internal and external bracing if recommended by the manufacturer.

1.4 CLOSEOUT SUBMITTALS

A. Installation and Maintenance Data: For underground ducts include installation and maintenance manuals.

1. Site conditions, excavation and preparation.

2. Instructions for joining ducts.

3. Instructions for proper backfilling and precautions.

4. Leak testing procedure.

1.5 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

PART 2 - PRODUCTS

2.1 UNDERGROUND DUCTWORK

A. Acceptable Manufacturers:

1. The BlueDuct® by AQC Industries, Roseville, MN 55126, (877-783-1520). www.aqcind.com and e-mail: team@aqcind.com.

B. Underground Duct System

1. Complete duct system (including inlet plenums, round duct, run-outs, diffuser boots, etc.) must be from one manufacturer and be of the same material, construction and connection method throughout. Field made duct components are NOT acceptable.

2. Provide elbows, ducts, diffuser boxes, plenums, clamp & gaskets, boots, saddle registers and caulk as required by drawings for underground installation.

3. Unless otherwise noted, all duct and fittings shall be constructed per SMACNA's Duct Construction Standards to withstand +10" w.g. and -2" w.g.

4. Ductwork shall be closed cell plastic material that is recyclable, does not emit volatile organic compounds, and conforms to ASTM-D2412. Ductwork shall be resistant to mildew, mold (UL 181B), and radon gas (BSS 7239-88). Ductwork shall not rust or crack under external stress or strain. Ductwork shall have integral R-10 equivalent thermal insulation value, without the use of external insulation, per NSF's P374 Protocol and verified by an NSF Thermal Testing Report.

5. All joints shall be sealed via gasket or bolts and sealant.

6. Clamps and gaskets shall be used on ductwork without flanges. Clamps shall be polyethylene with stainless steel plates and stainless-steel screws. Gaskets shall comprise of ¼" thick butyl rubber sealant tape that is water and UV resistant and shall not stain. Gaskets shall comply with ASTM-E84 for flame and smoke spread.

7. Flanged joints and duct branches shall use a co-polymer adhesive caulking sealant that is water and UV resistant. Flanges shall be connected with stainless steel bolts.

8. Assembled ductwork shall be able to maintain pressure with no leakage.

9. Duct system shall be installed by an AQC Industries' trained installer.

10. Fiberglass style (FRP) ductwork or PVC coated galvanized steel ductwork shall NOT be acceptable.

11. Duct system performance shall exceed SMACNA's Leakage Class 1 requirements at the system design static pressure.

12. Duct system shall carry a 10-year Limited Warranty.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Follow The BlueDuct Installation Instructions provided by AQC Industries. It is strongly recommended to complete installation training provided by AQC Industries prior to installation.

B. Excavate a trench evenly as per The Blue Duct Installation Instructions. No bedding is required except for cases of bedrock or clay where sand or light aggregate may be used.

C. Backfill material must consist of pea gravel or dry silica sand.

D. The sealant and gasket material provided by AQC Industries must be used as directed. The use of non-approved sealant or gasket will void warranty.

3.2 TESTING

A. The complete underground duct system shall be tested for leakage after final assembly.

B. Follow SMACNA air duct leakage test standard.

C. Allow 24 hours for The BlueDuct sealant to cure after final assembly before testing the duct system. Additional curing time may be required in high ambient conditions.

3.3 CLEANING

A. Remove dust and debris from ductwork prior to occupancy.

END OF SECTION 230405

SECTION 230410

PIPING, FITTINGS, VALVES AND NOTES (HOT WATER)

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements shall govern work in this section. Submit shop drawings for checking and approval.

1.1 PIPING NOTES

A. The Contractor shall erect all pipe, fittings, valves, hangers, anchors, expansion joints and all accessories specified, indicated on the Drawings or required to assure proper operation of all piping systems installed under this Contract. All piping shall be maintained at a proper level to assure satisfactory operation, venting and drainage. Piping and valves in any locality where possible shall be grouped neatly and shall be run so as to avoid reducing headroom or passage clearance.

B. All piping shall be new and of the material and weight specified under various services. Steel and wrought iron pipe 2" and larger shall be seamless or lap welded. All piping shall have the maker's name and brand rolled on each length of pipe.

C. All piping, fittings, valves and strainers shall be cleaned of grease, dirt and scale before installation. All temporary pipe openings shall be kept closed during the performance of the work. The ends of all piping shall be reamed smooth, and all burrs removed before installation.

D. All piping shall be cut accurately to measurements taken on the job. Offset connections shall be installed alignment of vertical to horizontal piping and where required to make a true connection and to provide for expansion. Bent or sprung pipe shall not be installed where shown on Drawings and where necessary to provide for expansion of piping. Cold spring hot lines one-half estimated distance of maximum expansion. Suitable pipe anchors shall be installed where shown or required.

E. Piping connections shall have unions where necessary for replacement and repair of equipment. Gate valves and controls valves shall be installed where shown and where necessary for proper operation and service.

F. Vertical piping shall be plumb and horizontal piping shall be parallel to walls and partitions. Piping shall be supported as required to prevent the transmission of noise and vibration.

G. Work shall include all pipe, fittings, offsets and requirements for the installation of piping of other work including ducts and conduit. Reducing fittings shall be used where pipe changes size. All piping shall be installed with ample clearance to center accurately in sleeves through floors, and walls and partitions.

H. Piping shall be downgraded to drain connections at low points and upgraded to vent connections at high points unless otherwise noted. Drain connections shall be valved and piped to a floor drain. Vent connections on mains shall be equipped with air vent valves fitted with a copper tube drip line extended to a drain outlet. Vent connections on branches and equipment shall be fitted with key type manual vent cocks.

I. Drain piping shall be installed from all equipment as required. The Contractor shall extend drain piping and turn down over floor drains.

PART 2 - PRODUCTS

2.1 PIPING (ABOVEGROUND)

A. All piping installed under this Section of the Specifications shall be in accordance with the following schedule.

1. All piping, except where indicated differently, (i.e., underground piping) shall be standard weight black steel pipe Schedule 40, Grade A53, black steel. Pipe 2” and smaller, cast iron screwed fittings. Pipe 2-1/2” and larger, steel welding fittings. Pipe and fittings as manufactured by National, Wheeling, Bethlehem or equal, manufactured in accordance with ASTM current edition. All pipes must be reamed before installation.

2. Where the Contractor elects to use copper piping, it shall be rigid Type "L" copper, Chase, Anaconda or approved equal. Fittings shall be wrought copper, Nibco, Anaconda, Mueller or approved equal. Where copper piping is used, make all additional provisions for expansion. All condensate piping shall be Type "M" copper, rigid, full size of unit drain tapping, or larger as shown on Drawings.

3. All drainage pipe lines, 2" larger except where galvanized screw pipe is shown on the Drawings or specified hereafter, shall be extra heavy cast iron soil pipe and fittings.

B. Piping installation shall be arranged for draining through accessible valves at low points.

C. Threaded short and close nipples shall be Schedule 80, extra heavy weight of the same material as pipe in system in which they are installed.

D. All bare copper pipe, tubing and fittings shall be cleaned with steel wool and all excess solder shall be removed.

2.2 PIPING (ABOVEGROUND) OPTIONAL

A. Pipe/Grooved (Standard): Carbon Steel, A-53B/A-106B - Roll or cut grooved-ends as appropriate to pipe material, wall thickness, pressures, size and method of joining. Pipe ends to be grooved in accordance with current listed standards conforming to ANSI/AWWA C-606.

B. Victaulic Mechanical Couplings for Joining Carbon Steel Pipe.

1. Standard Mechanical Couplings, 2 inch (DN50) through 12 inch (DN300): Manufactured in two segments of cast ductile iron, conforming to ASTM A-536, Grade 65-45-12. Gaskets shall be pressure-responsive synthetic rubber, grade to suit the intended service, conforming to ASTM D-2000. Mechanical Coupling bolts shall be zinc plated (ASTM B-633) heat treated carbon steel track head conforming to ASTM A-449 and ASTM A-183, minimum tensile strength 110,000 psi (758450 kPa) as provided standard.

    a. Rigid Type: Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with ANSI B31.1, B31.9, and NFPA 13.

        i. 2” (DN50) through 8” (DN200): Installation ready rigid coupling for direct stab installation without field disassembly. Gasket shall be Grade “EHP” EPDM compound with red color code designed for operating temperatures from -30 deg F (-34 deg C) to +250 deg F (+120 deg C).

    b. Flexible Type: Use in locations where vibration attenuation and stress relief are required. Flexible couplings may be used in lieu of flexible connectors at equipment connections. Three couplings, for each connector, shall be placed in close proximity to the vibration source.

        i. 2” (DN50) through 8” (DN0200): Installation ready flexible coupling for direct stab installation without field disassembly. Gasket shall be Grade “EHP” EPDM compound with red color code designed for operating temperatures from -30 deg F (-34 deg C) to +250 deg F (+120 deg C).

2. Flange Adapters: For use with grooved end pipe and fittings, flat faced, for mating to ANSI Class 125 / 150 flanges.

3. Grooved couplings shall meet the requirements of ASTM F- 1476.

4. Gasket: Synthetic rubber conforming to steel pipe outside diameter and coupling housing, manufactured of elastomers as designated in ASTM D-2000.

    a. Reference shall always be made to the latest published Selection Guide for Victaulic Gaskets for proper gasket selection for the intended service.

C. Grooved End Fittings

1. Standard fittings shall be cast of ductile iron conforming to ASTM A-536, Grade 65-45-12, forged steel conforming to ASTM A-234, Grade WPB 0.375" wall (9, 53 mm wall), or fabricated from Std. Wt. Carbon Steel pipe conforming to ASTM A-53, Type F, E or S, Grade B. Fittings provided with an alkyd enamel finish or hot dip galvanized to ASTM A-153. Zinc electroplated fittings and couplings conform to ASTM B633.

2. AGS Fittings shall be supplied with factory AGS grooved ends, for use with Victaulic W07 or W77 couplings and W741 flange adapter. Fittings shall be manufactured of ductile iron conforming to ASTM A-536, forged carbon steel conforming to ASTM A-234, or factory fabricated from carbon steel pipe conforming to ASTM A-53. Fittings shall be manufactured to the dimensional standards ASME B16.9. Orange enamel coated or galvanized.

3. Hole-Cut Branch Outlets

   a. Bolted Branch Outlet: Branch reductions on 2"(DN50) through 8"(DN200) header piping. Bolted branch outlets shall be manufactured from ductile iron conforming to ASTM A-536, Grade 65-45-12, with synthetic rubber gasket, and heat treated carbon steel zinc plated bolts and nuts conforming to physical properties of ASTM A-183.

   b. Strapless Outlet: 1/2"(DN15) or 3/4"(DN20) NPT outlet on 4" (DN100) and larger header sizes rated for 300 PSI (2065 kPa).

   c. Strapless Thermometer Outlet: To accommodate industrial glass bulb thermometers with standard 1-1/4"-18 NEF 2B extra fine thread and 6" (152mm) nominal bulb length on 4" (DN100) and larger header sizes rated for 300 PSI (2065 kPa).

D. Grooved End Valves

1. Butterfly Valves

   a. 2"(DN50) through 12"(DN300) Sizes: 300 psi CWP (2065 kPa) suitable for bidirectional and dead-end service at full rated pressure. Body shall be grooved end black enamel coated ductile iron conforming to ASTM A536. Disc shall be electroless nickel plated ductile iron with blowout proof 416 stainless steel stem. Disc shall be offset from the stem centerline to allow full 360 degree seating. Seat shall be pressure responsive Lubricated Nitrile. Valve bearings shall be TFE lined fiberglass, and stem seals shall be of the same grade elastomer as the valve seat. Valve shall be complete with ISO flange for actuation mounting. Valve operators shall be lever handle or gear operator, available with memory stop feature, locking device, chainwheel. (Valve with EPDM seat is UL classified in accordance with ANSI/NSF-61.)

2. Check Valves

   a. 2"(DN50) through 3"(DN80) Sizes Spring Assisted: Black enamel coated ductile iron body, ASTM A-536, Grade 65-45-12, stainless steel non-slam tilting disc, stainless steel spring and brass shaft, nickel-plated seat surface, 365 psi (2517 kPa). Victaulic Series 716H.

   b. 4”(DN100) through 12”(DN300) Sizes Spring Assisted: Black enamel coated ductile iron body, ASTM A-536, Grade 65-45-12, elastomer encapsulated ductile iron disc suitable for intended service, stainless steel

spring and shaft, welded-in nickel seat, 300 psi (2065 kPa). Victaulic Series 716.

c. 2”(DN50) through 4”(DN100) Sizes Horizontal Swing: Horizontal installation, ductile iron body, ASTM A-536, Grade 65-45-12, and Type 316 stainless steel clapper. Synthetic rubber bumper & bonnet seals suitable for intended service, stainless steel wetted parts, 300 psi (2065 kPa). Victaulic Series 712.

d. 4”(DN100) through 12”(DN300) Sizes Venturi Check: Black enamel coated ductile iron body, ASTM A-536, Grade 65-45-12 with venturi-like taps, elastomer encapsulated ductile iron disc suitable for intended service, stainless steel spring and shaft, welded-in nickel seat, 300 psi (2065 kPa). Victaulic Series 779.

3. Tri-Service Valve Assembly: Combination shut-off, throttling and non-slam check valve.

a. 2-1/2”(DN65) through 12”(DN300) Sizes**:** Vic®-300 MasterSeal™ butterfly valve with memory stop feature assembled with Series 716 (2-1/2” & 3”) (DN65 & DN75) or Style 779 Venturi Check (4” – 12”) (DN100-DN300). Series 779 check valve with venturi like taps for flow measurement. Working pressures to 300 psi (2065 kPa).

4. Ball Valves: 1-1/2”(DN40) through 6”(DN150) sizes, ASTM A-536, Grade 65-45-12, ductile iron body, chrome plated carbon steel ball and stem, TFE seats, with Fluoroelastomer seals. 800 psi (5515 kPa).

5. Plug Valves: 3"(DN75) through 12"(DN300) sizes, with memory stop for throttling, metering or balancing service. Unidirectional bubble-tight shut-off, bi-directional sealing optional. Ductile iron body, bonnet and plug, ASTM A-536, Grade 65-45-12. Plug encapsulated with synthetic rubber suitable for intended service. Welded-in nickel seat, stainless steel self-lubricating bearings. 175 PSI (1200 kPa). AWWA rigid groove dimensions may be adapted to IPS sized system through the use of Victaulic Style 307 transition couplings.

6. Circuit Balancing Valves

a. 2”(DN50) and Smaller Sizes: 300 psi (2065 kPa), y-pattern, globe type with soldered or threaded ends, non-ferrous Ametal® brass copper alloy body, EPDM o-ring seals. 4-turn digital readout handwheel for balancing, hidden memory feature with locking tamper-proof setting, and connections for portable differential meter. Victaulic / TA Hydronics Series 786 or 787 STAD.

i. Install Series 78U union port fitting and Series 78Y strainer/ball valve combination to complete terminal hookup at coil outlet.

ii. Install Series 793 differential pressure controller to stabilize differential pressure and ensure stable and accurate modulating

control. Ametal® brass copper alloy body, bonnet, cone and spindles, threaded ends only.

b. 2-1/2”(DN65) and Larger Sizes: 300 psi (2065 kPa), y-pattern, globe type with flanged or grooved ends, ASTM A536 ductile iron body, all other metal parts of Ametal® brass copper alloy, EPDM O-ring seals. 8, 12 or 16-turn digital readout handwheel for balancing, hidden memory feature with locking tamper-proof setting, and connections for portable differential meter. Victaulic / TA Hydronics Series 788 or 789 STAG.

c. Differential Pressure Controller: For use in conjunction with TA Balancing valves to stabilize differential pressure and ensure stable and accurate modulating control. Ductile iron or Ametal body, Ametal® brass copper alloy bonnet, cone and spindles, flanged ends only.

E. Grooved End Specialties

1. Expansion Joints

a. 2”(DN50) through 6”(DN150) Sizes: Packless, gasketed, type with grooved end telescoping body, suitable for axial end movement to 3”. 350 psi (2410 kPa). Victaulic Style 150 Mover®.

b. 3/4"(DN20) and Larger Sizes: Expansion joint consisting of a series of grooved end nipples joined with flexible-type couplings. Joint movement and expansion capabilities determined by number of couplings / nipples used in the joint. Victaulic Style 155.

2. Dielectric Waterways: 1”(DN25) through 8”(DN200) sizes, grooved, plain end, or threaded end, ASTM A-53 carbon steel or ASTM A-536 ductile iron body, zinc electroplated, with LTHS high temperature stabilized polyolefin polymer liner. Victaulic Style 47.

3. Strainers - Grooved-End

a. Y-Type Strainer. 2”(DN50) through 18”(DN450) sizes, 300 PSI (2065 kPa) Y-Type Strainer shall consist of ductile iron body, ASTM A-536, Grade 65-45-12, Type 304 stainless steel perforated metal removable baskets with 1/16" (1,6mm) diameter perforations 2"-3" (DN50-DN75) strainer sizes, 1/8" (3,2mm) diameter perforations 4"-12" (DN100-DN300) strainer sizes, and 0.156” (4mm) diameter perforations 14” -18” (DN350-DN450) strainer sizes. Victaulic Style 732 and W732.

F. Tooling:

1. Tools shall be manufactured and supplied by coupling manufacturer. Use roll sets or cut groovers compatible with the pipe material and wall thickness per manufacturer’s installation instructions.

2.3 VALVES

A. All valves, unless specified or noted otherwise, shall be designed for a working pressure of not less than 200 psi water or 125 psi steam with name and pressure rating of valve cast in body. All valves shall be of the same manufacturer, unless specified otherwise. Valves for cut-off shall be gate valves, unless otherwise specified.

B. All valves of same manufacturer: similar to Jenkins Bros., Walworth, Kennedy or approved equal.

C. Four inch and larger, flanged; smaller sizes, screwed.

D. All Gate and Globe valves shall be installed with handle in an upright position.

E. The Contractor shall furnish and install all valves shown on Drawings and all valves that are necessary for proper operation and maintenance of systems and equipment. All piping connections to each piece of equipment and all branch connections to mains shall have cut-off valves.

F. The following schedule of valves for hot water, etc. is based on Jenkins Brothers, Inc. catalog numbers (except as noted); equivalent Lukenheimer, Walworth, O-I-C, Crane Fairbanks Company valves will be acceptable.

G. Ball Valves

1. 1/4" to 2-1/2” rated for 600 p.s.i wog, with brass body, chrome plated brass ball, virgin PTFE seats and full port with threaded or solder connections.

2. 2-1/2” and larger rated for 200 p.s.i with carbon steel body, stainless steel full port ball, RTFE seats, lever operated to 4” gear operated 6” and above, with flanged end connections.

H. Gate Valves

1. Up to 2" : Bronze gate solid wedge, inside screw traveling stem union bonnet, -Fig. 47U

2. 2-1/2" and 3" : Iron body, bronze-mounted gate, solid wedge, OS&Y rising stem, -Fig. 650-A

3. 4" and larger: Iron body, bronze-mounted gate, solid wedge, OS&Y rising stem, -Fig. 651-A

I. Globe Valves

1. Up to 2" : Bronze body, regrinding seat ring and plug, union bonnet, -Fig. 546P

2. 2-1/2" and 3" : Iron body, bronze-mounted globe and angle, regrinding disc and seat ring, OS&Y -Fig. 613

3. All gate valves 6" and larger: Fitted 3/4" by-pass globe valve.

J. Plug Valves

1. Up to 2" : Lubricated, semi-steel short pattern wrench operated, -Fig. 142

2. 2-1/2" and larger: Lubricated, semi-steel short pattern wrench operated, -Fig. 143

3. Similar to Rockwell Mgd. Co., Jenkins, Kennedy or approved equal.

K. Butterfly Valves used for hot water shall be the following:

1. 2-1/2" to 12” rated for 175 p.s.i bubble tight close off, 14” and larger for 150 p.s.i close-off.

2. Full lug cast iron body, aluminum bronze disc, stainless steel stem EPDM peroxide cured seat.

3. 2-14” to 6” valves to be equipped with 10 position notch plate and lever lock handle.

4. On installation, valves to be in full open position when flange bolts are tightened and stem in a horizontal position except when equipped with a chain-wheel gear operator.

5. Provide chain wheel gear operator on all valves installed 7 feet or higher.

6. Valves to be designed with replaceable seat and parts kits.

7. Valve to be Bray series 31, Dezurik 637 or Demco.

L. Check Valves

1. 150 psi WSP class.

2. Up to 2" : Bronze, regrinding bronze disc, screw-in cap, -Fig. 762A.

3. 2-1/2" and 3" : Iron body, bronze mounted regrinding bronze seat ring and disc, -Fig. 623.

4. 4" and larger: Iron body, bronze mounted regrinding bronze seat ring and disc, -Fig. 624.

M. Drain Valves: All low points shall have drain valves, with hose ends. Where 1/2" and 3/4" sizes are indicated, "Standard" hose end drain valves shall be used. Provide brass hose end drain caps at each drain valve. Where larger than 3/4" drains are shown, gate valve shall be used. Provide brass nipples and reducer from drain valve size to 3/4" terminating with 3/4" hose end drain valve and cap.

2.4 FITTINGS

A. Nipples

1. All nipples shall have clean cut threads and shall be made from new pipe, standard weight for all lengths, except that close and shoulder nipples shall be extra heavy.

2. Fittings - 2-1/2 and Smaller: All fittings shall be standard weight steam pattern gray cast iron, Grinnell, Stockholm or equal approved.

3. Fittings - 3" and Larger: The Contractor has the option to use screwed, flanged or welded fittings so long as all ASME requirements are met.

B. Joints and Unions

1. Threaded joints shall be full and clean cut. The ends of pipe shall be reamed to the full inside diameter, all burrs shall be removed and no more than three threads shall be exposed beyond fittings when made up. Joints shall be made up tight with graphite base pipe joint compound. Exposed threads of ferrous pipe shall be painted with acid-resisting paint after caulking, lampwick or other material will be allowed for correction of defective joints.

2. Flange joints shall be made up perfectly square and tight. Screwed flanges and loose flanges shall be cast iron and welding flanges shall be steel. Flanges shall be faced true and bolted up tight with 1/16" Carlock ring type gasket.

3. Bolts shall be high quality steel with hexagon nuts and heads. The Contractor shall apply grease to threads of bolt.

4. Welded joints in piping shall be by the electric or oxyacetylene process using welding rods if the characteristics similar to pipe material and as recommended by the pipe manufacturer and shall be done in accordance with the ASME Code for pressure piping. Welding shall be done by qualified welders under the requirements of the ASME Boiler and Pressure Vessel Code.

5. The pipe lengths shall be aligned with welding rings and the abutting pipe ends shall be concentric. Prior to welding, the groove and adjacent surfaces shall be thoroughly cleaned of all grease, scale or rust. During welding, all slag, or flux remaining on the bead shall be removed before laying down the next bead. The welding metal shall be thoroughly fused with the base metal at all sections of the weld. Short lengths of pipe may be beveled on the job with oxyacetylene torch, provided all scale and oxides are removed.

6. Joints shall be butt-welded, single V-type. All fittings shall be steel welding fittings. Elbows and fittings formed with coupling or welded cut pipe sections shall not be acceptable.

7. Bonney Weldolets or welding saddles may be used for branch connections, which are less than one-half the size of the main to which they connect.

8. Ground Joint Unions, Flange Connections, Reaming & Filling Ground joint unions shall be 200 lb. s.w.p. for brass. Flanges shall be 150 lb. s.w.p. for brass, 125 lb. s.w.p. for cast iron.

9. Ground joint unions of flanges shall be used only on exposed accessible piping. Where concealed, right and left nipples and couplings must be used. Where flanged connections are used, full size gaskets must be inserted.

C. Threads: Shall be standard, clean cut and tapered. All piping shall be reamed free from burrs. All piping shall be kept free of scale and dirt. Caulking of threads will not be permitted. All piping shall be threaded and made up in accordance with the current edition of the ASA Standard Specifications for pipe threads.

D. Unions

1. Unions for use on ferrous pipe 2" and smaller shall be malleable iron with brass to iron ground joint spherical seat and threaded connections. Unions 2 1/2" and over shall be flanged type with gasket.

2. Unions for copper tubing shall be cast bronze conforming to ASA B16. The Contractor shall furnish adapters where required for copper pipe.

3. Where copper pipe connects to ferrous pipe or metals, the Contractor shall furnish EPCO isolating type dielectric unions. Plastic type isolating bushings are not acceptable.

4. Unions shall be installed wherever necessary for repair or replacement of equipment, valves, strainers, etc. Final connections to equipment shall be made in a manner that will permit removal without cutting of pipelines.

E. Solder

1. All sweat joints shall be made up with lead and antimony free solder.

2. Solder shall be Oatey or approved equal. Flux shall be non-toxic and non-corrosive.

3. All copper tubing ends shall be reamed, filed and cleared of burrs and rough edges. All pipes shall be reamed after cutting and threading.

F. Expansion

1. The entire piping installation shall be installed with adequate provision for expansion. No rigid connections will be permitted.

2. Branches shall be of sufficient length and have 3 elbow swings to allow for pipe expansion.

3. Provide expansion joints, guides and anchors equal to “Flexonics” Type HCF where indicated on Drawings or where necessary for proper expansion

compensation. Submit shop drawing.

4. Any breaks in the piping within the guarantee period due to improper provision for expansion must be replaced at the expense of this Contractor, and the conditions corrected to prevent future recurrence.

5. Any damages to surrounding areas and equipment due to this failure shall also be repaired and paid for at the expense of the Contractor.

6. Joints to have 150 psi rating, ANSI-B16.5 with liner and cover.

2.5 PIPING SLEEVES

A. Furnish sleeves built into place for all piping passing through walls, floors or building construction. Sleeves, not less than 1/2" larger in diameter than piping and its covering, if any, and extending full depth of construction pierced. Pack sleeves through walls/floors in accordance with Underwriters' Requirements.

B. Sleeves piercing exterior walls, integral waterproofed walls shall be standard weight steel piping. Furnish welded center flange buried in construction for sleeves through exterior walls below grade. At exterior walls, make pipes watertight in sleeves with oakum packing and caulked lead joints on both sides of wall. All other sleeves: Galvanized sheet steel with lockseam joints, #22 USSG for 3" or under. Sleeves for piping 4" and larger, #18 USSG.

C. Pipes passing through interior membrane waterproofed floors, cast iron flashing sleeve, with integral flashing flange and clamping ring, similar to Josam Series #1880. Adjust sleeves to floor construction with steel or wrought iron pipe nipples top and bottom, extending 3" above finished floor. Burn & J.R. Smith are equal.

D. Pipes passing through membrane waterproofed walls, cast iron flashing sleeve with internal flashing flange and clamping ring similar to Josam Series #1870. Make pipes watertight in sleeves with oakum packing and caulked lead joints. Burn & J.R. Smith are equal.

E. For flashing sleeves specified in Pars. C and D, lead flashing extended at least 10" around flashing sleeves, securely held in place by clamping device.

2.6 PIPING ENCLOSURES

A. Where concealed piping in ceilings and wall of finished spaces is not possible vertical or horizontal metal piping enclosures equal to "Sterling" model PCH (horizontal) or PCHV (vertical). Provide all required hangers, supports, corners, brackets, etc. color per Architect.

PART 3 - EXECUTION

3.1 GENERAL NOTES - PIPING NOTES, DRAINING, VENTING AND MISCELLANEOUS WATER SPECIALTIES

A. Piping shall be installed as indicated on Drawings. Elevations and dimensions are indicated as a guide only and are subject to change with actual job conditions.

B. Except for drainage piping, which shall pitch down with flow, mains shall pitch upward or be installed dead level as indicated. Horizontal runs shall be parallel to walls.

C. In general, all branch connections shall be top of bottom 45 degree or 90 degree, pitching up or down from mains.

D. Where indicated, flexible connectors shall be installed. All final connections to equipment, pumps, units, etc. shall have companion flanged, flange unions or ground joint unions. (125 lbs.)

E. All piping shall be adequately supported with approved type hangers so as to prevent absolutely any sagging of lines, or any undue strain on pipes or fittings. All pipe lines shall be capped during construction to prevent entry of dirt or other foreign material. All piping lines after erection shall be blown or flushed out to render the piping system as clean as possible before system water is added for operation.

F. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

G. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

H. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.2 DRAINING

A. All low points shall have drain valves with hose ends. Where 1/2" and 3/4" sizes are indicated, "Standard" hose end drain valves shall be used. Provide brass hose end drain caps at each drain valve. Where larger than 3/4" drains are shown, gate valve shall be used. Provide brass nipple and reducer from drain valve size to 3/4" terminating with 3/4" hose end drain valve and cap.

3.3 VENTING (For Hot Water)

A. All high points in piping shall be vented automatically with float vents. At all high points of piping, whether specifically indicated or not, provide Maid-o-Mist or B&G No. 7 or 27 Air Eliminators with shut off cock, auxiliary key vent and copper tubing overflow carried to floor along wall as indicated or directed.

3.4 WATER SPECIALTIES

A. Air Vents: Install at all high points automatic air vents to eliminate air binding. All automatic air vents shall be approved heavy duty type equipped with petcocks and tubing for manual venting. All vents installed in coils, etc. shall be of manual key operated type. All vents concealed from view shall be accessible through access doors. Vents shall be by Hoffman, Anderson or Bell & Gossett, 125 psig rated.

B. Pressure Gauge: Furnish and install pressure gauges on suction and discharge sides of each pump and as required to check operation of equipment; pressure gauges shall have 4-1/2" diameter dials, Ashton, Ashcroft or approved equal.

C. Install thermometers at all locations in piping system as noted on Drawings and as required to check system performance. Thermometers shall be installed at the supply and return of coils and 3-way diverting valves as manufactured by Trerice, Weksler or Moeller, with 4-1/2 inch face, cast aluminum case, chrome plated steel ring, white background with black embossed markings, glass window, stainless steel pointer, brass movement, 316 stainless steel bulb. Provide separable, universal angle sockets for all thermometers.

END OF SECTION 230410

SECTION 230420

SUPPORTS, SLEEVES AND PLATES

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

A. This Contractor shall furnish and install all plates, hangers and supports for his equipment including piping, headers, fans expansion tank, ductwork, etc.

B. All ductwork, piping and equipment shall be hung or supported from structural members only.

PART 2 - PRODUCTS

2.1 PIPING, DUCTWORK AND EQUIPMENT

A. All piping shall be supported from building structure in a neat and workmanlike manner wherever possible, parallel runs of horizontal piping shall be grouped together on trapeze hangers. Vertical risers shall be supported at each floor line with steel pipe clamps. Use of wire perforated metal to support pipes will not be permitted. Hanging pipes from other pipes will not be permitted.

B. Necessary structural members, hangers and supports of approved design to keep piping in proper alignment and prevent transmission of injurious thrusts and vibrations shall be furnished and installed. In all cases where hangers, brackets, etc., are supported from concrete construction, care shall be taken not to weaken concrete or penetrate waterproofing.

C. All hangers and supports shall be capable of screw adjustment after piping is erected. Hangers supporting piping expanding into loops, bends and offsets shall be secured to the building structure in such a manner that horizontal adjustment perpendicular to the run of piping supported may be made to accommodate displacement due to expansion. All such hangers shall be finally adjusted, both in the vertical and horizontal direction, when the supported piping is hot.

D. Pipe hangers shall be as manufactured by Grinnell, whose catalog numbers are given herein, or equivalent Carpenter and Paterson, or F&S Mfg. Co.

E. Piping shall be supported as follows unless otherwise indicated on the Drawings:

1. Heating piping shall be 1-1/2 " and smaller Fig. #260 adjustable clevis hanger. 2" and larger Fig. #174 one-rod swivel roll hanger.

2. Two-rod hangers shall be used for piping close to the ceiling slab or where conditions prohibit use of other hanger types.

3. Anchors for hanger rods shall be Phillips "Red Head" self-drilling type. Anchors shall be placed only in vertical surfaces.

4. Spacing of pipe supports shall not exceed 8 feet for pipes up to 1-1/2" and 10 feet on all other piping.

5. Hangers shall pass around insulation and a 16 gauge steel protective cradle; 12" long shall be inserted between hangers and insulation. Insulation under cradle shall be high density calcium silicate or approved equal to prevent crushing.

6. All piping shall be supported to allow free movement where expanding or contracting. Pipe shall be anchored as required or directed.

7. All lateral runs of piping shall be securely supported on hangers, rolls, brackets, etc. and in manner to allow for proper expansion and elimination of vibration.

8. 2" and smaller pipe, where run on walls, shall be supported on wrought iron "J" hook brackets with anchor bolts.

9. All horizontal pipes, where run overhead or on walls, shall be supported as follows unless otherwise indicated: On adjustable steel clevis type hangers suspended on hanger rods, pipe sizes up to and including 4".

F. Space limitations in hung ceilings spaces and conditions in other locations may require use of other type of hangers than those specified above. Suitable and approved pipe hangers shall be provided for such job conditions.

G. All supports shall be fastened to structural members or additional steel supports furnished by this Contractor.

H. Hanger rods shall be steel, threaded with nuts and lock nuts sizes in accordance with the following schedule:

Pipe Size	Rod Size
3/4" to 2" inclusive	3/8"
2-1/2" and 3' inclusive	1/2"
4" and 5" inclusive	5/8"

I. Hangers for copper tubing shall be tacked up with formed lead sheet on which tubing, or pipe shall be placed.

J. Where pipes pass through masonry, concrete walls, foundations, or floors, this Contractor shall set sleeves as are necessary for passage of pipes. These sleeves shall be of sufficient size to permit insulation where required to be provided around pipe passing through. This Contractor shall be responsible for exact location of these sleeves.

K. Sleeves shall not be used in any portion of building where use of same would impair strength of construction features of the building. Inserts for supporting lateral pipes and equipment shall be placed and secured to form work, and all sleeves inserts locations shall be thoroughly checked with Architect so as not to conflict with other trades.

L. Where pipes pass through floor or walls, they shall be provided with chromium plated escutcheons.

M. Anchor horizontal piping where indicated and wherever necessary to localize expansion or prevent undue strain on branches. Anchors: Heavy forged construction entirely separate from supports.

N. Anchor vertical piping wherever indicated and wherever necessary to prevent undue strain on offsets and branches. Anchors, unless otherwise noted: Heavy steel clamps securely bolted and welded to pipes. Extension ends shall bear on building construction.

O. Ducts shall be hung with 1" x 1/8" metal straps. When width of duct is less than 48", hangers shall be fastened to side of ducts. Auxiliary steel supports that may be required for all mechanical equipment shall be furnished and installed by this Contractor. All operating equipment including fans, piping, etc. shall be supported so as to produce minimum amount of noise transmission.

P. Refer to "General Conditions" as well.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230420

SECTION 230430

INSULATION AND COVERINGS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

A. Furnish insulation for all piping, equipment and sheet-metal work as noted.

B. Insulate no piping, ducts or equipment until tested and approved for tightness. All piping and ducts shall be dry when covered. Where existing insulation has been damaged, altered of removed during the course of the work, it shall be replaced with new insulation in a neat manner to match the adjacent insulation.

C. All insulation must be done by an approved Sub-Contractor or by mechanics skilled in this line of work.

D. Fire hazard classification shall be 2550 per ASTM E-84, NFPA 255 and UL 723. Insulation shall be rated non-combustible type classified flame spread - 25, smoke developed - 50.

E. The project is following IECC for compliance path.

PART 2 - PRODUCTS

2.1 DUCTWORK (INDOOR)

A. Supply, outside air intake and exhaust (on discharge side of fan) and return ductwork shall be covered with 2” fiberglass insulation (unless otherwise indicated) with aluminum foil vapor barrier. All joints shall be lapped so maximum coverage is achieved.

B. All insulated ductwork shall be insulated with fiberglass board insulation with canvas finish in areas where ductwork is exposed.

C. Insulation thickness shall be in accordance with the latest edition of the State Energy Code.

D. Thermal acoustic lining of ductwork within 20 feet of all indoor and outdoor air handlers shall be 1” thickness closed cell non-fiberglass unless otherwise noted. The lining shall have a mat facing and shall meet the Life Safety Standards as established by NFPA 90A and 9B and conform to the requirements of ASTMC 1071.

E. Kitchen exhaust duct shall be covered with fire barrier duct wrap, minimum 3 inches thick, and per NFPA requirements.

2.2 DUCTWORK (INDOOR EXPOSED IN MECHANICAL ROOMS)

A. All exposed ductwork shall be insulated with 2” thick rigid insulation and vapor barrier.

2.3 DUCTWORK (OUTDOOR)

A. All exposed ductwork shall be insulated with 2” thick rigid insulation by GC. Coordinate with GC. Ductwork shall be lined with 1” thickness closed cell non-fiberglass insulation by HVAC contractor.

B. GC shall cover insulation watertight with 15lb. roofing felt and two coats of vapor proof mastic or composite membrane of embossed UV resistant aluminum foil/polymer laminate with inner layer of rubberized asphalt and outer layer of polymer film.

C. Make proper provision with ductwork support(s) so that it is not crushed.

2.4 PIPING/EQUIPMENT (INDOOR)

A. All new heating water system supply and return and steam piping shall be covered with Manville Micro-Lok or equal approved fiberglass insulation with all service (factory applied) vapor retardant jacket. Seal with type H mastic.

B. Fittings shall be insulated with same material and thickness as adjoining pipe insulation and shall be pre-molded fittings or mitre cut segmental insulation wired on. Over the insulation, apply a wrapper of OCF glass cloth sealed with type H mastic. Apply aluminum bands on pipe covering in addition to self-sealing feature.

C. Insulation Material: Molded fibrous glass insulation, density not less than 4 lbs. per cubic foot.

D. Insulation Thickness: Shall be in accordance with the latest edition of the State Energy Code.

E. Jacket and Finish: White flame retardant type, meeting all requirements of "Fire Hazard Classification" of NFPA, similar to "Fiberglass" Type FRJ, Insul-Coustic, Johns-Manville or approved equal.

F. Insulation and Finishes for Fittings, Valves and Flanges

1. Valves, fittings and flanges other than vapor seal insulation: Insulated in same manner and same thickness as piping in which installed.

2. Use pre-molded sectional covering where available; otherwise use mitered segments of pipe covering.

3. Obtain written approval prior to using other than molded sectional covering.

G. Vapor seal Insulation for Valves, Fittings and Flanges: Same as above, except joints sealed with vapor barrier adhesive and wrapped with glass mesh tape. Each fitting shall be finished with two coats of vapor seal mastic adhesive.

H. Jacket and Finishes: Exposed fittings - 6 oz. canvas jacket adhered with lagging adhesive.

I. Concealed fittings: Standard weight canvas jacket adhered with lagging adhesive and with bands of 18 gauge copper coated steel - 2 bands at elbows, 3 at tee.

J. Insulation at Pipe Hangers

1. Where shields are specified at hangers on piping with fibrous glass covering, provide load bearing calcium silicate between shields and piping as follows:

a. For pipe covering without vapor barrier jacket, furnish at each shield 12" - long calcium silicate section with canvas section with canvas jacket continuous between shield and insulation.

b. For pipe covering with vapor barrier jacket, furnish at each shield 12" - long vapor barrier jacket section with section of fibrous glass replaced with section of calcium silicate. Vapor barrier jacket, continuous between shield and insulation for continuous vapor barrier.

K. Condensate drain and refrigerant piping shall be insulated with 1/2” Imcosheild un-split polyolefin insulation.

L. Equipment

1. Secure fibrous glass block or board insulation in place with wire or galvanized steel bands.

a. Small Areas: Secure insulation with 16 gauge wire on maximum 6” centers.

b. Large Areas: Secure insulation with 14 gauge wire or .015” thick by 1/2” wide galvanized steel bands on maximum 10” centers. Stagger insulation joints.

c. Irregular Surfaces: Where application of block or board insulation is not practical insulate with insulating cement built-up to same thickness as adjoining insulation.

2. Fill joints, voids and irregular surfaces with insulating cement to a uniform thickness.

3. Stretch wire mesh over entire insulated surface and secure to anchors with wire edges laced together.

4. Apply finishing cement, total of 1/2” thick, in 1/4” thick coats. Trowel second coat to a smooth hard finish. Neatly bevel insulation around hand-holes, cleanouts, ASME stamp, manufacturer’s nametag and catalog number.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230430

SECTION 230440

DAMPERS AND MISCELLANEOUS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

PART 2 - PRODUCTS

2.1 DAMPERS AND MISCELLANEOUS

A. Furnish and install where shown on Drawings ARROW PIN-LOCK Dampers No. OBDPL-507 (Opposed) as manufactured by the Arrow Louver & Damper Corp. of Maspeth, NY 11378, or approved equal. Frames and blades to 1/8" extruded aluminum.

B. Blades to be single unit PIN-LOCK design 6" wide, with the PIN-LOCK an integral section within the blade center axis. Frames to be a combination of 4" extruded aluminum channel and angle, with reinforcing bosses and groove inserts for vinyl seals.

C. Pivot rods to be 1/2" diameter extruded aluminum, PIN-LOCK design interlocking into blade section. Bearings to be "Double-Sealed" type with Celcon inner bearing on rod riding in Merlon Polycarbonate outer bearing inserted in frame so that outer bearing cannot rotate.

D. Blade linkage hardware is to be installed in angle or channel frame section out of air stream. All hardware to be of non-corrosive reinforced material or to be cadmium plated.

E. Rod bearing to be designed for minimum air leakage by means of overlapping design and by extruded vinyl seals to fit into integral ribbed groove inserts in both frames and blades. All dampers in excess of 10 sq. ft. free area to have reinforced corners by means of gusset plates.

F. Dampers shall be sized by the Control Manufacturer to properly control the flow of air and ensure minimum air stratification in mixing applications. Sizing shall be submitted for approval with information similar to that submitted on valve when sizing valve.

2.2 FIRE DAMPERS

A. Furnish and install at locations shown on Drawings, or as required by code, fire dampers. Dampers shall be multi blade construction UL labeled and be installed in accordance with UL 555, with breakaway connections. The units shall have stainless steel actuator springs with locking devices for horizontally mounted type.

2.3 COMBINATION FIRE / SMOKE DAMPERS

A. Furnish and install at locations shown on Drawings, or as required by code, combination fire smoke dampers.

B. Frame shall be a minimum of 16 gauge galvanized steel formed into a structural hat channel reinforced at corners for added strength. The blades shall be airfoil shaped single-piece hollow construction with 14 gauge equivalent thicknesses. Blade action shall be opposed. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame for long life. Galvanized bearing shall not be acceptable.

C. Blade edge seals shall be silicone rubber and galvanized steel mechanically locked into blade edge (adhesive or clip fastened seals shall be acceptable) and shall withstand a minimum of 450 degrees F. (232 degrees C.) Jamb seals shall be non-corrosive stainless steel flexible metal compression type to further ensure smoke management.

D. Each combination fire/smoke damper shall be classified for use for fire resistance ratings of less than 3 hours in accordance with UL Standard 555 and shall further be classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems in accordance with the latest version of UL555S and bear a UL label attesting to same. Damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers, required by this Specification. Testing and UL qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be leakage Class I (4 c.f.m./sq. ft. at 1" w.g. and 8 c.f.m./ft. at 4" w.g.).

E. As part of UL qualification, dampers shall have demonstrated a capacity to operate (to open and close) under HVAC system operating conditions, with pressures of at least 4" w.g. in the closed position, and 4000 f.p.m. air velocity in the open position.

F. In addition to the leakage rating already specified herein, the dampers and their actuators shall be qualified under UL555S to an elevated temperature of 350 degrees F. (177 degrees C.). Appropriate electric actuators (equal to Ruskin model MA) shall be installed by the damper manufacturer at time of damper fabrication. Damper and actuator shall be supplied as a single entity, which meets all applicable UL555S qualifications for both dampers and actuators. Damper and actuator assembly shall be factory cycled 10 times to assure operation.

G. Manufacturer shall provide factory assembled sleeve of 17" minimum length (Contractor to verify requirement). Factory supplied caulked sleeve shall be 20 gauge for dampers through 84" wide and 18 gauge above 84" wide.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230440

SECTION 230460

AUTOMATIC TEMPERATURE CONTROLS

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 QUALIFICATIONS OF BIDDER

A. All bidders must be building automation contractors in the business of installing direct digital control building automation systems for a minimum of 10 years.

B. All bidders must have an office in the within 50 miles of jobsite.

C. All bidders must be authorized distributors or branch offices of the manufacturers specified.

D. All bidders must have a trained staff of application Engineers, who have been certified by the manufacturer in the configuration, programming and service of the automation system.

E. Currently approved bidders:
   1. Energy Management of Facilities (EMF)
   2. Automated Control Logic (ACL)
   3. Richmar Controls & Service Company Inc.

1.2 SCOPE OF WORK

A. This Contractor shall furnish an electronic system of temperature controls. The District has standardized on Andover. All submitted controls shall be directly compatible with existing hardware and software without patch panels or translators or any kind. The ATC Sub-Contractor shall be subject to the District's approval. Communications between the school is via their Ethernet LAN and remote access is via the Web or Local Intranet. The intent of this specification is to extend and interoperate with this system and to provide a peer-to-peer, networked, distributed control system for the temperature control work that is part of this project. The installed system will interface directly with the existing proprietary as well as open protocol systems, including the existing District network, dynamic color graphics software and programming software. The existing software and database will be modified to accept the new equipment being installed under this project to maintain integrity for centralized scheduling, trending, programming and alarming. PC Desktop icons that "link" to a separate EMS system are not acceptable. Any costs associated with connecting to the existing energy management system, including licensed software, programming, training etc. shall be part of the controls contractor's bid. The contractor must demonstrate their ability to perform the integration to the existing Schneider Electric systems prior to submittal acceptance and invoicing.

B. Only licensed software toolsets will be acceptable for integration work. All systems as described in the sequence of operation will be shown via dynamic Web based graphics

with all pertinent system alarms for proper operation and maintenance. The use of separate PC workstations, gateways, metalinks, replacement of existing controllers and control devices and additional software graphic packages to accomplish this integration will not be accepted.

C. Prospective bidders shall visit the School District Buildings to verify existing DDC controls equipment and Contractor's ability to be compatible with these controls before bid. Contact the Schools Supt. of Buildings and Grounds for details. Contractor shall provide Web based graphics for controlled equipment that matches the functionality and appearance of the graphics already in use on the existing system. Contractor shall configure graphic display to meet Owner and Engineer requirements.

D. The Temperature Controls Contractor (TCC) shall provide each of the following portions of the complete EMCS as a standalone system that can communicate with any other DDC system which is following the same protocol.

1. Operator Workstations: Reuse existing OWS's, software and Databases in the district and provide guaranteed seamless two way communications via the Internet and District LAN, including full control, with both all existing DDC systems currently under control and the DDC system provided as a part of this project.
   The OWS's shall monitor, display, and control information from the DDC systems through one software package. Rebooting of the OWS to access the existing building's multiple systems is not acceptable. Use of separate ": Icons" to access multiple DDC systems is not acceptable. The existing database shall be modified to incorporate the work of this project.

   a. The system OWS's shall meet the hardware and performance requirements of this specification.
   b. The OWS's shall allow customization of the system as described in this specification.

2. The OWS's shall:

   a. Provide new color graphic control screens for all equipment provided or modified as part of this project, as outlined below and on the drawings.
   b. Allow operators to view and work (read and write) all DDC points associated with all DDC equipment provided or modified as part of this project, including all existing DDC points.
   c. Allow for custom graphics and/or control programming generation for any existing or new equipment.
   d. Provide seamless continuity of graphics and existing functionality for all existing Owner's equipment currently under DDC control.

E. All proposed controls contractors that intend on interoperating with the existing DDC system utilizing DDC controls other than those presently installed in the district, shall submit a Technical Proposal, complete with the diagrams, Specifications Compliance Reports, product information, and supporting documentation outlined below. The technical proposal will be utilized to evaluate the methodology that will be used to implement the interoperation and integration of the new controls of this project into the existing district wide energy management system. It will also be used as a basis for vendor

qualification on for the project. Arrange the Technical Proposal in order of the specification article numbers.

1. Provide a list of local jobs (three minimum) of similar type and size the bidder has installed, utilizing the products proposed for this project, with owner's representatives' names and telephone numbers for reference. This list should directly reflect:

    a. Projects that include direct integration to third party microprocessor controllers of the type specified within the scope where an integration and interoperation of Lon Works controls has been successfully achieved between two different manufacturers' controls systems.

        i. EMCS network wiring diagram showing interconnection of all panels, workstations, system printer(s) etc. A diagram describing system architecture for this project with product code numbers for workstation, network controllers, application specific controllers, transducers, sensors, communication network, etc.

2. Provide information on owner training provided as part of the bid package as well as additional opportunities and factory schools available with associated cost. Include details of operator HVAC Training System as specified herein.

3. Specification Compliance Report. Provide specification compliance report that addresses every paragraph within this specification section utilizing an outline format, as follows:

    a. Comply-bid package complies without exception;
    b. Exception – bid package meets the functional intent, but not the letter of the specification. For each paragraph that an exception is taken, identify all deviations from what is specified in the given paragraph and provide a description of what is excluded, what is included, and how the contractor intends to meet the functional intent;
    c. Does not comply – bid package cannot meet specified function and will not be provided.
    d. For all paragraphs in this specification section, indicates as "Comply" or "Exception" or "Does not comply". Provide and reference factory product documentation to substantiate compliance.

4. Provide a statement that all products used on this project are of current manufacture and are readily available through multiple distribution channels. Products in "field testing" status are not acceptable.

F. The BAS Contractor shall review and study all HVAC Drawings and the entire Specification to familiarize himself with the equipment and system operation and to verify the quantities and types of dampers, operators, alarms, etc. to be provided.

G. Prior to commencement of schedule programming meet with Owner to discuss block/individual scheduling of system/equipment and alarm protocols. Review equipment designations and graphics screens to be provided. Take minutes of this meeting and issue them to the Construction Manager/Owner's representative.

H. All temperature control wiring regardless of voltage shall be done by this Contractor. This shall include power wiring of control panels/components from available spare circuits in electrical panels. The automatic temperature control manufacturer shall provide wiring diagrams, field supervision and one (1) year guarantee on the installed DDC system and three (3) year factory warrantee on all control equipment manufactured by the DDC manufacturer.

I. Thermostats, temperature sensors, heating control devices, etc. are indicated on the Drawings in general. Provide any additional devices required to carry out project intent as herein described.

J. Thermostats/Temperature sensors in areas subject to vandalism shall have in addition separately mounted extra heavy guards. Submit sample.

K. Contractor shall include all new heating control devices, thermostats, etc. indicated on Drawings or that is part of a new system.

L. Contractor shall furnish all necessary electrical controls, motor starters, switches, etc. for proper operation of equipment furnished by him under this Contract, and as herein noted.

M. Point and component lists are to be used as a guide. If the sequence of operation requires additional points/control devices, this Contractor shall be responsible for providing same.

N. All control system components installed shall be manufactured by the DDC system manufacturer.

O. Communications cabling shall be run in hallways above hung ceiling with plenum cable and wiremold where exposed.

P. Removals shall include switches, relays, electric components not required for the new intent. Do not leave behind items with no function. Provide appropriate blanking plates/patching where removals occur in finished spaces.

Q. Provide services and manpower necessary for commissioning of system in coordination with the HVAC Contractor, Balancing Contractor, Owner's representative, and Commissioning Authority.

1.3 SOFTWARE CODE

A. Owner shall be furnished with a complete, hard-bound copy of <u>all</u> installed software code. Final payment shall be contingent upon this requirement being met.

1.4 CODE COMPLIANCE

A. Provide components and ancillary equipment, which are UL-916 listed and labeled.

B. All equipment or piping used in conditioned air streams, spaces or return air plenums shall comply with NFPA 90A Flame/Smoke/Fuel contribution rating of 25/50/0 and all applicable building codes or requirements.

C. All wiring shall conform to the National Electrical Code.

D. Comply with FCC rules, Part 15 regarding Class A radiation for computing devices and low power communication equipment operating in commercial environments.

E. Comply with FCC, Part 68 rules for telephone modems and data sets.

1.5 SUBMITTALS

A. All shop drawings shall be prepared in Visio Professional or AutoCAD software. In addition to the Drawings, the Contractor shall furnish a CD containing the identical information. Drawings shall be B size or larger.

B. Shop drawings shall include a riser diagram depicting locations of all controllers and workstations, with associated network wiring. Also included shall be individual schematics of each mechanical system showing all connected points with reference to their associated controller. Typical will be allowed where appropriate.

C. Submittal data shall contain manufacturer's data on all hardware and software products required by the Specification. Valve damper and airflow station schedules shall indicate size, configuration, capacity and location of all equipment.

D. Software submittals shall contain narrative descriptions of sequences of operation, program listings, point lists, and a complete description of the graphics, reports, alarms and configuration to be furnished with the workstation software. Information shall be bound or in a three ring binder with an index and tabs.

E. Submit submittal data and shop drawings to the Engineer for review prior to ordering or fabrication of the equipment. The Contractor prior to submitting shall check all Documents for accuracy.

F. The Engineer will make corrections, if required, and return to the Contractor. The Contractor will then resubmit with the corrected or additional data. This procedure shall be repeated until all corrections are made to the satisfaction of the Engineer and the submittals are fully approved.

1.6 SYSTEM STARTUP AND COMMISSIONING

A. Each point in the system shall be tested for both hardware and software functionality. In addition, each mechanical and electrical system under control of the BAS will be tested against the appropriate sequence of operation specified herein. Successful completion of the system test shall constitute the beginning of the commissioning phase. A written report will be submitted to the Owner indicating that the installed system has been started and balanced in accordance with the Drawings and Specifications.

B. The ATC Contractor shall set in operating condition all major equipment and systems, such as heating, DX cooling, heat recovery and all air handling systems, in the presence of the equipment manufacturer's representatives, as applicable, and the Owner and Architect's representatives. The ATC contractor shall work with the Commissioning Authority as required until all associated HVAC equipment is fully commissioned to the satisfaction of the Commissioning Authority.

C. The ATC Contractor shall provide all manpower and engineering services required to assist the HVAC Contractor, Balancing Contractor, and Commissioning Authority in testing, adjusting, and balancing all systems in the building Scope of Work. The Contractor shall have a trained technician available on request during the balancing and commissioning of the systems. The Contractor shall coordinate all requirements to provide a complete air balance with the Balancing Contractor and Commissioning Authority and shall include all labor and materials in his Contract.

D. Refer to specification section 23 0485 HVAC Systems Commissioning.

1.7 OPERATING AND MAINTENANCE MANUALS

A. The operation and maintenance manuals shall contain all information necessary for the operation, maintenance, replacement, installation and parts procurement for the entire system. This documentation shall include specific part numbers and software versions and dates. A complete list of recommended spare parts shall be included with the lead-time and expected frequency of use of each part clearly identified.

B. Following project completion and testing, the Contractor will submit As-Built Drawings reflecting the exact installation of the system. The as-built documentation shall also include a copy of all application software both in written form and on CD.

1.8 WARRANTY

A. The Contractor shall provide system warranty for 12 months after system acceptance or beneficial use by the Owner. During the warranty period, the Contractor shall be responsible for all necessary revisions to the software as required to provide a complete and workable system consistent with the letter and intent of the Sequence of Operation section of the Specification.

B. Updates to the manufacturer's software shall be provided at no charge during the warranty period.

1.9 SPECIFICATION NOMENCLATURE

A. Acronyms used in this specification are as follows:

1. EMCS Energy Management and Control System
2. NAC Network Area Controller
3. IDC Interoperable Digital Controller
4. FUI Full User Interface
5. BUI Browser User Interface

6. POT Portable Operator's Terminal
7. PMI Power Measurement Interface
8. DDC Direct Digital Controls
9. LAN Local Area Network
10. WAN Wide Area Network
11. OOT Object Oriented Technology
12. PICS Product Interoperability Compliance Statement

PART 2 - PRODUCTS

2.1 GENERAL

A. The Energy Management Control System (EMCS) shall be comprised of a network of interoperable, stand-alone digital controllers, a computer system, graphical user interface software, portable operator terminals, printers, network devices and other devices as specified herein.

B. The installed system shall provide secure password access to all features, functions and data contained in the overall EMCS.

2.2 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate Lon Works and Schneider Electric technology communication protocols in one open, interoperable system.

B. The programming computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135-1995, to assure interoperability between all system components is required. For each Lon Works device that does not have Lon Work certification, the device supplier must provide an XIF file for the device. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.

C. The supplied system must incorporate the ability to access all data using Java enabled browsers without requiring proprietary operator interface and configuration programs. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database or proprietary user interface programs shall not be acceptable.

D. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.

1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.

2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.3 NETWORKS

A. The Local Area Network (LAN) shall be either a 10 or 100 Megabits/sec Ethernet network supporting, Java, XML, HTTP, and CORBA IIOP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), Browser User Interfaces (BUIs) and/or Full User Interfaces (FUIs).

B. Local area network minimum physical and media access requirements:
1. Ethernet; IEEE standard 802.3
2. Cable; 10 Base-T, UTP-8 wire, category 5
3. Minimum throughput; 10 Mbps, with ability to increase to 100 Mbps

2.4 NETWORK ACCESS

A. Remote Access

1. For Local Area Network installations, provide access to the LAN from a remote location, via the Internet. The owner shall provide a connection to the Internet to enable this access via high-speed cable modem, asynchronous digital subscriber line (ADSL) modem, and ISDN line, T1 Line or via the customer's Intranet to a corporate server providing access to an Internet Service Provider (ISP). Owner agrees to pay monthly access charges for connection and ISP.

2. Where no Local Area Network exists, EMCS supplier shall provide the following:
a. 8 Port Ethernet hub (3Com, or equal)
b. Ethernet router (Cisco or equal)

3. The owner shall provide a connection to the Internet to enable this access via high-speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line or T1 Line. Owner agrees to pay monthly access charges for connection and ISP.

2.5 NETWORK AREA CONTROLLER (NAC)

A. The Network Area Controller (NAC) shall provide the interface between the LAN or WAN and the field control devices and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:

1. Calendar functions
2. Scheduling
3. Trending
4. Alarm monitoring and routing
5. Time synchronization

6. Integration of Lon Works controller data
7. Network Management functions for all Lon Works based devices

B. The Network Area Controller must provide the following hardware features as a minimum:

1. One Ethernet Port -10 / 100 Mbps.
2. One RS-232 port.
3. One Lon Works Interface Port – 78KB FTT-10A.
4. Battery Backup.
5. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
6. The NAC must be capable of operation over a temperature range of 0 to 55°C.
7. The NAC must be capable of withstanding storage temperatures of between 0 and 70°C.
8. The NAC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing.

C. The NAC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the NAC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.

D. The NAC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.

E. Event Alarm Notification and Actions

1. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
2. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up, telephone connection, or wide-area network.
3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
   a. To alarm
   b. Return to normal
   c. To fault
4. Provide for the creation of an unlimited number of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
5. Provide timed (schedule) routing of alarms by class, object, group, or node.
6. Provide alarm generation from binary object “runtime” and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

F. Control equipment and network failures shall be treated as alarms and annunciated.

G. Alarms shall be annunciated in any of the following manners as defined by the user:

1. Screen message text

2. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
   a. Day of week
   b. Time of day
   c. Recipient
3. Pagers via paging services that initiate a page on receipt of email message
4. Graphic with flashing alarm object(s)
5. Printed message, routed directly to a dedicated alarm printer

H. The following shall be recorded by the NAC for each alarm (at a minimum):

1. Time and date
2. Location (building, floor, zone, office number, etc.)
3. Equipment (air handler #, access way, etc.)
4. Acknowledge time, date, and user who issued acknowledgement.
5. Number of occurrences since last acknowledgement.

I. Alarm actions may be initiated by user defined programmable objects created for that purpose.

J. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.

K. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.

L. Provide a “query” feature to allow review of specific alarms by user-defined parameters.

M. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

N. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

2.6 DATA COLLECTION AND STORAGE

A. The NAC shall have the ability to collect data for any property of any object and store this data for future use.

B. The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:

1. Designating the log as interval or deviation.

2. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.

3. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.

4. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.

5. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

C. All log data shall be stored in a relational database in the NAC and the data shall be accessed from a server (if the system is so configured) or a standard Web Browser.

D. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.

E. All log data shall be available to the user in the following data formats:
1. HTML
2. XML
3. Plain Text
4. Comma or tab separated values

F. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.

G. The NAC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties, at a minimum:
1. Archive on time of day.
2. Archive on user-defined number of data stores in the log (buffer size).
3. Archive when log has reached its user-defined capacity of data stores.
4. Provide ability to clear logs once archived.

2.7 AUDIT LOG

A. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:
1. Time and date
2. User ID
3. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

2.8 DATABASE BACKUP AND STORAGE

A. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.

B. Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval.

C. The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

2.9 INTEROPERABLE DIGITAL CONTROLLER (IDC)

A. Controls shall be microprocessor based Interoperable Lon Mark™ or Lon Works Controllers (IDC). Where possible, all Interoperable Digital Controllers shall bear the applicable Lon Mark™ interoperability logo on each product delivered.

B. HVAC control shall be accomplished using Lon Mark™ based devices where the application has a Lon Mark profile defined. Where Lon Mark devices are not available for a particular application, devices based on Lon Works shall be acceptable. For each Lon Works device that does not have Lon Mark certification, the device supplier must provide an XIF file for the device. Publicly available specifications for the Applications Programming Interface (API) must be provided for each Lon Works / Lon Mark controller defining the programming or setup of each device. All programming, documentation and programming tools necessary to set up and configure the supplied devices per the specified sequences of operation shall be provided.

C. The Lon Works network trunk shall be run to the nearest Network Area Controller (NAC). A maximum of 126 devices may occupy any one Lon Works trunk and must be installed in buss architecture using the appropriate trunk termination device. All Lon Works and Lon Mark devices must be supplied using FTT-10A Lon Works communications transceivers.

D. The Network Area Controller will provide all scheduling, alarming, trending, and network management for the Lon Mark / Lon Works based devices.

E. The IDCs shall communicate with the NAC at a baud rate of not less than 78.8K baud. The IDC shall provide LED indication of communication and controller performance to the technician, without cover removal.

F. All IDCs shall be fully application programmable and shall at all times maintain their LONMARK certification. Controllers offering application selection only (non-programmable), require a 10% spare point capacity to be provided for all applications. All control sequences within or programmed into the IDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.

G. The supplier of any programmable IDC shall provide one copy of the manufacturer’s programming tool, with documentation, to the owner.

2.10 FULL USER INTERFACE SOFTWARE (EXISTING)

A. Operating System: The FUI shall run on Microsoft Windows NT Workstation 4.0, Service Pack 4 or later.

B. The FUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ

buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.

C. Real-Time Displays. The FUI, shall at a minimum, support the following graphical features and functions:

1. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the FUI shall support the use of scanned pictures.

2. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.

3. Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.

4. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
   a. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
   b. Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

5. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.

6. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.

D. System Configuration: At a minimum, the FUI shall permit the operator to perform the following tasks, with proper password access:

1. Create, delete or modify control strategies.
2. Add/delete objects to the system.
3. Tune control loops through the adjustment of control loop parameters.
4. Enable or disable control strategies.
5. Generate hard copy records or control strategies on a printer.
6. Select points to be alarmable and define the alarm state.
7. Select points to be trended over a period of time and initiate the recording of values automatically.

E. On-line Help: Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.

F. On-line Documentation: Provide a context sensitive, on-line documentation system to assist the operator in operation and trouble shooting of each integrated system. On-line help shall be available for all applications and shall provide the relevant data for that particular monitoring screen. As a minimum, provide a link to the Sequence of Operation, input/output summary, and cut sheets in either Adobe Acrobat™ or HTML format.

G. Security: Each operator shall be required to log on to that system with a username and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.

H. System Diagnostics: The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

I. Alarm Console

1. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.

2. When the Alarm Console is enabled, a separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

2.11 BROWSER USER INTERFACE SOFTWARE (EXISTING)

A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Netscape Navigator™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.

B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the EMCS, shall not be acceptable.

C. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Full User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

D. The Web browser client shall support at a minimum, the following functions:

1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
2. Graphical screens developed for the FUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the FUI shall be supported by the Web browser interface.
3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
4. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
5. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.
6. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
    a. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
        i. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
        ii. Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
    b. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
    c. View logs and charts
    d. View and acknowledge alarms
7. The system shall provide the capability to specify a user’s (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to a pre-defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
8. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

2.12 SYSTEM PROGRAMMING

A. The Full User Interface software (FUI) shall provide the ability to perform system programming and graphic display engineering as part of a complete software package. Access to the programming functions and features of the FUI shall be through password access as assigned by the system administrator.

B. A library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide "real-time" data updates. Any real-time data value or object property may be connected to display its current value on a user display. Systems requiring separate software tools or processes to create applications and user interface display shall not be acceptable.
Programming Methods:
1. Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user's application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.
2. Configuration of each object will be done through the object's property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.
3. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.
4. All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database objects shall not be allowed.
5. The system shall support object duplication within a customer's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

2.13 OBJECT LIBRARIES

A. A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.

B. The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.

C. In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) library, available to all registered users to provide new or updated objects and applications as they are developed.

D. The object library shall include objects to support the integration of devices connected to the Network Area Controller (NAC). At a minimum, provide the following as part of the standard library included with the programming software:

1. Lon Mark/Lon Works devices. These devices shall include, but not be limited to, devices for control of HVAC, lighting, access, and metering. Provide Lon Mark manufacturer-specific objects to facilitate simple integration of these devices. All network variables defined in the Lon Mark profile shall be supported. Information (type and function) regarding network variables not defined in the Lon Mark profile shall be provided by the device manufacturer.

2. For devices not conforming to the Lon Mark standard, provide a dynamic object that can be assigned to the device based on network variable information provided by the device manufacturer. Device manufacturer shall provide an XIF file and documentation for the device to facilitate device integration.

2.14 LONWORKS NETWORK MANAGEMENT

A. The Full User Interface software (FUI) shall provide a complete set of integrated Lon Works network management tools for working with Lon Works networks. These tools shall manage a database for all Lon Works devices by type and revision and shall provide a software mechanism for identifying each device on the network. These tools shall also be capable of defining network data connections between Lon Works devices, known as “binding”. Systems requiring the use of third party Lon Works network management tools shall not be accepted.

B. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.

C. The Network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices, and to view health and status counters within devices.

D. These tools shall provide the ability to “learn” an existing Lon Works network, regardless of what network management tool(s) were used to install the existing network, so that existing Lon Works devices and newly added devices are part of a single network management database.

E. The network management database shall be resident in the Network Area Controller (NAC), ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident, at all times, and within the control system shall not be accepted.

2.15 OTHER CONTROL SYSTEM HARDWARE

A. Motorized Control Dampers: Coordinate with the other trades for the exact quantity, size and location of all dampers. Dampers shall be black enamel finish or galvanized, with nylon bearings. Blade edge and tip seals shall be included for all dampers. Blades shall be 16-gauge minimum and 6 inches wide maximum and frame shall be of welded channel iron. Dampers with both dimensions less than 18 inches may have strap iron frames. Ruskin CD-46 or Equal.

B. Control Damper and Valve Actuators: Coordinate with other trades for exact quantity, size and location of all dampers. Provide all dampers unless Two-position or proportional electric actuators shall be direct-mount type. All actuators shall be spring return type. Provide one actuator per damper minimum.

C. Control Valves: Control valves shall be 2-way, or 3-way pattern as shown constructed for tight shutoff and shall operate satisfactorily against system pressures and differentials. Two-position valves shall be 'line' size. Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (except as may be noted on the drawings). Valves with sizes up to and including 2 inches shall be "screwed" configuration and 2-1/2 inch and larger valves shall be "flanged" configuration. Electrically controlled valves shall include spring return type actuators sized for tight shut-off against system pressures and furnished with integral switches for indication of valve position (open-closed). Three-way butterfly valves, when utilized, shall include a separate actuator for each butterfly segment.

D. Wall Mount Room Thermostats: Each room thermostat shall provide temperature indication to the digital controller; provide the capability for a software-limited set point adjustment and operation override capability. An integral LCD shall annunciate current room temperature and set point as well as override status indication. In addition, the thermostat shall include a port for connection of the portable operator's terminal described elsewhere in this specification.

E. Duct Mount, Pipe Mount and Outside Air Temperature Sensors: 10,000-ohm thermistor temperature sensors with an accuracy of ± 0.2ºC. Outside air sensors shall include an integral sun shield.

F. Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip set point.

G. Water Flow Meters (when required): Water flow meters shall be axial turbine style flow meters which translate liquid motion into electronic output signals proportional to the flow sensed. Flow sensing turbine rotors shall be non-metallic and not impaired by magnetic drag. Flow meters shall be 'insertion' type complete with 'hot-tap' isolation valves to enable sensor removal without water supply system shutdown. Accuracy shall be ±2% of actual reading from 0.4 to 20 feet per second flow velocities.

H. Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. Control panels shall meet all requirements of Title 24, California Administrative Code. All electrical devices within a control panel shall be factory wired. All external wiring shall be connected to terminal strips mounted within the panel. Provide engraved phenolic nameplates identifying all devices mounted on the face of control panels. A complete set of 'as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.

2.16 INPUT DEVICES

A. System accuracy of sensed conditions shall be as follows:

1. +/- .5°F for space temperature in the 0-130°F range

2. +/- .5°F for duct temperatures in the 40-130°F range

3. +/- 1.0°F for outside air temperatures in the (-30)-230°F range

4. +/- 1.0°F for water temperatures in the 30-230°F range

5. +/- .1 inch for filter status differential over a 0-2 inch range

B. The system shall maintain the specified analog end-to-end accuracy throughout the warranty period from sensor to controller readout.

C. Packaging: Sensors (transducers) will be appropriately packaged for the location.

1. Architectural housing for space mounting.
2. Weatherproof/sunshield housing for outdoors.
3. Thermal well housing for water applications.
4. Protective housing for duct mounting.

D. Environmental Ratings - The sensor/transducer shall be selected to withstand ambient conditions where:

1. Moisture or condensation is a factor.
2. Vibration exists from ductwork, equipment, etc.
3. Reasonably expected transient conditions exist for temperatures, pressures, humidities, etc. outside the normal sensing range.

E. Temperature Sensors

1. Temperature sensors will be by the use of thermistors (10K ohm at 77°F) or RTDs (PT100 curve).
2. Sensors in the return or discharge duct shall be of the single point type. Sensors in the mixed air will be of the average type.
3. Thermowells shall be brass or stainless steel for non-corrosive fluids below 250°F and 300 series stainless steel for all other applications.
4. Room temperature sensors: Sensing element only.

F. Digital Sensors

1. All digital inputs will be provided by dry contacts. The contacts will be wired normally open or normally closed as required.
2. Motor status (pumps, fans, etc.) shall be determined by current-operated switch.

2.17 OUTPUT DEVICES

A. The use of multiplexers will not be accepted.

B. Relays and Contactors

1. All digital outputs will be electrically isolated from the digital controller by interface relays.
2. Field relays shall have a minimum life of 1 million cycles without failure.
3. Contactors shall have a minimum life of ten thousand cycles without failure.

2.18 ACTUATORS

A. Standard manufacturer damper and valve actuators, proportional or two-position as required, sized to properly operate device. Damper actuators shall be of the direct coupled type, Belimo or equal.

2.19 WIRING AND CONDUIT

A. Where different wiring classes terminate within the same enclosure, maintain clearances and install barriers per the National Electric Code.

B. Where wiring is required to be installed in conduit, EMT shall be used. Conduit shall be minimum 1/2 inch galvanized EMT. Set screw fittings are acceptable for dry interior locations. Watertight compression fittings shall be used for exterior locations and interior locations subject to moisture. Provide conduit seal-off fitting where exterior conduits enter the building or between areas of high temperature/moisture differential.

C. Flexible metallic conduit (max. 3 feet) shall be used for connections to motors, actuators, controllers, and sensors mounted on vibration producing equipment. Liquid-tight flexible conduit shall be use in exterior locations and interior locations subject to moisture.

D. Junction boxes shall be provided at all cable splices, equipment terminations, and transitions from EMT to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal four-inch square with blank cover. Exterior and damp location JH-boxes shall be cast alloy FS boxes with threaded hubs and gasketed covers.

E. Where the space above the ceiling is a supply or return air plenum, the wiring shall be plenum rated. Teflon wiring can be run without conduit above suspended ceilings. EXCEPTION: Any wire run in suspended ceilings that is used to control outside air dampers or to connect the system to the fire alarm system shall be in conduit.

2.20 ENCLOSURES

A. All controllers and field interface panels shall be mounted in new enclosures unless otherwise stated in this specification.

B. All outside mounted enclosures shall meet the NEMA-4 rating.

C. Wiring within all enclosures shall be run in plastic track. Wiring within controllers shall be wrapped and secured.

2.21 CONTROL VALVES

A. Control Valves: Factory fabricated, of type, body material, and pressure class indicated. Where type or body material is not indicated, make selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature rating of piping system.

B. Globe Pattern: As follows:

1. Up to 2 inches: Bronze body, bronze trim, rising stem, renewable composition disc, screwed ends with backseating capacity re-packable under pressure.

2. Over 2 inches: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, renewable seat and disc.

3. Hydronic Systems: As follows:

a. Rating: Service at 125 psi WSP and 250°F.
b. Internal Construction: Replaceable plugs and seats of stainless steel or brass.
i. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
ii. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom of guided plugs.
c. Sizing: 3-psi maximum pressure drop at design flow rate.
d. Flow Characteristics: 2-way valves have equal percentage characteristics; 3-way valves have linear characteristics. Select operators to close valves against pump shutoff head.

C. Terminal Unit Control Valves: Bronze body, bronze trim, 2 or 3 port as indicated, replaceable plugs and seats, union and threaded ends.

1. Rating: Service at 125 psi WSP and 250°F.

2. Sizing: 3-psi maximum pressure drop at design flow rate, to close against pump shutoff head.

3. Flow Characteristics: 2-way valves have equal percentage characteristics; 3-way valves have linear characteristics.

4. Operators (2 Position): Synchronous motor with enclosed gear train, dual-return springs, valve-position indicator. Valves spring return to normal position for temperature protection.

5. Operators (Modulating): Self-contained, linear motor, actuator with 60-second full travel, with transformer and single-throw, double-pole contacts.

2.22 DAMPERS

A. Dampers: AMCA-rated, parallel or opposed blade design; form frames from not less than 0.1084-inch galvanized steel with mounting holes for duct mounting; damper blades not less than 0.0635-inch galvanized steel, with maximum blade width of 8 inches.

1. Blades secured to 1/2-inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass. Ends sealed against spring-stainless-steel blade bearings. Thrust bearings at each end of every blade.

2. Operating Temperature Range: From -40 to 200°F.

3. For standard applications as indicated, (as selected by manufacturer's sizing techniques) with optional closed-cell neoprene edging.

4. Provide low-leakage parallel or opposed blade design (as selected by manufacturer's sizing techniques) with inflatable seal blade edging, or replaceable rubber seals, rated for leakage at less than 10 cfm/sq.ft. of damper area, at differential pressure of 4 inches wg when damper is being held by torque of 50 inch-pounds; test in accordance with AMCA 500. Ruskin CD-46 or equal.

2.23 ACTUATORS

A. Electronic Actuators: The actuator shall be direct coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The actuator shall have electronic overload circuitry to prevent damage. For power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing. Non-spring return actuators shall have an external manual gear release to allow positioning of the damper when the actuator is not powered.

B. All valves shall be fully proportioning, unless otherwise specified, quiet in operation, and shall be arranged to fail safe, in either a normally open or normally closed position, in the event of power failure. The open of closed position shall be as specified or as required to suit job conditions. All valves shall be capable of operating at varying rates of speed to correspond to the exact dictates of the controller and variable load requirements.

C. Where valves operate in sequence with other valves or damper operators, provide on each valve a pilot positioner to provide adjustable operating ranges and starting points and positive close off at the required control signal pressure. Positioners must be directly connected to the valve stem. Ratio relays are not acceptable.

D. Valves shall be sized by the Temperature Control Manufacturer and guaranteed to meet the heating or requirements as specified and indicated on the Drawings. Unless otherwise specified, all shall conform to the requirements herein specified for the piping system in which they are installed.

2.24 CENTRAL CONTROL PANEL

A. Integrate new controls into existing central control touch screen panel. This central panel will allow for time clock scheduling, setpoints, monitoring of points and alarm. All freezestats will be reset manually at the central panel. All alarms will be displayed and reset manually at central panel.

B. All exhaust fans shall be controlled by the central control panel.

C. Central control panel shall be connected to existing District IT Network. District shall provide data drop.

2.25 AUXILIARY EQUIPMENT/DEVICES

A. Analog Sensors

1. Duct sensors (greater than four square feet): Monitoring range to suit application. Platinum or nickel wound RTD Type + 0.1% of range. Factory calibration point – 70 Deg. F at 1000 OHMS.

2. Space Temperature Sensors: Space Temperature Sensors shall be 5,000 or 10,000 ohm thermistor with wall plate adapter and blank cover assembly. The sensor shall include an integral occupancy override button and shall also include a RJ11 communications port. Space Temperature Sensors shall include space temperature adjustment slides where shown on the plans. The Space Temperature Sensors shall be mounted approximately 60” above the floor.

3. Hydronic Well Temperature Sensors: Water Temperature Sensors shall be well mounted 5,000 or 10,000 ohm thermistors.

4. Status Indication- Status indication for fans and pumps shall be provided by a current sensing sensor. The sensor shall be installed at the motor starter or motor to provide load indication. The unit shall consist of a current transformer, a solid state current sensing circuit (with adjustable set point) and a solid state switch. A red light emitting diode (LED) shall indicate the on off status of the unit. The switch shall provide a N.O. contact for wiring back to the Field Installed Controller.

5. Combination CO2 and Space Temperature Sensors: CO2 and space sensors are comprised of two sensors housed in one unit designed to measure both CO2 in the air and the building air temperature. Combination sensor shall have the following features:
   a. Self-Calibration CO_2 sensor with 5 year calibration interval.
   b. Push button override.
   c. CO_2 sensitivity +/- 20 ppm.
   d. CO_2 accuracy +/- 100 ppm.
   e. Space sensor: 5 or 10K thermistor.

2.26 DDC SENSORS AND POINT HARDWARE

A. Temperature Sensors

1. All temperature devices shall use precision thermistors accurate to +/- 1 degree F over a range of –30 to 230 degrees F. Space temperature sensors shall be accurate to +/- .5 degrees F over a range of 40 to 100 degrees F.

2. Standard space sensors shall be available in an off white enclosure for mounting on a standard electrical box.

3. Where manual overrides are required, the sensor housing shall feature both an optional sliding mechanism for adjusting the space temperature setpoint, as well as a push button for selecting after hours operation.

4. Where a local display is specified, the sensor shall incorporate either an LED or LCD display for viewing the space temperature, setpoint and other operator selectable parameters. Using built in buttons; operators shall be able to adjust setpoints directly from the sensor.

5. Duct temperature sensors shall incorporate a thermistor bead embedded at the tip of a stainless steel tube. Probe style duct sensors are useable in air handling applications where the coil or duct area is less than 14 square feet.

6. Averaging sensors shall be employed in ducts, which are larger than 14 square feet. The averaging sensor tube must contain at least one thermistor for every 3 feet, with a minimum tube length of 12 feet.

7. Immersion sensors shall be employed for measurement of temperature in all chilled and hot water applications as well as refrigerant applications. Thermal wells shall be brass or stainless steel for non-corrosive fluids below 250 degrees F. and 300 series stainless steel for all other applications.

8. A pneumatic signal shall not be allowed for sensing temperature.

B. Humidity Sensors

1. Humidity devices shall be accurate to +/- 5% at full scale for space and +/- 3% for duct and outside air applications. Suppliers shall be able to demonstrate that accuracy is NIST traceable.

2. Provide a hand held field calibration tool that both reads the output of the sensor and contains a reference sensor for ongoing calibration.

C. Pressure Sensors

1. Air pressure measurements in the range of 0 to 10” water column will be accurate to +/- 1% using a solid-state sensing element. Acceptable manufacturers include Modus Instruments and Mamac.

2. Differential pressure measurements of liquids or gases shall be accurate to =/- 0.5% of range. The housing shall be NEMA 4 rated.

D. Current and KW Sensors

1. Current status switches shall be used to monitor fans, pumps, motors and electrical loads. Current switches shall be available in solid and split core models and offer either a digital or an analog signal to the automation system. Acceptable manufacturer is Veris or approved equal.

2. Measurement of three-phase power shall be accomplished with a kW/kWH transducer. This device shall utilize direct current transformer inputs to calculate the instantaneous value (kW) and a pulsed output proportional to the energy usage (kWH). Provide Veris Model 6000 Power Transducer or approved equal.

E. Flow Sensors

1. Provide an insertion vortex flow meter for measurement of liquid or gas flows in pipe sizes above 3 inches.
2. Install the flow meter on an isolation valve to permit removal without process shutdown.
3. Sensors shall be manufactured by EMCO or approved equal.

F. Carbon Dioxide Sensors

1. Non-Dispersive Infrared (NDIR), 0-2000 PPM.
2. Power Requirement, 18-30 VDC.
3. Voltage output, 0-10- VDC Full Scale.
4. Current output, 4-20 mA

2.27 AIRFLOW MEASURING STATIONS

A. Provide a thermal anemometer using instrument grade self-heated thermistor sensors with thermistor temperature sensors. The flow station shall operate over a range of 0 to 5,000 feet/min with an accuracy of +/- 2% over 500 feet/min and +/- 10 ft/min for reading less than 500 feet/min.

B. The output signal shall be linear with field selectable ranges including 0-5 VDC, 0-10VDC and 4-20 mA.

C. Furnish Ebtron Series 3000 airflow stations or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. All DDC Controllers shall be networked to Central Communications controller.

B. Existing Front End Workstation in B & G office shall be configured for High School Addition access. Text/Graphic screens for each system shall match existing.

C. Communications cabling shall be run in hallways above hung ceiling with plenum cable and wiremold where exposed.

3.2 CONTRACTOR RESPONSIBILITIES

A. General: The Contractor or a Sub-Contractor shall perform installation of the building automation system. However, all installations shall be under the personal supervision of the Contractor. The Contractor shall certify all work as proper and complete.

B. Demolition: Remove controls, which do not remain as part of the building automation system, all associated abandoned wiring and conduit and all associated pneumatic tubing. The Owner will inform the Contractor of any equipment, which is to be removed, that will remain the property of the Owner. The Contractor will dispose of all other equipment that is removed.

C. Access to Site: Unless notified otherwise, entrance to building is restricted. No one will be permitted to enter the building unless their names have been cleared with the Owner or the Owner's representative.

D. Code Compliance: All wiring shall be installed in accordance with all applicable electrical codes and will comply with equipment manufacturer's recommendations. Should any discrepancy be found between wiring Specifications in Division 26 and Division 22, wiring requirements of Division 26 will prevail for work specified in Division 26.

E. Cleanup: At the completion of the work, all equipment pertinent to this Contract shall be checked and thoroughly cleaned, and all other areas shall be cleaned around equipment provided under this Contract. Clean the exposed surfaces of tubing, hangers, and other exposed metal of grease, plaster, or other foreign materials.

3.3 WIRING, CONDUIT, TUBING AND CABLE

A. All wire will be copper and meet the minimum wire size and insulation class listed below:

Wire Class	Wire Size	Isolation Class
Power	12 Gauge	600 Volt
Class One	14 Gauge Std.	600 Volt
Class Two	18 Gauge Std.	300 Volt
Class Three	18 Gauge Std.	300 volt
Communications	Per Mfr.	Per Mfr.

B. Power and Class One wiring may be run in the same conduit. Class Two and Three wiring and communications wiring may be run in the same conduit.

C. Where different wiring classes terminate within the same enclosure, maintain clearances and install barriers per the National Electric Code.

D. Where wiring is required to be installed in conduit, EMT shall be used. Conduit shall be minimum 1/2 inch galvanized EMT. Setscrew fittings are acceptable for dry interior locations. Watertight compression fittings shall be used for exterior locations and interior locations subject to moisture. Provide conduit seal off fitting where exterior conduits enter the building or between areas of high temperature/moisture differential.

E. Flexible metallic conduit (max. 3 feet) shall be used for connections to motors, actuators, controllers, and sensors mounted on vibration producing equipment. Liquid-tight flexible conduit shall be use in exterior locations and interior locations subject to moisture.

F. Junction boxes shall be provided at all cable splices, equipment termination, and transitions from EMT to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal four-inch square with blank cover. Exterior and damp location JH-boxes shall be cast alloy FS boxes with threaded hubs and gasket covers.

G. Where the space above the ceiling is a supply or return air plenum, the wiring shall be plenum rated. Teflon wiring can be run without conduit above suspended ceilings. EXCEPTION: Any wire run in suspended ceilings that is used to control outside air dampers or to connect the system to the fire management system shall be in conduit.

H. Coaxial cable shall conform to RG62 or RG59 rating. Provide plenum rated coaxial cable when running in return air plenums.

3.4 HARDWARE INSTALLATION

A. Installation Practices for Wiring and Tubing

1. All controllers are to be mounted vertically and per the manufacturer's installation documentation.
2. The 120 VAC power wiring to each Ethernet or Remote Site controller shall be a dedicated run, with a separate breaker. Each run will include a separate hot, neutral and ground wire. The ground wire will terminate at the breaker panel ground. This circuit will not feed any other circuit or device.
3. A true earth ground must be available in the building. Do not use a corroded or galvanized pipe, or structural steel.
4. Wires are to be attached to the building proper at regular intervals such that wiring does not drop. Wires are not to be affixed to or supported by pipes, conduit, etc.
5. Wiring in finished areas will be concealed in ceiling cavity spaces, plenums, and furred spaces and wall construction. Exception; metallic surface raceway may be used in finished areas on masonry walls. All surface raceway in finished areas must be color matched to the existing finish within the limitations of standard manufactured colors.
6. Wiring, in non-finished areas where possible, will be concealed in ceiling cavity spaces, plenums, furred spaces, and wall construction. Exposed conduit will run parallel to or at right angles to the building structure.
7. Wires are to be kept a minimum of three (3) inches from hot water or condense piping.
8. Where sensor wires leave the conduit system, they are to be protected by a plastic insert.

B. Installation Practices for Field Devices

1. Well-mounted sensors will include thermal conducting compound within the well to insure good heat transfer to the sensor.
2. Actuators will be firmly mounted to give positive movement and linkage will be adjusted to give smooth continuous movement throughout 100 percent of the stroke.
3. Relay outputs will include transient suppression across all coils. Suppression devices shall limit transients to 150% of the rated coil voltage.
4. Water line mounted sensors shall be removable without shutting down the system in which they are installed.
5. For duct static pressure sensors, the high-pressure port shall be connected to a metal static pressure probe inserted into the duct pointing upstream. The low-pressure port shall be left open to the plenum area at the point that the high-pressure port is tapped into the ductwork.
6. For building static pressure sensors, the high-pressure port shall be inserted into the space via a metal tube. Pipe the low-pressure port to the outside of the building.

C. Enclosures

1. For all I/O requiring field interface devices, these devices, where practical, will be mounted in a field interface panel (FIP). The Contractor shall provide an enclosure, which protects the device(s) from dust, moisture, conceals integral wiring and moving parts.
2. FIP’s shall contain power supplies for sensors, interface relays and Contractors, safety circuits, and I/P transducers.
3. The FIP enclosure shall be of steel construction with baked enamel finish; NEMA 1 rated with a hinged door and keyed lock. The enclosure will be sized for 20% spare mounting space. All locks will be keyed identically.
4. All wiring to and from the FIP will be to screw type terminals. Analog or communications wiring may use the FIP as a raceway without terminating. The use of wire nuts within the FIP is prohibited.
5. All outside mounted enclosures shall meet the NEMA-4 rating.
6. The wiring within all enclosures shall be run in plastic track. Wiring within controllers shall be wrapped and secured.

D. Identification

1. Identify all control wires with labeling tape or sleeves using either words, letters, or numbers that can be exactly cross-referenced with As-Built Drawings.
2. All field enclosures, other than controllers, shall be identified with a Bakelite nameplate. The lettering shall be in white against a black or blue background.
3. Junction box covers will be marked to indicate that they are a part of the BAS system.
4. All I/O field devices (except space sensors) that are not mounted within FIP's shall be identified with nameplates.
5. All I/O field devices inside FIP's shall be labeled.

E. Control System Switch-Over

1. Demolition of the existing control system will occur after the new temperature control system is in place including new sensors and new field interface devices.
2. Switch over from the existing control system to the new system will be fully coordinated with the Owner. A representative of the Owner will be on site during switch over.
3. The Contractor shall minimize control system downtime during switch over. Sufficient installation mechanics will be on site so that the entire switch over can be accomplished in a reasonable time frame.

F. Location

1. The location of sensors is per Mechanical and Architectural Drawings.
2. Outdoor air sensors will be mounted on the north building face directly in the outside air. Install these sensors such that the effects of heat radiated from the building or sunlight is minimized.
3. Field enclosures shall be located immediately adjacent to the controller panel(s) to which it is being interfaced.

3.5 SOFTWARE INSTALLATION

A. General: The Contractor shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third party software necessary for successful operation of the system.

B. Database Configuration: The Contractor will provide all labor to configure those portions of the database that are required by the points list and sequence of operation.

C. Color Graphic Slides: Unless otherwise directed by the Owner, the Contractor will provide color graphic displays as depicted in the Mechanical Drawings for each system and floor plan. For each system or floor plan, the display shall contain the associated points identified in the point list and allow for set point changes as required by the Owner.

D. Reports - The Contractor will configure a minimum of 6 reports for the Owner as listed below:

1. Central Plant Status Report
2. Air Handler Status Report
3. Energy Consumption Report
4. Space Temperature Report
5. Specialty Equipment Status Report

E. Documentation - As-Built software documentation will include the following:

1. Descriptive point lists
2. Application program listing
3. Application programs with comments
4. Printouts of all reports
5. Alarm list
6. Printouts of all graphics

3.6 COMMISSIONING AND SYSTEM STARTUP

A. Point-to-Point Checkout: Each I/O device (both field mounted as well as those located in FIP's) shall be inspected and verified for proper installation and functionality. A checkout sheet itemizing each device shall be filled out, dated and approved by the Project Manager for submission to the Owner or Owner's representative.

B. Controller and Workstation Checkout: A field checkout of all controllers and miscellaneous equipment 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 Owner or Owner's representative by the completion of the project.

C. System Acceptance Testing

1. All application software will be verified and compared against the sequences of operation. Control loops will be exercised by inducing a setpoint shift of at least 10% and observing whether the system successfully returns the process variable to setpoint. Record all test results and attach to the Test Results Sheet.

2. 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 to the Owner.

3. 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.

4. Perform an operational test of each third party interface that has been included as part of 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. 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.

3.7 SEQUENCES OF OPERATION

A. VRF System Ductless Split, Ceiling Units

1. Point List
   a. Space Temperature
   b. Occupied/Unoccupied
   c. VRF Space Temperature Setpoint
   d. VRF Indoor Mode (Heating/Cooling)
   e. VRF Indoor Unit fan speed
   e. Energy Recovery Unit Status
   f. Baseboard Fin Tube/Cabinet Heater Control Valve Status (if applicable)
   g. VRF Outdoor Mode/status

(Provide all required hardware and software to interface the BMS with the VRF system.)

2. Sequence of Operation
   a. Unoccupied Mode: Cooling shall not operate. Baseboard radiation/cabinet heater (if applicable) shall operate as Stage 1 heating. Room cassette VRF heat pump and heat recovery heating shall operate as stage 2 as required to satisfy space temperature setback setpoint.

   b. Occupied Mode: Heating or cooling shall operate as required based upon its own packaged controls and factory thermostat to maintain thermostat setpoint. Baseboard radiation/cabinet heater shall operate as Stage 1 heating. Room cassette VRF heat pump and heat recovery heating shall operate as Stage 2 as required to maintain space thermostat setpoint. Heat recovery mode shall operate, providing heating or cooling as required. Unoccupied/Occupied scheduling will be via BMS.

B. Rooftop Ventilation/Energy Recovery Air Handler Unit (ERUO-1 Academic Cafeteria)

1. Point List
   a. Space Temperature
   b. Supply Fan VFD (Speed and Status)
   c. Exhaust Fan VFD (Speed and Status)
   d. Energy Recovery Wheel VFD (Speed and Status)
   e. OA, EA, SA Temperatures
   f. Respective VRF Outdoor Unit Status
   g. OA, EA Damper Modulation
   h. Return/Recirculation Air Damper Position
   i. VRF DX Heating/Cooling Coil Status
   j. Dirty Filter Status
   k. Relative Humidity (Supply Air)
   l. Kitchen Hood Exhaust Fan Status

2. Sequence of Operation
   a. Unoccupied: In this mode:
   Supply and Exhaust fans off, OA and EA dampers closed. If the unoccupied average space temperature is not maintained by the respective baseboard radiation, the rooftop ventilation unit and associated VRF outdoor unit shall cycle on in the recirculation mode (return air damper open). Upon satisfaction, the rooftop unit shall stop until the next cycle, if required.

   b. Warm-up: During the heating season, a warm-up mode will be invoked if the return air temperature is below 60°F (adj.) upon unit start-up. In this mode:

      i. The OA dampers will open and thru a hard wired interlock and the supply fan will start. Fan will slowly ramp up to preset speed. The warm-up program will reset the heating supply air temperature set

point to 80°F (adj.). The heating will modulate to maintain the supply air temperature setpoint. The supply air setpoint will be reset linearly and inversely from 80°F (adj.) to 70°F (adj.) as the return air temperature increases from 60°F to 70°F (adj.)

ii. Once the return air has reached 72°F (adj.) the temperature shall be controlled as described in the occupied mode.

b. Occupied: In this mode

i. Supply and exhaust fans will start and ramp up slowly to the preset speed via VFD. The return fan will follow and track the supply fan as needed. The OA and EA dampers shall open. Minimum discharge air temperature shall be 72 degrees F.

ii. Perimeter Radiation valves will be the first stage of heating and open as needed to maintain the space temperature setpoint (adj.). Should additional heating be required the VRF air source outdoor unit serving the rooftop unit shall operate to maintain the heating setpoint by raising the discharge air temperature.

iii. VRF direct expansion cooling system shall operate as needed to maintain occupied cooling setpoint (adjustable). Hot gas reheat shall maintain relative humidity in discharge air to 60 % RH (adjustable).

iv. An adjustable dead band offset will prevent short cycling.

v. Note: the energy recovery wheel will be on when the unit is on and rotate as needed to maintain exhaust air temperature. Energy wheel freeze protection is integral to the unit.

vi. Minimum outdoor air shall be as scheduled on drawings.

c. Alarms: In this mode:

i. Should the command not equal the status within 90 seconds from start-up an alarm will be generated at the operator's workstation.

ii. Should any temperature fall outside of its preset limits (high/low) an alarm will be generated at the operator's workstation.

d. Ventilation Control:

i. Outdoor air ventilation shall be controlled by carbon dioxide sensors. Ventilation rate shall vary from minimum 1000 cfm to maximum 5,400 cfm, at full occupancy of 420 people. The four sensors shall average CO2 and control OA.

e. Demand Control Ventilation:

i. Ventilation method shall be by demand controls. There shall be no provision to remove CO2 by any other method other than dilution. Prior to space occupancy, a pre-occupancy purge cycle shall be initiated for a minimum 30 minutes. For this purge, fan shall start and run, and the outdoor air intake rate shall ramp up to 100 percent of design outdoor air (5,400 cfm). During occupancy, the outdoor

air supply shall start to increase beyond the minimum ventilation setpoint (1000 cfm), starting at an interior CO2 concentration of not greater than 100 PPM over that of the outdoor air concentration. The outdoor air supply shall continue to ramp up for full occupancy as CO2 concentrations rise to the upper limit of 1400 PPM over that of the outdoor air. Upon conclusion of occupancy, a post occupancy flush cycle shall occur. The fan shall run, and the outdoor air intake rate shall ramp up to 100 percent of design outdoor air (5,400 cfm) until indoor CO2 concentrations in the space are reduced to outdoor air levels. After the post occupancy flush cycle has completed, the rooftop unit shall revert to minimum outdoor air ventilation setpoint (1000 cfm). This minimum setpoint shall be satisfied whenever the system is in operation. The relief exhaust fan speed shall follow the outdoor air intake rate under all occupancies and conditions to maintain proper relief air. The economizer system shall override the CO2 control system when conditions permit free cooling of the space.

f. Economizer - In this mode:

i. If the outside air temperature is greater than the return air temperature, the system will operate as described in the occupied mode. Unit shall operate according to its own packaged controls to control the wheel operation and speed when outdoor conditions are favorable.

ii. If the outside air temperature is less that the return air temperature and the outside air temperature is greater than 50 Degrees F. (adjustable), the ERU heat transfer wheel rotation shall stop.

g. Kitchen Hood Make-up Air:

i. Kitchen hood exhaust fan shall be interlocked with this unit. Whenever the Kitchen hood exhaust fan EF-5 is energized, the cafeteria rooftop unit shall start and run (if not already running), the Demand Control Ventilation shall be over-ridden, and the energy recovery wheel shall stop. ERUO-1 exhaust fan shall slow down to allow adequate make-up air (3,500 cfm variable) to the Kitchen. The EF-5 airflow rate will vary depending on the smoke/heat development and ERUO-1 exhaust and outdoor air rate shall follow EF-5 as required and provide a five percent negative pressure within the Kitchen.

C. Fin-Tube Radiation, Convectors, Radiant Ceiling Panels

1. Point List
   a. Space Temperature
   b. Valve Modulation

2. Sequence of Operation
   a. Unoccupied Mode (Heating Season): Modulate control valve to maintain night setback temperature set-point (adjustable).

   b. Occupied Mode (Heating Season): Modulate control valve to maintain daytime temperature set-point (adjustable). Interface with second stage heating.

   (Provide all required hardware and software to interface the baseboard with the VRF system through the BMS.)

D. Cabinet Heaters

1. Point List
   a. Space Temperature
   b. Valve Modulation
   c. Fan Start/Stop

2. Sequence of Operation
   a. Unoccupied Mode (Heating Season): Modulate heating control valve to maintain night setback temperature set-point (adjustable). Fan shall not run if hot water is not enabled and available.

   b. Occupied Mode (Heating Season): Modulate heating control valve to maintain occupied temperature set-point (adjustable). Fan shall not run if hot water is not enabled and available.

E. Exhaust Fans (Toilet exhaust, Storage room exhaust)

1. Point List
   a. Fan Start/Stop
   b. Fan Status

2. Sequence of Operation
   a. Unoccupied Mode: Fans Off, Dampers Closed.

   b. Occupied Mode: Fans On, Dampers Open.

   c. Alarms generated at operator's workstation: Exhaust Fan Status.

F. Exhaust Fan (Kitchen Hood exhaust)

1. Point List
   a. Fan Start/Stop
   b. Fan Status
   c. VFD Status
   d. Hood smoke/Heat Generation Status

2. Sequence of Operation
   a. Unoccupied Mode: Fan enabled.
      Fan shall be energized by a local manual switch.

   b. Occupied Mode: Fan enabled.
      Fan shall be energized by a local manual switch, or smoke/heat generation within the hood. EF-5 shall be interlocked with Cafeteria unit ERUO-1. ERUO-1 shall provide make-up air to the Kitchen hood via the air transfer ductwork from the Cafeteria. Whenever EF-5 operates, the energy recovery wheel within ERUO-1 shall stop and the exhaust fan shall slow down to 1900 cfm to allow adequate make-up air to the exhaust.

G. Exhaust Fans (Science Prep, Art Storage, Maker-Space equipment, Faculty kitchenette)

1. Point List
   a. Fan Start/Stop
   b. Fan Status

2. Sequence of Operation
   a. Unoccupied Mode: Fans on, Dampers Open.

   b. Occupied Mode: Fans enabled and energized through local manual over-ride switch, Dampers Open.

   c. Alarms generated at operator's workstation: Exhaust Fan Status.

H. Cooling coils / Air Conditioners / Condensing Units (Data Rooms)

1. Point List
   a. System Enabled/Disabled
   b. System Status
   c. Space Temperature

2. Sequence of Operation
   a. Unoccupied Mode: System Disabled. (IT cooling units shall be enabled at all times)

   b. Occupied Mode: System Enabled.
      System shall operate in accordance with its own packaged controls.

   c. Alarms generated at operator's workstation: Space temp out of Bounds +/- 5 F.

I. Indoor Energy Recovery Ventilation Units
(ERU-1, 2, 4, 5, 6 Academic Classrooms/Offices)

1. Point List
   a. Supply Fan Status
   b. Exhaust Fan Status
   c. OA, EA, Air Temperatures

d. OA, EA, Damper
e. Discharge Air Temperature
f. VRF D/X Heating/Cooling Coil Status
g. Respective VRF Outdoor Unit Status
h. Energy Recovery Wheel VFD Speed Status
i. Dirty Filter Status
j. Return/Recirculation Air Damper Position

2. Sequence of Operation

a. Unoccupied - In this mode:
Supply and Exhaust fans off, OA and EA dampers closed, perimeter baseboard heat (if applicable) shall be Stage 1. If additional heat is required, the respective VRF cassette unit(s) shall start and run as stage 2 to maintain the night setback temperature (60°F). The respective outdoor VRF unit shall operate as required for all systems.

b. Occupied - In this mode:
i. The OA and EA dampers will open and thru a hard wired interlock the Supply and Exhaust fans will start.
ii. Energy transfer will be both sensible and latent energy between air streams. Latent energy transfer media transfer will be accomplished by direct water vapor transfer from one air stream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air.
iii. The respective outdoor VRF unit shall operate as required to maintain occupied heating or cooling discharge setpoint (72˚F adjustable) as sensed by the duct discharge temperature sensor. Perimeter baseboard heat (if applicable) shall be Stage 1. If additional heat is required, the respective VRF cassette unit(s) shall start and run as stage 2
iv. An adjustable dead band offset will prevent short cycling.

c. Alarms: In this mode:
i. Should the command not equal the status within 90 seconds from start-up an alarm will be generated at the operator's workstation.
ii. Should any temperature fall outside of its preset limits (high/low) an alarm will be generated at the operator's workstation.

d. Economizer - In this mode:
i. If the outside air temperature is greater than the return air temperature, the system will operate as described in the occupied mode.
ii. If the outside air temperature is less that the return air temperature and the outside air temperature is greater than 50 Degrees F. (adjustable), the ERU heat transfer wheel shall stop, mechanical cooling shall stop, and the economizer system shall be enabled.

J. Indoor Energy Recovery Ventilation Unit (ERU-3, Academic Medical Suite) (NOT USED)

1. Point List
   a. Supply Fan Status
   b. Exhaust Fan Status
   c. OA, EA, Air Temperatures
   d. OA, EA, Damper
   e. Discharge Air Temperature
   f. VRF D/X Heating/Cooling Coil Status
   g. Respective VRF Outdoor Unit Status
   h. Dirty Filter Status
   i. Return/Recirculation Air Damper Position

2. Sequence of Operation
   a. Unoccupied - In this mode:
      Supply and Exhaust fans off, OA and EA dampers closed, perimeter baseboard heat (if applicable) shall be Stage 1. If additional heat is required, the respective VRF cassette unit(s) shall start and run as stage 2 to maintain the night setback temperature (60°F). The respective outdoor VRF unit shall operate as required.

   b. Occupied - In this mode:
      i. The OA and EA dampers will open and thru a hard wired interlock the Supply and Exhaust fans will start.
      ii. Energy transfer will be both sensible and latent energy between air streams. Latent energy transfer media transfer will be accomplished by direct water vapor transfer from one air stream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air.
      iii. The respective outdoor VRF unit shall operate as required to maintain occupied heating or cooling discharge setpoint (72˚F adjustable) as sensed by the duct discharge temperature sensor. Perimeter baseboard heat (if applicable) shall be Stage 1. If additional heat is required, the respective VRF cassette unit(s) shall start and run as stage 2
      iv. An adjustable dead band offset will prevent short cycling.

   c. Alarms: In this mode:
      i. Should the command not equal the status within 90 seconds from start-up an alarm will be generated at the operator's workstation.
      ii. Should any temperature fall outside of its preset limits (high/low) an alarm will be generated at the operator's workstation.

   d. Economizer - In this mode:
      i. If the outside air temperature is greater than the return air temperature, the system will operate as described in the occupied mode.

ii. If the outside air temperature is less that the return air temperature and the outside air temperature is greater than 50 Degrees F. (adjustable), the ERU heat recovery bypass damper shall open, mechanical cooling shall stop, and the economizer system shall be enabled.

K. Indoor Energy Recovery Ventilation Unit (ERU-7 Academic Basement rooms)

1. Point List
   a. Supply Fan Status
   b. Exhaust Fan Status
   c. OA, EA, Air Temperatures
   d. OA, EA, Damper
   e. Discharge Air Temperature
   f. HW Coil Valve Status
   g. Energy Recovery Wheel Status
   h. Dirty Filter Status
   i. Return/Recirculation Air Damper Position

2. Sequence of Operation
   a. Unoccupied - In this mode:
      i. Supply and Exhaust fans off, OA and EA dampers closed. If heat is required, the ERU unit shall start and run to maintain the night setback temperature (60°F). The hot water coil control valve shall operate as required.

   b. Occupied - In this mode:
      i. The OA and EA dampers will open and through a hard wired interlock the Supply and Exhaust fans will start.
      ii. Energy transfer will be both sensible and latent energy between air streams. Latent energy transfer media transfer will be accomplished by direct water vapor transfer from one air stream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the outdoor air.
      iii. The hot water coil control valve shall operate as required to maintain occupied heating space setpoint (72˚F adjustable).
      iv. An adjustable dead band offset will prevent short cycling.

   c. Alarms: In this mode:
      i. Should the command not equal the status within 90 seconds from start-up an alarm will be generated at the operator's workstation.
      ii. Should any temperature fall outside of its preset limits (high/low) an alarm will be generated at the operator's workstation.

   d. Economizer - In this mode:
      i. If the outside air temperature is greater than the return air temperature, the system will operate as described in the occupied mode.

ii. If the outside air temperature is less that the return air temperature and the outside air temperature is greater than 50 Degrees F. (adjustable), the ERU energy recovery wheel shall stop, mechanical cooling shall stop, and the economizer system shall be enabled.

L. Indoor Energy Recovery Ventilation Unit (ERU-8 Community Lockers/Toilet rooms) (Alternate Add)

1. Point List
   a. Supply Fan Status
   b. Exhaust Fan Status
   c. OA, EA, Air Temperatures
   d. OA, EA, Damper
   e. Discharge Air Temperature
   f. VRF D/X Heating/Cooling Coil Status
   g. Respective VRF Outdoor Unit Status
   i. Dirty Filter Status
   j. Return/Recirculation Air Damper Position

2. Sequence of Operation
   a. Unoccupied - In this mode:
      Supply and Exhaust fans off, OA and EA dampers closed. If heat is required, the ERU unit shall start and run to maintain the night setback temperature (60°F). The respective outdoor VRF unit shall operate as required.

   b. Occupied - In this mode:
      The OA and EA dampers will open and through a hard wired interlock the Supply and Exhaust fans will start.
      Energy transfer will be both sensible and latent energy between air streams. Latent energy transfer media transfer will be accomplished by direct water vapor transfer from one air stream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the outdoor air.
      The respective outdoor VRF unit shall operate as required to maintain occupied heating or cooling space setpoint (72˚F adjustable) sensor.
      An adjustable dead band offset will prevent short cycling.

   c. Alarms: In this mode:
      i. Should the command not equal the status within 90 seconds from start-up an alarm will be generated at the operator's workstation.
      ii. Should any temperature fall outside of its preset limits (high/low) an alarm will be generated at the operator's workstation.

d. Economizer - In this mode:
   i. If the outside air temperature is greater than the return air temperature, the system will operate as described in the occupied mode.
   iii. If the outside air temperature is less that the return air temperature and the outside air temperature is greater than 50 Degrees F. (adjustable), the ERU heat recovery bypass damper shall open, mechanical cooling shall stop, and the economizer system shall be enabled.

M. Hot Water Circulator Pumps (HWP-1 & HWP-2)

1. Point List
   a. Pump Start/Stop
   b. Pump Status
   c. VFD Status
   d. System Differential Pressure

2. Sequence of Operation
   a. Occupied Mode: Pump HWP-1 or HWP-2 shall start when the outdoor air temperature drops below 60 º F. (adjustable).
   b. Unoccupied Mode: Pump HWP-1 or HWP-2 shall start when the outdoor air temperature drops below 40 º F. (adjustable).
   c. Lead / Lag: When the system calls for heat, the lead pump shall start, if the pump current sensor does not sense proper current within 4 minutes, the lead pump shall shutdown and the lag pump shall become lead and an alarm shall be generated at the OWS. Pumps shall alternate once each seven days to provide equal run time.
   d. Pump speed shall modulate through the respective VFD as required to satisfy the system differential pressure control sensor.

N. Two-Way Mixing Valve (Coils)

1. Point List
   a. HWS Temperature.
   b. HWR Temperature.
   c. Entering Mixed Air Temperature.
   d. Leaving Air Temperature.
   e. Valve Modulation.
   f. Freeze-Stat Status.

2. Sequence of Operation:
   The two-way control valve will modulate through the DDC system to modulate the hot water supply to satisfy low limit and room temperature setpoints.

3. Alarms: In all modes:

   a. Should the command not equal the status within 90 seconds from start-up, an alarm will be generated at the operator's workstation.

b. Should any temperature fall outside of its preset limits (high/low) an alarm will be generated at the operator's workstation.
c. A freezestat located on the discharge side pf the coil shall open the valve, stop the associated air handler, and an alarm shall be generated at the operator's workstation.

O. Space Temperature Setpoints

1. Heating mode
   a. Occupied: Temperature setpoint shall be maximum 72 degrees F.
   b. Unoccupied: Temperature setpoint shall be minimum 55 degrees F.

2. Cooling mode
   a. Occupied: Temperature setpoint shall be minimum 78 degrees F.
   b. Unoccupied: Temperature setpoint shall be maximum 85 degrees F.

P. Hot Water Heating System

1. Point List
   a. Outdoor Air Temperature
   b. Outdoor Relative Humidity
   c. HW Supply Temperature
   d. HW Return Temperature
   e. Pump HWP-1 Start/Stop
   f. Pump HWP-2 Start/Stop
   g. VRF Outdoor Unit #1 Status
   h. VRF Outdoor Unit #2 Status
   i. Hydro Unit 1 Status
   j. Hydro Unit 2 Status
   k. Hydro Unit 3 Status
   l. Hydro Unit 4 Status
   m. Hydro Unit 5 Status
   n. Hydro Unit 6 Status
   o. Hydro Unit 7 Status
   p. Hydro Unit 8 Status
   q. Hydro Unit 9 Status
   r. Hydro Unit 10 Status

2. Sequence of Operation

   a. Once enabled, the circulator pumps HWP-1/HWP-2 shall operate through variable frequency drives. A supply header temperature of 122 degrees F (adjustable) shall be maintained. The refrigerant to water heat exchangers and associated outdoor VRF heat pumps shall stage on as required to maintain the set point temperature in the building distribution hot water loop.

(Provide all required hardware and software to interface the BMS with the VRF system.)

Q. Hot Water Heating Pumps

1. Point List
   a. Pump Start/Stop
   b. Pump Status
   c. VFD Status
   d. Pressure Differential Control Sensor

2. Sequence of Operation

   a. Occupied Mode: Pump shall start when the outdoor air temperature drops below 60 º F. (adjustable).

   b. Unoccupied Mode: Pump shall start when the outdoor air temperature drops below 40 º F. (adjustable).

   c. Lead / Lag: When the system calls for heat, the lead pump shall start, if the pump current sensor, does not sense proper current within 4 minutes, the lead pump shall shutdown and the lag pump shall become lead and an alarm shall be generated.

   d. Pump speed shall modulate through the respective VFD as required to satisfy the system differential pressure control sensor.

R. Rooftop Ventilation/Energy Recovery Air Handler Units (ERUO-3 Community Gymnasium/Stage)

1. Point List

   a. Space Temperature
   b. Relative Humidity (Supply Air)
   c. Supply Fan VFD (Speed and Status)
   d. Exhaust Fan VFD (Speed and Status)
   e. Energy Recovery Wheel VFD (Speed and Status)
   f. OA, EA, SA Temperatures
   g. Respective VRF Outdoor Unit Status
   h. OA, EA Damper Modulation
   i. Return/Recirculation Air Damper Position
   j. VRF DX Heating/Cooling Coil Status
   k. Dirty Filter Status

2. Sequence of Operation
   a. Unoccupied: In this mode:
      Supply and Exhaust fans off, OA and EA dampers closed. The rooftop ventilation unit and associated VRF outdoor unit shall cycle on in the recirculation mode (return/recirculation air damper open). Upon satisfaction, the rooftop unit shall stop until the next cycle, if required.

b. Warm-up: During the heating season, a warm-up mode will be invoked if the return air temperature is below 60°F (adj.) upon unit start-up. In this mode:

i. The OA dampers remain closed, and the supply fan will start. Fan will slowly ramp up to preset speed. The warm-up program will reset the heating supply air temperature set point to 80°F (adj.). The VRF outdoor unit shall operate to maintain the supply air temperature setpoint. The supply air setpoint will be reset linearly and inversely from 80°F (adj.) to 70°F (adj.) as the return air temperature increases from 60°F to 70°F (adj.)
ii. Once the return air has reached 72°F (adj.) the temperature shall be controlled as described in the occupied mode.

c. Occupied: In this mode

i. Supply and exhaust fans will start and ramp up slowly to the preset speed via VFD. The return fan will follow and track the supply fan as needed. The OA and EA dampers shall open.
ii. The VRF outdoor unit serving the rooftop unit shall operate to maintain the heating setpoint.
iii. VRF direct expansion cooling system shall operate as needed to maintain occupied cooling setpoint (adjustable). Hot gas reheat shall maintain relative humidity in discharge air to 60 % RH (adjustable).
iv. An adjustable dead band offset will prevent short cycling.
v. Note: the energy recovery wheel will be on when the unit is on and rotate as needed to maintain exhaust air temperature. Energy wheel freeze protection is integral to the unit.
vi. Minimum outdoor air shall be as scheduled on drawings.

d. Alarms: In this mode:

i. Should the command not equal the status within 90 seconds from start-up an alarm will be generated at the operator's workstation.
ii. Should any temperature fall outside of its preset limits (high/low) an alarm will be generated at the operator's workstation.

e. Ventilation Control:

i. Outdoor air ventilation shall be controlled by carbon dioxide sensors. Ventilation rate shall vary from minimum 1000 cfm to maximum 6,600 cfm, at full occupancy of 923 people. The four sensors shall average CO2 and control OA.

f. Demand Control Ventilation:

i. Ventilation method shall be by demand controls. There shall be no provision to remove CO2 by any other method other than dilution. Prior to space occupancy, a pre-occupancy purge cycle shall be

initiated for a minimum 30 minutes. For this purge, fan shall start and run, and the outdoor air intake rate shall ramp up to 100 percent of design outdoor air (6,600 cfm). During occupancy, the outdoor air supply shall start to increase beyond the minimum ventilation setpoint (1000 cfm), starting at an interior CO2 concentration of not greater than 100 PPM over that of the outdoor air concentration. The outdoor air supply shall continue to ramp up for full occupancy as CO2 concentrations rise to the upper limit of 1400 PPM over that of the outdoor air. Upon conclusion of occupancy, a post occupancy flush cycle shall occur. The fan shall run, and the outdoor air intake rate shall ramp up to 100 percent of design outdoor air (6,600 cfm) until indoor CO2 concentrations in the space are reduced to outdoor air levels. After the post occupancy flush cycle has completed, the rooftop unit shall revert to minimum outdoor air ventilation setpoint (1000 cfm). This minimum setpoint shall be satisfied whenever the system is in operation. The relief exhaust fan speed shall follow the outdoor air intake rate under all occupancies and conditions to maintain proper relief air. The economizer system shall override the CO2 control system when conditions permit free cooling of the space.

g. Economizer - In this mode:

i. If the outside air temperature is greater than the return air temperature, the system will operate as described in the occupied mode. Unit shall operate according to its own packaged controls to control the wheel operation and speed when outdoor conditions are favorable.

ii. If the outside air temperature is less that the return air temperature and the outside air temperature is greater than 50 Degrees F. (adjustable), the ERU heat transfer wheel rotation shall stop.

S. Outdoor Energy Recovery Air Handler Unit (ERUO-2 Academic Toilet rooms)

1. Point List
   a. Supply Fan Status
   b. Exhaust Fan Status
   c. OA, EA, Air Temperatures
   d. OA, EA, Dampers
   e. Discharge Temperature
   f. Hot Water Coil Valve Status
   g. Hot Water Coil Discharge Air Temperature

2. Sequence of Operation
   a. Unoccupied - In this mode:
      Supply and Exhaust fans off, OA and EA dampers closed. Radiant ceiling panel heater shall be stage 1 heating. If additional heat is required, the ERU shall start and run, and the respective hot water coil control valve shall modulate to maintain the night setback temperature (60°F).

b. Occupied - In this mode:

i. The OA and EA dampers will open and thru a hard wired interlock and the Supply and Exhaust fans will start.
ii. Energy transfer in the heat recovery module will be both sensible and latent energy between air streams. Latent energy transfer media transfer will be accomplished by direct water vapor transfer from one air steam to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the outdoor air.
iii. Radiant ceiling panel heater (4th floor) shall be stage 1 heating. If additional heat is required, the respective hot water control valve shall modulate to maintain the occupied mode space temperature (72 degrees).

c. Economizer - In this mode:
i. If the outside air temperature is greater than the return air temperature, the system will operate as described in the occupied mode.
ii. If the outside air temperature is less that the return air temperature and the outside air temperature is greater than 50 Degrees F. (adjustable), the ERU heat transfer module bypass dampers shall open.

T. Electric Air Curtain Heaters

1. Point List
a. Space Temperature
b. Staged Electric Heater Status
c. Fan Start/Stop

2. Sequence of Operation
a. Unoccupied Mode (Heating Season): Fan shall start. Enable unit internal controls for electric heaters to maintain night setback temperature set-point (adjustable).

b. Occupied Mode (Heating Season): Fan shall start. Enable unit internal controls for electric heaters to maintain occupied temperature set-point (adjustable).

U. Electric Cabinet Heaters (Academic Building and Community Gymnasium)

1. Point List
a. Space Temperature (Local near entry doors)
b. Staged Electric Heater Status
c. Fan Start/Stop

2. Sequence of Operation
   a. Unoccupied Mode (Heating Season): Fan shall start. Enable unit internal controls for electric heaters to maintain night setback temperature set-point (adjustable).

   b. Occupied Mode (Heating Season): Fan shall start. Enable unit internal controls for electric heaters to maintain occupied temperature set-point (adjustable).

V. Electrical Generator Cooling (Academic Basement Generator room)

1. Point List
   a. Space Temperature
   b. Generator Status (operating yes/no)
   c. Intake/exhaust air damper positions
   d. Exhaust Bleed Damper modulation

2. Sequence of Operation
   a. Shutdown Mode Basement ventilation air system shall maintain room temperature set-point as required in occupied or night setback modes (adjustable).

   b. Operational Mode: Upon a call for generator operation, outdoor air and exhaust air dampers shall open fully. The damper motors shall be fast actuation type. Cooling airflow shall be provided by the generator radiator fan. If room heating is required, the generator exhaust duct air bleed damper shall modulate open to discharge warm air into the room as required to maintain minimum temperature set-point of 55 degrees (adjustable). Upon generator shutdown, the reverse shall occur.

   c. Alarms: In this mode:
      i. Should the outdoor air or exhaust air dampers not open within 10 seconds (adjustable) from command open, an alarm will be generated at the operator's workstation.
      ii. Should any temperature fall outside of its preset limits (high/low) an alarm will be generated at the operator's workstation.

W. Science Room/Art Room

1. Point List
   a. Motorized Isolation Dampers (Supply/Return Ductwork)
   b. Occupied/Unoccupied Mode

2. Sequence of Operation
   a. Unoccupied Mode: Upon shutdown of respective ventilation system ERU, the motorized dampers in the supply and return ductwork serving each room shall drive closed.

b. Occupied Mode: Upon startup of respective ventilation system ERU, the motorized dampers in the supply and return ductwork serving each room shall drive open.

X. Sump Pump Ejector (Academic Building)

1. Point List
   a. Pump Status
   b. High Level Switch Status

2. Sequence of Operation
   a. Should the sump high level switch be activated, an alarm shall be generated at the operator's workstation.

Y. Data/EMR Ductless Split Systems

1. Point List
   a. Condensing Unit Status
   b. Heating/cooling Mode
   c. Room Temperature

2. Sequence of Operation
   a. Should the respective Data or EMR room temperature (high/low) fall outside of preset limits, an alarm shall be generated at the operator's workstation.

Z. Exhaust Fans (Academic Medical Suite/Community Lower Level)

1. Point List
   a. Fan Start/Stop
   b. Fan Status

2. Sequence of Operation
   a. Unoccupied Mode: Fans off, Dampers closed.

   b. Occupied Mode: Fans energized, Dampers Open.

   c. Alarms generated at operator's workstation: Exhaust Fan Status.

AA. Supply Air Fans (Academic Medical Suite/Community Lower Level)

1. Point List
   a. Fan Start/Stop
   b. Fan Status

2. Sequence of Operation
   a. Unoccupied Mode: Fans off, Dampers closed.

   b. Occupied Mode: Fans energized, Dampers Open.

c. Alarms generated at operator's workstation: Exhaust Fan Status.

BB. Plumbing Backflow Preventer

1. Point List
   a. Leak Detector Status

2. Sequence of Operation
   a. Upon detection of water, an alarm shall be generated at the operator's workstation.

3.8 CONTROL DIAGRAMS

A. Complete new control diagrams showing type of apparatus, cycles of operation and details of all equipment must be submitted for checking and be approved before installation is started.

B. Submit three (3) preliminary copies of the control diagrams, sequence descriptions, and equipment shop drawings for checking and submit six (6) copies, complete for final approval.

C. At the completion of installation, control manufacturer shall furnish non-fading original; plastic laminated copies of all control diagrams as they apply to the particular instruments thereon. One complete set of non-fading plastic laminated diagrams shall be mounted on wall as directed.

3.9 CERTIFICATION

A. After completion of installation and after equipment has been placed on operation, the temperature control manufacturer shall submit in writing, a complete and detailed report and certification that the entire installation is operating exactly as specified and shall be guaranteed for one year. Report shall state temperature and throttling range readings and settings of all control instruments. Submit to the Engineer preliminary for checking and approval.

3.10 INSTALLATION

A. All work under the automatic temperature control Sub-Contract shall be done by competent skilled mechanics regularly in the employ of the temperature control manufacturer.

B. Bidder must be a control manufacturer currently involved in the production of commercial pneumatic/electric temperature controls. Franchises and associations are not considered control manufacturers.

3.11 TRAINING

A. The Contractor shall supply personnel to train key customer personnel in the operation and maintenance of the installed system. The training program shall be designed to provide a comprehensive understanding and basic level of competence with the system.

It shall be sufficiently detailed to allow customer personnel to operate the system independent of any outside assistance. On-line context sensitive HELP screens shall be incorporated into the system to further facilitate training and operation.

B. The training plan shall include detailed session outlines and related reference materials. The customer personnel shall be able to utilize these materials in the subsequent training of their co-workers.

1. Training time shall not be less than a total of 40 hours, and shall consist of:

a. 16 hours during normal day shift periods for system operators. Specific schedules shall be established at the convenience of the customer.

b. 24 hours of system training shall be provided to customer supervisory personnel so that they are familiar with system operation.

c. The specified training schedule shall be coordinated with the customer and will follow the training outline submitted by the Contractor as part of the submittal process.

d. Provide an as built Video training tape, showing and explaining all animated graphics in detail, all controllers and equipment the FMS operates (Four (4) Copies shall be supplied).

e. If further training is needed, the Contractor shall provide another 40 hours at no extra cost.

2. All training sessions shall be scheduled by the Construction Manager. The Contractor shall provide sign-in sheets and distribute minutes of each session prior to the subsequent session. This documentation shall be included in the Operation and Maintenance manuals.

END OF SECTION 230460

SECTION 230470

TESTING, START-UP AND ADJUSTMENTS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 TESTING, START-UP AND ADJUSTMENTS

A. Furnish all materials, supplies, labor and power required for testing. Make preliminary tests and prove work satisfactory. Notify Architect and all authorities having jurisdiction in ample time to be present for final testing of all piping. Test before insulating or concealing any piping. Repair defects disclosed by tests, or if required by Architect, replace defective work with new work without additional cost to Owner. Make tests in stages if so, ordered by Architect to facilitate work of others. Use of wicking in tightening leaking joints not permitted.

B. HVAC Contractor is responsible for work of other trades disturbed or damaged by tests and/or repair and replacement of his work and shall cause work so disturbed or damaged to be restored to its original condition at his own expense.

C. Unless otherwise specified, all piping systems shall be hydrostatically tested to 150 p.s.i.g. Tests shall be of four (4) hour duration during which time piping shall show no leaks and during time no sealing of leaks will be permitted.

D. HVAC Contractor shall balance out system and submit test reports showing operating data to include the following:
   1. C.F.M. of all air handling equipment.
   2. C.F.M. at each air outlet.
   3. G.P.M. for equipment.
   4. R.P.M. for each fan and fan motor.
   5. Motor power consumption.
   6. Air temperature readings before and after coils.
   7. Water temperature readings in and out of coils and through equipment.
   8. Pressure gauge readings before and out of all pertinent equipment.

E. If the performance of the systems does not conform to the design parameters, the Contractor shall return to the site until the systems perform as designed.

F. HVAC Contractor shall furnish services of qualified personnel, thoroughly familiar with job, to operate and make all adjustments so that system and control equipment shall operate as intended. This shall include adjustment/replacement of sheaves/impellers to achieve design performance. Adjustments shall be made including balancing of water and air systems in cooperation with qualified representatives of mechanical equipment manufacturers and temperature control manufacturer. This shall include any required adjustment/replacement of sheaves, belts, impellers, etc. to achieve design performance. Architect/Engineer is to be notified when this balancing is to be performed.

G. When all work is in an acceptable operating condition, furnish operating and maintenance manuals as specified in General Requirements.

H. All HVAC equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces.

I. Contractor shall include in his Bid, adjustment of air quantity below scheduled C.F.M. for air systems deemed “noisy” by Owner subsequent to initial balancing.

J. The Contractor shall be required to rectify of replace at his own expense, any equipment not complying with the foregoing requirements.

K. Final inspection and approval shall be made only after proper completion of all of above requirements.

END OF SECTION 230470

SECTION 230480

GENERAL LABELING, VALVE CHARTS AND PIPING IDENTIFICATION

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 GENERAL LABELING AND VALVE CHARTS

A. This Contractor shall have appropriate descriptive labels, identification tags and nameplates of equipment, valves, etc. furnished and installed under this Contract and shall be properly placed and permanently secured to (or adjacent to) the item being installed. All such labels, identifications, tags, nameplates, etc. shall be selected by the Architect/Engineer.

B. In general, labels shall be the lamacoid type of sufficient size to permit easy identification, black coated, white edged, with letters 3/16" high. Major equipment, apparatus, control panels, etc. shall have 8" x 4" lamacoid plates with lettering of appropriate size.

C. Provide tags for all valves, automatic and manual dampers. Tags shall be Type #2020 anodized aluminum of #1420 lamacoid engraved. Tags may not necessarily be standard. Fasten tags to valve or damper with brass chain.

D. All nameplates, labels, identifications and tags shall be as manufactured by the Seton Name Plate Co., of New Haven, CT or approved equal. Submit complete schedules, listings and descriptive data together with samples for checking and approval before purchasing. Labeling shall include the "number" of the equipment, valve, dampers, switch, etc. and service of the valve.

E. Mount on laminated plastic boards with transparent surface all valves, wiring diagrams, control diagrams, instruction charts, permits, etc. Valve chart shall be non-fading with original copies laminated.

1.2 IDENTIFICATION OF PIPING

A. This Contractor shall provide on all piping, semi-rigid, wrap around plastic identification markers equal to Seton Snap-Around and/or Seton Strap-On pipe markers.

B. Each marker background is to be appropriately color coded with a clearly printed legend to identify the contents of the pipe. Directions of flow arrows are to be included on each marker.

C. Identification of all piping shall be adjacent to each valve, at each pipe passage through wall, floor and ceiling construction and at each branch and riser take-off.

D. Identification shall be on all horizontal pipe runs, marked every 15 ft. as well as at each inlet outlet of equipment.

E. Indoor gas piping shall be painted yellow, with appropriate markers. Outdoor piping shall be painted gray, per the utility.

END OF SECTION 230480

SECTION 230485

HVAC SYSTEMS COMMISSIONING

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 RELATED DOCUMENTS

A. Section 01 9100 – Commissioning Requirements, including drawings and general provisions of the Contract, including General and Supplementary Conditions, and other Division 01 Specification Sections.

B. In the case of a conflict between this and any other section in the project specifications, the more stringent or detailed requirements shall apply.

1.2 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CxA: Commissioning Authority.

1.3 DESCRIPTION

A. The systems that shall be commissioned in this project include but are not limited to the following:

1. Central Building Automation System including packaged unitary controllers.

2. Equipment of the heating, ventilating and air conditioning systems.

1.4 OVERVIEW OF CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning inspections and tests at the direction of the CxA.

B. Attend construction phase controls coordination meeting.

C. Attend testing, adjusting, and balancing (TAB) review and coordination meetings.

D. Participate in HVAC systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

E. Provide information requested by the CxA for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data and provide data acquisition equipment to record data for the complete range of testing for the required test period.

G. Provide detailed startup procedures.

H. Provide copies of all submittals, including all changes thereto, with details as required in the appropriate subsection of 3.1 Responsibilities.

I. Facilitate the coordination of the commissioning process and incorporate commissioning activities into overall project schedule (OPS).

J. Ensure all subcontractors and vendors execute their commissioning responsibilities according to the contract documents and the OPS.

K. Provide required demonstration and training of owner's personnel.

L. Review and accept construction checklists provided by commissioning authority (CxA).

M. Prepare O&M manuals, according to the contract documents, including clarifying and updating the original sequences of operation to as-built/as-tested conditions.

N. Cooperate with the CxA for resolution of issues recorded in the "Issues Log"

O. Prepare and provide all documentation as necessary for the compilation of the Systems Manual.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. The HVAC Contractor shall provide all standard testing equipment required to perform startup, initial checkout, and testing requirements of Division 23.

B. The Controls Contractor shall provide all standard testing equipment required to test the Building Automation and Automatic Temperature Control System (BAS), including calibration of valve and damper actuators and all sensors. Trend logs for functional testing shall be generated through the BAS interface as requested by the CxA.

C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the following tolerances. Temperature sensors and digital thermometers shall have a certified calibration, performed within the past year, to an accuracy of 0.5°F and a resolution of ± 0.1 °F. Pressure sensors shall have an accuracy of ± 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.1 RESPONSIBILITIES

A. HVAC, Controls and TAB Contractors. The commissioning responsibilities applicable to each of the HVAC, Controls and TAB Contractors of Division 23 are follows:

1. Attend the initial commissioning meeting conducted at the start of construction, the commissioning meeting held 30 days prior to startup of the primary equipment, and all commissioning team meetings.

2. Provide a copy of approved shop drawings and startup reports for all commissioned equipment to the CxA. Supplement the shop drawing data with the manufacturer's installation and start-up procedures. This material should be identical to the literature which will be included in the Operation and Maintenance Manuals.

3. The Operation and Maintenance Manuals shall be submitted to the CM prior to the start of training (three (3) weeks before startup and training and at least sixty (60) days before substantial completion).

4. Perform and document results of Pre-functional Inspections at the direction of the CxA. Ensure that the inspection checklists are completed before startup or as specified by the CxA.

5. During the startup and initial checkout process, execute all portions of the manufacturer's start-up checklists for all commissioned HVAC equipment.

6. Perform and clearly document all completed startup and system operational checkout procedures and provide a copy to the CxA.

7. Perform and document results of equipment functional testing at the direction of the CxA. Ensure that the testing is completed in the timeline specified by the CxA.

8. Address current A/E punch list items and Commissioning corrective action items on the "Issues Log" before functional testing. Air and water TAB shall be completed, with discrepancies and problems remedied, before functional testing of the respective air-or water-related systems.

9. Provide skilled technicians to execute starting of equipment and to perform tests in accordance with all Division 23 sections. Where specified, startup shall be performed by a factory authorized service representative. Ensure that they are available and present during the agreed-upon schedules for the sufficient duration to complete the necessary tests, adjustments and problem-solving.

10. Correct deficiencies (differences between specified and observed performance as interpreted by the CxA and A/E) and retest the equipment.

11. Provide training of Owner's operating staff as specified in Division 23 Sections. Use expert qualified personnel.

12. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

13. Correct deficiencies and make necessary adjustments to O&M manuals for applicable issues identified in any seasonal testing.

B. HVAC Contractor. The responsibilities of the HVAC Contractor, during construction and acceptance phases in addition to those listed in (A) are:

1. Provide startup for all HVAC equipment.

2. Prepare a preliminary schedule for Division 23 pipe and duct system testing, flushing and cleaning, equipment start-up and TAB start and completion for use by the PM and CxA. Update the schedule as appropriate.

3. Notify the PM and CxA when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment, and TAB will occur. Be proactive in seeing that commissioning processes are executed and that the CxA has the scheduling information needed to efficiently facilitate the commission process.

4. Calibrations: The HVAC Contractor is responsible to calibrate all factory-installed sensors and actuators. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated by the HVAC Contractor.

5. Supervise all commissioning activities executed by subcontractors, including the Controls Contractor.

6. List and clearly identify on the as-built duct and piping drawings the locations of all flow meters, fire and smoke dampers, duct detectors, temperature sensors, relative humidity sensors, CO2 sensors, static and differential pressure sensors (air, water and building pressure).

C. Controls Contractor - The commissioning responsibilities of the Controls Contractor, during construction and acceptance phases in addition to those listed in (A) are:

1. Sequences of Operation Submittals. The Controls Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. The submitted sequences shall generally include the following, but can vary according to project needs:

   a. An overview narrative of the system (one or two paragraphs) generally describing its purpose, components and function.
   b. Logic diagrams detailing the flow of information for each control algorithm. These diagrams should include all inputs, outputs, and computations.
   c. All interactions and interlocks with other systems.
   d. Detailed delineation of control between any packaged controls and the building automation system, listing which points the only monitored at the BAS, and which points can be controlled by and adjusted at the BAS.

e. Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included but will generally require additional narrative).
f. Start-up sequences.
g. Warm-up mode sequences.
h. Normal operating mode sequences.
i. Unoccupied mode sequences.
j. Shutdown sequences.
k. Capacity control sequences and equipment staging.
l. Temperature and pressure control: setbacks, setups, resets, etc.
m. Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
n. Effects of power or equipment failure with all standby component functions.
o. Sequences for all alarms and emergency shut downs.
p. Seasonal operational differences and recommendations.
q. Initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
r. Daily/weekly/monthly schedules, as appropriate, if known.
s. To facilitate referencing in testing procedures, all sequences shall be written in small statements, each with a number for reference. Where possible, the numbering sequence shall correspond with Section 23 0460 Automatic Temperature Controls.

2. Control Drawings Submittal:

a. The control drawings shall have a key to all abbreviations.
b. The control drawings shall contain graphic schematic depictions of the system and each component.
c. The schematics shall include the system and component layout of any equipment that the control system monitors, enables, or controls, even if the equipment is primarily controlled by packaged or integral controls.

d. Provide a full points list with at least the following included for each point:

1. Controlled system.
2. Point abbreviation
3. Point description
4. Display unit.
5. Control point or setpoint (Yes/No)
6. Input point (Yes/No)
7. Output point (Yes/No)

e. The controls contractor shall keep the A/E, CxA, HVAC and TAB Contractor informed, in a timely manner, of all changes to this list during programming and setup.

3. Submit a written checkout plan indicating in a step-by-step manner, the procedures that will be followed to test, checkout and adjust the control system prior to functional testing. At minimum, the checkout plan shall include for each type of equipment controlled by the building automation system:

   a. System name.

   b. List of devices.

   c. Step-by-step procedures for testing each controller after installation, including:

      1. Process of verifying proper hardware and wiring installation.
      2. Process of downloading programs to local controllers and verifying that they are addressed correctly.
      3. Process for performing and documenting point-to-point checkout for each digital and analog input and output.
      4. Process of performing operational checks of each controlled component.
      5. Plan and process for calibrating valve and damper actuators and all sensors.
      6. A description of the expected field adjustments for transmitter, controllers and control actuators should control responses fall outside of expected values.

   d. A copy of the log and field checkout sheets that will document the process. This log must include a place for initial and final read values during calibration of each point and clearly indicate when a sensor, controller or command has “passed” and is operating within the contract parameters.

   e. A description of the instrumentation required for testing.

   f. Indicate the portion of the controls checkout plan that should be completed prior to TAB using the controls system for TAB work. Coordinate with the CxA and TAB Contractor for this determination.

4. Point-to-Point Checkout: Include in the checkout plan a point-to-point checkout. Each control point tied to a central control system shall be verified to be commanding, reporting and controlling according to its intended purpose. For each output, commands shall be initiated and verified to be functioning by visually observing and documenting the status of the controlled device in the field (e.g., valve or damper actuator response, pump or fan status). For each input, the system or conditions shall be altered to initiate the input response being tested and the response in the control system observed and recorded (e.g., high duct static pressure alarm).

5. Calibrations: The Controls Contractor is responsible to calibrate all field installed sensors and actuators using test and documentation methods approved by the CxA. The HVAC Contractor is responsible to calibrate all factory installed sensors and actuators.

a. Sensors installed in the unit at the factory, with a calibration certification provided, need not be field calibrated by the HVAC Contractor.

b. Valve leak-by tests shall be conducted by the Contractor when shown on a construction checklist.

c. All procedures used shall be fully documented by the Controls Contractor on suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.

6. Beyond the control points necessary to execute all documented control sequences, provide monitoring, control and virtual points as indicated in the Specifications.

7. Provide an official notice to proceed to the CxA and project team upon completion of the Building Automation System (BAS) and Automatic Temperature Control System (ATC) installation, including checkout and calibration of each controlled device, to confirm that all system programming is complete as to all respects of the Contract Documents. This shall be submitted by the Controls Contractor prior to the start of functional testing by the CxA.

D. TAB Contractor: The scope of work for the TAB Contractor is provided in Section 230460.

3.2 SUBMITTALS

A. The Contractor shall send one copy of product data, shop drawings and similar submittals to the CxA at the same time they are submitted to the A/E. The CxA will review the submittals and provide any comments to the A/E for inclusion in their comments. The Architect will transmit to the CxA, for the CxA's use in preparing functional test procedures; one reviewed and approved copy of product data, shop drawings and similar submittals received from the HVAC, Controls and TAB Contractors, pertinent to equipment and systems to be commissioned.

3.3 STARTUP

A. The HVAC, Controls and TAB Contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section. Equipment start-up is required to complete systems and sub-systems, so they are fully functional, in compliance with the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility, or partially shift that responsibility to any extent onto the Commissioning Agent or Owner.

B. Testing is intended to begin upon completion of a system. Refer to Section 019100 for additional information related to scheduling.

3.4 TESTS

A. The HVAC and Controls Contractors shall provide the necessary support to the CxA to complete functional testing. The Controls Contractor shall fully test and verify all aspects of the BAS Contract Work on a point / system / integrated operational basis for all points, features and functions specified. The following requirements apply to all mechanical and control systems and features that are to be commissioned when referenced below. Tests shall:

1. Verify functionality and compliance with the basis of design for each individual sequence module in the sequence of operations. Verify proper operation of all control strategies, energy efficiency and self-diagnostics features by stepping through each sequence and documenting equipment and system performance. Tests shall include startup, normal operation, shutdown, scheduled 'on' and 'off', unoccupied and manual modes, safeties, alarms, over-rides, lockouts and power failure.

2. Verify operation of systems and components that may be impacted during low, normal and high load conditions and during combinations of environmental and interacting equipment conditions that could reasonably exist and potentially result in adverse system reaction.

3. Verify all alarm and high and low limit functions and messages generated on all points with alarm settings.

4. Verify integrated performance of all components and control system components, including all interlocks and interactions with other equipment and systems.

5. Verify shutdown and restart capabilities for both scheduled and unscheduled events (e.g., power failure recovery and normal scheduled start/stop).

6. Verify proper sequencing of heat transfer elements as required to prevent simultaneous heating and cooling, unless specifically required for dehumidification operation.

7. Verify system response and stability of control loops under different load conditions and determine if additional loop tuning is required for dehumidification operation.

8. When applicable, demonstrate a full cycle from 'off' to 'on' and 'no load' to 'full load' and then to 'no load' and 'off'.

9. Verify time of day schedules and setpoints.

10. Verify all energy saving control strategies.

11. Verify that all control system graphics are complete, that graphics are representative of the systems, and that all points and control elements are shown in the same location on the graphics as they are located in the field.

12. Verify operation control of all adjustable system control points, including proper access level as agreed to during the controls system demonstration.

B. In addition to specific details, and/or standards referenced for acceptance testing indicated in other Division 23 sections, the following common acceptance criteria shall apply to all mechanical equipment, assemblies, and features:

1. For the conditions, sequences and modes tested, the equipment, integral components and related equipment shall respond to varying loads and changing conditions and parameters appropriately as expected, according to the sequence of operation, as specified, according to acceptable operating practice and the manufacturer's performance specifications.
2. Systems shall accomplish their intended function and performance (e.g., provide supply air and water at designated temperature and flow rate, etc., and maintain space conditions in terms of air temperature, relative humidity, and CO2 concentration) at specified levels at varying conditions.

3. Control loops shall be stable under all operating conditions. Control loops shall exhibit a quarter decay ratio type response to a step change or other upset and return to stable operation in a time frame that is reasonable and realistic for the system that they are associated with.

4. Resetting a manual safety shall result in a stable, safe, and predictable return to normal operation by the system.

5. Safety circuits and permissive control circuits shall function in all possible combinations of selector switch positions (hand, auto, inverter, bypass etc.).

6. Additional acceptance criteria may be defined by the CxA when detailed tested procedures are developed.

7. At the CxA's discretion, if large numbers of deficiencies or repeated deficiencies are encountered, the CxA shall suspend functional testing until the Contractor corrects the deficiencies and troubleshoots all remaining systems at issue on their own. The Contractor shall be responsible for any resulting schedule delays that increase the overall time period to complete functional testing.

8. Retesting: The CxA will direct the retesting of the equipment once at no charge to the Owner for their time. The CxA's time and expenses incurred for a second retest, if required due to no fault of the CxA, will be reviewed by the Owner to determine the appropriate means of compensation to the CxA for extension of services. The functional testing shall include operating the system and components through each of the written sequences of operation, and other significant modes and sequences, including startup, shutdown, unoccupied mode, manual mode, staging, miscellaneous alarms, power failure, security alarm when impacted and interlocks with other systems or equipment. Sensors and actuators shall be calibrated during construction checkout by the installing contractors and spot-checked by the CxA during functional testing.

3.5 WRITTEN WORK PRODUCTS

A. Written work products of Contractors shall consist of the filled out start-up, initial checkout, and test documentation in accordance with all Division 23 sections.

END OF SECTION 230485

SECTION 230490

GUARANTEE

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

1.1 GUARANTEE

A. The Contractor shall remove, replace and/or repair at his own expense and at the convenience of the Owner, any defects in workmanship, materials, ratings, capacities and/or characteristics occurring in the work within one (1) year or within such longer period as may be provided in the Drawings and/or Section of the Specifications, which guarantee period shall commence with the final acceptance of the entire Contract in accordance with the guarantee provisions stated in the General Conditions, and the Contractor shall pay for all damage to the system resulting from defects in the work and all expenses necessary to remove, replace, and/or repair any other work which may be damaged in removing, replacing and/or repairing the work.

END OF SECTION 230490

SECTION 260100

GENERAL CONDITIONS

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section.

1.1 DESCRIPTION OF WORK

A. It is the intention of the Specification and Drawings to call for finish work, tested and ready for operation.

B. Any apparatus, appliance material or work not shown on the Drawings but mentioned in the Specifications, or vice versa, or any incidental accessories or ancillary devices necessary to make ready for operation even if not particularly specified, shall be furnished, delivered and installed under their respective Division without additional expense to the Owner.

C. Minor details not usually shown or specified, but necessary for proper installation and operation, shall be included in the work as though they were hereinafter specified or shown.

D. Work under each section shall include giving written notice to the Architect of any materials or apparatus believed inadequate or unsuitable, in violation of laws, ordinances, rules and regulations of authorities having jurisdiction; and any necessary items of work omitted. In the absence of such written notice, it is mutually agreed that work under each section has included the cost of all necessary items for the approved satisfactory functioning of the entire system without extra compensation.

E. Small scale drilling through walls and floors which may contain asbestos shall be performed by a person with a “restricted asbestos handler allied trades certificate” and shall have a copy of it in his possession at all times while working of the project.

1.2 DRAWINGS

A. Drawings are diagrammatic and indicate the general arrangement of the system and work included in the Contract. (Do not scale the drawings). Consult the Architectural Drawings and details for exact location of fixtures and equipment; where same are not definitely located, obtain this information from the general construction supervisor.

B. Work under each section shall closely follow Drawings in layout of work; check Drawings of other Divisions to verify spaces in which work will be installed. Maintain maximum headroom; do not begin work until unsatisfactory conditions are corrected.

C. Make reasonable modifications in the layout as needed to prevent conflict with work of other Sections of the Specifications or for proper execution of the work.

D. It shall be understood that the right is reserved by the Architect/Engineer to change the location of equipment and apparatus to a reasonable extent as building conditions may dictate, prior to their installation without extra cost to the Owner.

1.3 SURVEYS AND MEASUREMENTS

A. Base all measurements, both horizontal and vertical, from established benchmarks. All work shall agree with these established lines and levels. Verify all measurements at site and check the correctness of same as related to the work.

B. Before proceeding with the work resolve discrepancies between actual measurements and those indicated, which prevent following good practice or intent of the Drawings or Specifications.

1.4 CODES AND STANDARDS – Coordinate with Division 1

A. The Codes and Standards listed below apply to all Electrical work codes or standards that are mentioned in these Specifications; the latest edition or revision shall be followed:

1. NEMA - Standards
2. ANSI CI - National Electrical Code (NFPA 70)
3. ANSI C50.13 - Rotating Electrical Machinery
4. NEMA MG2 - Construction and guide for selection, installation and use of electric motors.
5. NEMA MG1 - Motors and Generators

B. The following State and Local Codes shall apply: New York State Uniform Fire Prevention and Building Code, and Local Building Codes.

C. The following abbreviations are used within this Division of the Specifications:

1. IES - Illuminating Engineering Society.
2. NEC - National Electrical Code
3. ANSI - American National Standards Institute
4. ASTM - American Society for testing and materials
5. EPA - Environmental Protection Agency
6. IEEE - Institute of Electrical and Electronic Engineers
7. NEMA - National Electrical Manufacturers Association
8. NFPA - National Fire Protection Association.
9. OSHA - Occupational Safety and Health Administration
10. UL - Underwriter's Laboratories

1.5 PERMITS AND FEES

A. Give all necessary notices, obtain all permits and pay all Government and State sales taxes and fees where applicable, and other costs, including utility connections or extensions in connection with work of this Division. File all necessary plans, prepare all documents and obtain all necessary approvals of all Governmental and State departments having jurisdiction; obtain all necessary certificates of inspections for his work and deliver a copy to the Architect before request for acceptance and final payment for the work. Pay fees for utility construction/connections.

B. Include in the work, without extra cost to the Owner, any labor, materials, services, and apparatus, Drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on the Drawings and/or specified.

C. All materials furnished and all work installed shall comply with the rules and recommendations of the National Fire Protection Association, with the requirements of the local utility companies, with the recommendations of fire insurance rating organization having jurisdiction and with the requirements of all governmental departments having jurisdiction.

D. All materials and equipment for the electrical portion of the mechanical systems shall bear the approval label of or shall be listed by the Underwriter's Laboratories, Inc.

1.6 TEMPORARY LIGHT AND POWER – See Division 1

A. The Contractor shall furnish, install, maintain and, upon direction to do so, remove system of temporary lighting and power for the use of all construction trades.

B. The Electrical Contractor shall provide adequate electrical service for the needs of all Contracting Trades.

C. Wiring shall be provided for temporary use during building construction, including grounding and fused main cut-off switches. Temporary electric lines with branch switches shall be provided for lighting and for taps for electric tools, pumps and other temporary equipment; all connected to a main line looped through floor spaces and up stair wells or shafts. All power outlets shall be grounded to an equipment ground wire in an approved manner. Electric lines shall be extended to power tools, which cannot be located within reach of extension cords.

D. Light bulbs shall be provided in sufficient quantity to light the building for safety purposes. Extension cords shall be provided as may be essential to the proper execution of the work. Temporary lighting shall be provided for all stairs and other locations where needed for safety or the proper execution of the work.

E. The Electrical Contractor shall maintain temporary lighting and power systems in good working condition, including the relocation and reinstallation when required to avoid interference with the progress of construction.

F. Provide ground-fault personnel ampere protection for all single phase, 15 and 20 ampere receptacles. All receptacles and portable cord connectors shall have NEMA standard locking type configurations.

G. The Electrical Contractor shall turn lights on and off at the beginning and end of each working day of any trade unless otherwise directed. He shall arrange for all temporary light and power for all trades which do not have holidays (days off) similar to the electrical trade. The Electrical Contractor shall patch and repair all openings left damaged by the installation and removal of the temporary light and power.

1.7 MANUFACTURER'S IDENTIFICATION

A. Manufacturer's nameplate, name or trademark and address shall be attached permanently to all equipment and materials furnished under this Division. The nameplate of a contractor or distributor may not be used.

1.8 SHOP DRAWINGS – See Division 1

A. Submit for approval detailed shop drawings of all equipment and materials in accordance with working procedures.

B. Furnish all necessary templates and patterns for installation work and for the purpose of making adjoining work conform; furnish setting plans and shop details to other trades as necessary.

C. Submit shop drawings for the following:

1. Light fixtures.
2. Receptacles, switches, occupancy sensors.
3. Overcurrent protective devices.
4. Panelboards.
5. Clocks and P.A. system components.
6. Fire alarm system.

1.9 MATERIALS AND WORKMANSHIP

A. All materials and apparatus necessary for the work, except as specifically indicated otherwise, shall be new, of first class quality and shall be furnished, delivered, erected, connected and finished in every detail and shall be so selected and arranged as to fit properly into the building spaces. Where no specific kind or quality of material is given, a first class standard article as accepted by the Architect shall be furnished.

B. Furnish the services of an experienced Superintendent who shall be constantly in charge of the installation of the work, together with all skilled workmen, helpers, and labor to unload, transfer, erect, connect up, adjust, start, operate and test each system.

C. Unless otherwise specifically indicated on the Drawings or Specifications, all equipment and materials shall be installed in accordance with the recommendations of the manufacturer. This includes the performance of such tests as the manufacturer recommends.

1.10 PROTECTION

A. Work under each Section shall include protecting the work and materials of all other Sections from damage from work or workmen and shall include making good all damage thus caused. Be responsible for work and equipment until finally inspected, tested, 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 obstructing or other foreign material.

B. Work under each section includes receiving, unloading, uncrating, storing, protecting, setting in place and connecting up completely of any equipment supplied under each section. Work under each section shall also include exercising special care in handling and protecting equipment and fixtures and shall include the cost of replacing any of the above equipment and fixtures which are missing or damaged by reason of mishandling of failure to protect on the part of the Contractor.

1.11 BASES AND SUPPORTS

A. Unless specifically noted otherwise, provide all necessary supports, pads, bases, and piers required for all equipment under this Division. Provide all temporary bases and supports as required.

B. All equipment, unless shown otherwise, shall be securely attached to the building structure. Attachments shall be of a strong and durable nature; any attachments that are, insufficient, shall be replaced as directed by the Architect.

1.12 SLEEVES, INSERTS AND ANCHOR BOLTS

A. All conduits passing through floors, walls or partitions shall be provided with sleeves having an internal diameter one inch larger than the outside diameter of the conduit, or insulation enclosing the conduit.

B. Furnish all sleeves, inserts, and anchor bolts necessary to be installed under other sections of the Specifications to accommodate work of this section.

C. Sleeves through outside walls shall be cast iron sleeves with intermediate integral flange. Sleeves shall be set with ends flush with each face of wall. The remaining space shall be packed with oakum to within 2 inches of each face of the wall. The remaining shall be packed and made watertight with a waterproof compound.

D. Sleeves through concrete floors or interior masonry walls shall be schedule 40 black steel pipe, set flush with finished walls or ceiling surfaces but extending 2 inches above finished floors.

E. Sleeves through interior partitions shall be 22 gauge galvanized sheet steel, set flush with finished surfaces or partitions.

F. Inserts shall be individual or strip type of pressed steel construction with accommodation for removable nuts and threaded rods up to 3/4” inch diameter, permitting lateral adjustment. Individual inserts shall have an opening at the top to allow reinforcing rods up to 1/2” diameter to be passed through the insert body. Strip inserts shall have attached rods having hooked ends to allow fastening to reinforcing rods. Inserts shall be as manufactured by Carpenter and Patterson, Inc. or Grinnell Co., Inc.

G. Penetrations through fire-rated walls, ceilings and floors in which cables, conduits pass, shall be sealed by a UL approved fire stop fitting classified for an hourly rating equal to the fire rating of the floor, wall or ceiling shall be Gedney Fire Seal Type CFSF of CAPS.

1.13 PAINTING – See Division 1; all work required shall be performed by this Contractor.

A. All finish painting in finished areas shall be performed by others.

B. All materials shipped to the job site under the Division, such as panels and plates, shall have a prime coat and standard manufacturer's finish unless otherwise specified.

C. Inaccessible conduits, hangers, supports and anchors and ducts shall be coated prior to installing.

D. All components of the fire alarm system raceway shall be painted red. This includes but is not limited to conduit, junction boxes, pull boxes.

1.14 CUTTING AND PATCHING – See Division 1

A. All cutting and patching required for the work of this Division shall be done by this Division.

B. Work under this Division shall include furnishing, locating and setting inserts and/or sleeves. Do all drilling and cutting necessary for the installation.

C. All holes cut through concrete slabs and structural steel shall be punched or drilled from the underside. No structural member shall be cut without the written acceptance of the Architect and all such cutting shall be done in a manner directed by him.

D. Refer to Division 1 for additional requirements.

1.15 SCAFFOLDING, RIGGING AND HOISTING – Coordinate with Division 1

A. Furnish all scaffolding, rigging, hoisting, and services necessary for erection and delivery into the premises of any equipment and apparatus furnished under this Division. Remove same from premises when no longer needed.

1.16 EXCAVATING AND BACKFILLING

A. All excavation and backfilling for the work of this Division shall be performed by Division 2

1.17 WATERPROOFING

A. Where any work penetrates waterproofing, including waterproof concrete and floors in wet areas. Submit proposed method of installation for review by the Architect before beginning work. Furnish all necessary sleeves, caulking and flashing necessary to make opening absolutely watertight.

1.18 ACCESSIBILITY AND ACCESS PANELS

A. Be responsible for the sufficiency of the size of shafts and chases, the adequate thickness of partitions, and the adequate clearance in double partitions and hung ceilings for the proper installation of the work of this Division.

B. Locate all equipment, which must be serviced, operated or maintained in fully accessible positions. Minor deviations from Drawings may be allowed for better accessibility with approval of the Architect.

1.19 SHUTDOWNS – See Division 1

A. When installation of a new system necessitates the temporary shutdown of an existing utility operating system the connection of the new system shall be performed at such time as designated by and in consultation with the Utility Company. Work required after normal business hours shall be done so at no additional cost to the Owner.

1.20 CLEANING - Coordinate with Division 1

A. Thoroughly clean all equipment of all foreign substances inside and out before being placed in operation.

B. If any foreign matter should stop any part of a system after being placed in operation, the system shall be disconnected, cleaned and reconnected whenever necessary to locate and remove obstructions. Any work damaged in the course of removing obstructions shall be repaired or replaced when the system is reconnected at no additional cost to the Owner.

C. Upon completion of work remove from the premises all rubbish, debris, and excess materials. Any oil or grease stains on floor areas caused by work of this Division shall be removed and floor areas left clean.

1.21 RECORD DRAWINGS – Work shall be governed by requirements set forth in Division 1

A. Maintain at the job site a record set of Electrical Drawings on which any changes in location of equipment, panels, devices, and major conduits shall be recorded. Indicate dimensions of all items installed underground or in concrete.

1.22 OPERATING INSTRUCTIONS – Coordinate with requirements set forth in Division 1

A. Upon completion of all work and all tests, the Contractor shall furnish the necessary skilled labor and helpers for operating his system and equipment for a period specified under each applicable Section of this Division. During this period, he shall instruct the Owner or his representative fully in the operation, adjustment and maintenance of all equipment furnished. Give at least 7 days' notice to the Owner in advance of this period.

B. The manufacturer shall attest in writing that his equipment has been properly installed prior to start. The following is some of the equipment necessary for this inspection: fire alarm system. These letters will be bound into the operating and maintenance books.

1.23 ADJUSTING AND TESTING

A. After all equipment and accessories to be furnished are in place, they shall be put in final adjustment and subjected to such operating tests as will assure the Architect that they are in proper adjustment and in satisfactory permanent operating condition.

B. This particular work shall include the services of a factory engineer to inspect the installation and assist in the initial startup and adjustment to the equipment. The period of these services shall be for such time as necessary to secure proper installation and adjustments. After the equipment is placed in permanent operation, there shall be furnished the service of said engineer for the purpose of supervising the initial operation of the equipment and to instruct the personnel responsible for operation and maintenance of the equipment.

C. At the completion of the job when all panels, devices, etc. are at full working load the Contractor shall provide infrared scan thermographic inspection test of all connection points, terminals, etc. of wires #8 AWG and larger to detect "hot-spots" in the electrical current flow. Correct all hot-spots.

1.24 UNDERWRITER'S LABEL

A. All electrical equipment and materials shall be new and shall comply with the standards of and shall bear the label of the Underwriter's Laboratories.

1.25 ELECTRICAL SAFETY INSPECTION

A. Electrical Contractor shall arrange for an Electrical Safety Inspection to be performed by the Local Inspection Agency (i.e.: New York Electrical Inspection Services, Atlantic Inland, Middle Department Inspection Agency). A Certificate of Compliance “Underwriter’s Certificate” shall be issued to the Owner. All costs and coordination required shall be included in this Contractors Base Bid.

END OF SECTION 260100

SECTION 260125

SCOPE OF WORK

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

1.1 SCOPE OF WORK

A. The work under this section includes all labor, materials, equipment, tools, transportation and the performance of all work necessary and required for furnishing and installing all Electrical work shown on the Contract Documents, as specified herein and as otherwise required by job conditions or reasonably implied, including, but not necessarily limited to the following:

1. Provide temporary electric power via generator during construction for all trades until foundation is in place. Once building foundation is in place provide temporary utility power, utility meter and associated accessories for all trades during the remainder of construction. Once new service is installed the temporary power connection to utility can be removed and moved over to new service equipment. Once building has been completed all temporary power panels, cables, outlets, and lights shall be removed.

2. Installation of a new vault mounted utility transformer below sidewalk on property line.

3. Installation of new service cables in underground duct bank from utility pole to new manhole. Also, from new manhole to new main service switch.

4. The contractor shall dispose of all debris, including but not limited to fixtures, equipment, lamps, ballast, wiring devices and the like in accordance with, as defined by governing law and regulations of the jurisdiction where the work is being performed.

5. Installation of new electrical distribution system as indicated on the Drawings.

6. Service switchboards, distribution panelboard, circuit breaker panelboards, surge suppressors, feeder, conduit, cables and branch circuit wiring with all connections complete.

7. Conduit, conduit fittings, junction and pull boxes and all appurtenances necessary for the raceway systems including necessary supports and fasteners.

8. Electrical conductors, connectors, fittings and connection lugs.

9. Branch circuit devices, outlet boxes, pull boxes, motor disconnect switches, etc.

10. Power wiring to HVAC and Plumbing equipment including disconnect switches as shown and/or required by NEC.

11. Lighting fixtures and lamps including site lighting, digital lighting control, photo sensors and occupancy sensors.

12. Third Party commissioning of lighting controls. Electrical Contractor shall coordinate the commissioning of lighting controls with Third Party Commission Agent. Refer to specification section 26 0585 and 26 0890 for all requirements.

13. Installation of new diesel generator, automatic transfer switches, and associated equipment.

14. Installation of new fire alarm system and devices (i.e., automatic fan shutdown, for new HVAC equipment) as shown on Drawings.

15. Installation of new public address system in the building as shown on Drawings.

16. Installation of new wireless clock system in the building as shown on Drawings.

17. Stand-alone sound system in Gymnasium/Auditorium.

18. New Theatrical Lighting System in Gymnasium/Auditorium.

19. Provide new telephone/data wiring/conduit to data rack patch panel as indicated on drawings.

20. Provide new low voltage wire, Cat 6 cable, fiber optic cable, conduit supports, etc. infrastructure for the security (intrusion and surveillance) as indicated on the SE series drawings. Separate procurement for security Parts and Smarts by Yonkers Public Schools.

21. Provide roof mounted Photovoltaic System.

22. Core drilled holes for conduit passing through walls, ceilings and floors.

23. All necessary cutting, patching and core drilling incidental to the electrical work.

24. Rescue assistant call system

25. Temporary light and power.

26. Licenses, permits, inspection and approvals.

27. Grounding as required as per NEC.

28. Sleeves for conduit and watertight caulking between conduit and sleeve.

29. Testing.

30. Cutting, patching and drilling.

31. Excavation and backfill by others. Sand bedding by Electrical Contractor.

B. Coordination Drawings (if applicable): Attention is directed to Division 1 for coordination drawing requirements for this project. These drawings are critical to the proper execution of the work and failure to honor these requirements may become the basis for denial of any and all claims for either or both “time” and “money”.

1.2 WORK NOT INCLUDED

A. The following related items will be done by others:

1. Furnishing motors and controllers.

2. Concrete work.

3. Excavation and backfill.

END OF SECTION 260125

SECTION 260150

APPROVED MANUFACTURERS

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

1.1 APPROVED MANUFACTURERS

A. The following list of manufacturers constitutes an approved list:

1.	Panelboards	Siemens, Square D, GE
2.	Disconnect Switches	Siemens, Square D, GE
3.	Conduit (steel)	Wheatland, Allied, Republic Conduit
4.	Conduit Fittings (steel)	Appleton, Crouse-Hind, O-Z, T&B, M&W
5.	Wire and Cable	General, South Wire, Rome, Cerro
6.	Splicing Connectors	3M, O-Z, Thomas & Betts
7.	Outlet Boxes	Appleton, National, Steel City, Raco
8.	Wiring Devices	Arrow-Hart, Hubbell, P & S
9.	Fuses	Bussman, Ferraz-Shawmut, Littlefuse
10.	Lamp	GE, Sylvania, Philips
11.	Motion Sensors	Watt Stopper, Sensorswitch
12.	Fire Alarm System	Simplex-Grinnell, Pyrotronics, Edwards System Technologies or approved equal
13.	Public Address system	Rauland-Borg, Bogen or approved equal
14.	Generators	Cummins or Caterpillar

B. All materials and appliances shall have listing of Underwriters Laboratories, Inc. and be so labeled, or shall conform to their requirements, in which case certified statements to that effect shall be furnished by the manufacturer with a copy of an examination report by a recognized independent testing laboratory acceptable to the Architect and his Engineer. Use new materials and appliances throughout.

C. Where several types or makes of materials are specified, the Contractor has the option of using any of these, but after a type or make has been selected and has received the approval of the Architect, it shall be used throughout.

D. The Contractor shall provide all structural supports for the proper attachment of equipment supplied by him and also for all equipment supplied to him under other sections of the Specifications for mounting and connections.

E. Secure all equipment to the building structure independently. Do not secure to work of other trades such as ceiling lath, piping racks, etc., unless specified or noted otherwise.

F. Wall mounted equipment shall be directly secured to wall by means of steel bolts. Maintain at least 1/4" air space between equipment and supporting wall. Pre-fabricated steel channels providing a high degree of mounting flexibility, such as those manufactured by Kindorf and Unistrut, shall be used for mounting arrays of equipment.

G. All fastening, supports, hangers, anchors, etc., shall be of a type made for the specific purpose. On masonry walls, metallic expansion shield and machine screws shall be used. Screws with wooden plugs or anchors will not be acceptable on any part of the work.

END OF SECTION 260150

SECTION 260200

CONDUIT

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. The work under this section shall include the furnishing of all material, labor, tools and services necessary to install rigid metal conduit, electrical metallic tubing and liquid tight flexible metal conduit, including all fittings to complete all work shown on the Drawings or specified herein.

1.2 RELATED WORK

A. Cutting and patching.

B. Trenching: Excavation and backfill for conduit and utility on site.

C. Sheet metal flashing and trim.

1.3 REFERENCE FOR METAL RACEWAY

A. UL 5 - Surface Metal Raceways and Fittings.

B. UL 870 - Wireways, Auxiliary Gutters, and Associated Fittings.

PART 2 - PRODUCTS

2.1 RIGID STEEL CONDUIT

A. Industry standard heavy wall conduit.

B. Minimum 3/4" trade size.

C. Threaded.

D. Hot dipped galvanized finish by means of plating after cutting of threads.

2.2 INTERMEDIATE METAL CONDUIT

A. Industry standard steel conduit.

B. Minimum 3/4" trade size.

C. Threaded.

D. Hot dipped galvanized finish by means of plating after cutting of threads.

2.3 ELECTRICAL METALLIC TUBING

A. Industry standard thin wall conduit of galvanized steel only.

B. Minimum 3/4" trade size.

C. Maximum 4" trade size.

2.4 FLEXIBLE METAL CONDUIT

A. Galvanized steel tape formed into an industry standard interlocking coil.

B. Minimum 3/4" trade size except for connection of lighting fixtures.

C. Grounding type.

D. Separate ground conductor.

E. Use for short connections to motor terminal box, other vibrating equipment using a minimum length of 18" with 50% slack and a maximum of 6'.

F. From outlet box to recessed lighting fixtures with a maximum length of 6'.

2.5 WIREWAYS

A. Lay-in type, UL listed as wireway or auxiliary gutter.

B. Wireway shall be of code gauge steel construction (UL standard for Wireway Auxiliary Gutters and Associated Fittings) with removable cover. Tamperproof screws shall be provided for sealing covers to prevent access by unauthorized personnel. Wireway shall be provided with knockouts.

C. Connector and covers shall be attached so that removal of connectors is not necessary to utilize the lay-in feature.

D. Finish: All sheet metal parts shall be provided with a rust inhibiting phosphating coating and baked enamel finish. All hardware shall be plated to prevent corrosion. All screws extending into the wireway shall be protected by spring nuts or otherwise guarded to prevent wire insulation damage.

2.6 CONDUIT SUPPORTS

A. Conduit clamps, straps and supports: Steel or malleable iron.

2.7 CONDUIT FITTINGS

A. Use compression fittings for all EMT in exposed areas. Utilize set screw fittings only above hung ceilings and concealed areas.

2.8 SURFACE METAL RACEWAY

A. Metal raceway shall be of a two-piece design with a base and snap-on cover.

B. Raceway and all components shall be listed by Underwriters Laboratories

C. Single Channel: Steel, zinc plated, off-white finish suitable for repainting. Two piece design with metal base and snap-on cover. Wire Mold V700, Hubbell Inc. 750 Series, or Panduit PMR5/PMR7

D. Dual Channel: Steel, galvanized, off-white finish but suitable for repainting. Two-piece design with metal base and snap-on cover, minimum 0.04" thick base and cover. Base shall be divided by a removable barrier section. Provide duplex receptacles mounted in top cell and communication outlets in the bottom cell. Coordinate communications jack requirements with owner's IT personnel. Wiremold V4000, Wiremold DS4000 Series, Hubbell Inc. 4000 Series or Panduit PMR40.

PART 3 - EXECUTION

3.1 CONDUIT SIZING, ARRANGEMENT AND SUPPORT

A. Minimum size - 3/4". Provide grounding bushings on all conduits 1-1/4" and larger.

B. Arrange conduit to maintain headroom and present a neat appearance.

C. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.

D. Draw up couplings and fittings full and tight. Protect threads cut in field from corrosion. Paint newly threaded joints of steel conduit with T & B "Kopershield" compound before installation. Running threads prohibited; use three-piece unions or split couplings instead. Use only compression fittings for all EMT in areas where it will be exposed in finished and unfinished areas. Provide set screw fittings only when installed above hung ceilings.

E. Maintain minimum 6-inch clearance between conduit and piping. Maintain 12-inch clearance between conduit and heat sources such as flues; steam pipes and heating appliances.

F. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers, or bolted split stamped galvanized hangers.

G. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.

H. Do not fasten conduit with wire or perforated pipe straps. Remove all wire used for temporary conduit support during construction before conductors are pulled.

I. Exposed conduit on ceiling shall be parallel or perpendicular to wall and vice versa to ceiling when installed on wall. Secure conduit clamps and supports to masonry materials by toggle bolt, expansion bolt or steel insert. Spacing or conduit supports shall not exceed 7 feet.

3.2 CONDUIT INSTALLATION

A. Cut conduit square using a saw or pipe cutter, Deburr cut ends.

B. Bring conduit to the shoulder of fittings and couplings and fasten securely.

C. Use conduit hubs or sealing locknuts for fastening conduit to cast boxes and for fastening conduit to sheet metal boxes in damp or wet locations.

D. Install no more than the equivalent of three 90-degree bends between boxes.

E. Use conduit bodies to make sharp changes in direction, as around beams.

F. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2-inch size.

G. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.

H. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.

I. Provide No. 12 AWG insulated conductor or suitable pull string in empty conduit, except sleeves and nipples.

J. Install expansion-deflection joints where conduit crosses building expansion or seismic joints.

K. Where conduit penetrates fire-rated walls and floors, provide pipe sleeves two sizes larger than conduit; Pack void around conduit with fire-stop fittings with UL listed fire rating equal to wall or floor ratings; Seal opening around conduit with UL listed foamed silicone elastomer compound.

L. Installation of conduit in slab shall comply with ACI 318.

M. Route conduit through roof openings for piping and duct work where possible; otherwise, route through roof with pitch pocket.

N. Maximum size conduit in slabs above grade: 1 inch. Do not route conduits to cross each other in slabs above grade. Conduits crossing each other may not be larger than 3/4 inch.

O. All conduit used for fire alarm system shall be painted red.

P. For Surface Metal Raceway

1. When installing surface metal raceway contractor shall provide boxes from the same manufacturer of the surface metal raceway.

2. Install separate grounding conductor. Grounding conductors for surface metal raceways.

3. Surface metallic raceways in close proximity of other trades, shall be arranged to allow for proper clearance for servicing and headroom. Surface metallic raceway shall be installed parallel to walls, floors and ceilings in a neat workmanlike manner.

3.3 CONDUIT INSTALLATION OF SCHEDULE

A. Underground installations: PVC minimum Schedule 40, unless otherwise noted on Drawings.

B. Installations in or under concrete slab: PVC minimum Schedule 40, unless otherwise noted on Drawings.

C. Exposed outdoor locations: Rigid galvanized steel conduit.

D. Wet interior locations: Rigid galvanized steel conduit.

E. Concealed dry interior locations and above accessible ceiling for receptacle and lighting branch wiring: Electrical metallic tubing up to first junction box and flexible metallic tubing (MC cable only) thereafter.

F. Concealed dry interior locations other than receptacle and lighting branch wiring: Electrical metallic tubing.

G. Concealed dry interior locations and above accessible ceiling for fire alarm runs: Fire alarm armored cable type MC with red stripe as manufactured by AFC series 1800.

H. Concealed and exposed dry interior location for feeder runs: Electric metallic tubing.

I. Exposed dry interior in unfinished locations other than Boiler Rooms: Electric metallic tubing.

J. Final connections to motors: Flexible metallic tubing (MC cable). Minimum of 10” to maximum of 6’ for connections to motors.

K. Existing exposed dry interior locations (finished spaces), for branch wiring and fire alarm wiring, one-piece steel raceway (similar to Wiremold V-500, V-700).

L. Final connections to motors: Flexible metallic tubing (MC cable). Minimum of 18” to maximum of 6’ for connections to motors.

M. All conduit installed in boiler room up to 10’-0” AFF and lower shall be rigid galvanized steel conduit. All conduit above 10’-0” shall be electric metallic tubing.

N. Final connections to equipment and/or motors in boiler room, outdoors and potentially wet indoor areas: liquid tight, flexible; minimum of 18” to maximum 6’-0” connections.

END OF SECTION 260200

SECTION 260250

DUCT BANK

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 SECTION INCLUDES

A. PVC conduit.

B. Duct.

C. Manholes.

1.2 REFERENCES

ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated.

A. ASTM A48 - Gray Iron Castings.

B. ASTM C857 - Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.

C. ASTM C858 - Underground Precast Concrete Utility Structures.

D. ASTM C891 - Installation of Underground Precast Utility Structures.

E. ASTM C1037 - Inspection of Underground Precast Utility Structures.

F. IEEE C2 - National Electrical Safety Code.

G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

H. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).

I. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

J. NEMA TC 6 - PVC and ABS Plastic Utilities Duct for Underground Installation.

K. NEMA TC 9 - Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation.

L. NEMA TC 10 - PVC and ABS Plastic Communications Duct and Fittings for Underground Installation.

M. NEMA TC 14 - Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings.

N. NFPA 70 - National Electrical Code.

O. UL 651A - Type EB and A PVC Conduit and HDPE Conduit.

1.3 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience, and with service facilities within 100 miles of Project.

1.4 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories, Inc.

1.5 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated.

B. Verify routing and termination locations of duct bank prior to excavation for rough-in.

C. Verify locations of manholes prior to excavating for installation.

D. Duct bank routing is shown in approximate locations unless dimensions are indicated. Route as required to complete duct system.

E. Manhole locations are shown in approximate locations unless dimensions are indicated. Locate as required to complete ductbank system.

PART 2 - PRODUCTS

2.1 PVC CONDUIT

A. Manufacturers:

1. Carlon.

B. Rigid Plastic Conduit: NEMA TC 2, Schedule 40 PVC, with fittings and conduit bodies to NEMA TC 3.

C. Rigid Plastic Underground Conduit: UL 651A, Type A PVC High-density polyethylene, Schedule 40.

2.2 PRECAST CONCRETE MANHOLES

A. Manufacturers:

1. A.C. Miller or equal.

B. Description: Precast manhole designed in accordance with ASTM C858, comprising modular, interlocking sections complete with accessories.

C. Loading: ASTM C857, Class A-16.

D. Shape: Rectangular with truncated corners.

E. Nominal Inside Dimensions: 10 feet x 6 feet.

F. Corner Panel Dimensions: 3 feet wide.

G. Inside Depth: 6 feet.

H. Wall Thickness: 6 inches.

I. Base Section: Include 3 inches deep x 14 inches round sump with cast sleeve, and two 1 inch ground rod openings. Provide 4 inches diameter hole in bottom of manhole.

J. Top Section: Include 39 inches diameter grooved opening for frame and cover.

K. Riser Casting: 12 inches with manhole step cast into frame.

L. Frames and Covers: ASTM A48; Class 30B gray cast iron, 30 inches size, machine finished with flat bearing surfaces. Provide cover marked ELECTRIC OR TELEPHONE.

M. Duct Entry Provisions: Window knockouts.

N. Duct Entry Locations: As indicated.

O. Duct Entry Size: 6 inches.

P. Cable Pulling Irons: Use galvanized rod and hardware. Locate opposite each duct entry. Provide watertight seal.

Q. Cable Rack Inserts: Minimum load rating of 800 pounds. Locate on center.

R. Cable Rack Mounting Channel: 1-1/2 x 3/4 inch steel channel, 48 inch length. Provide cable rack arm mounting slots on 1-1/2 inch centers.

S. Cable Racks: Steel channel, 1-1/2 x 3/4 x 14 inches, with fastener to match mounting channel.

T. Cable Supports: Porcelain clamps and saddles.

U. Manhole Steps: Cast steps at 12 inches on center vertically.

V. Sump Covers: ASTM A48; Class 30B gray cast iron.

W. Source Quality Control: Inspect manholes in accordance with ASTM C1037.

2.3 ACCESSORIES

A. Underground Warning Tape: 4 inch wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.

B. Install a 6" deep bed of 3/4" crushed stone under each manhole.

2.4 CAST-IN-PLACE MANHOLE ACCESSORIES

A. Sump Covers: ASTM A48; Class 30B gray cast iron.

PART 3 - EXECUTION

3.1 DUCT BANK INSTALLATION

A. Install duct to locate top of ductbank at depths as indicated on drawings.

B. Install duct with minimum slope of 4 inches per 100 feet. Slope duct away from building entrances.

C. Cut duct square using saw or pipe cutter; de-burr cut ends.

D. Insert duct to shoulder of fittings; fasten securely.

E. Join nonmetallic duct using adhesive as recommended by manufacturer.

F. Wipe nonmetallic duct dry and clean before joining. Apply full even coat of adhesive to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

G. Install no more than equivalent of three 90-degree bends between pull points.

H. Provide suitable fittings to accommodate expansion and deflection where required.

I. Terminate duct at manhole entries using end bell.

J. Stagger duct joints vertically in concrete encasement 3 inches minimum.

K. Use suitable separators and chairs installed not greater than 5 feet on centers.

L. Band ducts together before placing concrete.

M. Securely anchor duct to prevent movement during concrete placement.

N. Place 3000 p.s.i. concrete around PVC conduits. Use mineral pigment to color concrete red.

O. Provide minimum 3” concrete cover at bottom, top, and sides of ductbank.

P. Provide two (2) No. 4 steel reinforcing bars in top of bank under paved areas.

Q. Connect to manhole wall using dowels.

R. Provide 2 at pull rope in each empty duct except sleeves and nipples.

S. Swab duct. Use suitable caps to protect installed duct against entrance of dirt and moisture.

T. Backfill trenches with clean tamped soil.

U. Interface installation of underground warning tape with backfilling. Install tape 6 inches below finished surface.

3.2 PRE-CAST MANHOLE INSTALLATION

A. Excavate for manhole installation.

B. Install and seal precast sections in accordance with ASTM C891.

C. Install manholes plumb.

D. Use precast neck and shaft sections to bring manhole cover to finished elevation.

E. Attach cable racks to inserts after manhole installation is complete.

F. Install 4" diameter drains in manholes and connect to site drainage system 4 inch pipe terminating in 1/3 cu yd crushed gravel bed.

G. Damp-proof exterior surfaces, joints, and interruptions of manholes after concrete has cured 28 days.

H. Backfill manhole excavation.

END OF SECTION 260250

SECTION 260300

WIRE AND CABLE

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. The work under this section shall include the furnishing of all material, labor, tools and services necessary to wire and cable in raceway specified in other sections to complete all work shown on the Drawings or specified herein.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Thermoplastic-insulated building wire: Type THHN.

B. Rubber insulated building wire: NEMA WC 3.

C. Feeders and branch circuits larger than number 6 AWG: Copper, stranded conductor, 600 volt insulation, type THHN.

D. Feeder and branch circuits 6 AWG and smaller: Copper conductor, 600 volt insulation, THWN/THHN, 6 and 8 AWG, stranded conductor; Smaller than 8 AWG, solid conductor.

E. Service feeders and branch circuits in conduit in contact with earth shall be type XHHW.

F. Control circuits: Copper, stranded conductor 600 volt insulation, THHN.

2.2 ARMORED CABLE

A. BX or pre-manufactured cables are not acceptable except for Type MC for branch wiring after the first junction box (for receptacle and lighting branch circuits) and final connections to motors in interior dry accessible locations, minimum length shall be 18” with a maximum length of 6’ for motors. Except for outdoor and boiler room equipment and/or motors. Provide flexible liquid tight conduit.

B. Type MC fire alarm cable with red stripe for concealed fire alarm wiring as manufactured by AFC series 1800.

C. Armored cable, Type MC size 14 through 6 AWG: Copper conductor, 600 volt thermoplastic insulation, rated 90 degrees C., with separate green ground conductor.

2.3 REMOTE CONTROL AND SIGNAL CABLE

A. Control cable for class 2 or class 3 remote control and signal circuits:

B. Copper conductor, 300 volt insulation, rated 60 degree C, individual conductors twisted together shielded and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts and plenums. Verify wiring type with manufacturer.

2.4 COLOR CODING

A. All wiring shall be color-coded. Neutral wire shall be white throughout, and each phase wire shall be identified any place in the system by its color code. All conductors in panel boxes and junction boxes shall be properly tagged with red non-flammable tags properly attached.

B. Wire shall be color coded as follows:

120/208 volt system		480/277 volt system		Fire Alarm
A Phase	Black	A Phase	Brown	Red
B Phase	Red	B Phase	Orange	
C Phase	Blue	C Phase	Yellow	

Equipment ground wires or ground jumpers shall be Green.

C. In addition to the basic color-coding described the following additional identification and tagging shall apply.

1. The switch legs for the local wall switches and in switch panel shall have distinctive stripes. In instances where color-coding is not practicable, such as short runs of heavy feeder cables, taping the ends of the cable with coded colors as indicated above or tagging will be permitted.

2. Cables shall be tagged in all pull boxes, wireways and wiring gutters of panels.

3. Where two (2) or more circuits run to or through a control device, outlet box or junction box, each circuit shall be tagged as a guide in making connections.

4. Tags shall identify wire or cable by number and/or piece of equipment served as shown on the Drawings.

PART 3 - EXECUTION

3.1 GENERAL WIRING METHODS

A. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 14 AWG for control wiring.

B. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet and for 20 ampere.

C. Use 10 AWG conductor for 20 ampere, 277 volt branch circuit home runs longer than 200 feet for 20 ampere.

D. Place an equal number of conductors for each phase of a circuit in same raceway or cable. No more than one of each phase shall be supported by a single neutral.

E. Splice only in junction or outlet boxes.

F. Neatly tag, identify, train and lace wiring inside boxes, equipment and panelboards.

G. Make conductor lengths for parallel circuits equal.

3.2 WIRING INSTALLATION IN RACEWAYS

A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricate for pulling 4 AWG and larger wires.

B. Completely and thoroughly swab raceway system before installing conductors.

C. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

3.3 CABLE INSTALLATION

A. Support cables above accessible ceilings; do not rest on ceiling tiles. Use spring metal clips or metal cable ties to support cables from structure (not ceiling suspension system). Include bridle rings or drive rings.

B. Use suitable cable fitting and connectors.

3.4 WIRING CONNECTIONS AND TERMINATIONS

A. Splice only in accessible junction boxes.

B. Use solderless pressure connections with insulating covers for copper wire splices and tape, 8 AWG and smaller. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps.

C. Provide extended gutters and tap blocks or pull boxes with tap rail systems similar to Burndy MT Series or Burndy Electrorail system for wire splices 6 AWG and larger.

D. Tape uninsulated conductors with electrical tape to 150 percent of the insulation value of conductor.

E. Thoroughly clean wires before installing lugs and connectors.

F. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

G. Terminate spare conductors with electrical tape.

3.5 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of the Specifications.

B. Inspect wire and cable for physical damage and proper connection.

C. Torque test conductor connections and terminations to manufacturer's recommended values.

D. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

3.6 WIRE AND CABLE INSTALLATION SCHEDULE

A. All wiring and cable shall be installed in conduit unless otherwise noted. Refer to conduit section 260200 for conduit types at various locations.

END OF SECTION 260300

SECTION 260320

OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. Work of this section includes all labor, materials, equipment and services necessary to complete the electrical work as shown of the Drawings and specified herein, including, but not limited to, the following:

B. Fuses

1. Current limiting cartridge fuses.
2. Time delay cartridge fuses.

C. Circuit Breakers

1. Standard molded case circuit breakers "bolted in" type.
2. Solid state circuit breakers.
3. Current limiting circuit breakers.
4. Enclosed circuit breakers.

1.2 SUBMITTALS

A. Shop drawings showing dimensions, location of equipment and method of installation.

B. Product Data: Manufacturer’s printed data, catalog cuts.

1.3 DISCONNECT SWITCHES

A. Fusible switch assemblies: Quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover when switch is in ON position. Handle lockable in OFF position. Fuse clips shall be designed to accommodate Class R, J fuses.

B. Non-fusible switch assemblies: Quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover when switch is in ON position. Handle lockable in OFF position.

C. Enclosures: NEMA Type 1, 3R or 4 as required.

1.4 FUSES

A. Voltage ratings of fuses shall be suitable for the supply characteristics to which they are applied.

B. Fuse type and size shall be suitable for installation in related disconnect switch or circuit breaker.

C. Current limiting fuses shall be as follows:

1. Regardless of actual available fault current, they shall, at full recovery voltage, be capable of safely interrupting fault currents of 200,000 amperes RMS symmetrical or 280,000 amperes RMS asymmetrical, deliverable at the line side of the fuse.

2. They shall have average melting time-current characteristics to meet the Underwriters' Laboratories requirements for "Class RK-1" 0-600 amp fuses.

D. Regardless of actual available fault current, they shall be capable of limiting peak let through current to the following values based on 200,000 amperes RMS symmetrical or 280,000 amperes asymmetrical being available:

Rating In Amperes	Peak Let Through Current In Amps
15-30	6,000
35-50	8,000
70-100	12,000
125-200	20,000
225-601	38,000

E. Fuses shall be rejection type. Fuse clip shall be rejection type.

F. Fuse Type and Application Table:

Category of Application	Acceptable Fuse Types (Bussman Designations @ 600V)
Motor feeder	LPS below 600A
Power panel feeders	LPS below 600A
Safety switches	LPS

1.5 CIRCUIT BREAKERS

A. "Bolted-In" type, manually operated, quick-make, quick-break, mechanically trip-free operating mechanisms for simultaneous operation, of all poles, with contacts, arc interrupters and trip elements for each pole. "Plug-in" breakers are not permitted. New circuit breakers to be installed in existing panelboards shall be U.L. certified for installation in those panelboards and be labeled with make and model.

B. Tripping units shall be "thermal-magnetic" type having bimetallic elements for time delay overload protection, and magnetic elements for short circuit protection.

C. Manually operable by mean of toggle type operating handles having tripped positions midway between the "on-off" position. Handle to be clearly labeled as to breaker rating.

D. Minimum frame size for all circuit breakers, 1, 2, or 3 pole shall be 100 amperes.

E. Their interrupting rating shall not be less than 25,000 amperes RMS symmetrical at 208 volt for distribution panels and 10,000 amperes for power panels.

1.6 APPLICATIONS

A. Category of Application for Fuses:

1. Feeders on switchboards.

2. Branch fused switch unit in distribution panel.

3. Fused safety switch.

4. Combination motor starters.

B. Category of Application for Circuit Breakers:

1. Panelboards.

2. Switchboards.

3. Individual enclosures.

4. Combination motor starters.

1.7 SPARE FUSES

A. Upon Engineer's acceptance of the electrical distribution system, provide spare fuses as follows: 10% of each type and rating installed 600 amperes and smaller (minimum of 3). Provide spare fuse cabinet with directory to store all spare fuses. Locate as directed by Engineer and/or Owner.

1.8 APPROVED MANUFACTURERS

A. Fuses: Bussman, Ferraz-Shawmut.

B. Circuit Breakers: Siemens, General Electric, Square D.

1.9 INSTALLATION

A. All material installation shall be in accordance with manufacturer recommendations and the provisions of all applicable codes.

B. All fuses and circuit breakers shall be selectively coordinated.

C. Install disconnect switches where indicated on Drawings.

D. Install fuses in fusible disconnect switches.

E. Disconnects shall have NEMA 3R enclosure.

1.10 RECORD DRAWINGS

A. Shop drawings showing dimensions, location of equipment and method of installation.

B. Product Data: Manufacturer’s printed data, catalog cuts, performance curves.

END OF SECTION 260320

SECTION 260350

BOXES

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. The work under this section shall include the furnishing of all material, labor, tools and services necessary to install wall and ceiling outlet boxes, floor boxes, pull and junction boxes to complete all work shown on the Drawings or specified herein.

1.2 RELATED WORK

A. Access doors.

B. Wiring devices: Service fittings and fire-rated poke-through fittings for floor boxes.

C. Cabinets and enclosures.

PART 2 - PRODUCTS

2.1 OUTLET BOXES

A. Sheet metal outlet boxes: ANSI/NEMA OS 1; Galvanized steel, with 1/2 inch male fixture studs where required.

B. Cast boxes: Cast feralloy, deep type, gasketed cover, threaded hubs.

C. Typical receptacle box shall be 4" square metal boxes, 30.8 cubic inch capacity with brackets as required. Provide 4" square raised device covers.

2.2 PULL AND JUNCTION BOXES

A. Sheet metal boxes: ANSI/NEMA OS 1; Galvanized steel.

B. Sheet metal boxes larger than 12 inches in any dimension: hinged enclosure in accordance with Section 260450.

C. Cast metal boxes for outdoor and wet location installations: NEMA 250; Type 4 and type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron box and cover with ground flange, neoprene gasket, and stainless steel cover screws.

D. Cast metal boxes for underground installation: NEMA 250; Type 4, inside flanged, recessed cover box for flush mounting, UL listed as raintight. Galvanized cast iron box and plain cover with neoprene gasket and stainless cover screws.

PART 3 - EXECUTION

3.1 COORDINATION OF BOX LOCATIONS

A. Provide electrical boxes as required in excess of that shown on Drawings and as required for splices, taps, wire pulling, equipment connections and code compliance.

B. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.

C. Locate and install boxes to allow access. Where installations are accessible, coordinate locations and sizes of required access doors with Division 1.

D. Locate and install to maintain headroom and to present neat appearance.

3.2 OUTLET BOX INSTALLATION

A. Do not install boxes back-to-back in walls. Provide minimum 6 inch separation, except provide minimum 24 inch separation in acoustic-rated walls.

B. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for boxes.

C. Provide knockout closures for unused openings.

D. Support boxes independently of conduit except for cast iron boxes that are connected of rigid metal conduits, both supported within 12 inches of box.

E. Use multiple-gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.

F. Install boxes in wall without damaging wall insulation.

G. Coordinate mounting heights and locations of outlets mounted above counters, benches and backspaces.

H. Position outlets to locate luminaries as shown on reflected ceiling plans.

I. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.

J. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.

K. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.

L. Provide cast outlet boxes in exterior locations exposed to the weather and wet locations.

3.3 PULL AND JUNCTION BOX INSTALLATION

A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.

B. Support pulls and junction boxes independent of conduit.

3.4 FLOOR BOX INSTALLATION

A. Set boxes level and flush with finish flooring material.

B. Use cast iron floor boxes for installation in slab on grade.

END OF SECTION 260350

SECTION 260400

WIRING DEVICES

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. The work under this section shall include the furnishing of all materials, labor, tools and services necessary to install receptacles, service fittings device plates and box covers to complete all work shown on the Drawings or specified herein.

1.2 REFERENCES

A. FS W-C-596 - Electrical power connector, plug, receptacles and cable outlet.

B. FS W-S-896 - Switch, toggle.

C. NEMA WD 1 - General purpose wiring devices.

D. NEMA WD 5 - Specific-purpose wiring devices.

1.3 SUBMITTALS

A. Submit product data under Provisions of Contract and Division 1.

B. Provide product data showing configurations, finishes, dimensions and manufacturer's instructions.

PART 2 - PRODUCTS

2.1 RECEPTACLES

A. Convenience and straight-blade receptacles: 125 V, 2 pole, 3 wire, 20 ampere specification grade, ground fault interrupting or isolated ground type.

B. Internal ground clip of receptacles shall be in one piece with the receptacle mounts.

C. Receptacles with riveted ground clips will not be accepted.

D. Isolated ground type receptacle shall be orange in color.

2.2 WALL SWITCHES

A. Wall switches for lighting circuits and motor loads under 1/2 hp: AC general use snap switch with toggle handle, rated 20 amperes and 120-277 volts AC.
B. Handle: Ivory plastic.

C. Pilot light type: Lighted handle. Pilot strap in adjacent gang.

D. Locator type: Lighted handle.

2.3 COVER PLATES

A. Decorative cover plate: Stainless steel 302/304 smooth Hubbell "S" series.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install receptacles on roof along parapet wall.

B. Install specific use receptacles at heights shown on contract drawings.

C. Drill opening for poke - through fitting installation in accordance with manufacturer's instructions.

D. Install plates on switch, receptacle, and blank outlets in finished areas, using jumbo size plates for outlets installed in masonry walls.

E. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings and on surface mounted outlets.

F. Install devices and wall plates flush and level.

END OF SECTION 260400

SECTION 260425

DIGITAL LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 SYSTEM DESCRIPTION

A. The distributed lighting control system as specified herein shall be comprised of stand-alone and networked control devices as indicated.

B. Control devices shall include but not be limited to lighting control panels, room controllers, wall switch stations, occupancy/vacancy sensors, daylight sensors, user interfaces, network interfaces, and related input/output devices.

C. The contractor shall provide all related conduit, wire, boxes, and mounting hardware to provide a complete and functional installation.

1.2 QUALITY ASSURANCE

A. Factory Assembly: All system components shall arrive at the job site completely pre-wired and ready for installation, requiring only the connection of lighting circuits and network terminations. All connections shall be made to clearly and permanently labeled termination points. Systems that require field assembly shall not be acceptable.

B. Component Testing: All system components and assemblies shall be individually tested prior to assembly. Once assembled, all finished products shall be tested for proper operation of all control functions per specifications prior to shipment.

C. NEC Compliance: All system components shall comply with all applicable sections of the National Electrical Code (NEC) as required.

D. NEMA Compliance: All system components shall comply with all applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.

E. UL Approval: All applicable equipment shall be tested to and listed under UL standard 508 and shall bare labels to indicate compliance. Lighting control relays shall be tested to UL standard 508 for both safety and endurance. System listed other ETL, or other UL sections shall provide documentation proving compliance with UL standard 508.

F. FCC Emissions: All applicable equipment shall comply with FCC emissions standards specified in Part 15, sub-part j for commercial and residential applications and shall bear labels indicating compliance testing. Equipment the does not meet these standards shall not be acceptable.

G. Title 24: All applicable system components and the system as a whole shall be certified as complying with Title 24 requirements.

1.3 SUBMITTALS

A. Submit a line-by-line comparison that describes the differences between each specifications requirement and the equipment / systems being proposed. Comparison shall include a complete listing of how the proposed equipment / systems differ from that specified with regard to size, quantity, quality, method of control, features and functions, control software functions and installation requirements.

B. Prior to fabrication and shipment of lighting control components, the manufacturer shall provide submittal documentation for approval under the general provisions of these specifications.

C. The submittal documentation shall include Class 2 control wire type and routing requirements necessary to match the proposed lighting control components.

D. Submittal documentation shall include a list of components to be supplied, panel schedules, wiring diagrams, detail drawings, and catalog submittal sheets demonstrating compliance with the specified requirements.

E. Provide as part of the submittal package a system riser drawing of sufficient detail to indicate relative placement of major system components and the required connections between each.

F. It shall be the responsibility of the contractor to verify all control wire requirements with the lighting controls manufacturer prior to rough in.

1.4 PROJECT CONDITIONS

A. The contractor shall not install lighting control system components in spaces where the ambient temperature cannot be maintained between 0 degrees to 40 degrees C (32 degrees to 104 degrees F) with a maximum humidity of 90%, non-condensing.

B. All stored and installed lighting control components shall be adequately protected from dust and dirt.

1.5 WARRANTY

A. The lighting control manufacturer shall warrant the system to be free from manufacturing defects for a period of 5 years from shipment.

B. The warranty shall include replacement parts deemed necessary to restore the system to normal operation.

C. The manufacturer shall provide telephone technical support and remote diagnostics where applicable during normal business hours excluding manufacturer holidays.

D. Upon request, the manufacturer shall make available for purchase service contract option(s) which include on-site technician visits for service and repair.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The basis for design is the NX Distributed Lighting Control System from Hubbell Control Solutions.

B. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval a minimum of 10 working days prior to the bid date and must be made available to all bidders.

C. By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring.

D. Provide complete shop drawings with deviations to the engineer for review and approval prior to rough-in.

2.2 GENERAL

A. Provide lighting control system hardware that is designed, tested, manufactured, and warranted by a single manufacturer.

B. System components shall be UL listed under the UL916 Energy Management Equipment standard.

2.3 SMART SENSOR MODULE

A. As indicated in the specifications and where shown on the plans, install Hubbell Control Solutions NXSMP series sensor module enabled fixture(s).

B. NXSMP Series Sensor Module shall be designed to install directly into or on the fixture housing or lens.

C. NXSMP Series Sensor Module shall consist of a completely self-contained distributed intelligent device containing the following sensing and control elements:

D. NXSMP Series Sensor Module Occupancy/Vacancy sensor shall provide automatic or vacancy switching of lighting load(s) within an area/zone based on the presence of human activity.

E. NXSMP Series Sensor Module Occupancy/Vacancy sensor shall be microprocessor controlled and utilize IntelliDAPT™ technology to optimize sensor behavior to adapt to space conditions and occupant usage patterns and adjust sensitivity and time delay to maximize energy savings and minimize false On and Off events.

F. NXSMP Series Sensor Module Occupancy/Vacancy sensor shall not require any adjustments of any kind at the time of installation or during operation.

G. NXSMP Series Sensor Module Occupancy/Vacancy sensor shall be powered by Smart Pack SmartPORT™ using plenum rated SmartPORT plug and play cables.

H. NXSMP Series Sensor Module Occupancy/Vacancy sensor shall have a timer that can be adjusted manually from 1 second to 20 minutes.

I. NXSMP Series Sensor Module Occupancy/Vacancy sensor sensitivity shall be adjustable from 1 to 10.

J. NXSMP Series Sensor Module Occupancy/Vacancy sensor shall include non-volatile memory for retaining device settings during power outages.

K. NXSMP Series Sensor Module Occupancy/Vacancy sensor shall have RED real time motion indicator LED visible from the front of the unit.

L. NXSMP Series Sensor Module Occupancy/Vacancy sensor may be programmed for active and inactive times.

M. NXSMP Series Sensor Module Occupancy/Vacancy sensor shall be available with the following 360° coverage patterns:
   1. 1:1 (mounting height to radius) up to 16 feet
   2. 1:1.5 (mounting height to radius) up to 12 feet
   3. 1:3 (mounting height to radius) up to 14 feet
   4. 1:1.4 (mounting height to radius) up to 45 feet indoors 32 feet outdoors

N. NXSMP Series Sensor Module daylight sensor shall continually measure the amount of visible light under the lighting fixture to provide continuous On/Off and full range dimming control of fixture or group under its control.

O. NXSMP Series Sensor Module daylight sensor shall utilize a closed loop daylight harvesting algorithm to maintain the required light level in response to changes in daylight.

P. NXSMP Series Sensor Module daylight sensor shall have independently programmable ramp up and ramp down times to allow the sensor to respond quickly to decrease in daylight and respond more slowly to increase in daylight to minimize the effect of sudden changes in daylight.

Q. NXSMP Series Sensor Module daylight sensor shall be capable of being programmed for active and inactive times.

R. NXSMP Series Sensor Module daylight sensor shall include non-volatile memory for retaining device settings during power outages.

2.6 DIGITAL ROOM CONTROLLER

A. As indicated and where shown on the plans, install Hubbell Control Solutions NXRC series Room Controller(s) to control the quantity of lighting and plug loads required.

B. Where indicated, the room controller shall provide 0 - 10 volt dimming capability for the required number of dimmable lighting loads.

C. The Room Controller shall integrate the functionality of connected control components including wall switch stations, occupancy sensors and daylight sensors to provide the required sequence of operation for the space.

D. Room Controllers and associated room control components shall operate in a totally standalone mode and not require the use of a network, software, computer or server for local control functions.

E. Room Controllers equipped with the optional NXBTC Real Time Clock, shall be capable of storing and running up to 99 local schedules. Setup shall be via Bluetooth using the NX Device Setup App. Schedules shall run autonomously without the need of any coordinator, gateway or master controller.

F. Mechanical:

1. The room controller housing shall measure 5.75" X 3.85" X 1.3" and be constructed of GSM UL rated 94 HB plastic approved for use in a return air plenum.

2. The housing and shall include an integral 1/2" chase nipple for external mounting to standard junction box knockout.

3. Four RJ45 SmartPORT connectors shall be accessible on the side of the enclosure for connection of room control devices.

4. Two recessed push buttons and associated LED indicators shall be accessible on the top of the enclosure to provide override, status, set-up and testing functions.

G. Electrical:

1. The room controller shall have a single power feed and shall be capable of operation at voltages between 120 and 347 volts AC, 50/60 Hz.

2. One or two output relays (model specific) shall provide a total combined power switching capacity of 20 amps per unit.

3. Where indicated provide one or two independent 0 - 10 volt dimming channels (model specific) for full range dimming control of fixtures equipped with compatible dimmable ballast or driver.

4. Each dimming output shall have a current sinking capacity of at least 30 mA.

5. The room controller shall be capable of supplying 250 mA of Class 2 auxiliary DC power for use by wall switch stations, occupancy sensors, and daylight sensors connected to the room controller's four RJ45 SmartPORT connectors.

6. Where indicated, room controllers shall be equipped with power monitoring circuitry capable of measuring and reporting the total connected load for each room controller.

H. Functional:

1. Provide an integral pushbutton and LED indicator for each load for status and to allow operation of the relays and dimmers for testing and verification without requiring other control devices to be connected.

2. The room controller shall have a default operation providing an automatic logical sequence of operation for each load as the room control devices are plugged into the SmartPORT connectors.

3. Default operation for occupancy sensors shall be automatic on, automatic off for all loads.

4. Upon connection of a switch, the operation shall automatically change to manual on, automatic off (vacancy) mode for all loads.

5. Provide capability to convert each load independently to automatic on or vacancy mode using only the integral push buttons and LED indicators on the room controller.

6. When in vacancy mode, provide a 30 second grace period after an off during which automatic on shall be temporarily enabled.

7. It shall be possible to connect up to eight (8) room controllers together using Cat5 patch cables to provide configurations up to 16 switched and dimmed loads operating as a single zone.

8. Provide the following set up and configuration functions without the need for additional devices or software:

   a. Assign/reassign relays for control by wall switch station buttons.
   b. Configure relays for occupancy or vacancy operation.
   c. Assign/reassign dimmers to raise/lower switches.
   d. Assign dimming channels for response to daylight sensor control.
   e. Auto calibrate default daylight sensor sequence of operation.
   f. Save preset scenes.

2.7 LOW VOLTAGE SWITCH STATIONS

A. Low voltage digital wall switch stations shall be of the programmable type using standard Cat5 cabling for connection to system SmartPORT™.

B. Stations shall have one to six buttons and provide lighting control functions as called out and shown on the plans.

C. All switches shall be single gang and be of the generic decorator style allowing easy ganging and use of a wide array of standard wall switch plate options.

D. Provide two RJ-45 ports per switch to allow for daisy chain connection of up to eight switches to each SmartPORT.

E. Switch station color shall be white, ivory, light almond, grey, or black as indicated.

2.8 OCCUPANCY SENSORS

A. Occupancy sensors shall be ceiling or wall mounted and use dual technology (ultrasonic and passive infrared), ultrasonic and/or passive infrared (model specific) sensing technology as indicated.

B. Sensors shall be Class 2 and connect to any room controller SmartPORT using a wiring adaptor and standard Cat5 patch cable.

C. Occupancy sensors shall be self-adaptive and not require manual calibration after installation. Digital circuitry and logic shall automatically make adjustments to the sensitivity and time delay based on learned occupancy patterns and the environment in which the sensor is installed.

D. Sensors using both ultrasonic and passive infrared (dual technology) shall operate such that detection by both technologies is required to initiate occupancy and continued detection by either technology will maintain occupancy.

E. Up to four occupancy sensors may be connected to one room controller.

2.9 DAYLIGHT SENSORS

A. The NX daylight sensor shall provide ambient light level information to the room controller allowing daylight responsive lighting control.

B. The system shall operate in an open loop sequence of operation reducing the amount of electric light as the quantity of daylight entering the room increases.

C. It shall be possible to configure up to six daylight zones in a room. Each zone shall be programmable to proportionally respond to the light level provided by the daylight sensor.

D. The daylight sensor shall be mounted and positioned to provide an unobstructed view of the windows per the manufacturer's directions.

2.10 EMERGENCY LIGHTING INTERFACE

A. Where emergency lighting is to be controlled by the lighting control system, provide UL924 listed load control relays as necessary to insure that emergency lights are automatically turned full on upon loss of normal power to the area.

PART – 3 EXECUTION

3.1 INSTALLATION

A. Install all equipment in accordance with manufacturer’s installation instructions.

B. The lighting controls shall be installed in accordance with specific guidelines and submittal documents provided by the lighting control manufacturer.

C. Where variations from the general specifications or drawings exist, the contractor shall request a clarification prior to rough in or installation.

D. The contractor shall verify all wire type and routing requirements with the lighting controls manufacturer prior to installation. Not part of this section are requirements for work including, but not limited to, raceways, electrical boxes, junction boxes, circuit protection, wiring, and fittings required for installation of the lighting control equipment.

3.2 STARTUP AND PROGRAMMING

A. The system manufacturer shall provide a factory authorized field engineer to the project site after installation has been completed and prior to system energization for the purpose of testing and adjustment of the system. Factory field engineer shall test and verify all system functions and ensure proper operation of the system components in accordance with the specifications and on-site conditions. The installing contractor shall notify the system manufacturer in writing that the system is completely wired and ready to be energized and tested 2 weeks prior to scheduling a field engineer for start-up of the system. Should the field engineer arrive on the job site and find the installation incomplete, the installing contractor shall pay the cost of any future visits by the field engineer required to complete the system start-up.

B. During the start-up procedure, the factory field engineer shall provide programming assistance and guidance to the building operating personnel in order to program the systems for initial operation.

C. Allow for up to 4 hours of on-site training on the use and maintenance of the lighting control system to be scheduled at the completion of startup and programming of the system.

3.3 TECHINICAL SUPPORT

A. The lighting controls manufacturer shall provide reasonable access to factory direct telephone technical support during normal business hours.

END OF SECTION 260425

SECTION 260450

CABINETS AND ENCLOSURES

PART 1 - GENERAL

Applicable Provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. The work under this section shall include the furnishing of all materials, labor, tools and services necessary to install hinged cover enclosures to complete all work shown on the Drawings or specified herein.

1.2 REFERENCES

A. NEMA 250 - Enclosures for electrical equipment (1000 volts maximum).

B. Submittals - Submit product data under Provisions of Contract and Division 1.

PART 2 - PRODUCTS

2.1 HINGED COVER ENCLOSURES

A. Construction: NEMA 250; Type 1 and 3R steel.

B. Finished: Manufacturer's standard enamel finish.

C. Covers: Continuous hinge, held closed by operable by key.

D. Provide barriers between normal and emergency wiring. Barriers shall be of non-current carrying material of adequate thickness for mechanical strength but in no case less than 1/4". Each barrier shall have an angle iron framing support all around.

2.2 FABRICATION

A. Shop assembles enclosures in accordance with ANSI/NEMA ISC 6.

B. Provide knockouts on enclosures.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosures plumb; Anchor securely to wall and structural supports at each corner, minimum.

B. Provide necessary feet for free-standing equipment enclosures.

C. Install trim plumb.

END OF SECTION 260450

SECTION 260500

SUPPORTING DEVICES

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. The work under this section shall include the furnishing of all material, labor, tools and services necessary to install rigid metal conduit, electrical metallic tubing and flexible metal conduit, including all fittings to complete all work shown on the Drawings or specified herein.

1.2 RELATED WORK

A. Conduit and equipment supports.

B. Fastening hardware.

1.3 REFERENCES

A. Conduit supports.

1.4 QUALITY ASSURANCE

A. Support system shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Support channel: Galvanized or painted steel.

B. Hardware: Corrosion resistant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fasteners in Pre-Cast Concrete: Fastener system of type for suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other necessary devices for attaching hangers of type required and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing in accordance to ASTM E1190 conducted by a qualified independent agency. Anchors shall not be installed where reinforcing strands are located in plank. Review pre-cast plank shop drawings to determine location.

B. Refer to pre-cast concrete plank shop drawings for location of strand reinforcing and cores. Do not anchor where reinforcing is located. Use fasteners in concrete, toggle bolts or thru-core anchors with plates supported on top of plank in cores.

C. Fasten hanger rods, conduit clamps, outlet, junction boxes to building structure using preset inserts, beam clamps and spring steel clips.

D. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; Expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet metal screws in sheet metal studs and wood screws in wood construction.

E. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.

F. Do not use powder-actuated anchors.

G. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

H. In wet locations install free-standing electrical equipment on concrete pads.

I. Install surface mounted cabinets and panelboards with minimum of four anchors. Provide steel channel supports to stand cabinet one inch off wall.

J. Bridge studs top and bottom with channels to support flush mounted cabinets and panelboards in stud walls.

END OF SECTION 260500

SECTION 260550

GENERAL LABELING AND IDENTIFICATION

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. The work under this section shall include the furnishing of all material, labor, tools and services necessary to install nameplates, tape labels, wire markers, conduit color coding to complete all work shown on the Drawings or specified herein.

1.2 RELATED WORK

A. Painting.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Division 1.

B. Include schedule for nameplates and tape labels.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Nameplates: Engraved three-layer laminated plastic, white letters on a black background.

B. Tape labels: Embossed adhesive tape with 3/16 inch black letters on a white background.

C. Wire and cable markers: Cloth markers, split sleeve or tubing type.

PART 3 - EXECUTION

3.1 INSTALLATION

A. De-grease and clean surfaces to receive nameplates and tape labels.

B. Install nameplates and tape labels parallel to equipment lines.

C. Secure nameplates to equipment fronts using screws, rivets, or adhesive. Secure nameplate to inside face of recessed panelboard doors in finished locations.

D. Embossed tape will not be permitted for any application. Use embossed tape only for identification of individual wall switches and receptacles and control device stations.

3.2 WIRE IDENTIFICATION

A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes and at load connection. Identify each branch circuit or feeder number for power and lighting circuits and each control wire number as indicated on equipment manufacturer's shop drawings for control wiring.

3.3 NAMEPLATE ENGRAVING SCHEDULE

A. Provide nameplates to identify all electrical distribution, control equipment and loads served including year of installation. Letter height: 1/2 inch for individual switches, loads served, distributions and control equipment identification. For example:

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B. Panelboards: 3/4 inch, identify equipment designation. 1/2 inch, identify voltage rating and source of power.

C. Individual circuit breakers, switches and motor starters in panelboards, switchboards and motor control centers: 1/4 inch, identify circuit and load served, including location.

D. Individual circuit breakers, enclosed switches and motor starters: 1/2 inch, identify load served.

3.4 FIRE ALARM

A. All fire alarm raceway components shall be painted red and identified.

END OF SECTION 260550

SECTION 260575

INTERIOR LUMINAIRES

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. Interior luminaires and accessories.

B. Emergency lighting units.

C. Exit signs.

D. LED Driver.

E. LED dimming and controls.

F. LED emergency power supply.

G. Lamps.

H. Luminaire accessories.

1.2 REFERENCES

A. ANSI/IES RP-16-10 – Nomenclature and Definitions for Illuminating Engineering.

B. ANSI C78.37 7 – Specifications for the Chromaticity of Solid-State Lighting (SSL) Products.

C. IES LM-79-08 – Electric and Photometric Measurements of Solid-State Lighting Products.

D. IES LM-80-08 – Measuring Lumen Maintenance of LED Light Sources.

E. IES 7M-21-11 – Projecting Long Term Lumen Maintenance of LED Light Sources.

F. IES LM-82-11 – IES Approved Method for the Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature.

G. UL 8750 – LED Equipment for Use in Lighting Products.

H. NEMA WD 6 - Wiring Devices – Dimensional Requirements.

I. NFPA 70 - National Electrical Code.

J. NFPA 101- Life Safety Code.

1.3 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

1.4 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70 and to requirements of NFPA 101.

B. Products: Listed and classified by Underwriters Laboratories, Inc. (UL), American National Standards Institute (ANSI) and Illuminating Engineering Society (IES).

1.5 SUBSITITUTIONS

A. All proposed substitutions must be submitted with each light fixture specification cutsheet, accompanied with footcandle calculation for all spaces, provided for Architect and Engineer's review, prior to approval.

B. If the substitution is accepted, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring.

PART 2 - PRODUCTS

2.1 LUMINAIRES

A. Furnish Products as scheduled.

2.2 EXIT SIGNS

A. Manufacturers: As scheduled.

B. Description: Exit sign fixture suitable for use as emergency lighting unit.

C. Housing: Extruded aluminum or steel as per schedule.

D. Face: Aluminum stencil face with red letters, unless otherwise noted.

E. Directional Arrows: Universal type for field adjustment, direction per drawing.

F. Mounting: Universal, for field selection or per drawing.

G. Lamps: L.E.D.

H. Input Voltage: As scheduled.

2.3 LED DRIVERS

A. Manufacturers: As scheduled.

B. Voltage: As scheduled.

2.4 LAMPS

A. Lamp Types: As specified for luminaire. LED source.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendent length required to suspend luminaire at indicated height.

B. Support luminaires 2 x 4 foot (600 x 1200 mm) and larger in size independent of ceiling framing.

C. All lay-in luminaries shall be supported with chains to building structure.

D. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.

E. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure. Provide auxiliary members spanning ceiling grid members to support surface mounted luminaires. Fasten surface mounted luminaires to ceiling grid members using bolts, screws, rivets, or suitable clips.

F. Install wall mounted luminaires, emergency lighting units and exit signs at 80” above finished floor, unless otherwise noted.

G. Install accessories furnished with each luminaire.

H. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

I. Bond products and metal accessories to branch circuit equipment grounding conductor.

J. Install specified lamps in each emergency lighting unit, exit sign, and luminaire.

3.2 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.3 ADJUSTING

A. Aim and adjust luminaires as indicated.

B. Position exit sign directional arrows as indicated.

3.4 CLEANING

A. Clean electrical parts to remove conductive and deleterious materials.

B. Remove dirt and debris from enclosures.

C. Clean photometric control surfaces as recommended by manufacturer.

D. Clean finished and touch up damage.

3.5 PROTECTION OF FINISHED WORK

A. Relamp luminaires that have failed lamps as substantial completion.

END OF SECTION 260575

SECTION 260580

THEATRICAL LIGHTING AND CONTROLS

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 GENERAL

A. Work Included

1. The Electrical Contractor, as part of the work of this section, shall provide, install and test a complete lighting control system as specified herein for areas indicated on the drawings and circuit schedules.

2. The Electrical Contractor shall furnish all conduit, wire, connectors, hardware and other incidental items necessary for the complete and proper operation of the lighting control system.

3. The Electrical Contractor shall coordinate all work described in this section with all other applicable plans and specifications, including but not limited to:
   a. General Conditions
   b. Electrical Section General Provisions
   c. Conduit
   d. Wire and Cable

B. System Description

1. The system shall be designed for the control of theatrical lighting and shall consist of factory pre-wired dimming and processing rack enclosures containing dimmers, relays, power supplies, breakers, terminals and/or control electronics, distributed power control and/or data distribution devices, and theatrical lighting fixtures.

2. System shall work in conjunction with specified low-voltage control stations.

C. Submittals

1. Manufacturer shall provide four (4) sets of full system submittals. Submittals shall include:
   a. Full system riser diagram(s) illustrating interconnection of system components, wiring requirements, back box sizes and any special installation considerations.
   b. Full set of technical data sheets.
   c. Detailed sets of power control device schedules
   d. Detailed sets of circuit and control schedules, including a complete list of all deviations from specifications.

e. Manufacturer shall provide any additional information, including equipment demonstrations, as required by the engineer or specifier to verify compliance with specifications.

D. Quality Assurance

1. Manufacturer shall be one who has been continuously engaged in the manufacturer of lighting control and theatrical lighting fixture equipment for a minimum of ten years. All fabrication must take place in a U.S. manufacturing plant.

2. The manufacturer shall have a factory authorized stocking service center with at least one full time service technician on staff located within 75 miles of the job site. In addition, the manufacturer shall have a toll free 24-hour hotline with a maximum response time of 20 minutes, 24 hours a day and 365 days a year.

3. All equipment, where applicable standards have been established, shall be built to the standards of Underwriters Laboratories, Inc., the National Electric Code and the United States Institute for Theater Technology. Permanently installed power distribution equipment such as dimmer racks and distribution shall be UL and C-UL Listed and bear the appropriate labels. Portable equipment such as consoles and fixtures shall be UL and C-UL Listed, ETL Listed and bear the appropriate labels.

E. Acceptable Manufacturers

1. Electronic Theatre Controls, Inc., Middleton, WI 53562, Phone: 608/831-4116, Fax: 608/836-1736

2. Alternative manufacturers must submit a full pre-approval package ten days prior to bid date. Package shall consist of items listed in Part 1, Section 1.03A.

3. Permission to bid does not imply acceptance of the manufacturer. It is the sole responsibility of the electrical contractor to ensure that any price quotations received, and submittals made are for controls systems that meet or exceed the specifications.

PART 2 – PRODUCTS

2.1 POWER CONTROL SYSTEM

A. General

1. Intelligent breaker system shall be 120V Sensor IQ as manufactured by ETC, Inc., or equal.
2. Breaker Panels shall be UL508, UL67, and UL924 Listed, and shall be so labeled when delivered.
3. Breakers shall be UL489 listed and shall be labeled when delivered.

4. Breaker Panels shall consist of a main enclosure with 12, 24, or 48 pole breaker sub-panels, integral control electronics for low voltage terminations and provision for accessory cards.
    a. Up to two accessory cards shall be supported per breaker panel.

B. Mechanical

1. The panel shall be constructed of 16-gauge galvannealed steel. All panel components shall be properly treated or finished in fine-textured, scratch resistant paint.
2. Breaker panels shall be capable of being mounted on the surface of a wall or recessed mounted.
3. Breaker panels shall be available in 12, 24, and 48 pole configurations:
    a. 12 pole main lug only (No provision for main Breaker)
4. Choice of panel covers shall be available for surface or recess mount applications. This outer panel shall ship complete with a locking door to limit access to electronics and breakers:
    a. Optional center-pin reject security screws shall be available for all accessible screws.
    b. Optional recess mount doors shall extend 1” beyond all panel edges to hide wall cut-out.
5. The unit shall provide interior cover over the control electronics and accessory cards to allow access only to class 2 wiring and prevent direct access to class 1 line voltage components.
6. The panel shall support up to twelve, twenty-four, or 48 single pole branch circuits.
    a. Branch circuits shall range from 15A to 30A capable of holding full rated load for minimum of three hours continuously.
    b. Two and three-pole circuits shall be supported at decreased density where each pole constitutes one of the available single-pole circuits. Mixing of circuits in any combination shall be supported.
7. Breakers shall provide manual switching control while power is unavailable to the panel such that critical lighting can be set to an on state, without the need for power to the panel.
8. Breaker output lugs shall accept 10-14 AWG dual conductor wire.
9. Breaker output lug shall support solid or stranded 6-14 AWG class B, C, or K copper wire.
10. Control wiring for DMX, station bus, and Emergency input terminations shall land on removable headers for contractor installation.

C. User Interface

1. The user interface shall contain an LCD display with button pad to include 0-9 number entry, up, down back arrow navigation and enter.
2. Test shortcut button shall be available for local activation of preset, sequence and set level overrides.
3. The user interface shall have a power status LED indicator (Blue), a DMX status LED indicator (Green), a network status LED indicator (Green) and an LED indicator (red) for errors.

4. Interface shall allow the backlight to timeout and shall provide user editable options to shut off backlight completely as well as adjust screen contrast.
5. Ethernet interface shall default to automatic IP through link local and DHCP. Upon receiving IP address, the address of the Network Interface Card (NIC) shall display in the about menu. Static address and settings shall also be possible.
6. The control interface shall support a USB memory stick interface for uploads of configurations and software updates.

D. Functional

1. Panel setup shall be user programmable. The control interface shall provide the following breaker setup features (per circuit):
   a. Type (1 pole, 2 pole, or 3 pole)
   b. Name
   c. Circuit Number
   d. DMX address
   e. sACN address
   f. Space Number
   g. Circuit Modes:
      i. Normal (priority and HTP based activation and dimming)
      ii. Latch-lock
      iii. Fluorescent
      iv. DALI
   h. On threshold level
   i. Off threshold level
   j. Include in UL924 emergency activation
   k. Allow Manual
2. Breaker panels shall support discrete addressing of each breaker. Panels that are restricted to use of start address with sequential addressing and cannot assign each 0-10V output control to any internal circuit shall not be acceptable.
3. The panel shall be capable of switching 6 poles on or off at once, or in a user-selectable delay per breaker using a period of 0.1 to 60 seconds, in 0.1 second increments.
4. An Ethernet connection shall provide advanced control of relays over streaming ACN (sACN) and transmit status, control override, and measured energy usage per branch circuit via an internal Web UI or central monitoring interface
   a. Control electronics shall report the following information per branch circuit.
      i. Breaker state (On/Off)
      ii. Breaker state (Open/Closed)
      iii. Current draw (In Amps)
      iv. Voltage
      v. Energy usage
5. Built-in Control shall include:
   a. Ability to record up to 16 presets in each space from the control panel, connected control stations, or timed events.

b. Presets shall be programmable by recording current levels (as set by DMX or connected control stations), by entering levels on the control panel directly, manually selecting breaker state on each breaker, or a combination of these methods. From the control panel, stations, or timed events it shall be possible to record values for up to 16 zones per space.
c. Up to 8 spaces in a single rack for total of up to 16 spaces shall be supported per system or system subnet.
d. Indication of an active preset shall be visible on the control panel display.
e. One 16-step sequence per space for power up and power down routines.
f. The panel shall have a UL924-listed contact input for use in Emergency Lighting systems. The panel shall respond to the contact input by setting included breakers to "on", while setting non-emergency breakers "off". Each breaker can be selected for activation upon contact input.
g. Upon Data loss the system shall provide options to hold last look infinitely or hold for a configured time period set by the installing technician then fade/switch to the input of the next available priority.
h. Control electronics shall respond directly to control stations for zone, preset, and sequence control. Systems that require secondary control systems for this functionality are not acceptable.
i. After power loss, electronics shall be capable of holding the system in its previous state until new level data (DMX, architectural presets, sequences and zones, or local overrides) is received to make each breaker change state.

6. The control of lighting and associated systems via timed and Astronomical clock controls.
   a. The breaker panel shall allow the activation of presets, sequence, and zone programming of up to 50 time clock events via a built in real and astronomical time clock.
7. The panel shall receive ESTA DMX512-A control protocol. Addressing shall be set via the user interface button keypad with any circuit patched to any DMX control address.
   a. 2,500V of optical isolation shall be provided between the DMX512 inputs and the control electronics as well as between control and power components.
   b. The breakers shall respond to control changes (DMX or Stations) in less than 25 milliseconds. DMX512 update speed shall be 40Hz.
   c. Setting changes shall be able to be made across all, some, or just one selected breaker in a single action from the face panel.
   d. DMX data loss shall allow for levels/breakers to be held for ever or for a specified time before switching to a lower priority source.
   e. Initial Panel setup:
      i. The breaker panel shall automatically detect the type of breaker or dimmer installed in each location without need for manual configuration of the physical arrangement.
      ii. Quick rack setup shall be available to apply address settings across all circuits for rack number, DMX Start Address, sACN universe, and sACN start address.

iii. Emergency Setup Menu shall provide optional delays when emergency is activated or deactivated, and option to turn off non-emergency circuits shall be available. Record function shall allow circuits that are turned on to be added to the emergency setting.

E. Electrical

1. Breaker Panels shall be available to support power input from:
   a. 120/208V three phase 4-wire plus ground
2. Conduit Entry:
   a. Feeders:
      i. Top or upper 6” of either side
      ii. Bottom or lower 6” of either side
      iii. Feeders shall enter through the top or bottom according to the orientation of the enclosure.
      iv. Feeder entry shall be nearest to the location of the feeder lugs or main breaker.
   b. Load:
      i. Load wiring shall enter through the top or bottom of the enclosure through the surface nearest to the breaker sub panel.
      ii. Load wiring may also enter through left and/or right side provided a low voltage chase is not required through the same area. If class 2 chase is required, a field installable barrier panel shall be provided upon request. The side of the panel where the barrier has been installed shall not permit load wiring.
   c. Low Voltage:
      i. Top or upper 6” of either side
      ii. Bottom or lower 6” of either side
      iii. For low voltage conduit entry at the breaker end of the cabinet, conduits shall be located at the outer 3” of the top/bottom panel.
3. Breaker
   a. Bus connection type: Stab on.
   b. 1, 2, or three poles.
   c. UL489 listed.
   d. 15 amp, 20 amp, or 30 amp.
   e. 22,000 SCCR; 65,000A series rated with main breaker.
   f High inrush trip curve (matches all Sensor breakers).
   g. Maintains trip curve through entire thermal range.
   h. Guaranteed not to trip at full load.
   i. Load lugs accept 6-14awg load wiring.
   j. Multi-conductor listed output terminal.
   k. Integral mechanically held air gap relay.
   l. Manual control of relay state using breaker handle w/o power.
   m. Integral current sensing.
   n. Integral position and trip sensing.
   o. Control and status provided by contact pads directly at bottom of the breaker case.
   p. No external wires or connections required for control or feedback.
   q. The breaker shall be capable of switching up to 30A.

4. The breaker panel shall support a maximum feed size:
   a. 100 Amps at 12 circuits
5. Breaker panels shall support main circuit breaker options:
   a. Main breaker options shall be optional and available for purchase upon request.
      i. Main breakers shall be field installable
   b. Main breakers shall be available in up to 100 Amps for 12 circuit panels.
      i. Series SCCR ratings apply as follows with appropriate main breaker:
      ii. 22,000A or 64,000 at 120/208V
   c. Main breakers shall allow the following range of wire sizes:
      i. Up to 300kcmil at 100A and 200A
      ii. Up to 2x250kcmil at 400A
   d. Main Lug input shall support up to 2x250kcmil.
   e. Breaker panel shall support a 500kcmil main lug option for 48-circuit panels.
6. Breaker remote switching ratings
   a. Mechanical 1,000,000 cycles
   b. 24A Resistive 100,000 cycles
   c. 16A Ballast (HID) 75,000 cycles
   d. 15A Electronic (LED) 100,000 cycles
   e. 15A Tungsten 45,000 cycles
   f. 30FLA; 180 LRA Motor Load 50,000 cycles
   g. Tested duty cycle: 12 operations (6 cycles) per minute
   h. Decreasing duty cycle significantly increases switch life
   i. Isolation: 4000V RMS
   j. Current reporting accuracy: 5%
   k. Latching state mechanical relay

F. Breaker Panel Accessories

1. A low voltage 0-10V dimming option shall provide up to 24 0-10v control outputs that are linked to relay circuits within the panel. Each output shall support up to 400mA of current sink per output.
2. A contact input option shall provide 24 dry contact inputs to be linked for direct or group relay control, to activate a preset, or to activate a sequence. Controller software shall allow for normally open maintained, normally closed maintained, or momentary toggle.
3. A DALI control option shall provide 24 control loops of broadcast DALI control, with each loop controlling up to 64 DALI devices.
4. A RideThru option shall provide short-term power backup of control electronics by automatically engaging when power is lost and recharging when normal power is present.
5. An Isolated Ground option shall provide each circuit in the panel with a ground terminal that is electrically isolated from the equipment ground.
6. Main Breaker options shall be available as shown in Section E.4.

G. Thermal

1. The panel shall be convection cooled. Panels that require the use of cooling fans shall not be acceptable.
2. The panel shall operate safely in an environment having an ambient temperature between 32ºF (0ºC) and 104ºF (40C), and humidity between 5-95% (non-condensing).

2.2 STAGE MANAGER'S PANEL

A. The Touchscreen Control Stations shall be the Unison Echo EchoTouch Controller Mk2 as manufactured by ETC, Inc., or equal.

B. General

1. The Touchscreen protocols station shall provide control of up to 512 networked addresses or up to 512 local DMX addresses on a maximum of eighty (80) control zones. Addresses may be distributed using DMX512-A or via sACN or Art-Net Ethernet-based lighting.
2. The Touchscreen station shall operate using graphic buttons, faders and other images on at least 7 user programmable control pages.
3. Touchscreen stations shall support default and fully graphical control pages
4. The Touchscreen shall integrate with ETC Unison Echo Controls.

C. Mechanical

1. Touchscreen stations shall consist of a seven-inch, backlit liquid crystal display (LCD) with a minimum resolution of 800 by 400 pixels with a capacitive multi-touch interface.
2. Touchscreen bezels shall be constructed of cast aluminum finished in a fine texture powder coat.
    a. Touchscreen shall be available in four standard colors:
        i. Cream (RAL 9001)
        ii. Gray (RAL 7001)
        iii. Black (RAL 9004)
        iv. Signal White (RAL 9003)
    b. The bezel shall have no visible means of attachment
3. Touchscreen stations shall support surface, flush and rack mounting options:
    a. Flush-mount to industry standard 3-gang back box.
    b. Surface back box dimensions shall be 7.35 in/187 mm wide x 4.88 in/124 mm high x 3.5 in/89 mm deep and available from the manufacturer.
    c. Rack mounting options shall fit in standard 19" racks and shall be no taller than 3 EIA rack units.

D. Electrical

1. The Touchscreen shall have an RJ45 Ethernet port for connection to a lighting system and for Power over Ethernet (PoE).

2. The Touchscreen shall have an EchoConnect connection terminals:
   a. Control wiring utilizing low-voltage, Class II unshielded twisted pair, type Belden 8471 or equivalent, and one #14 ESD drain wire (when not installed in grounded metal conduit).
   b. Control wiring shall be topology free. It may be point-to-point, bus, loop, home run or any combination of these. Control products that require daisy-chain wiring shall not be acceptable.
3. The Touchscreen shall use (2) #16 AWG stranded wires for 24 VDC operating power when not utilizing Power over Ethernet (PoE).
   a. The Touchscreen shall have typical power draw of 400mA.
4. The Touchscreen shall have a USB type A connector for firmware maintenance.
5. The Touchscreen shall be cULus Listed and CE Compliant.
6. The Touchscreen shall be FCC Compliant.

E. Network

1. Communications physical layer shall comply with IEEE 802.3i for 10BASE-T, 802.3u for 100BASE-TX and 802.3af for Power over Ethernet specifications.
2. All network cabling shall be Category 5 (or better), conforming to TIA-568A/B, and shall be installed by a qualified network installer.
3. Switches shall comply with power-over-Ethernet IEEE802.3af, unless a separate in-line power supply is provided.

F. Functional

1. System
   a. A maximum of 64 presets shall be contained in non-volatile electronic memory.
   b. A maximum of 4 internal sequences. Sequences shall record user-selected zone levels.
   c. The Touchscreen shall be equipped with an on-board help system.
   d. The Touchscreen software upgrades shall be made by the user via USB drive. Changing internal components shall not be required.
   e. The Touchscreen shall provide a USB port allowing show data to be saved for archival or transfer to other consoles or a personal computer.
   f. Systems that do not provide the above capabilities shall not be acceptable.
2. Patching
   a. The Touchscreen shall provide patching facilities for dimmers and multi-parameter devices via a built-in library of fixture definitions. The fixture library shall be updated via software-based updates. It shall be possible to create custom fixture definitions using an offline application.
   b. The Touchscreen shall support patching, address setting, and mode changes using Remote Device Management (RDM) on the local DMX/RDM port.
3. Playback Control
   a. Customizable zone display using Zone Map. It shall be possible to rearrange the graphical representations for control channels to closely mimic the positions of fixtures in the installation.
   b. Seven user customizable interactive pages.

c. Color and white pickers.
d. Touch-based parameter controls with reference-based palettes.
e. Virtual level wheel.

4. Layout and Configuration
   a. It shall be possible to view and modify the layout of the user pages.
   b. It shall be possible to add, remove or edit the following items:
      i. Preset Buttons
      ii. Off Buttons
      iii. Sequence Buttons
      iv. Zone and space modifier buttons
      v. Space combine buttons
      vi. Zone Fader
   c. There shall be three options for inactivity
      i. Dim screen to level
      ii. Turn screen off
      iii. Display user chosen inactivity image
   d. It shall be possible to have multiple configurations stored within an LCD Station.
5. Time Clock
   a. The Touchscreen shall have a built-in astronomical and real time event engine allowing the activation of presets and sequences.
      i. The system shall support 80 events.
      ii. The system shall support astronomical, real-time and manual control events in up to 16 control spaces.
   b. Timed events shall be programmable via the Touchscreen.
      i. Time Clock events shall be assigned to system day types. Standard day types include every day, weekday, weekend and day of the week.
      ii. Time Clock events shall be activated based on sunrise, sunset, time of day, open and closed events and a configurable state-based engine.
      iii. The Time Clock shall automatically compensate for regions using configurable daylight-saving time.
      iv. Presets shall support assignment to events via the Time Clock user interface.
   c. Timed events shall resume automatically after power loss.
   d. The Touchscreen shall support timed event hold.
      i. Timed event hold shall meet California Title 24 requirements.

2.3 LIGHTING CONSOLE AND ACCESSORIES

A. General

1. The lighting control console shall be a microprocessor-based system specifically designed to provide complete control of stage, studio, and entertainment lighting systems. The console shall be the ColorSource 20 AV or ColorSource 40 AV as manufactured by Electronic Theatre Controls, Inc., or equal.

2. The system shall provide control of up to 2,560 networked addresses or up to 1024 local DMX addresses on a maximum of forty (40) or eighty (80) control channels/devices. Addresses may be distributed using DMX512-A (two ports) or via sACN or Art-Net Ethernet-based lighting protocols.
3. A maximum of 999 cues may be contained in non-volatile electronic memory.
4. Twenty (20) or forty (40) faders shall provide access to individual intensity channels, intensity for devices as well as playbacks.
5. Four (4) configurable faders shall provide functionality for controlling audio volume, output of bump buttons, output from the cue list, output from playbacks, or crossfade control.
6. The console shall have one (1) built-in 7" color multi-touch touchscreen. The touchscreen shall provide the primary interface for system configuration, programming show data and multi-parameter control.
7. Six (6) softkey buttons shall be provided, five (5) of which may be configured by the user.
8. Console shall be equipped with an on-board help system, with on-board tutorial videos.
9. Console shall not require the use of an external monitor for normal use. Optional displays shall be accessible via connection to an external HDMI™ compatible monitor.
10. Console software upgrades shall be made by the user via USB memory stick. Changing internal components shall not be required.
11. The console shall provide a USB port allowing show data to be saved for archival or transfer to other consoles or a personal computer.
12. The console shall be supplied with an onboard 32GB SSD.
13. Systems that do not provide the above capabilities shall not be acceptable.

B. Controls and Playback

1. Patching
   a. The console shall provide patching facilities for dimmers and multi-parameter devices via a built-in library of fixture definitions. The fixture library shall be updated via software-based updates. It shall be possible to create custom fixture definitions using an offline application.
   b. The console shall support patching, address setting, and mode changes using Remote Device Management (RDM) on local DMX/RDM ports and on Net3 DMX/RDM Gateway ports.
2. Channel or Playback Faders
   a. Twenty (20) or forty (40) proportional, fully overlapping faders shall be provided with 45mm potentiometers and select/bump buttons.
   b. The faders shall provide direct manual control of intensity for all channels. Channel levels may be changed at any time by using the individual channel faders. Buttons shall select associated channels for control.
   c. Faders shall also control up to ten (10) pages of twenty (20) (or forty (40)) recordable memories or sequences. Memories shall record user-selected channel levels. Sequences shall record user-selected memories or channel levels.
      i. With color mixing systems, output of color from fixtures shall appear to be a combination of the active memories in a color space.

3. Programming Tools
   a. The console shall provide a 7" color multi-touch touchscreen with six (6) softkeys, as well as touch-based controls. The LCD shall provide system configuration, programming show data and multi-parameter control.
   b. Touch-based tools shall include:
      i. Forty (40) programmable color chips, white and color pickers.
      ii. Touch-based parameter controls with reference-based palettes.
      iii. Virtual Level/Rate wheel.
      iv. Virtual keypad for level entry.
      v. Customizable channel display using Stage Map. It shall be possible to rearrange the graphical representations for control channels to closely mimic the positions of fixtures in the venue.
      vi. Effects (intensity, color, shape, and parameter)
         - It shall be possible to assign multiple effects to the same channel and parameters. The playback of those effects shall play levels back relative to the combination of the two effects.
   c. Fixture selection shall be made via:
      i. Auto fixture selection on fader moves.
      ii. Pressing the selection button under channel faders.
      iii. Touching the channel icon in the stage map display on the touch screen.
      iv. Fixture Tags for Quick Selects
         - Selection of multiple fixture shall be possible through a special control dock that groups channels together based on the channel tile positions within a pre-defined area in the topographical view for channels.
         - Selection shall be possible through the use of informational tags. Selecting a predefined tag selects all fixtures sharing that same tag. At least two tags may be assigned to any one channel.
         - There shall be at least 27 Quick Select groupings.
   d. Two independent channels shall be provided with on/off functionality. Independents shall be patched in a location separate from patch.
   e. Image Playback
      i. It shall be possible to import image files to be stored on the console's internal drive.
      ii. Image files shall be played back from cues, playback faders as well as selecting the file and playing from the image tab.

C. Interface Options

   1. DMX512-A/RDM output (two (2) 5-pin XLR connectors).

D. Physical

   1. All operator controls and console electronics shall be housed in a single desktop console.

a. Size and weight:
   i. Twenty (20) fader console shall be equal to or less than 18.31" (465mm) wide 11" (279mm) deep 2.36" (60mm) high (including controls) and6.9 lbs. (3.13 kg.)
   ii. Forty (40) fader console shall be equal to or less than 26.31" (668mm) wide 11" (279mm) deep 2.36" (60mm) high (including controls), and 9.55 lbs. (4.33kg).

3. Twenty (20) Fader console shall be able to be mounted into a 19” equipment rack with the use of additional mounting hardware.
4. Console power shall be 12V AC or DC via an external power unit. The power unit shall operate with 90-265VAC line voltage, 50 or 60Hz. Console shall be provided with a universal power supply.

2.4 POWER AND DATA DISTRIBUTION EQUIPMENT

A. Data Plug-In Stations

1. General
   a. The Plug-in Stations shall consist of the appropriate connectors required for the functional intent of the system. These stations shall be available with DMX input or output, or Network connectors. Custom control connectors shall be available.
2. Connector Options
   a. The following standard components shall be available for Plug-in Stations:
      i. 5-Pin male XLR connectors for DMX input.
      ii. 5-Pin female XLR connectors for DMX output.
      iii. RJ45 connectors for Network connections - Twisted Pair.
   b. Custom combinations and custom control connections shall be available.
3 Physical
   a. Station faceplates shall be .80” aluminum, finished in fine texture, scratch-resistant black powder coat. Silk-screened graphics shall be white.
   b. The station panel shall mount into an industry standard back box, depending on size and quantity of connectors. A terminal block shall be supplied for contractor terminations.

B. Connector Strips

1. The connector strips shall be the ColorSource Raceway by ETC, Inc., or approved equal.
2. General
   a. Connector strips shall provide distributed power form incoming circuits to plugs along a raceway.
   b. Internal wiring shall be sized to circuit ampacity and shall be rated at 125°C.
   c. Connector strips shall support a combination of line voltage power and low voltage data distribution within a single raceway.
   d. Connector strips shall be listed by a nationally recognized test lab (NRTL). Connector strips that are not listed shall not be acceptable.

3. Physical
   a. Connector strips shall be 127mm H x 45mm D and fabricated from 1.6mm aluminum finished in black, white, or silver fine-texture powder coat paint.
   b. Connector strips shall be available in any length up to 72ft / 2195cm in specified increments of 1ft / 30.5cm and shipped fully wired with all splicing hardware.
   c. Connector strips shall weigh no more than 2.5lbs/ft. Connector Strips that weigh more than 2.5lbs/ft shall not be acceptable.
   d. Two connector panels supporting power and data outlets shall be supported for each 1ft / 30.5cm section of strip and shall be mounted on individual 125mm panels.
   e. Frames and connector panels shall be fabricated from 3mm die cast aluminum finished in black, white, or silver fine-textured powder coat paint.
   f. Circuits shall be labeled above each connector on the front of the strip using 15mm reverse silk screened lexan labels. All labels match connector strip finish with contrasting color circuit designations. Optional write-on labels shall be available upon request, connector strips that do not support write-on labels shall not be acceptable.
   g. Connector strips shall be supplied with appropriate brackets and hardware for mounting.
   h. Connector strips shall utilize junction brackets on 6ft / 152cm centers and support spans up to 12ft / 305cm between hanger brackets.
   i. Mounting brackets shall be 45mm x 3mm and 45mm x 1.9mm ASTM A5008 steel. All mounting hardware shall conform to ISO 898-1 class 8.8.
4. Electrical
   a. Connector strip shall support 120V/60Hz power input per branch circuit with support for multiple outlets wired to each circuit.
   b. The connector strip wiring terminal box shall support a maximum of eight 20A inputs utilized for:
      i. Up to six circuits for power distribution along the length of the connector strip.
      ii. One circuit for DMX Active Pass-thru connectors when required.
   c. The connector strip terminal box shall support hardwired or pluggable connector power and data input.
   d. Pluggable power and data inputs shall be fed by a single multi-conductor cable and a single DMX or Ethernet cable. The LKS data connector by Link S.r.l. or Link USA, Inc shall be supported, connector strips that do not support the LKS data connector shall not be accepted.
   e. Power output connectors shall be available as 20A grounded stage pin, 20A Twist-Lock, 20A "U" ground (dual rated "T-slot"), and 20A Neutrik powerCON TRUE1. Connector strips that utilize connectors that are not rated for plugging hot loads shall not be accepted.
   f. Terminations shall be consolidated at one end and utilize feed-through terminals individually labeled with corresponding circuit numbers.
      i. Performance lighting circuits shall utilize tension clamp terminals listed for AWG 20 – 8 / 0.5mm2 – 6mm2 gauge wire.

ii. Work light and DMX Active Pass-thru circuits shall use tension clamp terminals listed for AWG 20 – 12 / 0.5mm2 – 4mm2 gauge wire.
iii. Terminals that place a screw directly on the wire are not acceptable.

g. A low voltage data distribution system shall be supported to incorporate DMX/ RDM (ANSI E1.11-2008 USITT DMX512-A and ANSI E1.20 Remote Device Management) or Ethernet (IEEE 802.3).
i. Ethernet connections shall utilize standard RJ-45 connection.
ii. DMX output ports shall utilize 5-pin XLR style connectors.
iii. Connector strips shall utilize a voltage barrier to accommodate class 2 wiring in the same strip as class one circuits.
iv. Low voltage signals shall enter the connector strip via a strain relief or connector mounted at the specified end of the connector strip. One low voltage cable shall be supported for each connector strip.
v. Connector strips with multiple DMX outputs shall use active DMX/RDM pass through assemblies. Each strip shall support up to 24 active DMX/RDM pass through assemblies.
vi. DMX outputs without active splitting of the DMX/ RDM signal or that do not support RDM shall not be acceptable.

PART 3 – EXECUTION

3.1. INSTALLATION

A. It shall be the responsibility of the Electrical Contractor to receive and store the necessary materials and equipment for installation of the theatrical system. 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. The contractor shall deliver on a timely basis to other trades any equipment that must be installed during construction.

B. The electrical contractor shall be responsible for field measurements and coordinating physical size of all equipment with the architectural requirements of the spaces into which they are to be installed.

C. The electrical contractor shall install all lighting control and data equipment in accordance with manufacturers approved shop drawings.

D. All branch load circuits shall be live tested before connecting the loads to the power control system load terminals.

3.2. MANUFACTURER'S SERVICES

A. Upon completion of the installation, including testing of load circuits, the contractor shall notify the system manufacturer that the system is available for formal checkout.

B. Notification shall be provided in writing, three weeks prior to the time that factory-trained personnel are needed on the job site.

C. No power is to be applied to the system unless specifically authorized by written instructions from the manufacturer or manufacturer's representative.

D. The purchaser shall be liable for any return visits by the factory engineer as a result of incomplete or incorrect wiring.

E. Upon completion of the formal check-out, the factory engineer shall demonstrate operation and maintenance of the system to the owner's representatives. Training shall not exceed four working hours. Additional training shall be available upon request.

3.3 WARRANTY

A. Manufacturer shall warrant products under normal use and service to be free from defects in materials and workmanship for a period of two years from date of delivery.
   1. Exception: Theatrical LED fixtures shall be warranted for a minimum of five years.

B. Warranty shall cover repair or replacement of such parts determined defective upon inspection.

C. Warranty does not cover any product or part of a product subject to accident, negligence, alteration, abuse or misuse. Warranty does not cover any accessories or parts not supplied by the manufacturer.

D. Warranty shall not cover any labor expended or materials used to repair any equipment without manufacturer's prior written authorization.

END OF SECTION 260580

SECTION 260585

RIGGING

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 GENERAL REQUIREMENTS

A. Related Documents

1. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Governing Clause

1. For the sake of brevity, these specifications shall omit phrases such as "Contractor shall furnish and install", "unless otherwise indicated or specified", etc., but these phrases are nevertheless implied. Mention of materials and operations requires the Contractor to furnish and install such materials and perform such operations completely to the satisfaction of the owner's representative.

C. Scope of Work

1. One company shall be responsible for the installation of all aspects of the stage rigging equipment. Work under this section shall include furnishing all labor, materials, tools, transportation services, supervision, etc., necessary to complete installation of the stage rigging equipment as well as any other items as herein listed, all as described in these specifications, as illustrated on the accompanying drawings; or as directed by the Owner's Representative. Work includes the following:
   a. Motorized Rigging

D. Substitutions:

1. Specific items of equipment are specified by trade names. It has been determined by the systems designer that these are the particular items desired by the Owner and establish a standard of quality, equipment function and/or process. It is not the purpose or intent of these documents to eliminate competitive bids. In order to allow proper and fair comparison of pricing, contractors are required to submit their base bid price on the specified equipment. A contractor may submit an alternate bid based on equipment different from that specified only if that Contractor has received prior approval in writing from the Architect at least 10 days prior to bid. Accompanying each request shall be a letter specifically detailing each substitution including catalog data, specifications, operative samples, technical information, drawings, performance and test data, and complete descriptive and functional

information to assist in a fair evaluation. Failure to submit any substitution for prior approval or not providing sufficient data for evaluation shall require the exact item specified to be furnished. Architect's approval of a substitution for bid purposes will not relieve the contractor from the responsibility of meeting all specification criteria. If an approval of a substitution is granted, the Contractor shall be fully responsible for any and all changes (wiring, power, distribution, support structure, etc.) such substitution shall require.

E. Defective or Non-Approved Materials

1. Should any equipment be found defective, not meeting specifications, or that which has not been approved in writing by the Architect shall, upon discovery (including any time within the period of the guarantee), be replaced with the specified equipment or material at no additional cost.

F. Guarantee

1. The Contractor shall guarantee all of the work that is performed under this contract, including all materials, and workmanship, for a period of three (3) years from the date of full acceptance of the work in accordance with the following conditions.

2. Warranty shall be in effect on materials and equipment for three years from the date of system commissioning under the following conditions:

   a. Maintaining the warranty in effect requires annual inspection of the system by a factory trained and certified contractor. Continuing annual inspection is strongly encouraged.

   b. The three year warranty is contingent upon annual inspection at the end of the first and second years of service. The end user is responsible for making arrangements for each inspection with the contractor identified on the Motor Controller or a factory certified inspector/installer.

   c. In the event annual inspection is not requested and performed at the end of the first or second year of service, the warranty shall become void at the end of that year of service.

   d. Each warranty inspection report must be sent to the factory by the inspecting contractor within 10 days of completing the inspection.

3. Nothing in this guarantee shall cause repair or replacement by the Contractor where negligence, neglect or improper operation by the Owner has caused the failure of any equipment installed under this contract.

G. Discrepancies

1. All equipment shall be sized to fit properly. The exact measurements are the responsibility of the Contractor. If there are discrepancies in the specifications, the Contractor shall ask for a clarification from the Architect. If no clarification is requested, the Architect's judgment shall rule.

H. System Integrator

1. The Contractor may utilize a System Integrator to coordinate and assist in the installation of all aspects of the motorized rigging equipment as specified in this section. This shall include but not be limited to all motorized rigging and miscellaneous equipment. The following companies have prior approval as System Integrator:

2. In order to be considered as a System Integrator on this project, each Contractor requesting approval must submit to the Architect at least ten (10) days prior to the date of bid opening a letter expressing his intent to bid. This letter shall include a list of at least five (5) projects of similar size and scope completed by this firm within the last five (5) years. Inspection of one completed installation may be requested by the Architect/Engineer's Representative prior to consideration of request to bid. The System Integrator shall have been in business under the same name for five (5) full years preceding the date of this bid doing work similar to the type specified. ETCP certification in theatre rigging is required by the lead installer or project manager of the System Integrator to receive approval to bid. Verification of this certification must be provided to be considered for approval. The decision of the Architect as to the capability of the Bidder to successfully complete and maintain the system based on this pre-qualification information shall be final.

3. Pre-Bid request letter shall include a statement that all major items of equipment shall be bid and supplied as specified or shall contain details of all proposed substitute equipment for review by the Architect/Engineer's Representative. Substitute equipment items to include specifications, parts numbers, and details of interconnection to proposed system. The decision of the Architect as to the acceptability of substitute equipment shall be final.

4. The System Integrator shall employ only fully trained stage riggers and mechanics, for the erection of the stage equipment. The stage riggers shall be completely familiar with the type of equipment to be installed. A competent job superintendent shall be on the job at all times when work is in progress. The job superintendent must be ETCP certified in theatre rigging. A copy of the certification must be furnished to the General Contractor prior to the start of the installation.

I. Acceptable Equipment Manufacturers

1. For the purposes of establishing a standard of quality desired on this project, the rigging hardware products of Electronic Theatre Controls of Middleton, Wisconsin are specified.

2. All other companies must receive prior approval to bid this project. Please refer to the section regarding substitutions.

J. Documentation

1. SHOP DRAWINGS: Shop drawings and equipment data sheets shall be submitted to the Architect under general provisions within 45 days after award of the contract. Failure to comply with this 45 day requirement shall be cause for disqualification

of the selected Contractor and cancellation of contract without cost to the owner, on the basis that the selected Contractor does not have the ability or intention to comply with the specifications. Approval of submitted equipment shall be obtained prior to equipment purchase or fabrication. If shop drawings are rejected, correct and resubmit in the manner specified. All shop drawing information shall be submitted at the same time; no partial submittal shall be accepted. Drawings shall indicate complete details, dimensions, product types and locations of all equipment, clearances required, guides, cables, sets, Contractor fabricated equipment, and all other details required to completely describe the work to be performed. Submittals drawings shall be presented at a scale not less than 1/4" for equipment layouts and ½" = 1'-0" for equipment details, mounting and other details. Each sheet shall allow space for approval stamps and have the name of the project, the contractors and/or the supplier's name, address telephone number, and the date submitted. Submit the following items for Architect's approval, prior to fabrication:

a. Stage plan view.
b. Stage side section view.
c. Gridiron layout indicating all stage equipment.
d. Electrical riser diagrams indicating the necessary power and control wiring for all rigging equipment and systems.
e. Plan and elevation views indicating all power, motor and control hardware locations and layout.
f. Provide full dimensions for panel layouts with finishes and materials for all custom panels.
g. Details of installation and erection, including adjoining conditions and necessary clearances.
h. Indication by arrow and boxed caption of each variation from contract drawing and specifications, except those indicated as acceptable in specifications or on drawings.

2. RECORD DRAWINGS AND DATA: Submit in accordance with General Provisions. Within 30 days of final test and completion of the installation, submit the following to the Architect:
   a. Three (3) complete sets of "as built and approved" drawings showing systems and elements as installed, including field modifications and adjustments.
   b. Three (3) sets of maintenance data including a list indicating replacement parts lists for all items of equipment, wiring diagrams, control diagrams, any and all keys for cabinets, racks, key operated switches etc. and complete operation manuals.
   c. Three (3) Certificates of Guarantee.

3. INSTRUCTION OF OWNER PERSONNEL: This contractor or his representative, fully knowledgeable and qualified in systems operation, shall provide four (4) hours of instruction to the Owner-designated personnel on the use and operation of this System. Designated instruction times shall be arranged through the Architect.

4. PERMITS: Obtain all permits necessary for the execution of any work pertaining to the installation and conform in all trades with all applicable local codes and national codes. Obtain all permits necessary for operation of any equipment by the Owner.

5. CLEAN UP: It shall be the responsibility of this Contractor to remove all debris from the building or site caused by his operations to a common trash point or receptacle on the job site, as determined by the General Contractor.

END OF SECTION 260585

SECTION 260595

QUICKTOUCH FIXED SPEED CONTROL SYSTEM

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 GENERAL

A. The entire motor system shall be operated by a QuickTouch fixed speed controller. It shall be purpose-designed and fabricated to manage and operate motors specifically designed for overhead lifting. Each system shall incorporate mechanical, electrical and safety features that shall be inherent to this equipment and shall provide an engineered, efficient device to control the equipment. The mechanical, electrical and safety features of this control system shall establish the standard of quality, performance and safety by which motoring systems of other manufacture shall be evaluated.

B. The QuickTouch Control System shall consist of a surface, flush or rack mounted primary control panel and up to three remote E-stop stations.

C. The motoring system shall also include one QuickTouch Fixed Speed Remote control device with 30’ of flexible cable that may be attached to the system at the QuickTouch control panel.

D. The controller shall include the following features:
   1. Key operated power switch
   2. LCD display for feedback/operating information
   3. Key operated motor load profile training/enable switch
   4. Latching motor selection buttons with rear illuminated naming tabs
   5. Rear illuminated hold-to-operate (dead-man) up and down operation buttons
   6. Dedicated E-stop button
   7. Outlet for wired remote
   8. Optional door
   9. Optional rack mount kit

E. The control system shall only employ the QuickTouch controller, a power and control distribution infrastructure and the motors. A System that requires separate drive cabinets or motor-starters shall not be acceptable.

1.2 ENCLOSURE

A. The back box and face panel shall be fabricated from 16ga powder coated sheet steel specially formed to provide support for installation as well as support for all components installed within the housing.

B. The QuickTouch face panel shall be printed with complete labeling information to identify the function of each of the buttons in the control station.

C. The face panel shall identify the system as a QuickTouch controller for stage rigging.

D. The face panel shall be shades of grey. The ring surrounding the E-stop button shall be safety yellow and shall be rear illuminated

E. The steel panel to which all switches are mounted shall be removable via screws in the surface located underneath the face panel film.

1.3 LCD SCREEN

A. The liquid crystal display shall be purpose designed to communicate all information in human readable text.

B. The screen shall be rear illuminated and shall be dimmable.

C. During system start up the screen shall show the progress of the motors diagnostics self-tests. Upon completion of the startup sequence the screen shall indicate that the system is “OK” or shall provide specific information should a fault be detected. Fault conditions shall be reported in human readable text. Systems that report fault conditions in a series of blinking lights shall not be acceptable for this installation.

D. When a motor is selected the LCD screen shall readout the motor name or number, its current position above the floor, the amount of weight suspended from the batten, the preset position that is recorded, as well as a bar graph scale that shows the current position of the motor, top and bottom limits and the current weight suspended from the motor.

1.4 MOTOR SELECTIONS/OPERATION BUTTONS

A. There shall be rear illuminated motor selection buttons. Buttons shall remain illuminated until de-selected.

B. Up to four motors may be selected to move at one time. When the up or down button is pushed and held, each motor shall move to its next stop location. If the stop location is the adjustable preset, the motor can be made to continue to travel in the selected direction by releasing and re-pressing the up or down hold-to-operate button until the next stop for the motor(s) is reached.

C. A maximum of four motors may move at one time and only in one direction at a time.

D. Although four motors moving at one time is the factory default, it shall be possible to increase to eight or reduce to one the quantity of simultaneously moving motors.

E. As a backup, there shall be dedicated hardware to detect and disable the system when the user attempts to move more than the configured maximum quantity of motors.

F. All buttons shall fit neatly within each of the cover panel cutouts on the controller.

1.5 KEY SWITCHES

A. A key switch shall control power to the control system. The key must be in the lock and the key turned to the on position for the motoring system to operate.

B. A separate key is required to turn on the load profiling system. That key must be in the lock and turned to the “ON” position for load profiling to function.

C. When load profiling is turned on the motor shall know the amount of weight that is supposed to be supported by the batten at any location in the path of travel. Should the weight exceed or be reduced below the profiled weight by a preset value, the motor shall stop operation until the fault is cleared.

1.6 SLACK LINE DETECTOR

A. The slack line detector is located in the Powerhead. When a slack line condition occurs, it shall cease motor movement and result in a fault message on the LCD screen on the controller. Movement in the upward direction shall be possible to clear the fault.

1.7 E-STOP

A. The E-stop button on the QuickTouch controller shall be a mushroom button with a rear illuminated ring surrounding the button. During normal operation the E-stop button shall be in the out position. An E-stop can be activated via this button by firmly pressing the button in. The button shall latch and immediately cause a class zero stop of all motors in the system. The LCD screen shall report this as an E-stop fault. To continue system operation the E-stop button must be cleared by twisting the button to release the latch. Power to the control station must be cycled off/on to re-initiate the system. This action shall also initiate a self-test of the entire control system and contactors.

B. The illuminated ring around each E-stop button shall be dimmable. The status of the lighted ring shall provide additional information about the state of the system as follows:
   1. Ring at low intensity: no motor moving.
   2. Ring at high intensity: motor(s) moving.
   3. Ring blinking: system in E-stop condition.

C. Up to three remote E-stop stations may be connected to the system. Each additional E-stop station shall operate in the same way as the primary E-stop at the QuickTouch control panel.

1.8 SYSTEM DIAGNOSTICS

A. Upon energization the control system shall perform an automatic series of diagnostic tests that assure that all system safety functions are working. Should an error in the safety functions be determined, the controller shall report back a fault condition in the LCD display window and shall identify the nature of the fault.

B. Monthly, the system automatically shall perform an additional series of diagnostic tests to determine if there are any problems with any portion of the motor control system safety features. In the event of a problem, the controller shall report back a fault condition in the LCD display window and shall identify the nature of the fault.

C. Eleven months after a system inspection has been performed, the system shall remind the user to schedule full system maintenance/inspection. The reminder shall remain in the system with a count-down calendar until it is turned off by the factory authorized and trained inspector.

D. The installing contractor shall be able to leave contact information within the system. This information shall be displayed at power up and in the event of severe fault conditions.

1.9 REMOTE CONTROL PENDANT

A. An optional remote control pendant with 30' long attached cable and plug shall be provided for the system. The remote control must be plugged to the QuickTouch control panel. When the remote control is plugged in the E-stop on the remote is active. Systems requiring "shunt plugs" to bypass an unplugged remote control connector shall not be acceptable.

B. The remote control provides up/down control for those motors that have been preselected at the QuickTouch controller.

1.10 SYSTEM COMMISSIONING

A. It shall be possible to commission basic functionality of the system without a laptop computer or additional software.

B. A trained installer shall commission the full system via a laptop computer connected via the built-in USB port in the controller. USB connectivity shall not require special USB drivers.

C. Commissioning software shall feature an inspection report generator that allows a step by step inspection of the control system. Upon completion, the system shall generate an inspection report in PDF format.

PART 2 - INSTALLATION

2.1 GENERAL

A. Installation of this equipment shall only be performed by ETC approved and factory trained theatrical rigging installers. Installation shall be performed in a workmanlike manner and shall strictly adhere to the standards of these specifications and ETC's installation requirements. Where necessary, the installer may make adjustments to accommodate unforeseen impediments to installation. The completed work must achieve all electrical, safety and appearance requirements as established in these specifications.

B. Work shall be performed in accordance with OSHA and local codes.

C. On site welding shall only be performed per AWS D1.1 standards and with advanced approval from the architect or Owner's representative.

D. Division of Responsibilities

1. The Rigging contractor shall be responsible for providing and installing:

   a. Powerhead.
   b. Compression Tube, Compression Tube splices and Compression Tube beam clamps.
   c. Supplementary steel and/or mounting adapters for the hoisting systems, if required.
   d. Loft blocks.
   e. Wire rope lift lines and terminations.
   f. On electrics line sets: Cable Management system for distribution raceways, including low-voltage, ground and data wiring.
   g. On electrics line sets: Factory prewired electrical termination boxes that are part of the cable management system.
   h. On electrics line sets: Factory prewired distribution raceway mounted at the bottom of the wire rope on the stage electrics sets.
   i. Pipe batten attached to RACAs or Hanger Brackets.
   j. Batten end caps.
   k. Batten labels.
   l. Attachment of the prewired twist-lock connector to the Power and Control Distribution outlet.
   m. Attachment of the prewired circular pin connector data wire to the mating outlet on the Powerhead and on the Power and Control Distribution box.
   n. Termination of the low voltage data wiring at the controller and at all power and control distribution boxes and at each E-stop station.
   o. Face plates for all Control Stations, E-stop Stations and Power and Control Distribution Boxes.
   p. Set limit switches.

2. The Electrical contractor shall be responsible for providing and installing:

   a. All pipe, wiring and termination providing line voltage to all the Power and Control Distribution boxes.
   b. All pipe and wiring connecting data lines between the first Power and Control Distribution Box and the Control station.
   c. Pipe and wiring connecting data lines between Control Station and first E-Stop Station.
   d. All pipe and wiring connecting data lines between all E-Stop Stations.
   e. Back boxes for all Power and Control Distribution Boxes, the Control Stations and all E-Stop Stations.
   f. All pipe and wiring and all terminations of line voltage of dimmed and non-dimmed circuits that terminate at the termination boxes mounted on/near the Compression Tube.

END OF SECTION 260595

SECTION 260600

DISCONNECT SWITCHES

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. The work under this section shall include the furnishing of all materials, labor, tools and services necessary to install disconnect switches, fuses and enclosures to complete all work shown on the Drawings or specified herein.

1.2 SUBMITTALS

A. Submit product data under Provisions of Contract and Division 1.

B. Include outline Drawings with dimensions, equipment ratings for voltage, capacity, horsepower and short circuit.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - DISCONNECT SWITCHES

A. Siemens.

B. Square 'D'.

C. General Electric.

D. Or approved equal.

2.2 DISCONNECT SWITCHES

A. Fusible switch assemblies: Quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch is in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate class R, J fuses.

B. Non-fusible switch assemblies: Quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

C. Enclosures: NEMA Type 1; 3R; 4 as indicated on Drawings.

2.3 ACCEPTABLE MANUFACTURERS - FUSES

A. Bussman.

B. Ferraz-Shawmut.

C. Or approved equal.

2.4 FUSES

A. Fuses 600 amperes and less: ANSI/UL 198E, class RK1; RK5; Dual element, current limiting, time delay, 250 volt.

B. Interrupting rating: 200,000 rms amperes.

C. An additional fuse of each size required to be supplied.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install disconnect switches where indicated on Drawings.

B. Install fuses in fusible disconnect switches.

C. Disconnects installed outdoors shall have NEMA 3R enclosures.

D. Disconnects installed indoors in dry locations shall have NEMA 1 enclosure.

END OF SECTION 260600

SECTION 260650

GROUNDING

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. The work under this section shall include the furnishing of all materials, labor, tools and services necessary to install the power system grounding to complete all work shown on the Drawings or specified herein.

1.2 RELATED WORK

A. Panelboards.

B. Raceways.

C. Connection Equipment.

D. Electric Equipment.

E. Tests and Acceptance.

F. Transformers.

G. Electric Service.

1.3 SUBMITTALS

A. Manufacturers' data, catalog cuts of ground rods, connectors, bushings, etc., along with recommended installation procedures.

PART 2 - PRODUCTS

2.1 WIRING

A. All wiring used for grounding shall be insulated copper, unless otherwise noted. Size shall be in accordance with code for the application, minimum #12.

B. Where used in conjunction with computer equipment, grounding conductors shall be equal in size to the phase conductors.

C. Avoid splices in ground conductors.

2.2 RACEWAY

A. Grounding continuity shall be maintained for all metallic raceways.

B. Provide bonding jumpers across metal parts separated by non-conducting materials.

C. Where a grounding conductor is installed as a supplement to metallic raceway serving as the equipment grounding conductor, bonding conductor to the raceway at each end.

D. All raceway accessories, such as locknuts, bushings, expansion fittings, etc. shall be installed to provide maximum metal-to-metal bonding.

2.3 CLAMPS

A. Provide approved ground clamps for connecting grounding conductors to pipe, conduits, wireways, building steel, grounding rods, etc.

B. Where bond will be in an inaccessible location or as an alternate to ground clamps, provide exothermic weld, similar to Cadweld.

2.4 ACCESSORIES

A. Provide all necessary accessories of appropriate size and material for connection or termination of grounding conductors including:

1. Straps.
2. Clamps.
3. Lugs.
4. Bars and buses.
5. Isolators (where applicable).
6. Locknuts and bushings.

2.5 ACCEPTABLE MANUFACTURERS

A. Copperweld.

B. Cadweld (for exothermic welds).

C. O.Z. Gedney.

D. Burndy.

PART 3 - EXECUTION

3.1 SERVICE ENTRANCE/SWITCH

A. Coordinate all bonding and grounding requirements of the service entrance with the utility company.

B. Provide ground lug in each switchboard, minimum 25% of phase bus, along entire length of switchboard.

C. Separately connect each ground to existing grounding electrode. Test existing grounding electrode for proper resistance values and provide all necessary modifications required.

3.2 TRANSFORMERS

A. Bond each transformer secondary neutral to nearest building structural column or beam via transformer case grounding stud.

B. Provide jumper between transformer case and all conduit bushings.

C. Where a separate equipment-grounding conductor is provided the primary and/or secondary feeders; bond to transformer grounding stud.

D. Where isolation shield is provided, bond to transformer grounding stud.

E. Where a separate ground riser is provided in addition to or instead of building steel; bond transformer-grounding stud to the ground riser.

3.3 STRUCTURAL STEEL BUILDINGS

A. Select a column common to aligned electric closets as the bonding column for grounding of transformer neutrals, isolated grounds and separate equipment grounding conductors.

B. All grounding conductors in each closet shall be bonded in close proximity to one another.

C. Where a grounding conductor to be bonded is not in proximity to the common column, bond to the nearest column or structural beam.

D. Provide bonding jumper strap across all structural expansion joints where the grounding integrity of the structural system is reduced

3.4 RACEWAYS

A. Grounding continuity is to be maintained for all metallic raceways. Provide necessary clamps, bushings, straps and locknuts to assure continuity.

B. For non-metallic or flexible raceways, provide a separate equipment-grounding conductor bonded to both ends.

C. Where indicated, an additional equipment-grounding conductor shall be provided in metallic raceway.

D. Where indicated, an isolated ground conductor shall be provided in addition to the equipment-grounding conductor. Bond at each end to the isolated ground terminal identified.

3.5 EQUIPMENT

A. All equipment shall be grounded.

B. Where isolated grounding is indicated, it shall be for the isolation of internal equipment components only. All metallic enclosures of such equipment shall be connected to the equipment ground system.

3.6 PANELBOARDS

A. All panelboards and distribution panels shall be provided with a ground bar bonded to the enclosure. Provide an isolated ground bar connected to the incoming feeder ground where indicated.

3.7 TESTING

A. Upon completion of the installation, confirm the grounding continuity of all raceways, conductors and equipment. Maximum allowable resistance is 25 ohms.

3.8 RECORD DRAWINGS

A. Submit record As-Built Drawings indicating the location of all points where grounding conductors are bonded to steel, rods, plates, etc.

B. Indicate the location of all grounding buses not installed within distribution equipment.

END OF SECTION 260650

SECTION 260700

PANELBOARDS

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. The work under this section shall include the furnishing of all materials, labor, tools and services necessary to install the panelboards and to complete all work shown on the Drawings or specified herein.

1.2 RELATED WORK

A. Grounding

B. Overcurrent Protection

1.3 SUBMITTALS

A. Submit shop drawings for equipment and component devices under provisions of Division 1.

B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

C. Furnish two (2) sets of keys to Owner.

1.4 REFERENCES

A. FS W-C-375 - Circuit breakers, molded case, branch circuit and service.

B. FS W-P-115 - Power distribution panel.

C. NEMA AB 1 - Molded case circuit breakers.

D. NEMA KS 1 - Enclosed switches.

E. NEMA PB 1 - Panelboards.

F. NEMA PB 1.1 - Instruction for safe installation, operation and maintenance of panelboard rated 600 volts or less.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - PANELBOARD AND LOAD CENTERS

A. Siemens.

B. Square "D".

C. General Electric.

D. Or approved equal.

2.2 BRANCH CIRCUIT PANELBOARDS

A. Lighting and appliance branch circuit panelboards: NEMA PB 1; circuit breaker type.

B. Enclosure: NEMA PB 1; Type 1.

C. Cabinet size: Approximately 6 inches deep; 20 inches wide for 240 volt and less panelboards. Verity field conditions and alter dimensions to suit at no additional cost.

D. Provide surface cabinet front door-in-door with concealed trim clamps, concealed hinge and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

E. Provide panelboards with copper bus, rating as scheduled on Drawings. Provide copper ground bus in all panelboards and isolated ground bus in those as indicated on Drawings.

F. Minimum integrated short circuit rating: 10,000 amperes rms symmetrical for 240 volt rated for 125 amps or less, 22,000 amperes rms symmetrical for 240 volt rated greater than 125 amps to 225 amps and 30,000 amperes for emergency power panelboards (verify in field). If panelboard is noted as a main distribution panelboard, then panel shall be rated as a distribution panelboard. Contractor shall provide short circuit study to ensure adequacy.

G. Molded case circuit breakers: Bolt-on type thermal magnetic trip handle for all poles. Provide circuit breakers UL listed as type SWD for lighting circuits. Breaker handle to indicate ampere rating.

2.3 DISTRIBUTION PANELBOARDS

A. Description: NEMA PB 1, circuit breaker type. The bus of all panels rated a minimum 400 amps shall be distribution type.

B. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.

C. Minimum integrated short circuit rating: 65,000 amperes rms symmetrical for 240 volt panelboards; 65,000 amperes rms symmetrical for 480 volt panelboards, unless otherwise noted on Drawings.

D. Model Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR as specified on Drawings.

E. Enclosure: NEMA PB 1, Type 1.

F. Cabinet Front: Surface type, fastened with screws. Double hinged doors with flush lock, metal directory frame, finished in manufacturer's standard gray enamel. One hinged door to access breakers, the other to access wiring compartment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards flush or surface mounted as indicated on Drawings.

B. Mounting height maximum 6 ft. (2 m) to top circuit breaker.

C. Provide filler plates for unused spaces in panelboards.

D. Provide type written circuit directory for each branch circuit panelboard. Indicate loads served and panel name by matching that shown on panel schedules on Drawings. Revise directory to reflect circuiting changes required to balance phase loads. Provide a second copy and turn over to Owner.

E. Provide 3/4" thick plywood backboard for mounting of panels. Paint backboard with fire retardant paint.

F. Provide nameplates as indicated in Section 16550.

3.2 FIELD QUALITY CONTROL

A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.

B. Visual and mechanical inspection: Inspect for physical damage, proper alignment, anchorage and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches and fuses.

C. Provide thermographic inspections in accordance with Section 260100.

3.3 TESTS

A. Submit certification that each panelboard has withstood, without breakdown, a factory dielectric (Hi-Pot) test consisting of a one minute application of a 60 cycle AC test voltage applied between phase legs and from each phase leg to enclosure.

B. The applied test voltage shall have an RMS value of at least twice the line to line system voltage to which the panelboard is to be applied, plus one thousand volts (minimum 1500V).

3.4 RECORD DRAWINGS

A. Submit As-Built Drawings indicating the location of all panelboards.

END OF SECTION 260700

SECTION 260725

SWITCHBOARD

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 RELATED DOCUMENTS

A. The Contractor, Subcontractors, vendors and the like shall meet all Con Edison requirements.

1.2 SUMMARY

A. Work of this section shall be governed by the contract documents. Provide materials, labor, equipment and services necessary to furnish, deliver and install all work of this section as shown on the drawings, as specified herein and/or as required by job conditions.

B. The work shall include, but not be limited to, indoor, low voltage switchboards of the circuit breaker, front accessible only, rear aligned, groove mounted type, as shown on the drawings and specified herein.

1.3 REFERENCES

A. Related Work Specified Elsewhere

1. General Conditions: Section 26 0100
2. Overcurrent Protective Devices: Section 26 0320

1.4 INTENT AND CODES

A. This specification describes the equipment required. It does not cover all phases of manufacture or assembly. Supplier shall assume the responsibility for providing well-integrated units of good quality.

B. All codes, rules, regulations and ordinances governing this work, are as fully a part of this specification as if herein repeated or hereto attached. Where the requirements of this specification are more stringent than any applicable codes etc., the specification shall apply.

1.5 MATERIAL AND WORKMANSHIP

A. Unless otherwise specified all materials shall be new. Supplier shall be responsible for defects in equipment and devices furnished but not manufactured by him. Exposed finishes and other features shall match in all respects. Supplier alone shall be responsible for all errors of fabrication and for correct fitting of all components that must be erected and joined in the field.

1.6 SHOP DRAWINGS

A. Complete shop drawings showing size and arrangement of equipment, foundation and anchor bolt requirements, bill of materials, performance data and curves, wiring and elementary diagrams, methods of assembly, connections to other work and other pertinent data as called for in the various parts of this Specification shall be furnished by the Supplier for checking and approval.

1.7 MAINTENANCE AND OPERATING INSTRUCTIONS

A. In addition to submittal for approval, furnish to the Owner's Representative six (6) copies of the items listed below for all equipment and material furnished under this specification.

B. Each approved shop drawing, including all final comments, shall be folded down so that it can be placed in a loose leaf binder of the size using standard 8-1/2" x 11" paper. The drawings shall be folded in a manner that they can be fully opened without removal from the binder.

C. Complete detailed parts lists and/or assembly drawings.

D. All governing agencies' and/or manufacturer's test certificates, permits and inspection reports, insurance inspection and all shop or field performance tests, when required.

E. All operating and maintenance manuals as required by this specification. Such manuals shall be edited to identify equipment furnished.

F. Approved catalog cuts and/or material lists as required by this specification.

G. The Manufacturer's Specification, including tabulation of sizes and identifying numbers for all installed material and equipment. The applicable items in each brochure shall be clearly defined and marked.

H. List of recommended spare parts.

I. All of the above items shall be assembled in books identified for units covered, including all assemblies and components. Each book shall contain Table of Contents page. Forward all the above information except for field test and/or field inspection reports to the Owner's Representative promptly after approval of shop drawings for each item and before delivery of any equipment involved.

1.8 INSPECTION AND SHOP TESTS

A. Materials and/or equipment covered by this specification shall be subject to inspection by the Owner. Owner's Representative shall, during working hours, have access to all parts of the shop where material to be used in this equipment is being manufactured and shall be provided with all reasonable inspection facilities. Release of material and/or equipment shall not relieve the Supplier from contract responsibilities nor invalidate any claim which the Owner may make because of unsatisfactory materials and/or construction. (If you put this in it means witness testing which is an expensive item. I would only do this for a job with extensive medium voltage and up equipment unless you want a road trip out of this Same with B & C.).

B. Operational tests required by the Owner's Representative during inspection to demonstrate that equipment and components comply with the specification, shall be made by the Supplier. Tests shall be made with all removable elements in place unless otherwise permitted by the Owner's Representative.

C. Notify the Owner's Representatives of any scheduled test dates a minimum of one (1) week prior to factory test of equipment. All factory tests shall be witnessed by Owner's Representative unless otherwise directed and performance shall be complete to his satisfaction. A complete written report of tests specified herein shall be submitted promptly to the Owner's Representative

1.9 SHIPPING AND PROTECTION INSPECTION

A. All material, equipment and component parts shall be adequately protected to prevent damage, corrosion or entry of foreign matter during shipment, unheated storage or in a dusty atmosphere.

B. Each packing crate and carton containing components shall be visibly stenciled, clearly identifying contents as to the type(s) of unit(s) contained therein and the related equipment assembly or assemblies.

C. Each shipment shall contain packing slip listing all components.

D. For handling during shipment, lifting irons, eye bolts, or other lifting aids shall be bolted to the housing and shall not be removed until the equipment is in final position. The shipping sections may consist of completely assembled structures or sections of one or more units, as required to suit the handling facilities and to facilitate installation. Wiring that extends between sections to be terminated at accessible terminal blocks with wiring harnesses to facilitate field interconnections. Clearly identify all conductors and terminals.

1.10 SERVICE CONDITIONS

A. The material covered by this specification shall be designed for operation under conditions where the altitude does not exceed 3300 feet and the temperature of the cooling air does not exceed 40 Degrees C. maximum, 30 Degrees C. average, unless otherwise specified.

B. Construction shall conform to requirements for seismic restraints as specified in Section 260515.

1.11 GUARANTEE-WARRANTY

A. Guarantee that all equipment meets the design and performance requirements specified and alter and/or replace, at no costs to the Owner, any piece of equipment which fails to meet these requirements. This shall include any field work and factory trained supervision necessary.

B. All material included herein shall be free from defects and warranted for a period of 18 months from date of shipment of material from factory or 12 months from date of installation. Any parts found defective due to manufacture shall be replaced and reinstalled at no expense to the owner.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Scope

1. This part of the Specification covers the basic equipment and detailed construction requirements, and the required shop drawings to be submitted for the switchboard. All components, electric interconnections and accessories shall be designed and constructed in accordance with the latest applicable standards as recommended by the American National Standards Institute (ANSI), the National Electrical Manufacturers' Association (NEMA), the Institute of Electrical and Electronics Engineers (IEEE), the Underwriter's Laboratory (UL) as well as the construction details specified herein. In case of conflict between the aforementioned Standards and this Specification, the more stringent requirement shall apply.

2. Applicable requirements of all Local Codes shall also be complied with.

3. Switchboards shall conform to the following standards:

a. Underwriters Laboratories (UL) -

UL 891 - "Dead Front Electrical Switchboards".

Switchboards and its components shall be UL listed and labeled.

b. National Electrical Manufacturers Association

NEMA-PB2 - "Dead Front Distribution Switchboards".

NEMA-PB2.1 - General Instructions for proper handling, installation, operation, and maintenance of dead front distribution switchboards rated 600 volts or less.

4. The general arrangements, limiting dimensions, type and/or ratings are shown on the drawings accompanying this Specification. The basic equipment and detailed construction requirements for the various components entering into individual switchboards, shall be in accordance with the applicable provisions of this part. Coordinate the requirements of the various Parts of this Specification with the drawings when ordering equipment or material in accordance with the applicable provisions of this Part.

2.2 REQUIRED SHOP DRAWINGS

A. Shop drawings shall be submitted as specified in Part 1 - General. As a minimum the following drawings shall be submitted for approval in accordance with the procedure indicated, falling into two categories.

B. Drawings for Preliminary Approval to enable Supplier to proceed with equipment ordering and scheduling of fabrication:

1. Front elevation, one line diagram showing main and branch circuit breaker ratings and types and any information required for complete identification and location of major equipment items, including dimension outline sizes, weights, shipping splits, and arrangement of all equipment.

2. Voltage, phase, frequency, horizontal and vertical bus capacities, short circuit ratings.

3. Floor plan and top view showing materials, sizes, anchoring, location of power and control conduit, and ground cable entries above and below.

4. Preliminary Bill of Material or switchboard summary showing all major components.

5. Preliminary schematic diagrams of nonstandard circuits.

C. Detailed Engineering Drawings supplied to Owner promptly after approval of preliminary drawings.

1. Wiring and schematic diagrams of all power circuits. Wiring diagrams shall be separate from schematic diagrams and shall show equipment arrangement, terminal numbers and point-to-point wiring of each piece of equipment and terminal block. Interconnection wiring diagram shall be furnished, showing general physical arrangement of all units and terminal blocks used in wiring between such units. The separate schematic diagrams shall include complete three line diagrams for buses, low-voltage switch and fuse units and any other devices in this Switchboard.

2. Complete Bill of Material, or switchboard summary showing all components and materials, clearly describing same and providing numbers and data for checking.

3. Detailed sections through all frames showing equipment, buswork, bus phasing connections (l) and ground stud assembly on bus.

4. Detailed drawings showing provision for main and feeder bus extension and bus risers and indication of short circuit bracing.

5. Handling, installation and assembly drawing.

6. Final dimensioned outline drawings and accessories, phasing, location of jacking points, etc.

7. Device connection diagrams.

8. Nameplate data sheets.

9. Cable lug type, quantities and sizes.

10. Operating and maintenance instruction manuals for all types of equipment.

2.3 LIMITING DIMENSIONS

A. The dimensions indicated on the drawings are limiting and the orientation of the equipment shall be maintained. If a particular manufacturer's equipment exceeds any of the dimensions shown, it should be clearly stated in his proposal. The Owner will evaluate the cost of accommodating this equipment in the building design when reviewing his bid.

2.4 600 CLASS METAL-ENCLOSED SWITCHBOARD

A. General

1. Switchboard shall be indoor, free-standing, bolt-on circuit breaker type, group mounted, front accessible only, front and rear aligned and suitable for mounting against a wall, complete with all disconnects and accessories as shown on the drawings and specified herein.

2. Switchboards and buswork shall be fabricated to permit future expansion.

3. Where spaces for future circuit breaker units are shown, provide all current carrying components and covers, ready to receive the future units.

4. Provide nameplates for all units.

B. Enclosure

1. The entire assembly shall be totally metal enclosed, of indoor construction unless otherwise noted. Enclosures shall be fabricated of code gauge steel, formed and framed for rigidity. Fixed panels and framework shall be of bolted construction. Assembly shall be 90 inches high unless conditions require otherwise.

2. Cable compartments shall have adequate space for cables as required. Provide cable supports for each vertical section.

3. Housing shall be thoroughly cleaned and degreased after fabrication, bonderized and primed with zinc chromate. Finish shall be two coats of gray enamel, ANSI #61.

C. Buswork

1. Buswork shall be 3-phase, 4-wire fabricated of copper, tin or silver plated throughout extending the entire length of the assembly, ampere rating as shown on the drawings.

2. Main buswork shall have full capacity throughout the entire length of the switchboard. Vertical buswork shall be equal in size to the sum of the switch sizes in the vertical section including spares and spaces with a maximum size equal to that of the main bus. Bus extensions to feeder switches and from the load side of the switches to the cable compartment shall be equal to the size of the switch. The continuous current ratings of the busses shall be determined by temperature rise as limited by ANSI standards and the National Electrical Code. Neutral bus shall be full sized, rating scale as the phase busses.

3. Provide an A-B-C bus arrangement, left to right, top to bottom, front to back, throughout as viewed from the front of the switchboard.

4. Buswork shall be braced and supported to safely withstand short circuit stresses equal to the full available fault currents at the switchboard, minimum 100,000 AIC ampere RMS symmetrical.

5. Provide two-hole long barrel compression cable connectors for cable as indicated per phase, neutral and ground on all incoming conductors.

6. Provide bus tap lugs for connection of transient voltage surge suppressors as close to incoming conductors as possible.

7. Ground bus shall be rated 25 percent of the phase busses with minimum size of 3 inches by 1/4 inch and be continuous for the entire length of the switchboard. Ground bus shall be accessible from the front of the switchboard. Ground bus shall be copper.

D. Circuit Breaker - Provide thermal magnetic circuit breakers with interrupting capacity as shown on the Drawing. Where indicated on distribution schedule on drawing, provide circuit breakers with electronic trip units.

E. Accessories

1. The following accessories shall be furnished with each switchboard.

a. One (1) quart of touchup paint.
b. One set of special wrenches, removable hand cranks, tools as required to maintain and disassemble parts of the switchgear for field maintenance.

F. Approved Manufactures

1. The 600 volt class metal-enclosed switchboard shall be the product of one of the following approved manufactures:

a. General Electric Company - AV5
b. Square D I-line Switchboard
c. Eaton/Cutler Hammer Electric Corporation - POW-R-Line C, or equal.

PART 3 - EXECUTION

3.1 SHIPMENT

A. Prior to shipment, all equipment shall be cleaned. All openings shall be covered to prevent entrance of foreign material. Where necessary, desiccant bags shall be located within cabinets to provide a minimum of 3 months protection.

B. Equipment shall be shipped in sections to facilitate installation, complete with all accessories required for assembly. All wiring that extends between sections shall terminate on terminal blocks at the interface points, with a wiring harness (with framing strips) that will be field installed between adjacent sections. All terminal and wires shall be clearly marked with wire numbers.

3.2 INSTALLATION

A. General: Install and connect switchboard equipment in accordance with approved manufacturer's shop drawings including supplemental devices required to make each unit a complete installation.

B. Switchboards shall be anchored to two (2) 3-inch channel sills set flush with the concrete housekeeping pad. Provide all required shims, etc., to achieve a level installation.

C. Mechanical Connections

1. Make all required connections including split line connections.

2. Remove shipping irons after equipment is set in place.

D. Electrical Connections

1. Bus connections: Use manufacturer's recommended torque.

2. Install control wiring connections at shipping splits and coordinate with SCADA requirements for Emergency Switchboards.

3. Provide holes in plates to allow for required conduit connections.

4. Terminate low voltage cables.

5. Ground conduits and cables as specified in Section 26 0200 and 26 0300.

6. Insulating Tape: When main buses are insulated or enclosed by barriers, insulate with tape wrappings all cable connections for voltage level involved so no current carrying parts are exposed.

7. Cable Blocks: support all outgoing secondary cables from cable blocks.

3.3 FIELD QUALITY CONTROL

A. Phase Sequence

1. Coordinate with the system supply for proper phase sequence throughout.

2. Provide phase sequence indicator on jobsite to verify all secondary outgoing feeder rotation.

B. Test all circuit breakers or fuses and switches for proper operation.

C. Bus Bar Connections

1. Check for proper resistance values using “Ducter” low resistance ohmmeter. Make adjustments where valves exceed manufacturer’s recommendations.

2. “Megger” phase bus bars to assure that no grounds or shorts are present. Disconnect potential and control transformers, instrument fuses and other equipment which may cause false readings.

D. Start-Up and Acceptance

1. Coordinate with equipment supplier and Owner for preparatory work required prior to energizing and acceptance and in accordance with Owner’s start-up procedures.

E. Contractor shall leave the entire installation in perfect working order.

END OF SECTION 260725

SECTION 260750

ELECTRIC SERVICE

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. The work under this section shall include the furnishing of all materials, labor, tools and services necessary to install the electric service system and to complete all work shown on the Drawings or specified herein.

1.2 WORK BY THIS CONTRACT

A. Furnish and install primary and secondary equipment as follows:

1. Furnish and install concrete equipment pads.

2. Furnish and install secondary cables and conduit from utility transformer to building switchgear.

3. Install utility service transformer.

4. Furnish and install primary cables and ducts to splice or connect to utility equipment as shown on Drawings per Utility Company specifications.

B. Coordinate all work with the utility company to insure timely completion of all work consistent with the schedule established by the Contractor.

1.3 WORK BY SITE CONTRACTOR

A. Furnish and install the following:

1. Furnish and install primary cables and conduit from utility company service end box to utility transformer including all terminations.

2. Ground electric service and transformer as required.

3. Install utility transformer.

4. Furnish and install secondary conduit from transformer to within five (5) feet of building.

1.4 WORK BY UTILITY COMPANY

A. Furnish and install the following:

1. Furnish service transformers.

B. Furnish and/or install the following:

1. Furnish primary switchgear.
2. Furnish service transformers and network protectors.
3. Furnish current transformers.
4. Final connection to all primary equipment.

1.5 REFERENCE TO OTHER SPECIFICATION SECTIONS

A. Raceways.

B. Wire and Cable.

C. Switchboards.

D. Grounding.

1.6 SUBMITTALS

A. Submit complete details of work as approved by the utility including components, routing and location.

1.7 QUALITY ASSURANCE

A. Utility Company Standards.

B. National Electrical Code (NEC).

C. Underwriters Laboratories, Inc. (UL).

1.8 WORK BY ELECTRICAL CONTRACTOR

A. Furnish and/or install secondary equipment as follows:

1. Furnish and install secondary cables from utility transformer to building switchgear.
2. Furnish and install secondary conduit from within 5 ft. of building to switchgear room.
3. Furnish and install final connections on secondary utility transformer and building switchgear.
4. Furnish and install meter pan, current transformers and cabinets.
5. Furnish and install meter wiring.
6. Furnish and install switchgear grounding and bonding.

B. Coordinate all work with the utility company and site work contractor to insure timely completion of all work consistent with the schedule established by the General Contractor.

PART 2 - PRODUCTS

2.1 SERVICE ENTRANCE CONDUIT

A. Furnish and install conduit and cable as indicated in 1.2 A above.

B. Conduit, fittings and accessories shall be in accordance with the “Raceways” section of this specification and concrete encased.

2.2 SERVICE ENTRANCE CONDUCTORS

A. Furnish and install service entrance conductors between the utility transformer and building service equipment.

B. Conductors shall be 600V, cable suitable for service entrance use. Cable type and installation shall be per the “Wire and Cable” section of this specification.

PART 3 - EXECUTION

3.1 COORDINATION

A. Before proceeding contact the utility company, to coordinate schedule of work by all trades effected by the work.

B. Obtain copies of all utility design and installation standards applicable to the work to be performed.

C. Obtain utility company approval for work to be performed.

3.2 INSTALLATION

A. Before installation, submit applicable shop drawings including necessary details for the use of other trades.

B. Should field conditions prevent installation as approved by the utility, obtain approval of deviations prior to installation.

3.3 RECORD DRAWINGS

A. At completion submit complete as-built drawings to the Owner and the utility company including all dimensions necessary to identify exact location of work installed.

3.4 ACTIVATION OF SERVICE

A. Upon completion of the installation, coordinate activation of the service with the utility company.

B. Supply necessary manpower and miscellaneous work to facilitate activation.

C. Advise all trades of time of activation and confirm that all equipment to be energized has been properly protected and is suitable to be placed into service.

3.5 Consolidated Edison Company of New York, Inc. Customer's Electric Service Layout (2-80) Revision 1 Equipment to be installed by the Customer's Contractor

Case ID	MC-515815	**Service Address**	121 Mclean Avenue
Layout/Ticket #	C-2020-60771-WCY	**Unit/Suite#**	
Customer Service Date			Yonkers, NY 10705
		Project Name	
		Created By/Date	Farrell, Patrick/ September 20, 2021

Customer	Lee Pavone	**Contractor**	Sharmin Rahman
CompanyName	Yonkers Public Schools	**CompanyName**	Barile Gallagher and Associates
Address	1 LARKIN CTR	**Address**	39 MARBLE AVE
Unit/Suite#		**Unit/Suite#**	
City State Zip	YONKERS NY 10701	**City State Zip**	PLEASANTVILLE NY 10570
E-mail	lpavone@yonkerspublicschools.org	**E-mail**	srahman@bga-eng.com
Phone	(914)376-8008	**Phone**	(123)456-7890

Con Edison Service Determination
INSTALL OVERHEAD TRANSFORMER AND SERVICE
******** REQUIRED REQUEST/CALCULATE COST ESTIMATE TASK & SKETCH ******** AS PER NEW LOAD LETTER (DATED MAY 21, 2021) UPLOADED TO CPMS ON JUNE 28, 2021; THE NEW ESTIMATED DEMAND IS 439.6KVA. THE RULING OF MAY 26, 2021 REMAINS THE SAME FOR PREFERRED POE (3-167KVA OH TRANSFORMER) WITH COST TO CUSTOMER. NOTE: THE FEEDER CONCURRENCE ID 273 WAS APPROVED WITH CONDITIONS AS PER THE FOLLOWING COMMENTS: Multiple things will need to be done to address new overloads on 63U3 and its tie by the introduction of this customer. The station riser on 63U3 and previous ug section are 500 and should be upgraded to 750 EPR NL (M60-M5229-P4) and the spur it is on needs P12-P11-P10 (2 spans) on Lawrence St upgraded to 4/0 AL. On 1102, the feeder needs to be balanced (10A from B to A and 12A from B to C) and have 2/0 upgraded to 477 AL from J4-P14-P9 (850').

Customer Cost Estimate & Account Deposit

****Customer Cost**	
Account Deposit	
Advance of Need	

Please review the following items			
This Service Layout is subject to revision based on field conditions and customer or Con Edison needs.			
Modification of this Layout may only be done by an authorized Con Edison representative. Please contact your representative if you need a written revision.			
Please review the specifications referenced in this document to ensure any new equipment is compliant with the electric codes of the local authorities having jurisdiction and Con Edison specifications.			
This Layout is good for 6 months. Please check back with your representative for the most recent specifications prior to starting your work.			
Final Inspections are completed by Con Edison representatives at no cost to the customer.			
If you have any questions prior to starting your work, please notify a representative at the number provided in this email.			
Services installations that require permits for working on state roads, generally require more time to coordinate permit issuance with the NY State Department of Transportation.			
Approved certificates of inspection must be provided by the authorities having jurisdiction prior to energizing services.			
Representatives require 48 hours of notice to schedule inspections.			
Please follow this link to read and share information on safe excavation practices related to Call Before You Dig			
Equipment & Specifications			
Equipment	**QTY**	**Equipment Description**	**Specifications**
Customer Equipment		All New Customer Equipment i.e., Disconnects, Grounds, Troughing+	CODE
Customer Crab Configuration		2-4-500 Company- 3-4-500 Customer	EO-11626
Distribution Box		DB-6 Distribution Box 6'x4'x5'	EO-13331
General Requirement		AC Services	EO-2055
General Requirement		Low Tension AC Service Voltage Limitations	EO-2065
General Requirement		Basement Behind Property Line, No PLB, Indoor Metering	EO-6209
General Requirement		Property Line Splice Box	EO-6210
CT Cabinet		CT Cabinet for Greater Than 4-4-500 or 4-4-750	MES-377
Prerequisites for Final Inspection			
The Customer's/Contractor's responsibilities prior to service construction are to: Customer to complete by:			
Prerequisites for Final Inspection			
The Customer's/Contractor's responsibilities prior to requesting a Final Inspection are to: Customer to complete by:			
*Inability to meet the deadlines outlined above will jeopardize Con Edison's ability to meet the Customer Service Date.			

END OF SECTION 260750

SECTION 260775

SURGE PROTECTION DEVICES

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. This specification describes the mechanical and electrical requirements for a Surge Protection Device herein known and shown on all drawings as SPD. The SPD shall be suitable for application in category C High environments as described in ANSI/IEEE C62.41. The SPD shall be parallel in design and provide protection for the following modes: {Line to Neutral, Line to Ground, Line to Line, Neutral to Ground} for electrical distribution systems. “Series” type SPD units will be deemed unacceptable

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating weights, operating characteristics, furnished specialties, and accessories.

B. Product Certificates: For surge protection devices, signed by product manufacturer certifying compliance with the following standards:

1. UL 1283
2. UL 1449 3rd Edition

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain suppression devices and accessories through one source from a single manufacturer

B. Product Options: Drawings shall indicate size, dimensional requirements, and electrical performance of suppressors and are based on the specific system indicated.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NEMA LS 1, “Low Voltage Surge Protection Devices”

E. Codes and Standards

1. UL compliance and Labeling: Listed per UL 1449 3rd Edition
2. UL 1283 “Electromagnetic Interference Filters”
3. Comply with ANSI/IEEE C62.1, C62.41, and C62.45
4. NEC compliance: Comply with NEC as applicable to construction and Article 280 for installation.

1.4 MANUFACTURERS QUALIFICATIONS

A. Only pre-approved SPD products shall be accepted

B. Manufacturer Qualifications: All SPD units shall be manufacturer by a firm that strictly manufactures SPD products only, for at least 10 years. Firms must also regularly engage in the manufacturing of SPD products for Categories B (ANSI/IEEE 62.41) and C High.

C. The SPD shall be warranted for no less than 15 years and shall include free replacement in whole or in part during those 15 years for any reason of failure.

PART 2 - PRODUCTS

2.1 SERVICE ENTRANCE SUPPRESSORS

A. General: The A.C. Voltage Surge Protective Devices shall be a high speed, high current solid-state device designed to protect electronic equipment and electrical systems from transient over voltages. It shall limit the magnitude of a transient overvoltage present on the AC service or distribution power lines. The suppressor shall provide continuous bi-polar, bidirectional, non-interrupting protection and be capable of instant automatic reset with no degradation in protection capabilities. The suppressor shall be solid state, utilizing 40mm metal oxide arrestors (MOV's). Gas tubes are not acceptable. It shall start to suppress the transient at a minimum of 115% of the peak voltage of the sinewave. The suppressor assembly shall be installed in parallel of the service main disconnect, distribution or branch panel main lugs. Connect the suppressor to over current protection sized with an AIC rating equal to or greater than the panel rating. The suppressor shall be contained in an enclosure appropriate for the environmental application.

B. Electrical Performance

1. ANSI/IEEE Testing Minimum Requirements

	SVR UL 1449 2nd	VPR UL 1449 3rd	CAT B 6kV/3kA	CAT C High 20kV/10kA
480Y/277	800V	1200V	776V	904V
208Y/120	400V	700V	416V	528V

C. SPD specifics:

1. The surge protection device shall be permanently wired through an over current device (specific size shall be specified by the manufacturer) installed in the service entrance electrical equipment (rated with the same electrical characteristics of the panel) with leads as short as possible and not to exceed 18 inches.

2. Surge Protection Device Description - Modular Design with field replaceable modules and the following features and accessories:
   a. Fabrication using bolted compression lugs for internal wiring
   b. Replaceable bolt down modules per phase. The use of single “Brick” Module and/or “Plug In” type module designs will not be accepted.
   c. Arrangement with wire connections to phase buses, neutral bus, and ground bus
   d. A 200,000 AIC Fused Rotary Disconnect
   e. Remote Audio/ Visual Alarm Panel
   f. UL Listed 1283 Extended Power Range Filter
   g. Green/Red LED Indicator lights for power and protection status. Green = Power On / Protection Present Red = Failure
   h. Normally Open / Normally Closed Form C Dry Contacts
   i. Surge Event Counter

3. Peak Single-Impulse Surge Current Rating shall be 240kA per phase.

4. Standard unit housings shall be 16 gauge painted steel and match the NEMA rating of the panel board.

5. Standard unit warranty must be for at least 15 years and be stated in the manufacturer’s literature.

D. Approved Manufacturers

1. Atlantic Scientific – ZoneMaster PRO Series or Equal. (Contact: Andy Topinka @ 862-210-8126).

2.2 DISTRIBUTION PANEL SUPPRESSORS

A. General: The A.C. Voltage Surge Protective Devices shall be a high speed, high current solid-state device designed to protect electronic equipment and electrical systems from transient over voltages. It shall limit the magnitude of a transient overvoltage present on the AC service or distribution power lines. The suppressor shall provide continuous bi-polar, bi-directional, non-interrupting protection and be capable of instant automatic reset with no degradation in protection capabilities. The suppressor shall be solid state, utilizing 40mm metal oxide arrestors (MOV’s). Gas tubes are not acceptable. It shall start to suppress the transient at a minimum of 115% of the peak voltage of the sinewave. The suppressor assembly shall be installed in parallel of the service main disconnect, distribution or branch panel main lugs. Connect the suppressor to over current protection sized with an AIC rating equal to or greater than the panel rating. The suppressor shall be contained in an enclosure appropriate for the environmental application.

B. Electrical Performance

1. ANSI/IEEE Testing Minimum Requirements

	SVR UL 1449 2nd	VPR UL 1449 3rd	CAT B 6kV/3kA	CAT C High 20kV/10kA
480Y/277	700V	1000V	825V	950V
208Y/120	330V	600V	456V	550V

C. SPD specifics:

1. The surge protection device shall be permanently wired through an over current device (specific size shall be specified by the manufacturer) installed in the service entrance electrical equipment (rated with the same electrical characteristics of the panel) with leads as short as possible and not to exceed 18 inches.

2. Surge Protection Device Description - Modular Design with field replaceable modules and the following features and accessories:

   a. Fabrication using bolted compression lugs for internal wiring
   b. Replaceable bolt down modules per phase. The use of single “Brick” Module and/or “Plug In” type module designs will not be accepted.
   c. Arrangement with wire connections to phase buses, neutral bus, and ground bus
   d. UL Listed 1283 Extended Power Range Filter
   e. Green/Red LED Indicator lights for power and protection status. Green = Power On / Protection Present Red = Failure
   f. Normally Open / Normally Closed Form C Dry Contacts

3. Peak Single-Impulse Surge Current Rating shall be 100kA per phase

4. Standard unit housings shall have a transparent front cover for complete visual inspection and monitoring the status of protection for each module, any onboard diagnostics, module configuration, and wiring configuration.

5. Standard unit housings shall be non-metallic and meet NEMA 1, 2, 3, 3S, 4, 4X, 12 and 13 classifications

6. Standard unit warranty must be for at least 15 years and be stated in the manufacturer’s literature.

D. Approved Manufacturers

1. Atlantic Scientific Corporation – ZoneSentinel 100 Series or equal.
(Contact: Andy Topinka @ 862-210-8126).

2.3 BRANCH PANEL SUPPRESSORS

A. General: The A.C. Voltage Surge Protective Devices shall be a high speed, high current solid-state device designed to protect electronic equipment and electrical systems from transient overvoltages. It shall limit the magnitude of a transient overvoltage present on the AC service or distribution power lines. The suppressor shall provide continuous bi-polar, bidirectional, non-interrupting protection and be capable of instant automatic reset with no degradation in protection capabilities. The suppressor shall be solid state, utilizing metal oxide varistors (MOV's). Gas tubes are not acceptable. It shall start to suppress the transient at a minimum of 115% of the peak voltage of the sinewave. The suppressor assembly shall be installed in parallel of the service main disconnect, distribution or branch panel main lugs. Connect the suppressor to over current protection sized with an AIC rating equal to or greater than the panel rating. The suppressor shall be contained in an enclosure appropriate for the environmental application.

B. Electrical Performance

1. ANSI/IEEE Testing Minimum Requirements

	SVR UL 1449 2nd	VPR UL 1449 3rd	CAT B 6kV/3kA	CAT C High 20kV/10kA
480Y/277	800V	1000V	890V	1200V
208Y/120	400V	500V	435V	730V

C. Surge Protection Devices details:

1. The surge protection device shall be permanently wired through an overcurrent device (specific size shall be specified by the manufacturer) installed in the service entrance electrical equipment (rated with the same electrical characteristics of the panel) with leads trimmed as short as possible and not to exceed 18 inches.

2. Surge Protection Device Description - Non-Modular Design with the following features and accessories:

   a. 200,000 AIC Fused
   b. Built in Audible Alarm
   c. UL Listed 1283 Extended Power Range Filter
   d. Green/Red LED Indicator lights for power and protection status.
      Green = Power On / Protection Present Red = Failure
   e. Normally Open / Normally Closed Form C Dry Contacts

3. Peak Single-Impulse Surge Current Rating shall be 80kA per phase.

4. Standard unit housings shall be metallic in construction and meet NEMA 1,2,3,3S,4,4X,12, and 13 classifications.

5. Standard unit warranty must be for at least 10 years and be stated in the manufacturer's literature.

B. Approved Manufacturers

1. Atlantic Scientific Corporation – ZoneDefender PRO Series or equal. (Contact Andy Topinka @ 862-210-8126)

PART 3 - EXECUTION

3.1 APPLICATION OF SPD

A. General

1. Apply SPD on the load side of the first main disconnect at the electrical service entrance switchboard and on the load side of the main overcurrent device at the electrical distribution panelboard.

2. Coordinate system voltage, wiring configuration, and location as shown on project drawings.

3.2 INSTALLATION OF SPD

A. Service Entrance: Connect the SPD to a 60A Breaker with #6 AWG minimum conductors, #4 AWG maximum (for ease of dressing), to the Service Entrances panel being protected. The conductors are to be as short and straight as practically possible and shall not exceed 18 inches in length. The SPD shall be installed following the manufacturer's recommended practices and in compliance with all applicable codes.

B. Distribution Panels: Connect the SPD to a 60A or 30A (whichever is specified by the manufacturer for that model) with #8 AWG minimum conductors, #4 AWG maximum (for ease of dressing), to the Distribution panels being protected. The conductors are to be as short and straight as practically possible and shall not exceed 18 inches in length. The SPD shall be installed following the manufacturer's recommended practices and in compliance with all applicable codes.

C. Branch Panels: Install the SPD to with #10 AWG provided from the manufacturer to the Branch panels being protected. The conductors are to be kept as short and straight as practically possible and shall not exceed 18 inches in length that is provided. The SPD shall be installed following the manufacturer's recommended practices and in compliance with all applicable codes.

END OF SECTION 260775

SECTION 260785

AUTOMATIC TRANSFER SWITCH

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

2.1 SCOPE

A. Provide complete factory assembled power transfer equipment with digital electronic controls designed for surge voltage isolation and including voltage sensors on all phases of both sources, linear operator, permanently attached manual handles, positive mechanical and electrical interlocking, and mechanically held contacts.

B. The generator set manufacturer shall warrant transfer switches to provide a single source of responsibility for all the products provided. Technicians specifically trained to support the product and employed by the generator set supplier shall service the transfer switches.

2.2 CODES AND STANDARDS

A. The automatic transfer switch shall conform to the requirements of the following codes and standards:

UL1008.	The transfer switch shall be UL listed and labeled.
CSA C22.2, No. 14 – M91 Industrial Control Equipment.	
CSA 282,	Emergency Electrical Power Supply for Buildings
EN55011,	Class B Radiated Emissions
EN55011,	Class B Conducted Emissions
IEC 1000-4-5	(EN 61000-4-5); AC Surge Immunity. Similar waveforms are described in ANSI/IEEE 62.41-1991
IEC 1000-4-4	(EN 61000-4-4) Fast Transients Immunity
IEC 1000-4-2	(EN 61000-4-2) Electrostatic Discharge Immunity
IEC 1000-4-3	(EN 61000-4-3) Radiated Field Immunity
IEC 1000-4-6	Conducted Field Immunity
IEC 1000-4-11	Voltage Dip Immunity
NFPA20 –	Fire Pumps. Transfer switches serving fire pumps shall be specifically listed and labeled for that application.
NFPA70 –	National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
NFPA99 –	Essential Electrical Systems for Health Care Facilities
NFPA110 –	Emergency and Standby Power Systems. The transfer switch shall meet all requirements for Level 1 systems.
IEEE446 –	Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
NEMA ICS10-1993 – AC Automatic Transfer Switches.	

2.3 ACCEPTABLE MANUFACTURERS

A. Only approved bidders shall supply equipment provided under this contract. Equipment specifications for this project are based on microprocessor-based transfer switches manufactured by Cummins as distributed by Cummins Power Systems LLC. Basis of Design: Cummins model OTPC/ASCO 7000 series.

2.4 POWER TRANSFER SWITCH

A. Rating: As noted in contract drawings.

B. Main contacts shall be rated for 600 Volts AC minimum.

C. Transfer switches shall be rated to carry 100 percent of rated current continuously in the enclosure supplied, in ambient temperatures of -40 to +60 degrees C, relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet (3000M).

D. Transfer switch equipment shall have withstand and closing ratings (WCR) in RMS symmetrical amperes greater than the available fault currents shown on the drawings. The transfer switch and its upstream protection shall be coordinated. The transfer switch shall be third party listed and labeled for use with the specific protective device(s) installed in the application.

2.5 CONSTRUCTION

A. Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the source 1 and source 2 positions. The transfer switch shall be specifically designed to transfer to the best available source if it inadvertently stops in a neutral position.

B. Transfer switches rated through 1000 amperes shall be equipped with permanently attached manual operating handles and quick-break, quick-make over-center contact mechanisms. Transfer switches over 1000 amperes shall be equipped with manual operators for service use only under de-energized conditions.

C. Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.

D. Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plug(s), to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism.

E. Transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation but prevent direct contact with line voltage components.

F. Transfer switches that are designated on the drawings as 3-pole shall be provided with a neutral bus and lugs. The neutral bus shall be sized to carry 100% of the current designated on the switch rating.

2.6 CONNECTIONS

A. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.

B. Transfer switch shall be provided with AL/CU mechanical lugs sized to accept the full output rating of the generator set.

2.7 TRANSFER SWITCH CONTROL

A. Operator Panel: Transfer switch shall be provided with a control panel to allow the operator to view the status and control operation of the transfer switch. The operator panel shall be a sealed membrane panel rated NEMA 3R/IP53 or better (regardless of enclosure rating) that is permanently labeled for switch and control functions. The operator panel shall be provided with the following features and capabilities.

B. High intensity LED lamps to indicate the source that the load is connected to (source 1 or source 2); and which source(s) are available. Source available LED indicators shall operate from the control microprocessor to indicate the true condition of the sources as sensed by the control.

C. High intensity LED lamps to indicate that the transfer switch is “not in auto” (due to control being disabled or due to bypass switch enabled or in operation) and “Test/Exercise Active” to indicate that the control system is testing or exercising the generator set.

D. “OVERRIDE” pushbutton to cause the transfer switch to bypass any active time delays for start, transfer, and retransfer and immediately proceed with its next logical operation.

E. “TEST” pushbutton to initiate a preprogrammed test sequence for the generator set and transfer switch. The transfer switch shall be programmable for test with load or test without load.

F. “RESET/LAMP TEST” pushbutton that will clear any faults present in the control, or simultaneously test all lamps on the panel by lighting them.

G. The control system shall continuously log information on the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. This information shall be available via the service tool, or an operator display panel.

H. Display source condition information, including AC voltage for each phase of normal and emergency source, frequency of each source. Voltage for all three phases shall be displayed on a single screen for easy viewing of voltage balance.

I. Display source status, to indicate source is connected or not connected.

J. Display load data, including 3-phase AC voltage, 3-phase AC current, frequency, KW, KVA, and power factor. Voltage and current data for all phases shall be displayed on a single screen.

K. The display panel shall allow the operator to view and make the following adjustments in the control system, after entering an access code:

1. Set nominal voltage and frequency for the transfer switch.
2. Adjust voltage and frequency sensor operation set points.
3. Set up time clock functions.
4. Set up load sequence functions.
5. Enable or disable control functions in the transfer switch, including program transition.
6. Set up exercise and load test operation conditions, as well as normal system time delays for transfer time, time delay start, stop, transfer, and retransfer.

L. Display Real Time Clock data, including date, and time in hours, minutes, and seconds. The real time clock shall be “Year 2000” compliant and incorporate provisions for automatic daylight savings time and leap year adjustments. The control shall also log total operating hours for the control system.

M. Display service history for the transfer switch. Display source connected hours, to indicate the total number of hours connected to each source. Display number of times transferred, and total number of times each source has failed.

N. Display information for other transfer switches in the system, including transfer switch name, real time load in KW on the transfer switch, current source condition, and current operating mode.

O. Display fault history on the transfer switch, including condition, and date and time of fault. Faults to include controller checksum error, low controller DC voltage, ATS fail to close on transfer, ATS fail to close on retransfer, battery charger malfunction, network battery voltage low, network communications error.

2.8 INTERNAL CONTROLS

A. The transfer switch control system shall be configurable in the field for any operating voltage level up to 600VAC. Provide RMS voltage sensing and metering that is accurate to within plus or minus 1% of nominal voltage level. Frequency sensing shall be accurate to within plus or minus 0.2%. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions are not acceptable.

B. Transfer switch voltage sensors shall be close differential type, providing source availability information to the control system based on the following functions:

C. Monitoring all phases of the normal service (source 1) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of normal voltage level).

D. Monitoring all phases of the emergency service (source 2) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of pickup voltage level).

E. All transfer switch sensing shall be configurable from a Windows 95 or NT PC-based service tool, to allow setting of levels, and enabling or disabling of features and functions. Selected functions including voltage sensing levels and time delays shall be configurable using the operator panel. Designs utilizing DIP switches or other electromechanical devices are not acceptable. The transfer control shall incorporate a series of diagnostic LED lamps.

F. The transfer switch shall be configurable to control the operation time from source to source (program transition operation). The control system shall be capable of enabling or disabling this feature and adjusting the time period to a specific value. A phase band monitor or similar device is not an acceptable alternate for this feature.

G. The transfer switch shall incorporate adjustable time delays for generator set start (adjustable in a range from 0-15 seconds); transfer (adjustable in a range from 0-120 seconds); retransfer (adjustable in a range from 0-30 minutes); and generator stop (cooldown) (adjustable in a range of 0-30 minutes).

H. The control system shall be designed, and prototype tested for operation in ambient temperatures from -40C to +70C. It shall be designed and tested to comply with the requirements of the following voltage and RFI/EMI standards.

I. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.

2.9 CONTROL INTERFACE

A. The transfer switch will provide an isolated relay contact for starting of a generator set. The relay shall be normally held open, and close to start the generator set. Output contacts shall be form C, for compatibility with any generator set.

B. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.

2.10 ENCLOSURE

A. Enclosures shall be UL listed. The enclosure shall provide NEC wire bend space. The cabinet door shall be key-locking.

B. Transfer switches shall be mounted in enclosures of the type NEMA 1.

C. The cabinet shall provide code-required wire bend space at point of entry as shown on the drawings. Manual operating handles and all control switches (other than key-operated switches) shall be accessible to authorized personnel only by opening the key-locking cabinet door. Transfer switches with manual operating handles and/or non key-operated control switches located on outside of cabinet do not meet this specification and are not acceptable.

END OF SECTION 260785

SECTION 260800

FIRE ALARM SYSTEM

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION

A. At the time of bid, all exceptions taken to these Specifications, all variances from these Specification and all substitutions of operating capabilities or equipment called for in these Specification shall be listed in writing and forwarded to the Engineer. Any such exception, variances or substitutions which were not listed at the time of bid and are identified in the submittal, shall be grounds for immediate disapproval without comment.

B. The entire system shall be installed with aesthetics in mind. All control panels and remote annunciators installed in public spaces shall be semi-flush mounted with no exposed conduit or cable trays.

1.2 WORK INCLUDED

A. The work covered by this Section of the Specification shall include all labor, equipment, materials and services to furnish and install a complete fire alarm system of the addressable, non-coded type. It shall be complete with all necessary hardware, software and memory specifically tailored for this installation. It shall be possible to permanently modify the software on site by using a plug-in programmer. The system shall consist of, but not be limited to, the following:

1. Fire Alarm Control Panel and related remote data gathering panels.
2. Remote Annunciators with semi flush backbox.
3. Addressable manual fire alarm stations.
4. Addressable analog area smoke detectors.
5. Addressable analog duct smoke detectors.
6. Addressable analog heat detectors.
7. Magnetic door\card access release override control.
8. Audible notification appliances - horns.
9. Visual notification appliances - strobes.
10. Central station alarm connection control.
11. Air handling systems shutdown control.
12. Magnetic door holder release.
13. Dry pipe sprinkler release valve/deluge valve control.
14. Pre-Action Sprinkler System.
15. Sprinkler supervisory switches and tamper switch supervision.
16. Battery standby.
17. Kitchen Ansul System Monitoring

1.3 APPLICABLE CODES AND STANDARDS

A. All equipment shall be UL listed for its intended use and conform to the latest UL Standards.

B. Underwriters Laboratories Inc.: The system and all components shall be listed by Underwriters Laboratories Inc. for use in fire protective signaling system under the following standards as applicable:

1.	UL 864/UOJZ,	APOU Control Units for Fire Protective Signaling Systems.
2.	UL 268	Smoke Detectors for Fire Protective Signaling Systems.
3.	UL 268A	Smoke Detectors for Duct Applications.
4.	UL 217	Smoke Detectors Single Station.
5.	UL 521	Heat Detectors for Fire Protective Signaling Systems.
6.	UL 228	Door Holders for Fire Protective Signaling Systems.
7.	UL 464	Audible Signaling Appliances.
8.	UL 1638	Visual Signaling Appliances.
9.	UL 38	Manually Activated Signaling Boxes.
10.	UL 346	Waterflow Indicators for Fire Protective Signaling Systems.
11.	UL 1971	Standard for Signaling Devices for the Hearing Impaired
12.	UL 1481	Power Supplies for Fire Protective Signaling Systems.
13.	UL 1711	Amplifiers for Fire Protective Signaling Systems.
14.	UUKL	The Fire Alarm system shall be UUKL for Smoke Control.

C. This installation shall comply with:

1. Americans with Disabilities Act (ADA)
2. National Electric Code, Article 760.
3. National Fire Protection Association Standards: NFPA72
4. Local and State Building Codes and the Local Authorities Having Jurisdiction.
5. International Standards Organization (ISO): ISO-9001

1.4 RELATED DOCUMENTS

A. Secure permits and approvals prior to installation.

B. Prior to commencement and after completion of work notify Authorities Having Jurisdiction.

C. Submit letter of approval for installation before requesting acceptance of system.

1.5 RELATED WORK

A. The Contractor shall coordinate work in this Section with all related trades. Work and/or equipment provided in other Sections and related to the fire alarm system shall include, but not be limited to:

1. Sprinkler waterflow and supervisory switches shall be furnished and installed by the fire protection contractor but wired and connected by the electrical contractor. Modification of existing sprinkler devices to accommodate monitoring by the new fire alarm system shall be the responsibility of the fire alarm system installing contractor.

2. Duct smoke detectors shall be furnished, wired and connected by the electrical contractor. The HVAC contractor shall furnish necessary duct opening to install the duct smoke detectors.

3. New air handling and smoke exhaust system fan control circuits and status contacts to be furnished by the HVAC control equipment.

4. Elevator recall control circuits to be provided by the elevator control equipment. Modifications to the existing elevator controls to accommodate ANSI A17.1 shunt trip activation shall be provided by the elevator controls contractor. Any shunt trip circuit breakers and related wiring required for ANSI A17.1 compliance shall be provided by the electrical contractor (see power riser for more details).

5. Dry pipe/deluge sprinkler system release valve control circuits and supervision contacts shall be provided by the dry pipe/deluge sprinkler system control equipment.

6. Kitchen hood extinguishing systems status monitoring.

7. Fire pumps (manual, automatic and special service) status monitoring.
   a. Pump failure (fail to start) indication
   b. Pump running indication
   c. Phase reversal indication

8. Emergency generator status monitoring
   a. Running indication
   b. Fail to start indication

9. Gravity tank water level and fill pump status monitoring
   a. Water Level High Indication
   b. Water Level Low Indication
   c. Fill Pump Running Indication

10. Conduit: Section 26 02 00.

11. Wire and Cables: Section 26 03 00.

12. Installing dedicated outgoing RJ-31X telephone lines (2) shall be the responsibility of the Installing Electrical Contractor. Establishment of central station monitoring account shall be the responsibility of the fire alarm equipment vendor.

1.6 SUBMITTALS

A. Provide list of all types of equipment and components provided. This shall be incorporated as part of a Table of Contents, which will also indicate the manufacturer's part number, the description of the part, and the part number of the manufacturer's product datasheet on which the information can be found.

B. Provide description of operation of the system (Sequence of Operation), similar to that provided in Part 2 of this Section of the Specifications, to include any and all exceptions, variances or substitutions listed at the time of bid. Any such exceptions, variances or substitutions that were not listed at the time of bid and are identified in the submittal, shall be grounds for immediate disapproval without comment. The sequence of operation shall be project specific and shall provide individual sequences for every type of alarm, supervisory, or trouble condition which may occur as part of normal or off-normal system use.

C. Provide manufacturer's ORIGINAL printed product data, catalog cuts and description of any special installation procedures. Photocopied and/or illegible product data sheets shall not be acceptable. All product datasheets shall be highlighted or stamped with arrows to indicate the specific components being submitted for approval.

D. Provide manufacturer's installation instruction manual for specified system.

E. Provide samples of various items when requested.

F. Provide copy of state License to perform such work.

G. Provide copies of NICET Level II Fire Alarm certifications for the two (2) technicians assigned to this project.

H. Provide shop drawings as follows:

1. Coversheet with project name, address and drawing index.

2. General notes drawing with peripheral device backbox size information, part numbers, device mounting height information, and the names, addresses, point of contact, and telephone numbers of all contract project team members.

3. Device riser diagram, which individually depicts all control panels, annunciators, addressable devices, and notification appliances. Shall include a specific, proposed point descriptor above each addressable device. Shall include a specific, discrete point address that shall correspond to addresses depicted on the device layout floor plans. Drawing shall provide wire specifications, and wire tags shown on all conductors depicted on the riser diagram. All circuits shall have designations that shall correspond with those require on the control panel and floor plan drawings. End-of-line resistors (and values) shall be depicted.

4. Control panel termination drawing(s). Shall depict internal component placement and all internal and field termination points. Drawing shall provide a detail indicating where conduit penetrations shall be made, so as to avoid conflicts with internally mounted batteries. For each additional data gathering panel, a separate control panel drawing shall be provided, which clearly indicated the designation, service and location of the control enclosure. End-of-line resistors (and values) shall be depicted.

5. See section 3.4 DOCUMENTATION AND TRAINING for other documents relating to this section.

6. Device typical wiring diagram drawing(s) shall be provided which depict all system components, and their respective field wiring termination points. Wire type, gauge, and jacket shall also be indicated. When an addressable module is used in multiple configurations for monitoring or controlling various types of equipment, different device typical diagrams shall be provided. End-of-line resistors (and values) shall be depicted.

7. Device layout floor plans shall be created for every area served by the fire alarm system. CAD Files (AutoCAD – latest edition) shall be provided by the consulting engineer for the fire alarm system equipment vendor in the preparation of the floor plans. Floor plans shall indicate accurate locations for all control and peripheral devices. Drawings shall be NO LESS THAN 1/8-INCH SCALE. All addressable devices shall be depicted with a discrete address that corresponds with that indicated on the Riser Diagram. All notification appliances shall also be provided with a circuit address that corresponds to that depicted on the Riser Diagram. If individual floors need to be segmented to accommodate the 1/8” scale requirements, KEY PLANS and BREAK-LINES shall be provided on the plans in an orderly and professional manner. End-of-line resistors (and values) shall be depicted.

8. Contained in the title block of each drawing shall be symbol legends with device counts, wire tag legends, circuit schedules for all addressable and notification appliance circuits, the project name/address, and a drawing description which corresponds to that indicated in the drawing index on the coversheet drawing. A section of each drawing title block shall be reserved for revision numbers and notes. The initial submission shall be Revision 0, with Revision A, B, or C as project modifications require.

I. Battery calculations shall be provided on a per power supply/charger basis. These calculations shall clearly indicate the quantity of devices, the device part numbers, the supervisory current draw, the alarm current draw, totals for all categories, and the calculated battery requirements (which reflect a 20% DEGRADE, for 24 Hour supervisory, 5 minute alarm operation). Battery calculations shall also reflect all control panel component, remote annunciator, and auxiliary relay current draws. Failure to provide these calculations shall be grounds for the complete rejection of the submittal package.

J. Table of contents, product data sheets, sequences of operation, battery calculations, installation instructions, licenses, NICET certifications and B-Size (blackline) reduced shop drawings shall be provided by the fire alarm vendor as part of a single, spiral bound submittal book. The submittal book shall have laminated covers indicating the project address, SED number, system type, and contractor. The book shall consist of labeled dividers, and shall not exceed 9 ½" in width, and 11 ½" in height. No less than three (3) sets of submittal booklets shall be provided to the consulting engineer for review and comment. Additional copies may be required at no additional cost to the project.

K. Scale drawing sets shall be submitted along with the submittal booklets. These drawings may be either D-Size or E-Size printed drawings and of a sufficient resolution to be completely read. Sets shall be bound and folded so as to not take up more than 100 square inches of space. No less than three (3) sets of scale drawing sets shall be provided to the consulting engineer for review and comment. Additional copies may be required at no additional cost to the project.

1.7 WARRANTY

A. All work performed, and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance or approval by AHJ. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The catalog numbers used are those of Edwards EST by UTC Fire and Security “or equal” and constitute the type and quality of equipment to be furnished. Red Hawk Fire and Security, Nick Delfico nick.t.delfico@redhawkus.com 914-769-8900, is an Edwards EST authorized fire alarm vendor. For a list of Edwards EST authorized fire alarm vendors, contact Dana Ferrer at UTC Fire and Security at dana.ferrer@fs.utc.com.

B. If equipment of another manufacturer is to be submitted for approval as equal, the contractor shall, at the time of bid, list all exceptions taken to these Specifications, all variances from these Specifications and all substitutions of operating capabilities or equipment called for in these Specifications and forward said list to the Engineer. Any such exceptions, variances or substitutions that were not listed at the time of bid and are identified in the submittal, shall be grounds for immediate disapproval without comment. Final determination of compliance with these Specifications shall rest with the Engineer, who, at his discretion, may require proof of performance.

C. Alternate product submissions made without proof of no less than three (3) factory authorized and certified manufacturer’s distributors residing within 50 miles of the project job site shall be rejected. These distributors must not only provide installation support but must have a service organization capable of 24 hour emergency call service and MUST HAVE BEEN CONTRACTED AND DELIVERED NO LESS THAN FIVE (5) ACCEPTED PROJECTS USING THE SUBMITTED PRODUCT OVER THE PAST YEAR.

D. Alternate product submissions based upon use of a product line considered proprietary in its distribution, design, application software, or ongoing maintenance and repair shall not acceptable. Proof of a product's non-proprietary nature shall be the burden of the contractor at the time of Bid and shall be in the form of written documentation. The determination of a product's compliance to this requirement shall be exclusively that of the Consulting Engineer.

E. All products used shall be of a single manufacturer. Submission of notification appliances, auxiliary relays, or documentation from other than a single manufacturer shall not be acceptable and will be grounds for immediate disapproval without comment.

2.2 CIRCUITING GUIDELINES

A. Each addressable analog loop shall be circuited so device loading is not to exceed 80% of loop capacity in order to leave for space for future devices. The loop shall have Class B operation.

B. Where it is necessary to interface conventional initiating devices provide intelligent input modules to supervise Class B zone wiring.

C. Each of the following types of devices or equipment shall be provided with supervised circuits as shown on the drawings but shall be typically as follows:

1. Sprinkler Valve Supervisory Switches: Provide one (1) supervisory module circuit for each sprinkler valve supervisory switch.

2. When waterflow and tamper switches exist at the same location, provide one (1) dual input addressable module. When odd numbers of devices exist at a single location, provide additional single input addressable modules.

D. Each of the following types of alarm notification appliances shall be circuited as shown on the drawings but shall be typically as follows:

1. Audible Signals: Provide sufficient spare capacity to assure that the addition of five (5) audible devices can be supported without the need for addition control components (power supplies, signal circuit modules, batteries, etc.)
2. Visual Signals: Provide sufficient spare capacity to assure that the addition of three (3) audible devices can be supported without the need for addition control components (power supplies, signal circuit modules, batteries, etc.)

E. Each of the following types of remote equipment associated with the fire alarm system shall be provided with a form 'C' control relay contact as shown on the drawings, but shall be typically as follows:

1. HVAC Fan Systems: Provide one (1) shutdown control relay contact for each HVAC fan system.
2. HVAC Supply Fans: Provide one (1) shutdown control relay contact for each HVAC supply fan.

3. HVAC Return Fans: Provide one (1) shutdown control relay contact for each HVAC return fan.

F. Provide a dedicated 24VDC circuit to feed all auxiliary relays required for inductive loads. Circuits shall be supervised via an end-of-line relay and addressable input module. Auxiliary relays shall not derive their power from the starter or load being controlled.

G. Each control or data gathering panel shall have a dedicated 20Amp-120VAC feed. This feed shall come from an emergency or lighting circuit breaker panel and shall have a locked circuit breaker. Earth grounds shall also terminate to the same circuit breaker panel from each respective control panel.

2.3 FIRE ALARM SYSTEM SEQUENCE OF OPERATION

A. The system shall identify any off normal condition and log each condition into the system database as an event.

1. The system shall automatically display on the control panel Liquid Crystal Display the first event of the highest priority by type. The priorities and types shall be alarm, supervisory, trouble, and monitor.

2. The system shall have a Queue operation and shall not require event acknowledgment by the system operator. The system shall have a labeled color coded indicator for each type of event; alarm - red, supervisory - yellow, trouble - yellow, monitor - yellow. When an unseen event exists for a given type, the indicator shall be lit.

3. For each event, the display shall include the current time, the total number of events, the type of event, the time the event occurred and up to a 42 character custom user description.

4. The user shall be able to review each event by simply selecting scrolling keys (up-down) for each event type.

5. New alarm, supervisory, or trouble events shall sound a silencing audible signal at the control panel.

B. Operation of any alarm initiating device shall automatically:

1. Update the control/display as described above (A.1.)

2. Sound all audible appliances in a Temporal-3 Pattern. ALL AUDIBLE APPLIANCES SHALL BE SYNCHRONIZED WITH EACH OTHER WHEN TWO OR MORE HORNS CAN BE HEARD. Audible devices shall have the ability to be silenced.

3. Activate all strobe appliances throughout the facility. ALL STROBE APPLIANCES SHALL BE SYNCHRONIZED WITH EACH OTHER IN ANY LOCATION WITH TWO OR MORE DEVICES IN A COMMON FIELD OF VIEW. Visual devices shall be non-silenced unless the system is successfully reset.

4. Operate control relay contacts to shut down all HVAC units serving the floor of alarm initiation.

5. Operate control relay contacts to return all elevators that serve the floor of alarm initiation to the ground floor. If the alarm originates from the ground floor, operate control circuits contacts to return all elevators to the floor above or to a level as directed by the local fire department.

6. Operate control relay contacts to release all magnetically held smoke doors throughout the building.

7. Visually annunciate the individual point of alarm on all remote annunciator panels. The visual indication shall remain on until the alarm condition is reset to normal.

8. Transmit an alarm condition, via the integral central station communicator, to central station/Local Fire Department (as required by the AHJ).

C. Elevator smoke and heat detector sequences shall comply with the ANSI A17.1 requirements for main/alternate floor recalls, and shunt trip activations.

D. Activation of a sprinkler supervisory initiating device shall:

1. Update the control/display as described above (A.1.)

2. Transmit a supervisory condition, via the integral central station communicator, to central station/Local Fire Department (as required by the AHJ).

3. Visually annunciate the individual point of alarm on all remote annunciator panels. The visual indication shall remain on until the alarm condition is reset to normal.

E. The entire fire alarm system wiring shall be electrically supervised to automatically detect and report trouble conditions to the fire alarm control panel. Any opens, grounds or disarrangement of system wiring and shorts across alarm signaling wiring shall automatically:

1. Update the control/display as described above (A.1.)

2. Transmit a trouble condition, via the integral central station communicator, to central station/Local Fire Department (as required by the AHJ).

3. Visually and audibly annunciate a general trouble condition, on the remote annunciator panels. The visual indication shall remain on until the trouble condition is repaired.

F. Purge / Smoke Control:
The panel shall be UUKL listed specifically for smoke control operation to allow the smoke purge control to be housed in the FACP cabinet (if approved by the Local Authority). The smoke control switches shall be located behind a locked glass door.

2.4 SUPPORT FOR INSTALLER AND OWNER MAINTENANCE

A. Provide a coded one-man walk test feature. Allow audible or silent testing. Signal alarms and troubles during test. Allow receipt of alarms and programmed operations for alarms from areas not under test.

B. Provide internal system diagnostics and maintenance user interface controls to display/report the power, communication, and general status of specific panel components, detectors, and modules.

C. Provide loop controller diagnostics to identify common alarm, trouble, ground fault, Class A fault, and map faults. Map faults include wire changes, device type changes by location, device additions/deletions and conventional open, short, and ground conditions. Ground faults on the circuit wiring of remote module shall be identified by device address.

D. Allow the user to display/report the condition of addressable analog detectors. Include device address, device type, percent obscuration, and maintenance indicator. The maintenance indicator shall provide the user with a measure of contamination of a device upon which cleaning decisions can confidently be made.

E. Allow the user to report history for alarm, supervisory, monitor, trouble, smoke verification, watchdog, and restore activity. Include Facility Name, Licensee, Project Program Compilation date, Compiler Version, Project Revision Number, and the time and date of the History Report.

F. Allow the user to disable/enable devices, zones, actions, timers and sequences. Protect the disable function with a password.

G. Allow the user to activate/restore outputs, actions, sequences, and simulate detector smoke levels.

H. Allow the service user to enter time and date, reconfigure an external port for download programming, initiate auto programming and change passwords. Protect these functions with a password.

I. THE END-USER SHALL RETAIN COMPLETE OWNERSHIP TO THE PROGRAMMING DATABASE RUNNING IN THE SYSTEM. The fire alarm equipment vendor shall provide useable hard and soft copies of the software database to the End-User at the end of the warranty period. The database provided shall be useable by any authorized and certified distributor of the product line and shall include all applicable passwords necessary for total and unrestricted use and modification of the database. The Consulting Engineer shall define the extent of hardcopy database documentation to be provided.

2.5 UL LISTED AND APPROVED EQUIPMENT

A. Fire Alarm Control Panel Requirements: The fire alarm control panel or panels and all system devices (horn-strobes, strobes, pull stations, smoke and heat detectors, etc. shall be Edwards Systems Technology (EST) type EST3 series (or equal). All under one label “UL listed and approved” for the use of fire alarm systems in this area of the United States of America. The operating controls shall be located behind locked door with viewing window. All control modules shall be labeled, and all zone locations shall be identified.

B. System Controllers: The main controller 3-CPU shall be supervised, site programmable, and of modular design supporting up to 125 detectors and 125 remote modules per addressable Signaling line Circuit (SLC). The CPU shall support up to 10 SLC's per panel for a total system capacity of 2500 Intelligent Addressable points. The system shall be designed with peer-to-peer networking capability for enhanced survivability, with support for up to 64 nodes, each with up to 2500 points and an overall capacity of 160,000 points. The cabinets shall be steel, with a red finish.

C. The system shall store all basic system functionality and job specific data in non-volatile memory. All site specific and operating data shall survive a complete power failure intact. Passwords shall protect any changes to system operations.

D. The Main Controller Module shall control and monitor all local or remote peripherals. It shall support a large 960 character LCD, power supply, remote LCD and zone display annunciators, printers, and support communication interface standard protocol (CSI) devices such as color computer annunciators and color graphic displays. If configured as a network, each system shall display each and every point in the system and shall also support up to 64 remote LCD display annunciators. Remote LCD annunciators shall also display each and every point in the system and be sized with the same number of characters as in the main FACP display.

E. The panel shall have an interface module for remote site monitoring. The module shall have a dialer (alarm communicator transmitter (DACT)) module to transmit alarm, supervisory and trouble signals to a Central Monitoring Station (CMS). The DACT shall support dual telephones lines, Contact I.D. communications, and configured for dual tone multi-frequency (DTMF) or pulse modes. It shall be possible to delay AC power failure reports, auto test call, and be site programmable. The dialer shall be capable of transmitting every individual alarm condition to the central station.

F. The system shall have built-in automatic system programming to automatically address and map all system devices attached to the main controller. A minimum default single stage alarm system operation shall be supported with alarm silence, event silence, drill, lamp test, and reset common controls.

G. Advanced Windows-based System Definition Utility with Program Version Reporting to document any and all changes made during system start-up or system commissioning shall be used to maintain site specific programming. Time and Date Stamps of all modifications made to the program must be included to allow full retention of all previous program version data. It shall support programming of any input point to any output point. The system shall support the use of Bar Code readers to assist custom programming

functions. It shall allow authorized customization of fundamental system operations using initiating events to start actions, timers, sequences and logical algorithms. The system program shall meet the requirements of this project, current codes and standards, and satisfy the local Authority Having Jurisdiction.

H. The system shall support distributed processor intelligent detectors with the following operational attributes; integral multiple differential sensors, automatic device mapping, electronic addressing, environmental compensation, pre-alarm, dirty detector identification, automatic day/night sensitivity adjustment, normal/alarm LEDs, relay bases, sounder bases and isolator bases.

I. The system shall use full digital communications to supervise all addressable loop devices for placement, correct location, and operation. It shall allow swapping of “same type” devices without the need of addressing and impose the “location” parameters on replacement device. It shall initiate and maintain a trouble if a device is added to a loop and clear the trouble when the new device is mapped and defined into the system.

J. Each controller shall contain a RS232 printer/programming port for programming locally via an IBM PC. When operational, each controller shall support a printer through the RS232 port and be capable of message routing.

K. System circuits shall be configured as follows: Addressable analog SLC loops Class B (Style 4); Initiating Device Circuits Class B; Notification Appliance Circuits Class B; Network Communications Class B; Annunciator Communications Class B.

L. Single stage operation shall be provided.

M. The system shall have a UL Listed Detector Sensitivity test feature, which will be a function of the smoke detectors and performed automatically every 4 hours.

N. The system shall support 100% of all remote devices in alarm and provide support for a 100% compliment of detector isolator bases.

O. All panel modules shall be supervised for placement and return trouble if damaged or removed.

P. The system shall have a CPU watchdog circuit to initiate trouble should the CPU fail.

Q. The system evacuation signal rate shall be temporal 3-3-3.

R. Audible notification appliances shall be affected by signal silence features. Visual signal appliance shall not be affected by signal silence features.

S. User Interface: The 3-LCDXL Display Module shall be of membrane style construction with a 24 line by 40-character (960 total characters) Liquid Crystal Display (LCD). The LCD shall use super-twist technology and backlighting for high contrast visual clarity and a colored gray/black and white display. In the normal mode the LCD shall display the time, a customer facility name, and the number of history events. In the alarm mode the LCD display the total number of events and the type of event on display. The LCD shall

reserve 42 characters of display space for each user custom message by addressable device. The module shall have visual indicators for the following common control functions; Power, Alarm, Supervisory, Monitor, Trouble, Disable, Ground Fault, CPU fail, and Test. There shall be common control keys and visual indicators for reset alarm silence, panel silence, and drill. Provide four pairs of display control keys for selection of event display by type (alarm, supervisory, monitor and trouble) and forward / backward scrolling through event listings. The operation of these keys shall be integrated with the related common control indicators to flash the indicators when undisplayed events are available for display and turn on steady when all events have been displayed. The LCD shall display the first event of the highest priority as well as the previous seven (7) alarm events “hands free” in chronological order so that the arriving firefighter may track the fires progression. Provide system function keys; status, reports, enable, disable, activate, restore, program, and test. The module shall have a numeric keypad, zero through nine with delete and enter keys.

T. Power Supplies: The power supply shall be a high efficiency switch mode type with line monitoring to automatically switch to batteries for power failure or brown out conditions. The automatic battery charger shall have low battery discharge protection. The power supply shall provide internal power and 24 Vdc at 7.0A continuous for notification appliance circuits. The power supply shall be capable of providing 7A to output circuits for a maximum period of 100 ms. All outputs shall be power limited. The battery shall be sized to support the system for 24 hours of supervisory and trouble signal current plus general alarm for 5 minutes.

U. Auxiliary power supplies shall be a high efficiency switch mode type with line monitoring to automatically switch to batteries for power failure or brown out conditions. The automatic battery charger shall have low battery discharge protection. The power supply shall provide internal power and 24 Vdc at 7.0A continuous for notification appliance circuits. The power supply shall be capable of providing 7A to output circuits for a maximum period of 100 ms. All outputs shall be power limited. The battery shall be sized to support the system for 24 hours of supervisory and trouble signal current plus general alarm for 5 minutes. Network alpha-numeric annunciators shall be located throughout the facility as indicated on the plans. The system shall have the capacity to support 64 network annunciators or EST3 network panel nodes. Each annunciator shall contain a supervised, back lit, liquid crystal with a minimum of 8 line with 21 characters per line. Where required, the annunciator shall include additional zonal annunciation and manual control without additional enclosures. The annunciator shall support full ability to serve as the operating interface to the system and shall include the following features; Matched appearance with other system displays. Each LCD Display on each node (cabinet) in the system shall be configurable to show the status of any or all of the following functions anywhere in the system: Alarm, Supervisory, Trouble, Monitor.

V. Firefighters Smoke Control System – FSCS

1. The FSCS shall be utilized for control of both Smoke Control and Post Fire Smoke Purge.

a. Smoke control shall include Atrium, Stair, Elevator Shaft Smoke Control as well as zoned smoke control per the project plans and Building Code as the Mechanical Code.

b. Post Fire Smoke Purge shall include post fire smoke evacuation per the Building Code.

2. The FSCS shall be integral to the Fire Command Station or Fire Alarm Control Panel. It shall include switch/LED modules that provide three position (on/off/auto and open/closed/auto) switches and 4 LED's (normal, on, off, fault or normal, open, closed, fault) per each smoke control system controlled as required by the building Code.

a. The FSCS shall be UL864 and UUKL listed.
b. The FSCS shall include 3 position switches for each smoke control system. Each switch shall include On/Off/Auto positions for control of smoke control fan systems and Open/Closed/Auto positions for Smoke Control Dampers systems.
c. The FSCS shall include the following indicators for each smoke control system:
   i. Fans, Dampers, or other operating equipment in their normal status – White Indicator
   ii. Fans, Dampers, or other operating equipment in their off or closed position – Red Indicator
   iii. Fans, Dampers, or other operating equipment in their on or open Status – Green Indicator
   iv. Fans, Dampers, or other operating equipment in Fault - Yellow Indicator
   v. Smoke Control switch and LED modules shall include a printable portion next to each switch and LED set for a custom descriptor of each smoke control system. The printable portion shall include text and graphical icons indicating the function of the smoke control system.
d. Verification All Dampers that are part of the smoke control system shall include verification per the building code and NFPA 92A.
   i. Verification shall mean end switches (true open and true closed) for each smoke control damper.
   ii. All fans used for smoke control shall include verification the building code and NFPA 92A. Verification shall mean duct pressure, airflow, or equivalent sensors.
   iii. The white normal indicator shall give the FSCS operator a clear indication that the smoke control equipment is operating properly. Dampers that are not open or not closed (mid-point) shall extinguish the white indicator.
e. When a smoke control fan is indexed to start manually or from the fire alarm system all dampers shall open. When fan is indexed to stop, all dampers shall close unless indicated differently on the project plans.

f. Fire detection systems providing control input or output signals to mechanical smoke control systems or elements thereof shall comply with the requirements of Chapter 9 and NFPA 72.

3. The FSCS shall include manual post fire smoke purge. Manual smoke purge shall be integral to the FSCS or located on Led/Switch modules directly adjacent to the smoke control controls and indicators. A 2-position On/Off switch shall be included by floor or area for manual **e**vacuation of smoke. Each 2-position switch shall include a green indicator that displays when the purge fan is on and a yellow trouble indicator. A graphic diagram indicating the portions of the building served by each post fire smoke purge system shall be included.

4. Fans will not be affected upon system reset. Restarting the fans may be accomplished by turning them back on in an individual sequential fashion or through individual manual switches at the FSCS controls to eliminate the possibility of all fans turning on simultaneously.

5. Under normal circumstances, smoke exhaust fans, respective fire-smoke dampers, motorized dampers shall be closed unless noted otherwise on the project plans.

W. It must be possible to have up to 64 network annunciators or EST3 panels on the network.

X. Each annunciator must be capable of supporting custom messages as well as system event annunciation. It must be possible to filter unwanted annunciation of trouble, alarm or supervisory functions on a by point or by geographic area.

Y. The annunciators shall be mounted in stand-alone enclosures or integrated into the network panels as indicated on the plans.

2.6 COMPONENTS

A. Intelligent Devices — General: Each remote device shall have a microprocessor with non-volatile memory to support its functionality and serviceability. Each device shall store as required for its functionality the following data: device serial number, device address, device type, personality code, date of manufacture, hours in use, time and date of last alarm, amount of environmental compensation left/used, last maintenance date, job/project number, current detector sensitivity values, diagnostic information (trouble codes) and algorithms required to process sensor data and perform communications with the loop controller. Each device shall be capable of electronic addressing, either automatically or application programmed assigned, to support physical/electrical mapping and *supervision by location.* Setting a device's address by physical means shall not be necessary.

B. Intelligent Detectors — General: The System Intelligent Detectors shall be capable of full digital communications using both broadcast and polling protocol. Each detector shall be capable of performing independent fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patterns and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted deceptive nuisance alarms. Signal patterns that are not typical of fires shall be eliminated

by digital filters. Devices not capable of combining different fire parameters or employing digital filters shall not be acceptable. Each detector shall have an integral microprocessor capable of making alarm decisions based on fire parameter information stored in the detector head. Distributed intelligence shall improve response time by decreasing the data flow between detector and analog loop controller. Detectors not capable of making independent alarm decisions shall not be acceptable. Maximum total analog loop response time for detectors changing state shall be 0.5 seconds. Each detector shall have a separate means of displaying communication and alarm status. A green LED shall flash to confirm communication with the analog loop controller. A red LED shall flash to display alarm status. The detector shall be capable of identifying up to 32 diagnostic codes. This information shall be available for system maintenance. The diagnostic code shall be stored at the detector. Each smoke detector shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings. Each detector microprocessor shall contain an environmental compensation algorithm that identifies and sets ambient “Environmental Thresholds” approximately six times an hour. The microprocessor shall continually monitor the environmental impact of temperature, humidity, other contaminates as well as detector aging. The process shall employ digital compensation to adapt the detector to both 24-hour long term and 4-hour short-term environmental changes. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 80% and 100% of the allowable environmental compensation value. Differential sensing algorithms shall maintain a constant differential between selected detector sensitivity and the “learned” base line sensitivity. The base line sensitivity information shall be updated and permanently stored at the detector approximately once every hour. The intelligent analog detectors shall be suitable for mounting on any Signature Series detector mounting base.

C. Fixed Temperature/Rate of Rise Heat Detector/Combination Heat and CO Detector, SIGA2-HRS, SIGA2-HCOS: Provide intelligent combination fixed temperature/rate-of-rise heat detectors SIGA-HRS. The heat detector shall have a low mass thermistor heat sensor and operate at a fixed temperature and at a temperature rate-of-rise. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. Systems using central intelligence for alarm decisions shall not be acceptable. The intelligent heat detector shall have a nominal fixed temperature alarm point rating of 135 degrees F (57 degrees C) and a rate-of-rise alarm point of 15 degrees F (9 degrees C) per minute. The heat detector shall be rated for ceiling installation at a minimum of 70 ft (21.3m) centers and be suitable for wall mount applications. Where shown on the project plans, include SIGA2-HCOS combination Heat and Carbon Monoxide (CO) detector. The combination Heat and CO device shall report separately to the control panel where a heat condition is considered a fire alarm and a CO condition is a supervisory alarm with separate and unique evacuation sequence.

D. Photoelectric Smoke Detector, SIGA2-PS: Provide intelligent photoelectric smoke detectors SIGA2-PS. The analog photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings. The integral microprocessor shall dynamically examine values from the sensor and initiate an

alarm based on the analysis of data. Systems using central intelligence for alarm decisions shall not be acceptable. The detector shall continually monitor any changes in sensitivity due to the environmental effects of dirt, smoke, temperature, aging and humidity. The information shall be stored in the integral processor and transferred to the analog loop controller for retrieval using a laptop PC or the SIGA-PRO Signature Program/Service Tool. The photo detector shall be rated for ceiling installation at a minimum of 30 ft (9.1m) centers and be suitable for wall mount applications. The photoelectric smoke detector shall be suitable for direct insertion into air ducts up to 3 ft (0.91m) high and 3 ft (0.91m) wide with air velocities up to 5,000 ft/min. (0-25.39 m/sec) without requiring specific duct detector housings or supply tubes. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5%. The photo detector shall be suitable for operation in the following environment: Temperature: 32 degrees F to 120 degrees F (0 degrees C to 49 degrees C), Humidity: 0-93% RH, non-condensing, Elevation: no limit.

E. Addressable Carbon Monoxide (CO) Detector, EST model SIGA2-COS with audible sounder base. Provide intelligent addressable Carbon Monoxide Detector with Temporal 4 Audible Base. The CO detection element shall indicate a trouble condition at the FACP signaling end of life and the CO element of the detector shall be field replaceable. It shall be programmed at the main control panel as a supervisory indication and transmit a separate supervisory signal to the central station. The CO detector shall be UL 2075 listed.

F. Standard Detector Mounting Bases, SIGA-SB / SIGA-SB4: Provide standard detector mounting bases SIGA-SB suitable for mounting on North American 1-gang, 3½" or 4" octagon box and 4" square box. The base shall, contain no electronics, support all Signature Series detector types and have the following minimum requirements: Removal of the respective detector shall not affect communications with other detectors, Terminal connections shall be made on the room side of the base, bases that must be removed to gain access to the terminals shall not be acceptable. The base shall be capable of supporting one (1) Signature Series SIGA-LED Remote Alarm LED Indicator. Provide remote LED alarm indicators where shown on the plans.

G. Audible Detector Mounting Base, SIGA-AB4GT. Where shown on the project plans include detector audible/sounder base model SIGA-AB4GT. The sounder base shall be capable of two tones, Temporal 3 for a fire condition and Temporal 4 for a Carbon monoxide condition. The tones shall be fully programmable and also synchronize the sound with other sounder bases. The system shall be UL2017 listed for dual signaling for this purpose.

H. Duct Detector Housing, SIGA-SD: Provide model SIGA-SD Low profile intelligent addressable DUCT smoke detector as indicated on the project plans. Provide for variations in duct air velocity between 100 and 4,000 feet per minute and include a wide sensitivity range of .79 to 2.46%/ft. Obscuration. Include one Form-C shut down relay rated 2.0 amps @ 30 Vdc and also include slave high contact relays if required. Provide an air exhaust tube and an air sampling inlet tube that extends into the duct air stream up to ten feet. The addressable DUCT housing shall be suitable for extreme environments, including a temperature range of –20 to 158 degrees F (-29 to 70 degrees Celsius) and

offer a harsh environment gasket option. Provide Remote Alarm LED Indicators SIGA-LED and/or remote test station model SD-TRK as indicated on the project plans.

I. Intelligent Modules — General: It shall be possible to address each Intelligent Signature Series module without the use of DIP or rotary switches. Devices using DIP switches for addressing shall not be acceptable. The personality of multifunction modules shall be programmable at site to suit conditions and may be changed at any time using a personality code downloaded from the Analog Loop Controller. Modules requiring EPROM, PROM, ROM changes or DIP switch and/or jumper changes shall not be acceptable. The modules shall have a minimum of 2 diagnostic LEDs mounted behind a finished cover plate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The module shall be capable of storing up to 24 diagnostic codes which can be retrieved for troubleshooting assistance. Input and output circuit wiring shall be supervised for open and ground faults. The module shall be suitable for operation in the following environment: Temperature: 32 degrees F to 120 degrees F (0 degrees C to 49 degrees C), Humidity: 0-93% RH, non-condensing.

J. Single Input Module, SIGA-CT1 (Waterflow Detectors, Tamper Switches etc.): Provide intelligent single input modules SIGA-CT1. The Single Input Module shall provide one (1) supervised Class B input circuit capable of a minimum of 4 personalities, each with a distinct operation. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers. The single input module shall support the following circuit types: Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.), Normally-Open Alarm Delayed Latching (Waterflow Switches), Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.), Normally-Open Active Latching (Supervisory, Tamper Switches).

K. Dual Input Module, SIGA-CT2: Provide intelligent dual input modules SIGA-CT2. The Dual Input Module shall provide two (2) supervised Class B input circuits each capable of a minimum of 4 personalities, each with a distinct operation. The module shall be suitable for mounting on North American 2 ½" deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers. The dual input module shall support the following circuit types: Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.), Normally-Open Alarm Delayed Latching (Waterflow Switches), Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.), Normally-Open Active Latching (Supervisory, Tamper Switches).

L. Single Input Signal Module, SIGA-CC1: Provide intelligent single input signal modules SIGA-CC1. The Single Input (Single Riser Select) Signal Module shall provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation. When selected as a telephone power selector, the module shall be capable of generating its own "ring tone". The module shall be suitable for mounting on North American 2 ½" (64mm) deep 2-gang boxes and 1 ½" (38mm) deep 4" square boxes with 2-gang covers, or European 100mm square boxes. The single input signal module shall support the following operations: Audible/Visible Signal Power Selector (Polarized 24 Vdc @ 2A).

M. Control Relay Module, SIGA-CR: Provide intelligent control relay modules SIGA-CR. The Control Relay Module shall provide one form “R” dry relay contact rated at 2 amps @ 24 Vdc to control external appliances or equipment shutdown. The control relay shall be rated for pilot duty and releasing systems. The position of the relay contact shall be confirmed by the system firmware. The control relay module shall be suitable for mounting on North American 2 ½” (64mm) deep 1-gang boxes and 1 ½” deep 4” square boxes with 1-gang covers.

N. Intelligent Manual Pull Stations — General: It shall be possible to address each Signature Series fire alarm pull station without the use of DIP or rotary switches. Devices using DIP switches for addressing shall not be acceptable. The manual stations shall have a minimum of 2 diagnostic LEDs mounted on their integral, factory assembled single or two stage input module. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The station shall be capable of storing up to 24 diagnostic codes that can be retrieved for troubleshooting assistance. Input circuit wiring shall be supervised for open and ground faults. The fire alarm pull station shall be suitable for operation in the following environment: Temperature: 32 degrees F to 120 degrees F (0 degrees C to 49 degrees C), Humidity: 0-93% RH, non-condensing.

O. Manual Pull Station, SIGA-270: Provide intelligent single action, single stage fire alarm stations SIGA-270. The fire alarm station shall be of metal construction with an internal toggle switch. Provide a locked test feature. Finish the station in red with silver “PULL IN CASE OF FIRE” English lettering. The manual station shall be suitable for mounting on North American 2 ½” (64mm) deep 1-gang boxes and 1 ½” (38mm) deep 4” square boxes with 1-gang covers.

P. Notification Appliances – General: All appliances shall be UL Listed for Fire Protective Service. All strobe appliances or combination appliances with strobes shall be capable of providing the “Equivalent Facilitation” which is allowed under the Americans with Disabilities Act accessibly guidelines (ADA(AG)), and shall be UL 1971, and ULC S526 Listed. All appliances shall be of the same manufacturer as the Fire Alarm Control Panel (NO EXCEPTIONS) specified to insure absolute compatibility between the appliances and the control panels, and to insure that the application of the appliances are done in accordance with the single manufacturers’ instructions. Any appliances that do not meet the above requirements and are submitted for use must show written proof of their compatibility for the purpose intended. Such proof shall be in the form of documentation from THE CONTROL PANEL MANUFACTURER clearly stating that the control equipment (as submitted) is 100% compatible with the submitted Notification Appliances.

Q. Strobes, G1RF-VM Series: Provide EST Series G1RF-VM series low profile wall mounted strobes at the locations shown on the drawings. Strobes shall provide synchronized flash outputs. Strobe output shall be field selectable as indicated on the drawings in one of the following intensity levels; 15/75, 15cd, 30cd, 75cd or 110cd*. Low profile strobes shall mount in a North American 1-gang box or surface mounted on a matching back box provided by the manufacturer, as directed in the field. * The fire alarm vendor may select below 75 candela where allowed by the appropriate release of ADA. 15/75 strobes may be used in corridors and in locations where 15 candela is required per NFPA wall and ceiling tables (see NFPA 72).

R. Temporal Horn Strobes, G1RF-HDVM Series: Provide EST Series G1RF-HDVM low profile wall mount horn/strobes at the locations shown on the drawings. The horn/strobe shall provide an audible output of 84.4 dBA at 10 ft at the high setting and for smaller room size locations (as indicated on the plans) a low dB setting (field selectable) of 79.4 dB at 10 ft. when measured in reverberation room per UL-464. Strobes shall provide synchronized flash outputs. The strobe output shall be as indicated on the drawings in one of the following field selectable intensity levels*; 15/75, 15cd, 30cd, 75cd & 110cd devices. The horn shall have a selectable steady or synchronized temporal output. Low profile horn/strobes shall mount in a North American 1-gang box or surface mounted on a matching back box provided by the manufacturer, as directed in the field. * The fire alarm vendor may select below 75 candela where allowed by the appropriate release of ADA. 15/75 strobes may be used in corridors and in locations where 15 candela is required per NFPA wall and ceiling tables (see NFPA 72).

S. Temporal Horn, G1RF-HD: Provide EST Series G1RF-HD low profile wall mount horn at the locations shown on the drawings. The horn shall provide an audible output of 84.4 dBA at 10 ft at the high setting and for smaller room size locations (as indicated on the plans) a low dB setting (field selectable) of 79.4 dB at 10 ft. when measured in reverberation room per UL-464. The horn shall have a selectable steady or synchronized temporal output. Low profile horn shall mount in a North American 1-gang box or surface mounted on a matching back box provided by the manufacturer, as directed in the field.

T. Multi-Voltage Control Relays, MR-200 Series: Provide remote control relays connected to supervised ancillary circuits for control of fans, dampers, door releases, etc. Relay contact ratings shall be DPDT and rated for 10 amperes at 115 Vac. A single relay may be energized from a voltage source of 24 Vdc, 24 Vac, 115 Vac, or 230 Vac. A red LED shall indicate the relay is energized. A metal enclosure shall be provided.

U. Electromagnetic Doorholders – General: Electromagnetic doorholders submitted for use must have written proof of their compatibility for the purposes intended. Such proof shall be in the form of documentation from all manufacturers that clearly states that their equipment (as submitted) is 100% compatible with each other for the purposes intended.

V. Wall Mounted, 1504/1505/1508/1509 Series: Provide flush, semi-flush or surface wall mounted electromagnetic doorholder/releases rated at 24 Vac/dc as directed by the Consulting Engineer. Finish shall be brushed zinc.

W. STI Stopper II Lexan Guards: Manual pull stations that are provided with STI Stopper II lexan guards shall include non-audible alarms as required on the plans. They shall be surface or flush mounting, as required for each individual device.

X. Projected Beam Detector – Single End – Model GE/EST EC-50/100R. The projected beam type smoke detector shall be a 4-wire 12/24 Vdc device monitored by the Fire Alarm control panel through a two circuit SIGA-CT2 monitor module (one zone for alarm and one for trouble). The unit shall be listed to UL 268 and shall consist of an integrated transmitter and receiver. The beam detector shall operate between a range of 15 and 160 feet (4.57 and 48.77 m) or 160 and 330 feet (48.77 and 100 m)(contractor shall determine distance to select appropriate model). It shall feature automatic gain control, which will compensate

for gradual signal deterioration due to dirt accumulation on the lenses. The unit shall include a wall mounting bracket. Testing shall be carried out using a calibrated test filter. It shall be possible to test the detector without direct access to it by means of a remotely installed key-operated test station.

PART 3 – EXECUTION

3.1 INSTALLATION

A. The entire system shall be installed in a workmanlike manner, in accordance with approved manufacturer's wiring diagram. The contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation. All wiring shall be of the type recommended by the manufacturer, approved by the local Fire Department and specified with in.

B. All penetration of floor slabs and firewalls shall be sleeved (1" conduit minimum) fire stopped in accordance with all local fire codes.

C. End of Line Resistors shall be furnished as required for mounting as directed by the manufacturer. Devices containing end-of-line resistors shall be appropriately labeled. Devices should be labeled so removal of the device is not required to identify the EOL device.

D. All manual pull stations shall be mounted 48 inches above the finished floor, as measured to the handle.

E. All audio/visual devices shall be mounted 80 inches above the finished floor, as measured to the lens. Devices shall be mounted no less than 6 inches from the ceiling. All audiovisual devices shall have lexan covers in all areas.

F. No area smoke detectors shall be mounted within 36 inches of any HVAC supply, return air register or lighting fixture.

G. No area smoke or heat detector shall be mounted within 12 inches of any wall. All detectors shall be installed in strict accordance with NFPA 72 (1999) guidelines for such devices.

H. All mechanical rooms, boiler rooms, gymnasiums, wiring closets, custodian rooms, attic spaces, etc. or areas with no hung ceilings shall be piped with 3\4" conduit. All device plenum rated wiring shall be mechanically protected with conduit. All areas in public view shall be in metal V-700 wiremold (or equal).All boxes must be painted red and labeled "FIRE ALARM".

I. All addressable modules shall be mounted within 36 inches of the monitored or controlled point of termination. This shall include, but is not necessarily limited to, fan shutdown, elevator recall, shunt trip, sprinkler status points, or door release. Label all addressable modules as to their function.

J. New door holders shall derive their 24VAC/VDC power from a separate power supply housed in a dedicated, metal enclosure. The power supply shall have a 120VAC feed and is to be centrally located to serve door holders on a per floor or area basis. All existing door holders shall be connected to new FACP. E.C. shall extend all existing wiring in order to make this work. Locations and quantities of door holder power supplies shall be referenced and submitted in the submission package for approval by the Consulting Engineer.

K. All low voltage wiring terminated to the fire alarm system shall be PLENUM RATED with no exceptions and no less than No. 18 AWG in size, and solid copper.

L. All line voltage (120VAC) wiring shall be no less than No. 12 AWG in size, and solid copper. This shall include all system grounding. FACP must have a DEDICATED 20 Amp circuit marked back at the power panel NO EXCEPTIONS.

M. All wiring shall be color-coded throughout, to National Electrical Code standards.

N. Power-limited/non-power-limited NEC wiring standards SHALL BE OBSERVED.

O. All junction box covers shall be painted federal safety red and labeled FIRE ALARM SYSTEM ONLY in black letters.

P. Fire alarm system wiring shall not co-mingle with any other system wiring in the facility. Conduits shall not be shared under any circumstance. Only when fire alarm wiring enters the enclosure of a monitored or controlled system will co-habitation be permitted (i.e., at fan starters or elevator controllers). THIS WILL BE FIELD INSPECTED BY THE PROJECT ENGINEER.

Q. Fire alarm control panel enclosures shall have engraved labels indicating, “FIRE ALARM SYSTEM”, and the areas of the building served by that panel.

R. Auxiliary relays shall be appropriately labeled to indicate “FIRE ALARM SYSTEM” and their specific function (i.e., FAN S-1 SHUTDOWN).

S. All fire alarm wiring shall be continuous and unspliced. Terminations shall only occur at fire alarm devices or control panel enclosures under terminal screws. All other splicing methods are specifically disallowed (i.e., plastic wirenuts).

T. All fire alarm wiring shall be installed using a dedicated system of supports (i.e., bridle rings). Fire alarm wiring shall not be bundled or strapped to existing conduit, pipe or wire in the facility. THIS WILL BE FIELD INSPECTED BY THE PROJECT ENGINEER

U. All fire alarm wiring shall be sleeved when passing through any wall, using conduit sleeves (1” min.) with bushings, and fire stopped in accordance with Code.

V. The system shall be arranged to receive power from one three wire 120 Vac, 20 A supply. All low voltage operation shall be provided from the fire alarm control panel.

W. All fire alarm devices shall be accessible for periodic maintenance. Should a device location indicated on the Contract Drawings not meet this requirement, it shall be the responsibility of the installing contractor to bring it, in writing, to the attention of the Project Engineer. Failure to bring such issues to the attention of the Project Engineer shall be the exclusive liability of the installing Electrical Contractor.

X. The existing fire alarm system shall remain in operation until such time that approval has been granted for its removal. The installing Electrical Contractor shall be responsible for the upkeep of the existing system until such time that it can be removed.

Y. The installing Electrical Contractor shall be responsible for the removal of ENTIRE existing fire alarm system components and controls on the demolition drawing shown or not, upon approval of the AHJ and the Consulting Engineer. The End-User reserves the right to retain any existing fire alarm system components, upon their request. All existing fire alarm system components requiring special handling for disposal (due to radioactivity) shall be the responsibility of the installing contractor. Written proof of proper disposal by the installing contractor shall be required prior to release of outstanding retainage.

3.2 FIELD QUALITY CONTROL

A. The system shall be installed and fully tested under the supervision of a trained manufacturer's representative. The system shall be demonstrated to perform all of the function as specified.

B. The installing contractor or fire alarm equipment vendor shall have no less than two (2) NICET Level II fire alarm technicians dedicated to this project.

C. The Installing Contract and the Fire Alarm System Vendor shall, upon the request of the Consulting Engineer or End-User, attend any and all project meetings for the purpose of accurately determining progress.

D. It shall be the responsibility of the installing contractor to assure that construction debris does not adversely affect any sensing devices installed as part of this project. Should it be deemed necessary by the Consulting Engineer, End-User or AHJ, the installing contractor shall be responsible for the cleaning of all smoke detectors prior to final acceptance.

3.3 TESTS

A. The fire alarm system vendor shall test the system in accordance with the manufacturer's requirements and NFPA 72. The vendor shall provide completed NFPA 72 reports to the Consulting Engineer for review and approval prior to final acceptance.

B. Each individual system operation on a circuit by circuit basis shall be tested for its complete operation. The procedure for testing the entire fire alarm system shall be set forth with the consent of the code enforcement official, the Engineer and the manufacturer.

3.4 DOCUMENTATION AND TRAINING

A. The contractor shall compile and provide to the owners three (3) complete manual on the completed system to include SITE SPECIFIC operating and maintenance instruction, catalog cuts of all equipment and components, as-built wiring diagrams and a manufacturer's suggested spare parts list. An operational Video, on DVD media, shall also be included.

B. In addition to the above manuals, the Electrical Contractor shall provide the services of the manufacturer's trained representative for **two (2)** separate calendar days for a period of four **(4) hours** per day to instruct the owners' designated personnel on the operation and maintenance of the entire system.

C. As-Built drawings shall consist of the following:

1. Complete revision of all previously submitted drawings
2. Point-to-point depiction of all device wiring on the device layout floor plans.
3. One (1) set of B-size, laminated as-built drawings.
4. Two (2) sets of 30"x42"inch 1\16"=1' scale drawings showing all points of fire alarm. One set shall be submitted with the close-out documents. Second set shall be mounted in frame with a lexan cover. These drawing must be submitted to project Engineer or approval.

D. Turnover of all software database hard/soft copies shall be required. This shall include all possible programming software logs, diskettes or CDs containing exported project files, hard copies of all device maps, the revision number of the version of programming utility used, and all required passwords. The turnover of all database information shall occur prior to the end of the One (1) warranty period (or period as amended earlier in this specification).

END OF SECTION 260800

SECTION 260810

TELECOMMUNICATIONS AND AUDIO/VIDEO CABLING SYSTEM

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

A. The work covered by this specification includes the system integration and construction described, including all labor necessary to perform and complete such work; all materials and equipment incorporated or to be incorporated in such work; and all services, facilities, tools and equipment necessary or used to perform and complete such work and all systems configuration, testing and turnover for a fully operational and functioning backbone system.

B. Before the start of any work coordinate all equipment, devices, cable, racks, supports etc. with Owner.

1.2 IT INFRASTRUCTURE SYSTEM

A. Lateral Cabling

1. Provide, test and document Category 6 UTP copper horizontal communications cabling as shown in construction documents. Horizontal cabling in Basement and 1st Floor shall derive from new data racks in MDF Data Closet B04 located in Basement. On 2nd, 3rd and 4th Floors horizontal cable shall derive from new data rack mounted patch panel located on each floor. For 2nd Floor in Data Closet 207a, for 3rd floor Data Closet 307a and for 4th Floor in Data Closet 407a. In the Community Building horizontal cable shall derive from new data rack mounted patch panel located Basement Data Closet GB02. Cable shall terminate at each Wireless Access Point (WAP) and each data outlet location as per construction documents. Cabling shall be run above the ceiling supported by J-hooks, inside surface mounted raceway or within conduit. Leave 10' slack neatly coiled and tie wrapped in closet for flexibility.

2. Core drill and provide conduit sleeve as required to provide access through cinderblock walls into classrooms for lateral cabling above ceilings.

3. All lateral cabling installation shall be concealed above ceiling. In areas that require being exposed cable shall be run in the following manner: In unfinished area install cable in EMT conduit and in finished area (classrooms, offices, corridors, etc.) provide steel surface mounted raceway to hide and protect lateral cable. No cabling shall be run exposed except in data rack closet on cable management.

B. Provide all cable termination patch panels, blocks, equipment racks and cable management organizers, rear support wire management, ladder rack, cross connect supports and guide rings as required for a full and complete installation.

C. Provide all outlet jacks, connectors, terminating devices, faceplates, and similar components required for a complete installation as indicated in details in construction documents.

D. Provide all labeling and documentation of all cables, racks, outlets and hardware installed under this contract.

E. Provide all testing and test documentation as described below.

F. Provide J-STD-607-A standard-compliant telecommunications ground backbone cables, bus bars, connectors and components required for a complete telecommunications grounding system installation.

G. Provide all connections to the telecommunications grounding system.

H. Provide fire-stopping of all rated wall penetrations and openings through rated walls after installation of telecommunications cabling.

I. Provide all non-specified miscellaneous hardware, including, but not limited to nuts, bolts, re-enterable cable ties, spiral wrap, wire rings, supporting hardware and similar components required for a complete cabling system installation.

J. Remove all abandoned cabling.

1.3 AUDIO/VISUAL

A. Lateral Cabling

1. Provide, test and document HDMI cable and Category 6 cable as shown in construction documents. Horizontal cabling shall derive from Teacher’s outlet to Interactive Monitor as indicated in construction documents. Category 6 cabling shall be run above the ceiling supported by J-hooks, inside surface mounted raceway or within conduit. Leave 5' slack neatly coiled and tie wrapped above ceiling to data closet.

2. All lateral cabling installation shall be concealed above ceiling and vertical cabling in wall in conduit stub-ups. In areas that require being exposed cable shall be run in steel surface mounted raceway to hide and protect cable. No cabling shall be run exposed.

B. Provide all cable and wire termination at outlets and guide rings as required for a full and complete installation.

C. Provide all outlet jacks, connectors, terminating devices, faceplates, and similar components required for a complete installation as indicated in detail in construction documents.

D. Provide all labeling and documentation of all cables, outlets and hardware installed under this contract.

E. Provide all testing and test documentation of cables.

F. Provide all non-specified miscellaneous hardware, including, but not limited to nuts, bolts, re-enterable cable ties, spiral wrap, wire rings, supporting hardware and similar components required for a complete cabling system installation.

G. Remove all abandoned cabling.

1.4 TELEPHONE

A. Provide in MDF Data Closet B04 a new PBX cabinet for 100 phone line connection. Confirm with Yonkers IT Dept prior to ordering.

B. Provide in 2nd Floor Data Closet 207a, in 3rd floor Data Closet 307a and Community Building Basement Data Closet GB02 a mini PBX cabinet for 25 phone line connection in each location. Confirm with Yonkers IT Dept prior to ordering.

C. Provide 25 pair telephone cable from each closet, Data Closet 207a, 307a and Community Building GB02 to Main PBX located in MDF Data Closet B04 in Basement. Confirm with Yonkers IT Dept prior to ordering.

D. Provide termination on both ends, label and test for continuity and sound.

1.5 SUBMITTALS

A. General: The contractor shall submit product documentation for all components that will be used for this project. The documentation must be approved before order and installation. The contractor shall furnish the product documentation on any substituted product with the bid response. The remaining submittals shall be furnished for approval one (1) week after award of contract.

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations to be consistent with existing building arrangement. Coordinate with Owner before the start of any work.

C. At completion of installation, furnish a complete set of As-Built documents, including plan view and elevation drawings, cable test results and cable termination and cross connection schedules.

D. As-Built drawings shall be submitted in format as indicated in division 1. As-built cable schedules shall be provided in (1) hard copy and (1) computer CD format.

1.6 QUALITY ASSURANCE

A. All products and materials shall be new, clean, and free of defects or damage and of first quality.

B. The Contractor shall be responsible for the receipt, delivery and safe storage of materials and equipment to the job site. Deliver materials (except bulk materials) in manufacturers' unopened containers.

C. The Contractor shall comply with all applicable governmental regulations and with all Federal, State, County, City, and other applicable codes, ordinances, regulations and BICSI installation practices.

D. Local electrical and building codes may differ from national codes. Follow the most stringent code or recommendations.

E. It is the intent of these Specifications to provide a complete workable telecommunications cabling system ready for the Owner's use. Any item not specifically shown on the Drawings or called for in the Specifications, but normally required to conform to the intent, is to be considered as part of the Contract.

F. Any given item of equipment or material shall be the product of one manufacturer throughout the facility. Multiple manufacturers of any one item shall not be permitted, unless specifically noted otherwise or approved by the Owner.

G. These Specifications are equipment and performance Specifications. Actual installation shall be as indicated on the Drawings. Any discrepancies found between the Specifications and Drawings shall be brought to the attention of the Construction Manager. Installation and details indicated on the Drawings shall govern if they differ from the Specifications.

H. Certain terms such as "shall, provide, install, complete, etc." are not used in some parts of these Specifications. This does not indicate that the items shall be less than completely installed or that systems shall be less than complete.

1.7 COORDINATION OF THE WORK

A. Coordinate project and schedule work with the general contractor in accordance with the schedule and construction sequence.

B. Wherever work interconnects with work of other trades, provide the information necessary to properly install all the connections and equipment. Identify all items of work that require access so that the ceiling trade will know where to install access doors and panels, and where to leave ceiling spaces accessible for wiring installation.

C. Attend all construction meetings as requested by the Owner or Construction Manager.

D. Maintain a complete file of shop drawings available at all times to the Construction Manager.

E. Prior to actual installation, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper compliance with the design intent.

PART 2 - PRODUCTS

Substitutions or alternates for the manufacturers listed will not be permitted without the written consent of the Owner. Refer to Section 1.4, Submittals, for further information. Submit shop drawings for checking and approval.

2.1 UTP COPPER CABLE

A. For Horizontal Cable, Plenum rated, (4) 23 AWG twisted unshielded pairs, to meet or exceed Category 6 code performance standards, solid copper, insulated conductors, UL Listed CMP Manufacturer: Commscope, Hitachi or AMP Netconnect - Color – Data: Blue and Telephone: White.

2.2 AUDIO/VISUAL CABLE

A. Category 6 Cable shall be utilized for HDMI and data runs.

2.3 TERMINATION HARDWARE

A. Patch Panel for UTP terminations. Meet or exceed TIA and ISO Category 6 component performance requirements. Universal wiring T568A or T568B. All terminations shall be T568B. Manufacturer: AMP Netconnect.

B. Category 6 Modular Jack for UTP terminations. Meet or exceed TIA and ISO Category 6 component performance requirements. Universal wiring T568A or T568B. All terminations shall be T568B. Color – Blue for Data and White for Voice. Manufacturer: AMP Netconnect.

2.4 OUTLET COMPONENTS

A. Refer to construction documents, provide Legrand for outlet component type for data/telephone and audio/visual.

B. For Teacher’s Desk location provide HDMI 2-RJ-45 bulkhead in single gang stainless steel wall plate.

C. Provide at Smartboard/TV stainless steel wall plate, HDMI and RJ-45 Bulkheads. Run 6” VGA and 3.5mm composite video flying lead.

D. For Data and combination Telephone/Data provide 4 port angled cover plate with label window manufactured by Commscope # 1-406185-1-1 White.

2.5 FIRE STOP FITTINGS

A. Flame stopper providing fire stopping to existing through-wall cable penetrations. Up to four hour F and T ratings ensures product will maintain the integrity of fire rated walls whether empty, partially filled or fully loaded. Plenum rated and low air (smoke) leakage.

B. Manufacturer: Nelson Firestop Product, Part No.: Nelson FSP (Putty Bars), Nelson CLK (Silicone Sealant), Nelson LBS (Latex Sealant), Nelson ES1399 (Elastomeric Sealant) or approved equal.

2.6 EQUIPMENT RACKS, CABLE PATHWAYS AND CABLE MANAGEMENT

A. 7' Height (45RU) Cable Management Rack. All 14 gauge steel construction. Color black. Provide all mounting hardware as required. Bond to grounding bus bar.
Manufacturer: Mid Atlantic R4 Series, R412-4524B

B. 7' Height Vertical Cable Manager w/ Door. 6" width. Color black.
Manufacturer: Mid Atlantic VCD-6-45-DC

C. Horizontal cable management panels. Color Black.
Manufacturer: Mid Atlantic Part No.: HCM-1D (1 RU), HCT-2 (2RU)

D. Ladder rack. 12"W. 12" rung-spacing. Steel construction. Color black. Provide all mounting hardware as required. Bond to grounding bus bar.
Manufacturer: Chatsworth Products, Inc. Part No.: 10250-712 or approved equal.

E. Surface-mount raceway. Steel construction. Used to contain data/telephone cabling within classrooms when cabling cannot be concealed. No cabling shall be run exposed. Provide bends and all required and necessary accessories. Color white. Manufacturer: Wiremold Model No.:700WH or approved equal.

F. Surface-mounted raceway. Steel construction. Used to contain power and data/telephone cabling within classrooms when cabling cannot be concealed. No cabling shall be run exposed. Provide bends and all required and necessary accessories. Color white.
Manufacturer: Wiremold: Model No.:4000WH or approved equal.

G. Deep Single Gang Surface-mount receptacle box when installed on existing wall. Steel construction. Use in classrooms or Offices for data/ telephone. Color white
Manufacturer: Wiremold Model No.: 5744 WH or approved equal.

H. Radius drop for ladder rack. Color black.
Manufacturer: Chatsworth Products, Inc. Part No.: 12100-712(Cross-member), 12101-701(Stringer) or approved equal.

I. Cable-retaining posts for ladder rack. Color black.
Manufacturer: Chatsworth Products, Inc., Part No.: 10596-706 or approved equal.

J. Velcro-type cable ties. Lengths as needed. Plenum-rated.
Manufacturer: Ortronics., Part No.: OR-70700143 (8"), OR-70700144 (12") or approved equal.

K. "J" Hooks. Suitable for attachment to beam flanges, "U" channel, purlings, deck plates, smooth or threaded rod and designed for Category 6 cabling. For use as a cable support in ceilings. Manufacturer: Erico, Arlington Industries, B-Line Part No.: As Required or approved equal.

L. All conduit riser, drops and conduit run for Rapid Cable shall have a drag wire left in place for future use.

2.7 GROUNDING COMPONENT

A. Cabinet and Rack grounding kit. Complete kit for new installation.
Manufacturer: Panduit, Part No.CGK630U or approved equal.

B. Jumper Kits. Manufacturer: Panduit, Part No.: CGJ620U(for M6 Rail), CGJ620UC(for thru-hole Rail), CGJ5620UB(for Cage Nut Rail), RGEJ1057PFY (for equipment) or approved equal.

2.8 LABELS

A. Labels. Self-adhesive, self-laminating, with white matte finish printing area, clear plastic shield. Pin feed for machine printing. Used for cable identification. Labels shall be provided on both ends of all cables. 1" width for horizontal cabling, 2" width for riser cabling. Length as required for other cable media.
Manufacturer: W. H. Brady Co. Type:1" Width for horizontal cabling, 2" Width for riser cabling and length as required for other cable media or approved equal.

B. Labels. White polyester. Laser printable for use on face plates. 1" x 4". Coordinate label placement with Owner.
Manufacturer: W. H. Brady Co., Part Number: CL-211-619 or approved equal.

C. Labels. White Polyester. Laser printable. For use on patch panels. 3/4" x 1/4", 1" x 1/2".
Manufacturer: W. H. Brady Co., Part Number: CL-041-619 (0.75" x 0.25") or approved equal.

D. Labels. White polyester. Laser printable. Used for cable ladders, racks, frames, etc., as required.
Manufacturer: W. H. Brady Co., Part Number: BCDAT-2-619 or approved equal.

E. Labels. Paper label inserts for 110 blocks. Utilize EIA 606 compliant colors.
Manufacturer: W. H. Brady Co.
Part Number: DATA-177-124-BL – Blue – Data Cables
Part Number: DATA-177-124-RD – Purple – VIOP
Part Number: DATA-177-124-WT – White – Wireless Access Point
Part Number: DATA-177-124-PK – Pink – Security
Part Number: DATA-177-124-YL – Yellow – Misc. riser
Part Number: DATA-177-124-GR – Green – PBX Termination
Or approved equal.

F. Confirm all labeling methods with Owner before the start of any work.

2.9 PATCH CABLE FOR DATA CLOSETS

A. This contractor shall provide the following quantity of cables. Confirm with the District before the start of any work. Final colors shall be confirmed with Yonkers IT Dept. prior to ordering.

1. 10 Ft Cat6 Blue Snagless Ethernet Network Patch Cable M6-10-BL 275
2. 15 Ft Cat6 Blue Snagless Ethernet Network Patch Cable M6-14-BL 125
3. 5 Ft Cat6 Blue Snagless Ethernet Network Patch Cable M6-5-BL 275
4. 7 Ft Cat6 Blue Snagless Ethernet Network Patch Cable M6-7-BL 275

2.10 IT CLOSET EQUIPMENT

A. The contractor will provide the following equipment in the IT closets as directed by the District.

1. Provide a total of 5 Data Racks. This shall include and not limited to all Patch Panels, Vertical and Horizontal cable management, ladder racks for a complete operating infrastructure system to support all cables (Cat 6 and Fiber Optic Cable) as indicated in contract documents associated.

2. The exact location of rack placement and arrangement of ladder racks, patch panels, wire management, etc. in all closets shall be coordinated with District before the start of any work. Contractor must obtain written confirmation before proceeding with installation.

PART 3 - EXECUTION

3.1 GENERAL

A. Follow manufacturers' instructions for installing all telecommunications cabling. Where instructions are unavailable, follow approved industry practice.

B. Compare communications drawings and specifications with the drawings and specifications of other trades, report any discrepancies to the Consultant; and obtain written instructions for changes necessary in the work. Include most stringent requirements in bid.

C. Repairs or changes caused by contractor's neglect shall be made at contractor's expense. Protect finished work of other trades from damage or defacement and remedy any damages as required.

D. Clean up all debris generated by installation activities and discard as directed by the Construction Manager.

E. Maintain a current copy of this Specification and related Drawings at the job site at all times.

3.2 CABLE DISTRIBUTION

A. Follow room boundaries when pulling cables through ceilings for distribution into walls, conduits, wiring channels, outlets, etc.

B. All cable distribution from the Data Closet/Rack to all work locations (except as noted) shall be run in the ceiling plenum. Ceiling support grids and service hangers shall not be used to support cabling.

C. Cable shall be loose bundled into cable supports. Use only approved re-enterable cable ties to secure cables in overhead distribution.

3.3 EMI/RFI AVOIDANCE

A. To avoid electromagnetic interference (EMI) route cables to maintain the following minimum distances:

1. Twelve inches from lighting fixtures.
2. Thirty-six inches from electrical lines of 5 KVA or greater.
3. Forty inches from transformers or motors.

B. Maintain minimum twelve-inch separation between telecommunication cables running exposed in ceiling and parallel electrical cables/conduits.

C. Telecommunication cables shall cross electrical cables/conduits only at 90 degree angles.

3.4 STAFFING

A. Contractor who is awarded this contract to have minimum of 20 years using the same name doing business in low voltage ceiling installations.

B. Provide Yonkers Public School District the last 5 low voltage cable installations along with contact information.

C. Contractor to certify cable with either Siemon or Hitachi standards and provide certification. In order to certify, the Siemon standard of 25 years and Hitachi standard of lifetime guarantee. Confirm all specific requirements with vendor which includes and is not limited to certified company and installer.

D. Designate a qualified foreman. The foreman shall be present in the field at all times during the performance of the work.

E. Provide a supervisory work force sufficient to maintain efficient performance of the contractor's responsibilities.

F. Use only skilled and reliable work force and discontinue the services of anyone employed on this project upon written request by the Owner, Architect, Construction Manager or Consultant.

G. Use personnel who are qualified (at minimum) to perform all of the installation and testing work activities required under the contract.

H. Provide and use the proper tools in good working order for the performance of the work. The Consultant reserves the right to review the tools and tool maintenance procedures of the contractor and require replacements to be obtained.

I. Telephone and data industry cable installation standards, TIA/EIA and BICSI standards, and manufacturers' instructions shall be used for in-process quality control and final acceptance of the work.

3.5 CABLE SLACK

A. Provide a minimum of 12-inches of slack 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. Provide a minimum of 5-feet slack in a loop in UTP at the head of each stub-up or distribution conduit.

C. Provide a minimum of 10-feet slack in a loop in optical fiber cable at its point of entry to an equipment room.

D. Provide a minimum of 10-feet slack for overhead mounted Wireless Access Point outlets.

E. Provide a minimum of 2-feet slack in Audio/Visual cables above the ceiling near projector location.

3.6 FIRE STOPPING

A. Seal all penetrations through fire rated walls and walls created by or made on the behalf of the contractor so that the original fire rating of the wall is maintained as required by Article 300-21 of the National Electric Code.

B. Use sealant material that has passed fire exposure testing in accordance with standard time-temperature curve in the standard, UL, ASTM E 119, and NFPA 251 and the hose stream test in accordance with UL 1OB.

C. Provide removable fire-stopping pillows (IPC flame safe sealbags or approved equivalent) in an approved fashion in openings greater than 4" diameter, or 4" x 4" square cross section. Provide wire mesh grate over bags as recommended by manufacturer subsequent to installation.

3.7 CABLE TESTING

A. Test all cables installed under the contract.

B. Pre-installation Inspection

1. Visually inspect all cables, cable reels and shipping cartons for shipping damage. Return visibly damaged items to the manufacturer.

2. Prior to testing, submit for review and approval copies of test report forms proposed for use. Forms shall, at minimum, contain: Project name; Contractor's name; Date of test; Media type and description; Make, model and serial number of the test equipment used and date of last calibration.

C. Post Installation Testing

1. Test only completed systems. Partial or statistically sampled testing is not acceptable, except by prior, written approval from the Consultant.

2. Paired and multi-conductor metallic cables: perform an end-to-end test for continuity, ground fault, shorts and crossed pairs for each cable pair/conductor.

   a. Test cable pairs from the work area outlet, through all conductors to patch board in data closet/rack room.

3. 4-pair Category 6 UTP: in addition to end-to-end tests listed above.

   a. Test for length, capacitance, attenuation, noise, resistance, NEXT, FEXT, ELFEXT, PSNEXT, PSELFEXT and delay skew with injected standard signals. Utilizing automated test equipment, set up and measure a basic link to determine the actual swept frequency ACR. Compare the ACR to the ISO/IEC Cat 6/Class E ACR at 300 or 350 MHz. Test bi-directionally in accordance with ANSI/TIA/EIA-568-( ).

   b. Test cabling not cross connected or patched within the closet as a permanent link.

4. For 4-pair replace the entire cable if a bad pair or conductor is found.

5. For Audio/Visual replace the entire cable if any defects are found.

6. Remove defective cable in its entirety from point to point. Do not abandon cables in place.

7. The Consultant reserves the right to observe the conduct of any or all portions of the testing process and to conduct, and to require the Contractor, using the Contractor's equipment and labor, a random re-test of up to five (5) percent of the cable plant to confirm documented test results.

8. Document all test results and corrective procedures and submit to the Consultant within ten (10) working days of test completion.

9. In addition to the actions specified above, the contractor may be required to be present while the owner or owner's designated representatives conduct performance tests of the transport electronics connected to the cabling system.

3.8 ACCEPTANCE

A. Once testing has been completed, both as-built and testing documentation have been delivered to the Consultant, and the Consultant is satisfied that all work is in accordance with the contract documents, the Consultant shall notify the contractor in writing of the acceptance of the work performed. The date of this acceptance shall constitute the commencement of the warranty period.

3.9 CABLE IDENTIFICATION SYSTEM

A. Use color coding in accordance with the EIA-606 standards.

B. Jacks, faceplates and wall outlets at the user locations, termination blocks and individual lateral cables shall be labeled with (at minimum) machine generated black uppercase lettering on a permanent adhesive label stock, covered with a permanent water resistant sealer. Labeling stock and/or lettering must be used that provides a high contrast with the color of the terminating equipment, faceplate or cable.

C. Place labels on both ends of the cable at least 4 inches from the point at which the cable is terminated on the connector or terminal block.

D. Provide permanent, machine generated cable tags. Temporary tags are acceptable only during construction. Label each tag with the appropriate cable number as shown on the drawings and as indicated on the cable schedules provided by the Consultant.

E. Cable identification numbers shown on the plans are presented in an abbreviated format. All cables ID's shall (at minimum) indicate the floor, originating closet ID, and the sequential cable number shown on drawings.

F. If at any time during the job the permanent cable tag becomes illegible or is defaced or removed, immediately replace it with a duplicate pre-printed cable tag.

3.10 PANEL IDENTIFICATION

A. Furnish a nameplate for each patch panel, cross-connect field, equipment rack, etc. Unless otherwise noted, use a permanent adhesive label stock, covered with a permanent water-resistant sealer.

3.11 TERMINATING BLOCKS, DISTRIBUTION RACKS AND PATCH PANELS

A. Locate and place all terminating, and distribution hardware as shown on drawings.

B. Assemble and install all equipment per manufacturers' printed instructions.

C. Terminate all horizontal Category 6 UTP cables directly on the 110-type termination strips at the rear of rack-mounted 48-port patch panels, unless otherwise noted.

D. Label patch panels and window jack locations.

3.12 CABLE PULLING

A. Do not exceed a pulling tension of 25 lbs. on 4-pair UTP cables.

B. To limit the incidence of micro-bending of the individual fiber strands, use mesh-type, swivel-eye pulling grips for all fiber optic cable pulling. This type of pulling grip is also recommended for all other building cable, as required.

3.13 CABLE INSTALLATION

A. Special Conditions

1. Furnish and install communications cables per the drawings and specifications provided by the Consultant and per manufacturer's recommendations.
2. Install backbone cable as an uninterrupted conductor section from the point of origination to the point of termination as indicated on the drawings, without splices or mechanical couplers between the points of origin and termination.
3. Install each station cable as an uninterrupted conductor section from the data closet/rack to the user-end termination point, as indicated on the drawings, without splices or mechanical couplers between the points of origin and termination.
4. Contractor shall support all backbone cable, data, telephone and all audio/visual horizontal cable bundles on J-hooks. Install J-hooks with the appropriate mounting hardware every 5-feet OC (maximum) for open cable runs. J-hooks shall not be fastened to suspended ceiling support structures, electrical or plumbing piping or any other trade work.
5. Provide all other outlet configurations in accordance with the Drawings.

B. Terminate all four-pair UTP horizontal cables on 4-pair Category 6 jacks. The pinning configuration of the outlet jacks shall be T568B unless otherwise specified by the Owner prior to installation. The jacks shall then be inserted into appropriate faceplates for flush wall mounted receptacles, surface-mounted channels or boxes.

C. Unless otherwise noted, route all data/telephone cable above the finished ceilings, transitioning vertically to wall mounted back boxes and/or surface-mounted wiring channels via conduit stub-ups into the ceiling void as required.

D. Label each outlet and each cable with an appropriate ID number.

E. Provide proper cable bends and supports.

F. Fiber cable terminations shall consist of MTRJ connector and SC connectors. Coordinate with Owner before the start of any work.

END OF SECTION 260810

SECTION 260820

FIBER OPTIC CABLING SYSTEM

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

A. The intent of this specification is to provide high bandwidth fiber optic backbone for the IT Infrastructure and Security System. The configuration is as shown on the drawings. The opto-electronic equipment necessary to 'light' this optical fiber is not being provided as part of this installation. However, care is taken to terminate the fiber properly, to install it in an area that is environmentally sound and to enclose it in cabinets that have room to house additional equipment.

1.2 HORIZONTAL AND VERTICAL FIBER OPTIC CABLE INSTALLATION

A. Provide, test and document 12 Strand Fiber Optic Cable (Refer below for specification of cable type.) horizontal and vertical cabling as shown in construction documents. The MDF Closet is located in Basement B04. Provide a separate 12 Strand Fiber Optical Cable from each of the following closets to MDF G-32A:

1. Second Floor IDF Closet 207a to MDF B04.
2. Basement of Community Building GB02 to MDF B04.

B. Cabling shall be run above the ceiling supported by J-hooks, inside surface mounted raceway or within conduit. Leave 10' slack neatly coiled and tie wrapped in closet for flexibility. Within closet fiber cable shall be installed within orange inner duct. Provide connectors, testing, labelling, etc. as indicated in the remainder of this documents.

C. Core drill and provide conduit sleeve as required to provide access through cinderblock walls into classrooms for lateral cabling above ceilings.

D. All lateral cabling installation shall be concealed above ceiling. In areas that require being exposed cable shall be run in the following manner: In unfinished area install cable in EMT conduit and in finished area (classrooms, offices, corridors, etc.) provide steel surface mounted raceway to hide and protect lateral cable. No cabling shall be run exposed except in data rack closet on cable management.

1.3 SUBMITTALS

A. Submit the shop drawings, product data, samples and quality control specified below at the same time as a package.

B. Shop Drawings

1. Complete manufacturers' construction details and specifications for the cables, including physical characteristics of optical fiber, strength members and jackets.

2. Overall dimension of cable.

3. Termination data, including the following:

a. List of materials.
b. Method of terminating cables.
c. Precautionary measures.
d. Written statement from cable manufacturer that terminations submitted are acceptable, and suitable for the proposed application.

4. Cable manufacturer's certified test data (attenuation, bandwidth).

5. Maximum pulling strain allowed for each type of cable.

C. Product Data

1. Catalog sheets, specifications, and installation instructions for all products.

2. Written statement from cable manufacturer indicating recommended pulling compounds.

D. Samples

1. Two(2) foot samples of each type of cable.
2. Samples of termination materials if requested.

E. Quality Control Submittals

1. Installers' Qualifications Data: Include the following who will be performing the work:

a. Employers name, business address and telephone number
b. Name and addresses of the required number of similar projects worked on which meet the experience criteria.

F. Contract Closeout Submittals: After installation test reports.

1.4 QUALITY ASSURANCE

A. Installers' Qualifications: The persons installing the work of this section shall be personally experienced in optical fiber cabling system and shall have been engaged in the installation of optical fiber cable for a minimum of two(2) years.

1.5 DELIVERY, STORAGE AND HANDLING

A. Cable Delivery

1. No cable over one(1) year old when delivered to the site will be accepted.

2. Keep ends of cables sealed at all times, except when making terminations. Use methods approved by cable manufacturer.

B. Cable Storage:
Store where cable will be at temperature recommended by cable manufacturer for optimum workability.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Acceptable Manufacturers and Model No.'s are: Hitachi Model 61337-6 or Corning 006T88-3110-A3.

2.2 OPTICAL FIBER CABLE

A. Fiber optic cable shall consist of 50 micron, twelve (12) strands optical fiber, armored tight buffered (plenum) construction, plenum-rated outer jacket, TIA/EIA 568-C.3, ISO/IEC 11801, 2ND Edition, Telecordia GR-409-core listed. Continuous operating temperature - 0^{o}C to 70^{o}C. Multi-mode OM3/OM4 optical fiber operating at 850/1300 nanometer (nm), maximum attenuation 3.25/1.0 dB/km.

2.3 CONNECTORS

A. Connector shall be a no-adhesive/no-epoxy/no-polish connector. The connector shall have a 50 micron fiber stub pre-epoxied and pre-polished in the ferrule tip. The back end this fiber, which is precisely cleaved, shall be centered inside of an alignment chamber. The fiber to be terminated shall be simply prepped and cleaved before insertion into the connector, similar to LC multi-mode contactors Corning 95-05-0-99-X.

2.4 ACCESSORIES

A. Pulling Compounds: As recommended by cable manufacturer.

B. Tags: Precision engrave letters and numbers with uniform margins, character size minimum 3/16" high.

1. Phenolic: Two(2) color laminated engravers' stock, 1/16" minimum thickness, machine engraved to expose inner core color (white).

C. Markers: Premarked self-adhesive; W.H. Brady Co.'s B940, Thomas and Betts Co.'s E-Z Code WSL self-laminating, Ideal Industries' Mylar/Cloth wire markers, or Markwick Corp.'s permanent wire markers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installing cable, test the cable on the reels to verify that the cables' parameters are in accordance with the manufacturers' certified test data.

3.2 INSTALLATION

A. Installing Cables

1. Install cables in conduit or through 1" plenum rated inner duct from telecommunication room's data rack to each LDF.

2. Keep ends of cables sealed watertight at all times, except when making splices or terminations.

3. No grease, oil, lubricant other than approved pulling compound may be used to facilitate the pulling-in of cables.

4. Use pulling attachment connected to the cable strength member for pulling in cables. Seal pulling attachment watertight.

B. Terminations

1. Terminate cable in accordance with manufacturers’ approved installation instructions.

2. No splicing of optical fiber cables will be allowed except:

a. Connectorized splices will be allowed in the OFTB.

C. Identification of Optical Fiber Cables: Identify cables in LDFs and in equipment to which they connect:

1. Install tags on each cable indicating cable number, date installed (month, year), type of cable and manufacturer. Attach tags to cables with non-ferrous metal wire or brass chain.

2. Use markers to identify each optical fiber in equipment to which they connect.

3.3 FIELD QUALITY CONTROL

A. Testing

1. Perform test on optical fiber after cable has been installed complete with connectors. All strands shall be tested for end-to-end attenuation loss at 850 nm and 1300 nm. Procedure for the test shall comply with EIA/TIA 526-14, Method B: Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.

a. Demonstrate that the amount of power coupled into each optical fiber by its transmitter, the attenuation and connector losses, and the power received at the detector in the receiver is no greater than 75% of the parameters required by the transmitter/receiver manufacturer.

b. The total optical attenuation (dB loss) will not exceed .5 dB/per mated connector ports and 3.75 dB/km for the fiber.

2. Perform test in the presence of the Authority's Representative. Failed strands shall be corrected or replaced and re-tested for compliance.

3. Supply equipment (optical power meter) Siecor P/N OTS-110-52 and (LED light source) Siecor P/N OS-100D-55 necessary for performing test.

4. Submit printed report of test results signed by Company Field Advisor and Authority's Representative.

END OF SECTION 260820

SECTION 260825

PUBLIC ADDRESS SYSTEM

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 GENERAL

A. This section and associated drawings define a communications system for an intercom, public address, and master clock system. The bidder shall provide infrastructure, cable, hardware, and equipment, as defined, to provide a complete and operational communications system.

B. Where applicable visit the site, verify all existing items shown on plans, or specified, and be familiar with the working conditions, hazards, and local requirements involved; submission of bids shall be deemed evidence of such visit. All proposals shall take these existing conditions into consideration before bidding.

C. All materials, unless otherwise specified, shall be new, free from any defects, and of the best quality of their respective kinds. All like materials shall be of the same manufacture, model, and quality, unless otherwise specified.

D. Contractor shall do all necessary cutting and drilling of present walls, floors, ceilings, etc., for the installation of new work; but no structural work shall be cut, unless specifically shown on drawings and/or approved by the Owner. All exposed building surfaces damaged by installation or removal of electrical work shall be patched and finished in the same materials and manner as adjacent areas by this Contractor.

E. If, applicable, contractor shall co-ordinate his work with the Owner for times which changeover, removal of existing equipment, and new connections of existing systems can be completed.

1.2 RACEWAYS AND CABLES

A. Electrical work will conform to the National Electric Code and applicable local ordinances.

B. All 125-volt electrical conductors shall be installed in galvanized electrical metallic tubing with compression type fittings and couplings, minimum 1/2" size conduit.

C. All low-voltage wires and cables concealed in walls shall be run in EMT conduit from flush outlet boxes to above accessible ceilings. Provide conduit where cables penetrate firewalls above ceilings.

D. All EMT entering boxes shall be served with insulating throat connectors and locknuts.

E. No raceway shall be located in proximity of hot water lines or excessive heat.

F. Where raceways cannot be run concealed in walls, use Wiremold Series surface raceway complete with all fittings, box extension rings, and required accessories. Co-ordinate routing of surface raceways with the Owner.

G. Use Cast "C" clamps, "U" straps, or ring hangers attached to rods, and/or brackets fastened to structure.

H. No perforated straps or tie wires permitted for supporting raceways.

I. Use wire ties for supporting low voltage cables run concealed above ceilings. Do not run cables loose on ceiling tiles. Support from structure above. Group cables in bundles.

J. Tie mounts, plates, and anchors shall be used.

K. Ground all electrical apparatus in accordance with the National Electric Code.

1.3 QUALITY ASSURANCE

A. Manufacturers must be regularly engaged in the manufacture of integrated communication systems, master clock systems, and ancillary equipment, of types and capacities required. Approved products shall have been in satisfactory use in similar service for not less than five years.

B. Installer's Qualifications: Firms with at least five years of successful installation experience with projects utilizing integrated communications systems and equipment similar to that required for this project.

C. All items of equipment including wire and cable shall be designed by the manufacturer to function as a complete system and shall be accompanied by the manufacturer's complete service notes and drawings detailing all interconnections.

D. The Contractor shall be an established communications and electronics Contractor that has had and currently maintains a locally run and operated business for at least five years. The Contractor shall be a duly authorized distributor of the equipment supplied with full manufacturer's warranty privileges.

E. The Contractor shall show satisfactory evidence, upon request, that he maintains a fully equipped service organization capable of furnishing adequate inspection and service to the system. The Contractor shall maintain at his facility the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied.

F. Except where specifically noted otherwise, all equipment supplied shall be the standard product of a single manufacturer of known reputation and experience in the industry. The Contractor shall have attended the manufacturers installation and service school and upon request must show proof of attending such a school.

G. Installing contractor must have a service office within 75 miles of the site and be expected of providing service within a 24-hour period of time.

1.4 SCOPE OF WORK

A. Furnish and install all materials, labor, equipment, permits, etc., to provide communications system as described herein and illustrated on the drawings for a complete operating system.

B. All manufactured articles, material, and equipment shall be applied, installed connected, erected, used, cleaned, adjusted, and conditioned as recommended by the manufacturers, or as indicated in their published literature, unless specifically herein specified to the contrary.

C. All work shall be performed by competent workmen and executed in a neat and workmanlike manner providing a thorough and complete installation. Work shall be properly protected during construction, including the shielding of soft or fragile materials. At completion, the installation shall be thoroughly cleaned, and all tools, equipment, obstructions, or debris present as a result of this portion of work shall be removed from the premises.

D. Program the operational characteristics matching the operation described herein, adjusting for call routing, transfers, priorities, and volume levels.

E. Remove all existing conduit, wire device, etc., being abandoned due to relocation.

F. The Contractor shall provide a minimum of eight hours of in-service training with this system. These sessions shall be broken into segments, which will facilitate the training of individuals in the operation of this system. Operator Manuals and User Guides shall be provided at the time of this training.

1.5 SUBMITTALS

A. Submit the shop drawings, product data, and quality control submittals specified below at the same time as a package.

B. Shop Drawings: Composite wiring and/or schematic diagrams of the complete system as proposed to be installed. Drawing shall include relative position of all major components, typical connections, field components, accessories, and cable types.

C. Include catalog cutsheets, manufacturers default specifications, Users operation guide, and bill of materials.

D. Quality control shall include the following:

1. Submit the Name, address, and telephone number of the nearest fully equipped service organization.

2. Submit a certificate of completion of installation and service training from the system manufacturer.

E. Program the operational characteristics matching the operation described herein, adjusting for call routing, transfers, priorities, and volume levels.

F. Remove all existing conduit, wire device, etc., being abandoned due to relocation.

G. The Contractor shall provide a minimum of eight hours of in-service training with this system. These sessions shall be broken into segments, which will facilitate the training of individuals in the operation of this system. Operator Manuals and User Guides shall be provided at the time of this training.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The system shall be manufactured by Telecor, Inc. or approved equal.

B. Manufacturer's names are listed herein to establish a standard. The products of other manufacturers will only be acceptable if approved by the specifying architect and the Owner 10-days prior to the bid. The substitute material must be of a quality as good or better than the material specified, and will serve with equal efficiency and dependability, the purpose for which the items specified were intended.

C. Final approval of these alternates shall be determined at the time of completion. Failure to provide the "functional equivalent" shall result in the removal of the alternate system and installation of the specified system at the contractor's cost.

D. The intent is to establish a standard of quality, function and features. It is the responsibility of the bidder to ensure that the proposed product meets or exceeds the intent of these specifications.

E. The functions and features specified are vital to the operation of this facility and therefore inclusion in the list of acceptable manufacturers does not release the contractor from compliance with the requirements of this specification.

2.2 PRODUCT OVERVIEW

A. Furnish and install all equipment, accessories, and materials in accordance with the specifications and drawings to provide a complete and operating Communication system as outlined below.

B. Following is an outline of the basic functions required, set as a minimum standard. These functions must be included in the bid. Any exceptions to these functions must be listed and submitted as part of the bid. If several manufacturers are required to provide these functions proof must be provided that they will function as one integrated system to the user.

C. Intercom Features/Public Address Features

1. Individual intercom circuit for every Classroom
2. Urgent Call Placement
3. Monitor Areas of the building during a crisis from the rescue team or on site security officer.
4. All Call Announcements.
5. Emergency Announcements.
6. Automatic Page.
7. Urgent Call-In Page.
8. 32 Zones of Audio Program Distribution.
9. 32 Zones of Paging.
10. Monitor areas of the building during a crisis from the rescue team or on site security.
11. Page areas of the building during a crisis from the rescue team or on site security officer.
12. Temporary Speaker Exclusion for Special Events.
13. Complete System Programming and diagnostics from LAN, WAN or Internet.

D. Time Control and Event Scheduler

1. 16 Schedules of Class Change Signals.
2. 32 Zones of Class Change Signals.
3. 1536 Class Change Signal Events.
4. Weekly System Event Scheduler.
5. Analog or Digital Clock Correction and Synchronization.
6. Supports Electronic Message Displays for Timekeeping, Count up-down timers and full alphanumeric messaging.
7. Automatic Daylight Savings Time Correction.

2.3 INTERCOM/PA FEATURES AND PRODUCT DESCRIPTION

A. Supply and install a complete microprocessor based Public Address, Intercom, and master clock system using 25-volt speakers and horns.

B. The system shall consist of the Central Control Unit, Administrative Control Console(s), Integrated Master Clock and Rack Equipment. All other necessary devices that are required by this specification to create a complete and operational system such as Staff Phones, Call Buttons, Speakers, Horns, Amplifiers, Program Sources and Secondary Clocks must be supplied under this contract.

C. The system shall be capable of multiple open voice intercom paths used for intercom, paging, program distribution, or emergency paging. The system shall be initially equipped with minimum of one intercom speech path.

D. Provide a separate circuit for each classroom and administrative office so each room can be individually addressed.

E. Corridor speakers, classrooms and outside horns shall be combined into groups of owners' preference. There must be 32 independent software paging zones that each circuit may be a part of. Each individually point must also have the ability to be paged independent of the software zones.

F. The system will have the ability to utilize VOIP intercom stations in addition to industry standard 25 volt speakers. The VOIP stations will operate in the same manner as the conventional speakers. The system must be a hybrid system having the capability of using either or both types of stations wherever it is deemed necessary and practical by the owner. The VOIP stations must have the ability to incorporate a call switch and must be capable of operating on the existing school LAN/WAN network.

G. The system specified is based on the Telecor XL system providing at least the following features and functions. It shall be installed and programmed by an authorized and certified Telecor dealer.

1. The central control unit shall have the capacity for expanding the system to 300 stations and 4 Administrative Consoles with the addition of plug in modules, as required.

H. It shall be complete with circuitry for accomplishing all functions for signaling and communications to all stations, page zones, and administrative control consoles. The unit shall contain all required electronics on modular, plug-in type boards for ease of service and future expansion.

I. All programmable functions shall be stored in a non-volatile EEPROM memory and shall not be lost in event of a power failure.

1. Programming functions shall be accomplished through the use of a standard Internet web-browser interface. Any PC connected to the schools network and provided with the proper authorization shall have multi-level access to system programming. Any off-site PC shall have multi-level access to the system through the use of the public internet, provided they have been granted proper authorization by the school.

2. The intercom system shall be connected to a (school provided) Ethernet network port using the TCP/IP protocol for PC programming, performing diagnostics, or logging transactions either on or off-site.

3. The system shall support remote programming and support through a wide area network connection.

4. The programming interface shall support configurations for multiple sites and allow the user, after logon, to select which site to program from a list of all sites.

5. The user interface shall support usernames and passwords. There shall be multiple levels of access allowed. Some users may only have view privileges only while others may only edit their site.

6. The program shall also serve as part of the documentation process. Page Zones and bell schedules shall support user-definable names and display as pick lists when editing the configuration.

7. Diagnostic functions shall be accomplished through any PC connected to the school network and provided with the proper authorization and diagnostic software. Any off-site PC shall have access to the system for diagnostics through the use of the public internet, provided that they have been granted proper authorization and have been provided diagnostic software.

8. Although the Intercom PA system is programmed through a PC interface, the system shall not have to rely upon a personal computer for day to day operation. All programming information is loaded into the intercom system allowing independent operation of the system.

9. The final copy of the program and the configuration of data files shall be provided to the school in electronic format.

J. The audio channel(s) shall be priority driven allowing for the highest priority signal type access to a voice channel. The system shall be user programmable to allocate, upon demand, either of the channel(s) to facilitate simultaneous intercom conversations, pages, program distributions, or combination thereof.

1. Call switches shall be provided and shall be programmable and capable of routing incoming calls from classrooms to a specific control console or specific group of consoles. Every point shall be individually programmed. Up to 16 different console groups can be assigned.

2. Calls may be answered from any annunciating control console, administrative telephone, attendant console and Caller ID enabled single-line telephones. When calls are routed to multiple consoles or console display units simultaneously, once answered, the call shall be automatically cancelled from all other consoles or displays.

3. The system shall support both "normal calls" and "emergency calls" from a single call switch. Merely depressing the call switch repetitively 3 times or flashing the hook-switch of the room telephone 3 times shall initiate emergency calls. Call switches may also be programmed to initial an emergency call by pressing and holding the button for three seconds.

4. If an emergency call is not answered within a user programmable time, the call will automatically call all other Administrative Control Consoles in the system.

5. The system shall be capable of monitoring supervised call-in lines. Any supervised line shall alert the control console if the line is cut. The system can be checked daily from the control console for damaged lines.

6. All call switches shall be associated with a speaker assembly.

7. Every call switch point shall support an independent programmable priority level.

K. Pre-announce tones will alert the classroom of incoming calls with distinct tones for each priority level. To prevent unauthorized monitoring, the tone will sound whenever the classroom is being monitored and will repeat at regular intervals. Facilities shall also be provided to defeat the tone repeat function from the administrative console if it is not desired.

L. Provide automatic gain control on intercom speech to assure constant speech level.

M. System shall have the capabilities of interfacing with a local Gym or Auditorium Sound System, providing automatic bridging of the local system, whenever it is accessed from the console. The system shall automatically track the local system, controlling the audio program as programmed from the control console.

N. System will provide emergency and All Call paging and a minimum of 32 zones of group paging. The paging zones shall be independent of the time tone and audio program distribution zones. Systems sharing zones for both paging and time tone shall not be acceptable.

O. 32 different sections of the building can be monitored either on or off the premises from a control console or telephone.

P. System shall support up to 5 low-impedance microphones, which can be individually programmed to announce in any individual room or assigned to any of the 32 paging zones. The microphone(s) shall be software programmable for control and distribution thus eliminating the need to go to the central electronics for set-up.

Q. Distribution of paging announcements can be made from any administrative control console, telephone, or dedicated microphone set-up.

R. Emergency announcements shall have the highest priority over any other system function.

S. System shall support general announcements made from a conventional microphone to facilitate reading a script and the participation of multiple announcers. Keying the microphone shall automatically mute all other audio programs at a lower priority in the system and transmit the microphone audio to All Rooms or specific speaker zones, as programmed into the system software.

T. The system must have the capability of distributing audio program sources from any administrative control console, telephone system phone or intercom system DTMF phone. Program distribution shall be accomplished on an all rooms basis, selected rooms basis or an individual room.

U. Classroom phones, if required, must have the ability to add or remove themselves from an ongoing program from their room phone.

V. Inputs shall be provided from at least 3 different line level sources and 5 different low impedance sources. Available inputs include microphones, tuners, tape players, or auxiliary sources.

1. The program source(s) can be located remotely from the central electronics so that the customer does not have to go to the communications closet to select the program.

2. The control console shall be able to selectively monitor program sources being distributed.

W. Any area of the building shall be software programmable into 32 zones for easy selection of receiving audio programs. These zones shall be independent from the page and time tone zones. Individual rooms shall also be included or excluded independently from receiving audio programs.

X. Systems whose only method of distributing an audio program is by the use of mechanical switch banks shall not be accepted.

Y. Systems, which cannot support the distribution of program material by at least two separate methods, will not be acceptable.

Z. The Central Control Unit shall provide a 0 dB signal for connections to an external amplifier for distribution of program audio, time signals and paging announcements.

AA. The system shall provide capability for multiple open voice intercom paths used for intercom, paging, program distribution, or emergency paging (Minimum of two).These paths shall be global, non-blocking circuitry. Systems offering multiple-speech paths, which are restricted to a single speech path per group of room stations or circuit card, due to hardware constraints, will not be accepted. The intercom channels shall be universal allocating channels on demand.

BB. The system shall support the automatic distribution of user programmable; class change time signals (Bell Schedule) to all selected areas:

1. The system shall support a minimum of 1536 events and 16 schedules.

2. Building time zones shall be used to select which areas receive the tone. They must be totally independent from page zones and program zones.

3. Ability to produce 8 different tone signals for classroom time changes or emergency signals selected from a combination of over 1500 tones.

4. All time signal programming shall be accomplished from a control console or a PC utilizing a standard web browser program.

5. Facilities for displaying console clock in 24-hour or 12-hour format, selectable at the control console.

6. The duration of the tone, as well as frequency, burst length and output level shall be software programmable from the console or a web browser.

7. The system shall support running all time schedules concurrently.

8. All system tones shall be user programmable for the following durations in seconds: 2, 3.5, 5, 6, 8, 10, 12.

9. The system shall provide the ability to have music on class change allowing any source to be distributed to specific program zones.

CC. The intercom channel(s) must be equipped with an auto call back function allowing callers to simply request call back in the event that a channel is busy alleviating the need to repeatedly call the system.

2.4 TELEPHONY FEATURES AND PRODUCT DESCRIPTION

A. The system shall integrate to the facility phone system to allow any authorized telephone system extension to:

1. Place intercom calls to any classroom or work area.

2. Make paging announcements to any of the 32 zones.

3. Initiate system tones to any area of the facility.

4. Distribute programs to any zones and zone monitor any area of the building.

B. The system shall allow the facility phone system to answer any calls from call switches or intercom handsets. When the phone system is equipped with standard Caller-ID support, all information about the caller such as room number and call priority will be available on the display of the telephone.

C. The integration to the phone system will utilize unused CO ports from the KSU/PBX or VOIP Hybrid System. This system is described in another section of the project documents. Coordinate with the phone system vendor to ensure the availability of these ports. Up to 2 ports may be required.

2.5 MASTER CLOCK FEATURES AND PRODUCT DESCRIPTION

A. The system shall provide for automatic clock correction for Daylight Savings Time, Spring Ahead/Fall Back. Daylight savings shall not require the use of any user input at the time of daylight savings.

B. The master clock system shall support a minimum of 16 schedules and 1536 events as outlined in the Intercom/PA Features section.

C. The system shall support Electronic Message Displays. These displays are integral to the emergency notification needs of the facility. At least two of these displays are required for

this project. Provide where indicated on the project drawings. Consult with project engineer if more detail is needed.

1. The display shall accommodate the normal messaging provided on other Telecor digital clocks. Additionally, the display shall accommodate full alphanumeric character support along with other grammatical symbols to provide complete message display capability. Messages of up to 127 characters in length shall be supported through the use of scrolling. Scroll speed shall be user adjustable through the use of an infrared handheld remote control.

2. The display shall provide enhanced timekeeping capabilities. The display shall provide the ability to perform count-up and countdown timing, lap timing, start, stop, reset and pause. All timing shall be displayed, in days, hours, minutes, seconds and tenths of seconds. Activation of timer functions shall be available through the use of a handheld remote or external pushbutton. There is the ability of sounding a buzzer at the EMD speaker when the timer elapses. In addition, a custom message can be displayed when the timer elapses, such Class Change Over or Test Over.

3. The display can be programmed to be part of the bell schedule of the school allowing the timer feature to be used for class change periods. The display can be used for visual confirmation of bell tone descriptions such as "End of Period 1", "Start of Period 2" or any other customized information that can be schedule set.

4. The displays are hardware addressable and can be assigned to one of eight software "Message" Zones for the display of different messages in select areas of a facility.

5. In the event of an Emergency Call from a classroom, the origin of the Emergency Call is displayed on multiple Electronic Message Displays, giving the opportunity for school staff to respond more quickly. In addition, a console or room telephone has the ability to activate a specific message for display on a group of EMDs. This allows an emergency procedure such as school lock down to be activated from any telephone, quickly and efficiently.

2.6 ADMINISTRATIVE TELEPHONES

A. The intercom/paging system control console shall be microcomputer based, desk top console, occupying no more than 75 sq. inches of desk space and weighing 2 lbs. It shall be manufactured of high impact, molded plastic with a standard 12 button keypad. It shall be Model MCC-300.

B. The console shall provide selected, two-way voice communications and signaling between the console and room stations as well as between other control consoles in the system. The console shall be equipped with a telephone handset with a retractable cord to allow private conversations. A built-in microphone and speaker shall provide for push-to-talk intercom conversations.

C. Incoming calls shall be annunciated on a two line 20-character LCD backlit digital display by room number and priority level. The display shall be angle adjustable to ensure the clearest viewing of console information.

D. All incoming calls shall be held in memory and displayed sorted by priority and order received. Each of the six levels of priority shall be displayed by a unique priority prefix and call-in tone. The console shall also have facilities for reviewing all incoming calls stored in memory.

E. The distribution of program material shall be controlled from the administrative control console, room selector switch or DTMF intercom handset. System shall support distribution to any of 31 distribution zones, individual rooms or combination thereof.

F. Paging announcements shall be distributed from the control console on an Emergency All Call, All Call, All-Call multiple zone, or individual basis to classroom speakers.

1. Any control console in the system shall have the ability to be designated as the current console and have the incoming calls from room stations, enunciate at that specific console. This function shall be programmed from the control console and shall allow for simple transfer of the current console assignment to any other console in the system.

G. The console shall also provide the ability for the operator to place on hold, or clear any incoming calls registered in the system from the console keypad.

H. Facilities for activating and controlling remote devices from the control console keypad. The system shall control the operation of external bells, utilizing the internal time clock within the system.

I. Capabilities for user programming of alphanumeric architectural room numbers from the control console. The system shall be capable of using 2, 3, 4 digit number, or a letter (A = I) and a 3 digit number. The number for both the classroom speaker and the telephone shall be the same.

J. The console shall retain the last room number dialed until another room number is dialed or previous call is cancelled.

K. Ability to manually distribute tone signals on an all-call basis from the keypad of the Administrative Control Console cabinet.

L. The console shall have the ability to program or change all of the operational characteristics of the Intercom/PA system.

2.7 PROGRAM SOURCES

A. Provide an AM/FM CD player, Telecor model T-CDP or approved equal. The unit shall be equipped with a LCD information display, front panel indicators and controls, clock, bass, treble, bass enhance, mute and digital signal processing.

1. The AM section shall be tuned over a range of 531 to 1602 KHz. The FM section shall be tuned over a range of 87.5 to 108.0 MHz. The unit shall be equipped to accommodate storage of up to 12 memory selections, six from each band. Storage can be manually accomplished or automatically performed by the unit based on the strongest signals.

2. The CD player shall provide utilize a sampling frequency of 44.1 KHz. The unit shall provide controls for play, stop, fast forward, rewind, track forward, track reverse, pause and eject. The unit shall provide a preview function, which will play the first 10 seconds of each track on the CD. The unit shall allow for random track play mode by the push of a single button.

2.8 AMPLIFERS

A. The power amplifiers shall be manufactured by Telecor. The system shall be sized at watt per classroom, 1 watt per corridor speaker, and 3.5 watts per horn. The amplifier load shall not exceed 80% capacity.

B. The amplifiers shall be capable of producing an audio output of 60, 125 or 250 watts RMS at less than 1% distortion with a balanced output.

C. They shall be designed to operate on a line voltage of 115 AC. One amplifier shall be provided for each audio channel.

2.9 EQUIPMENT RACKING

A. The central electronics equipment shall be contained in an upright rack, Telecor model 242, 261 or 277 or approved equal. The rack must be sized by the contractor to house all components required by this specification plus 20% spare for additions.

B. The rack shall be 21.9" wide and 18.5" deep. It shall be constructed of CRS, using 16 gauge material for the top and bottom of the rack and 14 gauge material for the sides. The rack shall be equipped with both front & rear mounting rails, punched on standard EIA centers. The rack shall be complete with a hinged, locking rear door. The rack shall be finished in Black Baked Enamel.

2.10 CALL SWITCHES

A. The Call Switch shall be a Telecor model CS-1 or approved equal. Furnish and install where indicated on the plans.

1. The switch shall be a momentary action, push-button switch mounted on a 1-gang brushed stainless steel plate suitable for flush or surface mounting on a standard single gang back box with 3 - 9/32" mounting centers.

2. The stainless steel plate shall be inscribed "Push to Call".

2.11 SPEAKERS

A. The loudspeaker/transformer/baffle assembly shall be a Telecor model STB-11 or approved equal. It shall be used for flush mounting on ceilings. Furnish and install as indicated on the plans.

1. The loudspeaker size shall be 8 inches in diameter and have a power handling capacity of 15 watts. The voice coil shall be of high-temperature bonded construction, be one inch in diameter and have an impedance of 8 ohms. The speaker shall have a frequency range of at least 50 Hz to 15,000 Hz and an axial sensitivity of 91dB at 4 ft, with a 1 watt input signal @ 1000Hz.

2. The loudspeaker shall be equipped with a factory wired 25/70 volt line-matching transformer. The transformer shall have the primary taps at 1/4, 1/2, 1, 2 and 4 watts. The insertion loss shall be no greater than 1.0 dB. The transformer shall be mounted to the speaker with the secondary leads soldered to the speaker terminals.

3. The assembly shall include a baffle constructed of 22 gauge, cold-rolled steel finished with a mar-resistant white, semi-gloss, epoxy coating. The baffle shall have a diameter of 13". The STB-11 shall mount to a T8 support bridge, used to attach the assembly to suspended ceilings. The support bridge will accept an enclosure, model H8, to provide a protective enclosure. The H8 enclosure shall attach to the support bridge with appropriate mounting screws.

B. The loudspeaker/transformer/baffle and enclosure shall be Telecor models S8T2570, B25 and SH-20SB. It shall be used for surface mounting on walls or ceilings. Furnish and install as indicated on the plans.

1. The speaker/transformer assembly shall be a Telecor model S8T2570 or approved equal. The loudspeaker size shall be 8 inches with a ceramic magnet and seamless cone. The ceramic magnet shall weigh no less than 6 oz. The speaker shall have a frequency range of at least 50 Hz to 15,000Hz at a 10 watt handling capability, and an axial sensitivity of at least 95 dB at 4 feet, with a 1 watt input. The voice coil shall be 1.0 inch in diameter with an 8 impedance. The loudspeaker shall be equipped with a factory wired 25/70 volt line-matching transformer. The transformer shall have the primary taps at 1/4, 1/2, 1, 2 and 4 watts. The insertion loss shall be no greater than 1.0 dB. The transformer shall be mounted to the speaker with the secondary leads soldered to the speaker terminals.

2. The baffle shall be a Telecor Model B25 or approved equal. It shall be constructed of 22 gauge, cold rolled steel and finished with a mar-resistant, white, semi-gloss, epoxy coating. Speaker studs shall be concealed. The baffle shall measure 12 " square and shall mount a standard 8" loudspeaker. It shall mount to a Telecor H20 or SH20-SB enclosure.

3. The enclosure shall be a Telecor Model SH20-SB or approved equal suitable for the surface installation of 8" speaker/baffle assembles. The enclosure shall be suitable for ceiling or wall installation. It shall be a welded assembly, constructed

of 18 gauge, cold rolled steel and finished with a mar-resistant, white, semi-gloss, epoxy coating. The interior shall be coated to prevent mechanical and acoustical resonances. The enclosure is furnished with four "J" clips to facilitate screw mounting of the baffle.

C. The loudspeaker/transformer/ baffle assembly shall be a Telecor model WB-11 or approved equal. It shall be used for surface mounting on walls. Furnish and install s indicated on the plans.

1. The baffle/enclosure shall be constructed of " medium density fiberboard, glued in all 4 joints and using a corner bead of adhesive to add structural integrity. The construction shall be of a miter-fold design and covered in a walnut-grain vinyl, with a black cloth grill.

2. The front baffle shall be sloped, providing directional sound dispersion. The loudspeaker shall have a diameter of 8 inches and a power handling capacity of 15 watts. The voice coil shall be of high-temperature bonded construction, be one inch in diameter and have an impedance of 8 ohms. The speaker shall have a frequency range of at least 50 Hz to 15,000 Hz and an axial sensitivity of 91dB at 4 ft, with a 1 watt input signal @ 1,000Hz.

3. The loudspeaker shall be equipped with a factory wired 25/70 volt line-matching transformer. The transformer shall have the primary taps at 1/4, 1/2, 1, 2 and 4 watts. The insertion loss shall be no greater than 1.0 dB. The transformer shall be mounted to the speaker, with the secondary leads soldered to the speaker terminals.

4. The enclosure shall measure 9 " wide and 10 " high with a projection of 5 " at the top and 3 " at the bottom. A mounting bracket shall be located on the rear of the enclosure to facilitate installation.

2.12 HORN LOUDSPEAKERS

A. The horn style loudspeaker shall be a Telecor model A-15T or approved equal. Furnish and install as indicated on the plans.

1. The horn shall be a double re-entrant type, with a flared bell and an integral compression driver rated for 15 watts of continues audio power. The frequency response shall be 375 -14,000Hz. Nominal sensitivity shall be such that a sound pressure level of 110 dB at 1000 Hz (on axis) at distance of one meter is produced with an input of one watt. Sound dispersion shall be no less than 100 degrees, regardless of the mounting position.

2. The horn shall contain a weatherproof, built-in, 25/70 volt line matching transformer. Power taps shall be at 0.48, 0.94, 1.8, 7.5 or 15 watts for a 25V line and 1, 2, 3.8, 7.5 or 15 watts for a 70 V line. The power taps shall be screwdriver adjustable. Impedance selection shall be 5,000, 2500, 1300, 666, 333, 87, or 45 ohms.

3. The unit shall include a die-cast universal mounting bracket, allowing the horn to be positioned both in the vertical and horizontal planes with a single adjustment. The wiring terminals and the screwdriver power tap shall be enclosed by a clear plastic cover for security and weather protection.

4. The horn shall be finished in a grey epoxy. Dimensions shall be 9 1/4" deep with a diameter of 8.

B. The horn style loudspeaker shall be a Telecor model A-30T or approved equal. Furnish and install as indicated on the plans.

1. The horn shall be a double re-entrant type, with a flared bell and an integral compression driver rated for 30 watts of continues audio power. The frequency response shall be 275 -14,000Hz. Nominal sensitivity shall be such that a sound pressure level of 115 dB at 1000 Hz (on axis) at distance of one meter is produced with an input of one watt. Sound dispersion shall be no less than 90 degrees, regardless of the mounting position.

2. The horn shall contain a weatherproof, built-in, 25/70 volt line matching transformer. Power taps shall be at 0.94, 1.8, 7.5, 15 or 30 watts for a 25V line and 2, 3.8, 7.5, 15 or 30 watts for a 70 V line. The power taps shall be screwdriver adjustable. Impedance selection shall be 5,000, 2500, 1300, 666, 333, 168, 87, or 45 ohms.

3. The unit shall include a die-cast universal mounting bracket, allowing the horn to be positioned both in the vertical and horizontal planes with a single adjustment. The wiring terminals and the screwdriver power tap shall be enclosed by a clear plastic cover for security and weather protection.

4. The horn shall be finished in a grey epoxy. Dimensions shall be 10 " deep with a diameter of 10.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with the installer present, for compliance with requirements and other conditions affecting the performance of the Nyquist E7000 Series Educational System.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 EQUIPMENT MANUFACTURERS REPRESENTATIVE

A. All work described herein to be done by the manufacturer's authorized representative shall be provided by a documented factory authorized representative of the basic line of equipment to be utilized.

B. As further qualification for bidding and participating in the work under this specification, the manufacturer's representative shall hold a valid C-10 Contractor's License issued by

the Contractor's State License Board of New York. The manufacturer's representative shall have completed at least 10 projects of equal scope, giving satisfactory performance, and shall have been in the business of furnishing and installing sound systems of this type for at least five years. The manufacturer's representative shall be capable of being bonded to ensure the owner of performance and satisfactory service during the guarantee period.

C. The manufacturer's representative shall provide a letter with submittals from the manufacturer of all major equipment stating that the manufacturer's representative is an authorized distributor. This letter shall also state that the manufacturer guarantees service performance for the life of the equipment and that there will always be an authorized distributor assigned to service the area in which the system has been installed.

D. The contractor shall furnish a letter from the manufacturer of the equipment. This letter shall certify that the equipment has been installed according to factory intended practices, that all the components used in the system are compatible, and that all new portions of the systems are operating satisfactorily. Further, the contractor shall furnish a written unconditional guarantee, guaranteeing all parts and all labor for a period of five years after final acceptance of the project by the owner.

3.3 DIVISION OF WORK

A. While all work included under this specification is the complete responsibility of the contractor, the following division of actual work listed shall occur:

B. The conduit, outlets, terminal cabinets, etc., which form part of the rough-in work, shall be furnished and installed completely by the electrical contractor.

C. The balance of the system, including installation of speakers and equipment, making all connections, etc., shall be performed by the manufacturer's authorized representative. The entire responsibility of the system, its operation, function, testing and complete maintenance for one year after final acceptance of the project by the owner, shall also be the responsibility of the manufacturer's authorized representative.

3.4 INSTALLATION

A. The installation, adjustment, testing, and final connection of all conduit, wiring, boxes, cabinets, etc., shall conform to local electrical requirements and shall be sized and installed in accordance with the manufacturer’s approved shop drawings.

B. Low-voltage wiring may be run exposed above ceiling areas where they are easily accessible.

C. The contractor shall install the new system at the location shown on the plans.

D. All Staff Stations and Call Switches shall be wall-mounted:

1. Mount at 54" AFF.
2. All wiring should be concealed.
3. Verify exact location with architect.

4. Avoid mounting near doors to prevent students from activating and running out of the rooms.

E. Admin Stations can be desk or wall mounted.

F. Speaker and telephone lines run above ceiling and not in conduit shall be tie-wrapped to a ceiling joist with a maximum spacing of 8' between supports. No wires shall be laid on top of ceiling tile.

G. Connect field cable to each Analog Speaker transformer using UL butt splices for #22 AWG wire.

H. Contractor shall provide a minimum of eight hours of configuration and operational instruction to school personnel.

I. On the first school day following installation of the Nyquist System, the contractor shall provide a technician to stand by and assist in system operation.

J. Mark and label all demarks IDF and MDF points with destination point numbers. Rooms with more than one outlet shall be marked XXX-1, XXX-2, XXX-3, etc. where XXX is the room number.

K. No graphic room number shall exceed the sequence from 000001 through 899999.

1. All outside speakers shall be on a separate Page Zone and Time Zone.
2. All zones shall be laid out not to exceed 40 Watts (@25V) maximum per zone.
3. All hallway speakers shall be tapped at 1 Watt (@25V) maximum.
4. All outside horns shall be tapped at 3.75 Watts (@25V) maximum.
5. All classroom speakers shall be tapped at ½ Watt (@25V) maximum.
6. Large rooms, such as cafeterias, shall be tapped at 2 Watts (@25V) maximum.

L. Plug disconnect: All major equipment components shall be fully pluggable by means of multi-pin receptacles and matching plugs to provide for ease of maintenance and service.

M. Protection of Cables: Cables within terminal cabinets, equipment racks, etc., shall be grouped and bundled (harnessed) as to type and laced with No. 12 cord waxed linen lacing twine or T and B wire-ties, or hook and loop cable management. Edge protection material shall be installed on edges of holes, lips of ducts, or any other point where cables or harnesses cross a metallic edge.

N. Cable identification: Cable conductors shall be color-coded, and individual cables shall be individually identified. Each cable identification shall have a unique number located approximately 1-1/2" from cable connection at both ends of cable. Numbers shall be approximately 1/4" in height. These unique numbers shall appear on the As-Built Drawings.

O. Shielding: Cable shielding shall be capable of being connected to common ground at point of lowest audio level and shall be free from ground at any other point. Cable shields shall be terminated in the same manner as conductors.

P. Provide complete “in service" instructions of system operation to school personnel. Assist in programming of telephone system.

3.5 GROUNDING

A. The contractor shall provide equipment grounding connections for Integrated Telecommunications / Time / Audio / Media System as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to ensure permanent and effective grounds.

B. The contractor shall provide ground equipment, conductor, and cable shields to eliminate shock hazard and to minimize the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments.

C. The contractor shall provide all necessary transient protection on the AC power feed and on all station lines leaving or entering the building.

D. The contractor shall note on their drawings the type and locations of these protection devices and all wiring information.

E. The contractor shall furnish and install a dedicated, isolated earth ground from the central equipment rack and bond to the incoming electrical service ground buss bar.

3.6 DOCUMENTATION

A. Provide the following directly to the Supervisor of Technology Services.

1. One printed copy of all field programming for all components in system.
2. One copy of all diagnostic software with a copy of field programming data for each unit.
3. One copy of all field wiring runs, location, and end designation of system.

END OF SECTION 260825

SECTION 260830

XR WIRELESS CLOCK SYSTEM

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this Section. Submit shop drawings for checking and approval.

1.1 GENERAL REQUIREMENTS AND SCOPE

A. Furnish and install a complete new XR wireless clock system using Primex Wireless Inc. XR wireless system.

B. All bids shall be based on the equipment as specified herein. The specifying authority must approve any alternate system.

1.2 SECTION INCLUDES

A. Transmission Systems GPS Receiver Primary Transmitter.

B. Satellite Transmitter.

C. Clocks.

D. Analog.

E. Specifier Note: Edit the following list as required for the project. List other sections with work directly related to this section.

1. Related Sections.
2. Division 26 – Electrical (120 volt grounded outlet required for transmitter).

1.3 REFERENCES

A. This Technical Specification and Associated Drawings Primex Wireless XR Satellite Time System User Manual.

1.4 DEFINITIONS

A. GPS: Global Positioning System, a worldwide system that employs 24 satellites in an integrated network to determine geographic location anywhere in the world, and which employs and transmits Universal Coordinated Time, the world's most accurate and reliable time.

B. UTC: Universal Coordinated Time.

C. NTP: Network Time Protocol, used for synchronizing the clocks on computer networks and devices from either a public server or a separate server on a private local area network.

1.5 SYSTEM DESCRIPTION

A. XR wireless clock system shall continually synchronize clocks throughout the facility, and shall be capable of clock readouts in multiple time zones where desired.

B. The system shall provide wireless time from a master time source. This time source will either be the atomic clock on the GPS system or the clock from a defined NTP server that the XR transmitter can access via the customer Ethernet. The master time will be synchronized to UTC. Hard wiring will not be required to the clocks installed for the system. Clocks shall automatically adjust for Daylight Saving Time in locations where DST is observed.

C. Analog Clocks shall be synchronized to within 10 milliseconds 6 times per day, and the system shall have an internal oscillator that maintains plus or minus one second per day between synchronizations, so that clock accuracy shall not exceed plus or minus 0.2 seconds.

D. The system shall include an internal clock reference so that failure to detect the master time source shall not result in the clocks failing to indicate time. Additionally, XR transmitters will have an internal battery backup of up to eight hours in the event of a power failure so that settings and the correct master time will be instantly recalled upon restoration of power.

E. The system shall incorporate a “fail-safe” design so that failure of any component shall not cause failure of the system. Upon restoration of power or repair of failed component, the system shall resume normal operation without the need to reset the system or any component thereof.

F. Clock locations shall be as indicated, and clocks shall be fully portable, capable of being relocated at any time.

G. The system must operate in accordance with a “Radio Station Authorization”, Form FCC 601 – LM, granted by the Federal Communications Commission (FCC). This license will be issued to and held by the end user.

1.6 REGULATORY REQUIREMENTS

A. Equipment and components furnished shall be of manufacturer’s latest model.

B. The end user will hold a license, known as a “Radio Station Authorization” granted by the FCC.

1. This license grants the end user protected use for wireless transmission at the designated frequency.
2. This license will designate a unique “call sign” for each end user.

C. Transmitter and receiver shall comply with Part 90 of FCC rules as follows:

1. This device may not cause harmful interference, and this device must accept interference received, including interference that may cause undesired operation.
2. Transmitter frequency shall be governed by FCC Part 90.35.
3. Transmitter output power shall be governed by FCC Part 90 257 (b)
4. System shall be installed in compliance with local and state authorities having jurisdiction.

1.7 SUBMITTALS

A. Product Data: Submit complete catalog data for each component, describing physical characteristics and method of installation. Submit brochure showing available colors and finishes of clocks.

B. Operating License: Submit evidence of application for FCC Radio Station Authorization prior to installing equipment. Furnish the license or a copy of the application for the license, to the Owner/End User prior to operating the equipment. The original license must be delivered to the Owner/End User. All Licensing fees shall be paid by this contractor.

C. Samples: Submit one clock for approval. Approved sample shall be tagged and shall be installed in the work at location directed.

D. Manufacturer's Instructions: Submit complete installation, set-up and maintenance instructions.

E. Floor plans indicating the location of system transmitter(s), approved by manufacturer, will be submitted to owner prior to installation.

1.8 SUBSTITUTIONS

A. Proposed substitutions, to be considered, shall be manufactured of equivalent materials that meet or exceed specified requirements of this Section.

B. Proposed substitutions shall be identified not less than 10 days prior to bid date.

C. Other systems requiring wiring and/or conduit between master and clocks will not be accepted.

D. Other systems using wireless technology in an unlicensed frequency range will not be accepted.

E. Other systems using wireless technology where the license is held by any party other than the end user will not be accepted.

1.9 QUALITY ASSURANCE

A. Permits: Obtain operating license for the transmitter from the FCC.

B. Qualifications

1. Manufacturer: Company specializing in manufacturing commercial time system products with a minimum of 30 continuous years of documented experience including 4 years' experience producing GPS wireless time systems.
2. Installer: Company with documented experience in the installation of commercial time systems.
3. Prior to installation, a site survey must be performed to determine proper transmitter placement.

1.10 DELIVERY STORAGE AND HANDLING

A. Deliver all components to the site in the manufacturer's original packaging. Packaging shall contain manufacturer's name and address, product identification number, and other related information.

1.11 PROJECT SITE CONDITIONS

A. Clocks shall not be installed until painting and other finish work in each room is complete.

B. Coordinate installation of GPS receiver for access to the roof or exterior side wall so that the bracket and related fasteners are watertight.

1.12 SYSTEM STARTUP

A. At completion of installation and prior to final acceptance, turn on the equipment; ensure that all equipment is operating properly, and that all clocks are functioning.

1.13 WARRANTY

A. Manufacturer will provide a 1 year warranty on all components.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. XR wireless clock system shall be manufactured by Primex Wireless, Inc., 965 Wells Street, Lake Geneva WI 53147 Tel: (800) 537-0464 Fax: (262) 248-0061 www.primexwireless.com.

2.2 SEQUENCE OF OPERATION

A. Transmitter Operation
When power is first applied to the transmitter, it checks for and displays the software version. It then checks the position of the switches and stores their position in memory. The transmitter looks for the master time source.

B. NTP Time Source
With the XR transmitter in NTP mode, it connects over the Ethernet to the IP address of the NTP server. This IP address is programmed into the transmitter as part of its configuration. Once the connection to the NTP server is acknowledged, it downloads time data and synchronizes its internal master clock to NTP time. The transmitter then starts to transmit its internal time once every second. The transmitter updates its internal clock in this mode once per hour.

C. Analog Clock Operation
Apply power or insert batteries. Follow set up procedures detailed in manufacturer's instructions.

1. After initial setup, the clock will shut off the receiver. Six times each day, the microprocessor will activate the receiver and starting with the stored channel, it will again look for a valid time signal. If necessary, the clocks will resynchronize to the correct time.
2. If the clock has not decoded a valid time signal for a pre-determined number of days, it will go to a step mode. Low battery voltage is a common cause of the clock to not properly decode a time signal. If a clock goes into step mode, replace the batteries first and then determine if the clock synchronizes to master time before attempting other troubleshooting methods.

2.3 EQUIPMENT

A. General:

1. The clock system shall include a transmitter, indicating clocks, and all accessories for complete operation.
2. The Clock face shall have the custom Yonkers School Logo which shall be coordinated with owner.

B. Transmitter: Primex Wireless Model XR01IN, consisting of a wireless transmitter, surge suppressor/battery backup, and a mounting shelf. Unit shall obtain current NTP time from Ethernet network. The clock system shall transmit time continuously to all clocks in the system.

C. Transmission: Frequency Ranges: 72.020 to 72.980 MHz, 74.610 to 74.790 MHz, 75.210 to 75.390 MHz, 75.440 to 75.600 MHz. Each range is reserved by the FCC for licensed fixed mobile broadcasts.

1. Transmission Power: 1 watt (30dBm) maximum
2. Radio technology: narrowband FM

3. Number of channels: 74
4. Channel bandwidth: 20 kHz maximum
5. Transition mode: one-way communication
6. Data rate: 2 KBps
7. Operating range: 32 degree F to 158 degrees F (0 degrees C. to 70 degrees C).

D. Transmitter

1. Transmitter output power: +26 to +30 dBm
2. Frequency deviation: +/- 4 kHz
3. Transmitter power requirements: 120 VAC 60 Hz
4. Internal power requirements: 5 VDC
5. Carrier frequency stability: +/- 20 ppm
6. Transmitter shall have 74 selectable channels to assure interference-free reception.
7. Transmitter shall have the following switches:
   Time zone adjustment switches for all time zones in the world.
   Includes: Eastern, Central, Mountain, Pacific, Alaska, and Hawaii.
8. DIP Switch to allow the following configuration: Daylight Saving Time bypass option, 12-hour or 24-hour display, GPS or NTP time source, Local or LAN configuration, UTC+ or UTC-, 30 minute UTC offset option.
9. Transmitter housing shall be black metal case, 16-3/4 inches (424.4mm) by 12 inches (304.8mm) by 1-7/8 inches (46.4mm) in size.
10. Antenna shall be 46 inches (1168mm) high, commercial type, mounted on top center of transmitter housing. Antenna gain shall be < 2.2 dB. Antenna polarization shall be vertical.

E. Transmitter housing shall incorporate a display which shall include the following:

1. Time readout
2. AM and PM indicator if 12-hour time display is set
3. Day and date readout
4. Time zone indicator including Standard or Daylight Savings Time
5. On screen menu to verify diagnostics, errors, time updates, and switch settings, toggled by sequence of push buttons next to display
6. Status LEDs: Green, which when solid indicates transmitter is broadcasting, yellow which flashes in the event of lack of time update after 48 hours, red which flashes to indicate connection or internal transmitter problem.

F. Internal clock

1. Transmitter shall contain an internal clock such that failure to update time from source will not disable the operation of the clocks.
2. Power supply (included)
   Input: 120 volt AC 50/60 Hz, 0.4 amps.
   Output: 9 volt DC, 1.5 amps.
3. Surge Protector/Battery Backup (included).
   Input: 120 volt AC 60 Hz +/- 1 Hz.
   Output: 120 volt AC, 500VA, 300 watts
   Surge Energy Rating: 365 joules

2.4 ADDITIONAL EQUIPMENT

A. Wireless Receiver Switches: Switches shall receive time packets from the Primary Transmitter and relay the synchronized time to the Satellite Transmitter connected to it. The unit shall include the following:

B. Antenna mounted on top of the switch housing, 11-1/2 inches (292mm) long.

C. Power Supply:
Input 120 VAC 50/60 Hz, 0.4 amps
Output: 9 volt DC, 1.5 amps

D. RS 232 data cable, 5 feet (1.5mm) long

E. Daylight Savings Time Bypass Switch
1. Dimensions: 4-1/4 inches (108mm) long, 5/-3/4 inches (146mm) wide, 1-1/4 inches (31.75mm) deep.
2. Weight: 12 ounces (.34kg)
3. Operating Range: 32 degrees F to 158 degrees F (0 to 70 degrees C)

F. Satellite Transmitters Primex Wireless Model XR01R: Satellite Transmitters shall receive the signal from the Wireless Receiver Switches and transmit the signal to the devices in its vicinity, which are out of the range from the Master Transmitter. The unit shall include the following:
1. Antenna mounted on top of the housing, 46 inches (1168mm) long.
2. Wireless Receiver Switch.
3. Power Supply Input: 120 VAC, 50/60 Hz, 0.4 amps
Output: 9 volt DC, 1.5 amps.
4. 6 foot (1.83m) cord
5. Surge Suppressor/Battery Backup
6. Mounting Shelf.
7. Transmission Power: 1 watt maximum
8. 72 MHz frequency.

G. Traditional analog clocks (battery): Analog clocks shall be wall mounted. Clocks shall have polycarbonate frame and polycarbonate lens. Face shall be white. Hour and minute hands shall be black.
1. 12-1/2 inch (317.5mm) diameter analog clock: Primex Wireless
Model 14155
2. 16 inch (406.4mm) diameter analog clock: Primex Wireless Model 14163Additional colors, finishes, and dial faces are available from manufacturer.
3. Analog clocks shall be battery-operated, Analog clocks shall be capable of automatically adjusting for Daylight Saving Time. An on-off switch located on the transmitter shall disable this function If desired.
4. Time shall be automatically updated from the transmitter 6 times per day.
5. Analog clocks shall remember the time during changing of batteries.
6. 12.5 inch (317.5mm) analog clocks shall have a tamper proof/theft
resistant clock lock mounting slots.

H. Analog clock receivers shall be as follows:

1. Receiver sensitivity: >-110 dBm
2. Receiver power: dual lithium battery pack, supplied by manufacturer.
3. Antenna type: internal
4. Antenna gain: -7 dBd

I. If the transmitter stops transmitting valid time signals due to power failure, the clocks will continue to function as accurate quartz clocks until valid time signal is decoded. If signal transmission is not restored after 96 hours, second hand will “five step” as visual indicator that the signal has been lost. Should the clocks lose power and signal, the clocks will not function.

J. Wire Guards: Provide one for each analog clock as follows:

1. Analog clock wire guard Primex Wireless Model 14123, 18 by 18 inch (457.2 by 457.2mm) size, for 16 inch (406.4mm) Diameter analog clocks. Gym and Cafeteria.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that construction is complete in spaces to receive equipment and that rooms are clean and dry.

B. Verify that 120 volt electrical outlet is located within 6 feet (1.83m) of location of transmitter and the outlet is operational and properly grounded.

3.2 INSTALLATION

A. Provide all equipment necessary for a complete and operable system.

B. Provide one Model Number 14005, 18 inches long, by 3 inches wide by 15 inches deep

3.3 TRANSMITTER

A. Locate transmitter where indicated, a minimum of 2 to 3 feet (.6 to 1 meter) above the floor, away from large metal objects such as filing cabinets, lockers or metal framed walls. Transmitter(s) will be placed at locations indicated below:

1. Primex Wireless Applications Engineering Dept. should be consulted to determine the number and placement of transmitter(s) required for the project. Contact Primex Wireless Technical Support at 1-800-404-8117.
2. If NTP will be used as master time source. Connect CAT5/CAT5e/CAT6 EIA/TIA standard Ethernet cable from transmitter LAN port to available network drop. Set GPS/LAN DIP switch to NTP.

3. The NTP will be the master time source, the network drop used to connect the XR transmitter must have connectivity to the NTP server, which can be verified by the customer IT manager. The default NTP address is time.nist.gov. If the network has a different NTP IP address, it may be programmed into the transmitter by the installer to allow connection to the proper network time. Contact Primex Wireless Technical Support at 1-800-404-8117.
4. Connect antenna to transmitter, using care not to strip threads.
5. Connect power supply to the transmitter.
6. Set the channel number on the display to correspond to the FCC license.
7. Plug power supply into electrical outlet.
8. Analog clocks perform the following operations with each clock:
   a. Set clock to correct time in accordance with manufacturer's instructions.
   b. Observe analog clock until valid signals are received and analog clock adjusts itself to correct time.

B. Install the analog clock on the wall in the indicated location, plumb, level and tight against the wall. If using 12-1/2 inch (317.5mm) clock, attach using clock-lock hanging method and suitable fasteners as approved by clock manufacturer.

1. Analog clocks (AC): Perform the following operations with each clock:
2. Observe clock until valid time signals are received and analog clock adjusts itself to correct time.
3. Install the analog clock on the wall in the indicated location, plumb, level, and tight against the wall. Attach using clock-lock hanging method and suitable fasteners as approved by clock manufacturer.

C. Wire guards: Secure to wall, using approved theft-resistant fasteners.

3.3 ADJUSTING

A. Prior to final acceptance, inspect each clock, adjust as required, and replace parts which are found defective.

3.4 CLEANING

A. Prior to final acceptance, clean exposed surfaces of clocks, using cleaning methods recommended by clock manufacturer. Remove temporary labels from clock faces. Do not remove labels from backs of clocks.

3.5 DEMONSTRATION

A. Provide training to Owner's representative on setting and adjusting clocks, replacing batteries and routine maintenance.

3.6 PROTECTION

A. Protect finished installation until final acceptance of the project.

3.7 TESTING

A. All devices must be tested at their operational location under normal operational conditions to assure reception of signal.

END OF SECTION 260830

SECTION 260850

AUDITORIUM / GYM SOUND SYSTEM

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 GENERAL CONDITIONS

A. The Contractor acknowledges and warrants that he has closely examined all the Contract Documents, that they are suitable and sufficient to enable the Contractor to complete the Work in the time allotted for the Contract Sum as accepted by the Owner and that they include all Work, whether or not shown or described, which reasonably may be inferred to be required or useful for the completion of the Work in full compliance with all applicable codes, laws, ordinances, rules, and regulations.

B. Design, engineer and provide complete means of support, suspension, attachment, fastening, bracing of the work of this section including existing and new installed equipment in accordance with local building codes and regulations. Provide engineering of such support by parties licensed to perform work of this type in the Project jurisdiction.

C. Provide all cable and wire associated with this specification section and related documents.

D. All systems shall be completely installed with all of the necessary interconnection, power supplies, patch cords, snakes, portable equipment cables and wiring to provide a fully functioning system. The governing overall requirement for this project is a complete and functional system. Include work not usually shown or specified but necessary for proper installation and operation of the system or piece of equipment.

E. Execution of the Contract by the Contractor is a representation and warranty that the Contractor has carefully examined the Contract Documents and represents and warrants that the Contractor is thoroughly familiar with the nature and location of the Work, the Site, the specific conditions under which the Work is to be performed, and all matters which may in any way affect the Work or its performance. The Contractor further represents that as a result of such examinations and investigations, the Contractor has thoroughly reviewed and understands the Contract Documents and their Intent and purpose, and is familiar with all applicable codes, ordinances, laws, regulations and rules as they apply to the Work, and that the Contractor will abide by same.

F. Claims for additional time or additional compensation as a result of the Contractor's failure to follow the foregoing procedure and to familiarize itself with all local conditions and the Contract Documents will not be permitted.

G. The term “provide” shall be defined as: designed, engineered, furnished, installed, certified and tested by the Integrator/Contractor.

H. The Audio-Visual Integrator shall perform all required control system configuration, programming, software, software set-up, calibration and re-calibration to provide a complete working system in accordance to the project specifications and Owner requirements. All Set up and adjustment of specified hardware and software.

1.2 SYSTEM DESCRIPTION

A. Auditorium / Gymnasium
1. The loudspeaker system shall consist of Left/Right wall mounted speakers.
2. One equipment rack shall be wall mounted on stage.
3. The system DSP shall be programed to auto mix microphones and sources.
4. A wireless microphone system shall be provided with antennas remoted per the manufactures requirements.
5. A remote input wall plate shall be provided at the scoring table location with an aux input for music and a mic input for the announcer.
6. An assistive listening system shall be provided with a remote antenna per the manufacturers recommendations. Quantities of receivers, headsets and loops shall be per occupancy per ADA requirements.
7. The audio DSP shall connect to the school intercom. Program from the intercom shall mute or over-ride the local program. Coordinate functionality with Owner.
8. The audio DSP shall be connected to a contact closure from the fire panel to mute audio when the alarm is activated.

1.3 INFORMATION SUBMITTALS

A. No submittals are required of if bidding “As Specified”.

B. Requests for substitutions of equal equipment must be submitted no less than 5 days prior to the bid date for consideration. The Owner shall be the final judge of the acceptability of substitutions.

C. Final system As-Built drawings shall be generated and submitted as part of the project close-out documents.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. The work included in this section shall be performed by an Audio-Visual Systems Contractor/Integrator with a minimum (5) years direct experience with the devices, equipment, and systems of the type and scope specified in this section and have operated under the same business name.

2. The Bidder shall have on staff a programmer certified by the manufacturer of the control systems or DSP specified below or demonstrate equal or greater general experience. The owner will determine the acceptability of any presented equal experience.

B. Insurance

1. Contractor to maintain Commercial General Liability insurance at $1,000,000 per occurrence for the duration of the project.

2. Contractor to maintain automobile insurance at $1,000,000 per claim for the duration of the project.

C. Site Conditions

1. Contractor to clean their work area at the end of each work day, leaving the facility in the condition it was found.

2. Contractor by the end of the project to restore any damage done to the facility during installation including patching and painting walls as required.

1.5 WARRANTY AND SERVICE

A. Installation warranted free of faulty workmanship.

B. All components, products and materials, warranted free of defects for a period of one (1) year from date of final acceptance. This minimum warranty provision shall not diminish the terms of individual equipment manufacturers' warranties.

PART 2 - PRODUCTS

2.1 GENERAL

A. Performance Standards and Quality of Products:

1. Materials and equipment specified herein have been selected as the basis of acceptable quality and performance and have been coordinated to function as components of the specified systems.

2. Where a particular material, device, piece of equipment or system is specified directly, the current manufacturer's specification for the same shall be considered to be a part of these specifications, as if completely contained herein in every detail.

3. All materials and products will be new and of professional quality. Unless specifically stated in the drawings or specifications, no existing or used materials will be installed.

B. Quantity

1. Provide the quantity of products as shown on the Contract Drawings, or as otherwise indicated herein.

2. The equipment listed in section 2.2 consists of all major equipment for the project. The Contractor will integrate into the system design and provide any additional components, wiring, programming, etc., to complete a functional system operating as described within the specifications and the drawings.

3. Components or equipment not specified or indicated on the drawings that are required to make a fully functional systems per the Owner's requirements and the design intent, shall be furnished and installed by the Contractor, and shall be submitted for Owner review.

4. All owner furnished existing equipment shall be integrated into the system.

2.2 MAJOR SYSTEM COMPONANTS

Qty	Item	Manufacturer	Notes
2	AFI-8	Apogee Sound	Main Speakers
2	MM-120	Adaptive Technologies	Speaker Mounting
1	CA-8000D	Apogee Sound	2ch Amplifier
1	CORE 12x4	Bogen	System Mixer / DSP
1	D-J3	RDL	Mic and Line Input Wall Plate
1	PMD-526C	Bogen	CD w/ Bluetooth
1	DDU250	Bogen	Desk Top Announcer Mic
1	XLR25	Bogen	25' Mic cable
4	SF4	Bogen	Mic Stand
1	UHFADS	Bogen	Antenna Distribution
4	UHF8011HH/BP	Bogen	Wireless Mic Combo System, Hand Held and Body Pack
1	UHFHSMB	Bogen	Headworn Mic
1	VAR1	Bogen	Voice Actuated Relay
1	CN2400S	Furman Sound	Power Distro/Sequencer/Filter
1	CWR-18-26PD	Middle Atlantic	Wall Mount Rack, 12RU
1	D2	Middle Atlantic	2RU Rack Drawer
1	LS-55-072	Listen Technologies	With additional receivers, headphones and loops
			as required by occupancy per ADA.
			Include rechargeable batteries and charging stations.

PART 3 – EXECUTION

3.1 SYSTEM PERFORMANCE TESTS

A. Final systems quality and performance, testing, calibrating, programming and overall commissioning shall be performed by the installer prior to the commencement of owner training. Installer shall furnish all labor, instruments, equipment, temporary power, and materials necessary to perform the system tests outline below at no additional cost. The system shall be fully tested and operational before final inspection by the Owner.

B. Test that all circuits and wiring are free of shorts and grounds and that all wiring has been terminated in the proper polarity, including loudspeakers, microphone and line input plates.

C. Microphone inputs shall be moderately compressed in the DSP to minimize level variation and equalized for both good fidelity and gain before feedback.

D. Measure the acoustic performance of the sound system with a TEF, SMAART or an equivalent high-resolution system. Parametric equalization shall be performed to obtain the most uniform response possible over the listening area.

E. Output limiters shall be set in the DSP to minimize the chance of accidental damage to the speakers and to prevent levels that would cause amplifier clipping.

F. Normal operating levels shall be set in conjunction with the Owner to insure acceptable levels are achieved and that excessive levels are not possible.

G. Post equalization/preset/routing DSP settings should be saved to a removable media and should be kept on file for use in the event of DSP failure. This file shall be transmitted to the Owner as part of the close-out documents.

H. The Sound System Installer shall confirm the system gain structure is set properly, allowing for normal use level program to occur without system components clipping or overloading. No audible hiss, buzz or hum shall be present.

I. Confirm all other sources and systems are setup, adjusted and functioning properly including but not limited to DSP and Remote control panel programming, Assisted Listening Systems, intercom systems and recording systems.

3.2 DEMONSTRATION AND ACCEPTANCE TESTING

A. Acceptance:

1. After inspections and tests indicate that the entire Audio system and sub systems as specified herein and indicated on the drawings are in total compliance with the drawings and specifications, a letter indicating said compliance shall be issued.

2. Final acceptance of the installation will be granted when it is clear to the Owner that the following conditions have been met:
   a. All fixed equipment has been furnished and installed according to drawings and specifications.
   b. All portable equipment has been turned over to the Owner.
   c. All equipment and installation have been tested and shown to perform as specified.
   d. All instruction manuals, software source code and as-built documentation have been completed and delivered to the Owner's Representative.

3. The Warrantee period will begin only when all of the above listed items have been performed to the satisfaction of the Owner.

END OF SECTION 260850

SECTION 260860

RESCUE ASSISTANCE SIGNAL SYSTEM - AUDIO/VISUAL

PART 1 – GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 SUMMARY

A. Section Includes: Furnish, install, and wire all equipment associated with the installation of an Audio-Visual Rescue Assistance Signal System to comply with ADA requirements. This work shall include a main annunciator panel, remote call stations, power supply, outlet boxes, cables and wiring as shown on the drawings and as specified herein.

1.2 SUBMITTALS

A. General: Data sheets on all equipment being provided as well recommended cable types. Internal control cabinet drawings showing internal block diagram connections shall be provided. Wiring diagrams showing typical field wiring connections as well as single line floor plan indicating equipment locations as well as cable routings and quantities.

B. Product Data: Submit product data, including manufacturer's (Spec-Data) product sheet, for specified products.

C. Shop Drawings: Submit shop drawings showing layout, profiles and product components, including anchorage and accessories. Include cabling diagrams, wiring diagrams, station installation details, and equipment cabinet details.

D. Quality Assurance Submittals: Submit the following:

1. Test Reports: Certified test reports showing compliance with specified performance characteristics.
2. Manufacturer's Instructions: Manufacturer's installation instructions.
3. Manufacturer's Field Reports: Manufacturer's field reports specified herein.

E. Closeout Submittals: Submit the following:

1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance. Include troubleshooting guide, wiring terminal identification and equipment parts list.

2. Warranty: Warranty documents specified herein.

F. Project Closeout

1. A one-year maintenance contract offering continued factory authorized service of this system shall be provided as part of this contract. Built drawings that include changes to wiring, wiring designations, junction box labeling and other pertinent information shall be supplied upon completion of the project.
2. The contractor shall furnish manufacturer's manuals of the completed system including individual specifications sheets, schematics, inter-panel and intra-panel wiring diagrams.
   a. All information necessary for the proper maintenance and operation of the system must be included.
   b. Provide four copies.

3. As built drawings that include changes to wiring, wiring designations, junction box labeling, and other pertinent information shall be supplied upon completion of the project.
4. Provide a minimum of two (2) hours of in-service training with the system.
   a. These sessions shall be broken into segments that will facilitate the training of the system users in operating station equipment.
   b. Operating manuals and user’s guides shall be provided at the time of training.

1.3 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

1. Warranty Period: [Specify term.] years commencing on the Date of Substantial Completion.
2. All materials and installation shall be guaranteed to be free of defects in material and workmanship for one year after final acceptance of installation and tests.

1.4 INSTALLATION STANDARDS

A. The system shall be installed in accordance with the 1993 NEC and ADA requirements.

B. The completed system shall be in compliance with state and local electrical codes.

C. All wiring shall test free from grounds and shorts.

1.5 SYSTEM OPERATIONS

A. Furnish, install and place into operation a Rescue Assistance System for this building as indicated on the drawings and as specified herein.

B. A common annunciator shall be provided at the main building entrance where shown on the drawings to indicate light and tone signals from multiple remote call stations.

1. When the call station switch is activated, a red LED button illuminates and a one shot tone sounds.
2. When the alarm signal is acknowledged, the remote call station is signaled with a flashing light and tone.
3. Voice communication with the remote call can then be initiated from the annunciator.
4. Optional access to a public telephone system shall be provided when specified.

PART 2 PRODUCTS (RESCUE ASSISTANCE SYSTEM - AUDIO/VISUAL)

2.1 RESCUE ASSISTANCE-VISUAL EQUIPMENT

A. Manufacturer: Cornell Communications, Inc.

1. Contact: 7915 N 81st St., Milwaukee, WI 53223-3830;
Telephone: 800- 558-8957; (414) 351-4660; Fax: (414) 351-4657.

2.2 PRODUCT SUBSTITUTIONS

A. Substitutions: No substitutions permitted.

2.3 CORNELL 4200 RESCUE ASSISTANCE-AUDIO/VISUAL SYSTEM AND COMPONENTS

A. Equipment

1. This system shall consist of multiple remote call stations, which will share a common annunciator panel and optional access to a public telephone system for external alarm notification.

B. Annunciator

1. The annunciator panel shall be a CORNELL Model A4200 series, with a minimum capacity for (10) zones, surface mounted at the Main Fire Department Entrance to the building.

a. Verify location with the Local Fire Marshal and the Architect.

2. An alternate action switch with internal LED indicator shall be included for each zone.

a. A yellow LED light on the zone switch shall illuminate and the alarm shall emit a repeating sound if the supervised wiring is faulted.

3. An audible alarm shall be mounted on the annunciator panel, which will emit a minimum sound level of 90 db at 30 cm when a remote station calls.

    a. Depressing the zone switch will answer a zone and open the intercom line to the zone.

4. The front panel shall have silk-screened zone designations and operating directions as well as zone designation strips.
5. The power supply shall be a 120 volt emergency battery backup, CORNELL model B-5243A or P-512243A.
6. The optional, TAK-4200 telephone access kit will place a call to a designated location via a dedicated public telephone line to notify them of the alarm.

C. Remote Call Stations

1. The remote call station shall be CORNELL Model 4201A, with one momentary switch with LED and loudspeaker.
2. The station shall have hands free voice communication with the annunciator.
3. The station shall have silk-screened operating instructions.
4. The station shall be flush wall mounted on a 2-gang stainless steel plate with a 48" maximum mounting height for forward reach, and a 54” maximum for side reach.
5. The Vandal Proof Call Station shall be Cornell Model 4201/V. The standard two gang mounting plate cm be flush mounted or wall mounted and incorporate heavy duty switches and speakers along with stainless steel plates and tamper-proof screw. The 4201/V shall contain water resistant switch and speaker for exterior applications.

2.4 SOURCE QUALITY

A. Source Quality: Obtain rescue assistance equipment and system from a single manufacturer.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.

3.2 EXAMINAITON

A. Site Verification of Conditions: Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

3.3 INSTALLATION

A. Cabling Requirements

1. Wiring from the annunciator to the call station shall be 22- gauge, 2 conductor shielded audio pair + 3 conductor unshielded.
2. Wiring from the annunciator to the power supply shall be 18-gauge, 2 conductor.
3. Verify cable types with the Rescue Assistance System Manufacturer.
4. The optional telephone access kit requires a 120V AC outlet and dedicated external telephone line.

B. Rescue Assistance Signal System - Audio/Visual Installation

1. Complete system shall be installed in strict accordance with manufacturer's recommendations.
2. Wiring shall be installed in raceways throughout the building.

a. Conduit, if required, shall be 1/2" minimum.

3.4 FIELD QUALITY REQUIREMENTS

A. Site Tests (Post Installation Testing): Checkout final connections to the system shall be made by a factory technician authorized by the manufacturer of the products installed.

1. Factory authorized technicians shall demonstrate operation of the complete system and each major component to the staff.
2. System field wiring diagrams shall be provided to this subcontractor by the system prior to installation.

B. Inspection: Perform a complete functional test of the system upon completion of the installation and instruct the staff in the operation and maintenance of the system.

3.5 CLEANING

A. Cleaning: Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance. Remove construction debris from project site and legally dispose of debris.

END OF SECTION 260860

SECTION 260875

PACKAGED ENGINE GENERATOR SYSTEM – DIESEL INDOOR

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 SCOPE

A. Provide complete factory assembled generator set equipment with digital (microprocessor-based) electronic generator set controls, digital governor, and digital voltage regulator.

B. Provide factory test, startup by a supplier authorized by the equipment manufacturer(s), and on-site testing of the system.

C. The generator set manufacturer shall warrant all equipment provided under this section, whether or not is manufactured by the generator set manufacturer, so that there is one source for warranty and product service. Technicians specifically trained and certified by the manufacturer to support the product and employed by the generator set supplier shall service the generator sets.

1.2 CODES AND STANDARDS

A. The generator set installation and on-site testing shall conform to the requirements of the following codes and standards, as applicable. The generator set shall include necessary features to meet the requirements of these standards.

1. CSA 282, 1989 Emergency Electrical Power Supply for Buildings
2. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
3. NFPA37 –
4. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
5. NFPA99 – Essential Electrical Systems for Health Care Facilities
6. NFPA110 – Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1prototype tests required by this standard shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement.

B. The generator set and supplied accessories shall meet the requirements of the following standards:

1. NEMA MG1-1998 part 32. Alternator shall comply with the requirements of this standard.
2. UL142 – Sub-base Tanks
3. UL1236 – Battery Chargers

4. UL2200. The generator set shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed.

5. Seismic Certified per IBC 2000, 2003, and 2006. Provide certificate of compliance. Generator sets not certified shall deemed not acceptable.

C. The control system for the generator set shall comply with the following requirements.

1. CSA C22.2, No. 14 – M91 Industrial Control Equipment.
2. EN50082-2, Electromagnetic Compatibility – Generic Immunity Requirements, Part 2: Industrial.
3. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
4. FCC Part 15, Subpart B.
5. IEC8528 part 4. Control Systems for Generator Sets
6. IEC Std 801.2, 801.3, and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions.
7. UL508. The entire control system of the generator set shall be UL508 listed and labeled.
8. UL1236 –Battery Chargers.

D. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

PART 2 - PRODUCTS

2.1 GENERATOR SET

A. Ratings

1. The generator set shall operate at 1800 rpm and at a voltage of: 120/208 Volts AC, Three phase, 4-wire, 60 hertz.
2. The generator set shall be rated at 450 kW, 562.5 kVA at 0.8 PF, Standby rating, based on site conditions of: Ambient temperatures up to 50 degrees C.
3. The generator set rating shall be based on emergency/standby service.

B. Manufacturer

1. Basis of Design and Pre-Approved: Cummins, model DFEJ as supplied by Cummins Sales & Service – East Region, 890 Bronx, NY 10473. Contact: Ed Cheung at email: ed.cheung@cummins.com.

2. It is intended that all products specified herein be of standard ratings, therefore, the KW and KVA, starting KVA and maximum allowable voltage dip, engine displacement ratings, etc., shall be the manufacturer's next size or rating to exactly meet the specifications. No exceptions.

C. Performance

1. Voltage regulation shall be plus or minus 0.5 percent for any constant load between no load and rated load. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 percent.
2. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.5%.
3. The diesel engine-generator set shall accept a single step load of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
4. Locked rotor kVA shall be match performance of the specified HC5F alternator. Upon 100% application of its nameplate rating of 450 KW, the diesel engine/ac alternator system starting voltage dip shall not exceed 30.1%. Recovery time shall not exceed 3.6 seconds. This shall be tested and verified during the field acceptance system check out test.
5. The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic, and no 3rd order harmonics or their multiples. Telephone influence factor shall be less than 40.
6. The generator set shall be certified by the engine manufacturer to be suitable for use at the installed location and rating, and shall meet all applicable exhaust emission requirements at the time of commissioning.

D. Construction

1. The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.
2. All switches, lamps, and meters in the control system shall be oil-tight and dust-tight. All active control components shall be installed within a UL/NEMA 3R enclosure. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts.

E. Connections

1. The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept mechanical or compression terminations of the number and type as shown on the drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings.
2. Power connections to auxiliary devices shall be made at the devices, with required protection located at a wall-mounted common distribution panel.
3. Generator set control interfaces to other system components shall be made on a permanently labeled terminal block assembly. Labels describing connection point functions shall be provided.

2.2 ENGINE AND ENGINE EQUIPMENT

A. The engine shall be diesel EPA Tier 2 certified, 4 cycle, radiator and fan cooled. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Two cycle engines are not acceptable. Engine accessories and features shall include:

1. An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed. The governing system shall include a programmable warm up at idle and cooldown at idle function. While operating in idle state, the control system shall disable the alternator excitation system.
2. Skid-mounted radiator and cooling system shall be rated for full load operation as measured at the alternator air inlet. Radiator fan shall be suitable for use in a system with 0.5 in H_2O restriction. Radiator shall be sized based on a core temperature that is 20F higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/fan operation in a controlled environment. Radiator shall be provided with a duct adapter flange. The equipment manufacturer shall fill the cooling system with a 50/50-ethylene glycol/water mixture prior to shipping. Rotating parts shall be guarded against accidental contact.
3. Electric starter(s) capable of three complete cranking cycles without overheating.
4. Positive displacement, mechanical, full pressure, lubrication oil pump.
5. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.
6. An engine driven, mechanical, positive displacement fuel pump. Fuel filter with replaceable spin-on canister element. Fuel cooler, suitable for operation of the generator set at full rated load in the ambient temperature specified shall be provided if required for operation due to the design of the engine and the installation.
7. Replaceable dry element air cleaner with restriction indicator.
8. Flexible supply and return fuel lines.
9. Engine mounted battery charging alternator, 40-ampere minimum, and solid-state voltage regulator.
10. Coolant Heater
    a. Engine mounted, thermostatically controlled, coolant heater(s) for each engine. Heater voltage shall be as shown on the project drawings. The coolant heater shall be UL499 listed and labeled.
    b. The coolant heater shall be installed on the engine with silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 12 inches. The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heaters shall have provisions to isolate the heater for replacement of the heater element without draining the coolant from the generator set. The quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.

c. The coolant heater shall be provided with a DC thermostat, installed at the engine thermostat housing. An AC power connection box shall be provided for a single AC power connection to the coolant heater system.

d. The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 104F (40C) in a 40F (4C) ambient, in compliance with NFPA110 requirements, or the temperature required for starting and load pickup requirements of this specification.

11. Provide vibration isolators, quantity as recommended by the generator set manufacturer.

12. Starting and Control Batteries shall be calcium/lead antimony type, 24 volt DC, sized as recommended by the engine manufacturer, complete with battery cables and connectors. The batteries shall be capable of a minimum of three complete 15-second cranking cycles at 40F ambient temperature when fully charged.

13. Provide exhaust silencer(s) for each engine of size and type as recommended by the generator set manufacturer and approved by the engine manufacturer. The mufflers shall be critical grade. Exhaust system shall be installed inside sound enclosure.

14. A UL listed/CSA certified 10 amp voltage regulated battery charger shall be provided for each engine-generator set. The charger shall be mounted inside sound enclosure. Input AC voltage and DC output voltage shall be as required. Chargers shall be equipped with float, taper and equalize charge settings. Operational monitors shall provide visual output along with individual form C contacts rated at 4 amps, 120 VAC, 30 VDC for remote indication of:
    a. Loss of AC power - red light
    b. Low battery voltage - red light
    c. High battery voltage - red light
    d. Power ON - green light (no relay contact)

15. Charger shall include an Analog DC voltmeter and ammeter, 12 hour equalize charge timer, and AC and DC fuses.

2.3 AC GENERATOR

A. The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single prelubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system and shall be UL1446 listed. Actual temperature rise measured by resistance method at full load shall not exceed 80 degrees Centigrade.

B. The sub Transient reactance shall not exceed 6.6 at 80 C rating for 208 VAC.

C. Motor starting capability shall be a minimum of 1210 KVA. The generator set shall be capable of recovering to a minimum of 90% of rated no load voltage following the application of the specified kVA load at near zero power factor applied to the generator set.

D. The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.

E. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds.

2.4 GENERATOR SET CONTROL

A. The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification.

B. The control shall be mounted on the generator set or may be mounted in a free-standing panel next to the generator set if adequate space and accessibility is available. The control shall be vibration isolated, and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.

C. The generator set mounted control shall include the following features and functions:

1. Control Switches

a. Mode Select Switch: The mode select switch shall initiate the following control modes. When in the RUN or MANUAL position the generator set shall start and accelerate to rated speed and voltage as directed by the operator. A separate push-button to initiate starting is acceptable. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.

b. EMERGENCY STOP switch: Switch shall be Red "mushroom-head" push-button. Depressing the emergency stop switch shall cause the generator set to immediately shut down and be locked out from automatic restarting.

c. RESET switch: The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.

d. PANEL LAMP switch: Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.

2. Generator Set AC Output Metering. The generator set shall be provided with a metering set including the following features and functions:

a. Digital metering set, 1% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three-phase voltages (line to neutral or line to line) simultaneously.

b. Analog voltmeter, ammeter, frequency meter, power factor meter, and kilowatt (KW) meter. Voltmeter and ammeter shall display all three phases. Meter scales shall be color coded in the following fashion: green shall indicate normal operating condition, amber shall indicate operation in ranges that indicate potential failure, and red shall indicate failure impending. Metering accuracy shall be within 1% at rated output. Both analog and digital metering are required.

c. The control system shall monitor the total load on the generator set and maintain data logs of total operating hours at specific load levels ranging from 0 to 110% of rated load, in 10% increments. The control shall display hours of operation at less than 30% load and total hours of operation at more than 90% of rated load.

d. The control system shall log total number of operating hours, total kWH, and total control on hours, as well as total values since reset.

3. Generator Set Alarm and Status Display

a. The generator set control shall include LED alarm and status indication lamps. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. Functions indicated by the lamps shall include:
- The control shall include five configurable alarm-indicating lamps. The lamps shall be field adjustable for any status, warning, or shutdown function monitored by the genset. They shall also be configurable for color, and control action (status, warning, or shutdown).
- The control shall include green lamps to indicate that the generator set is running at rated frequency and voltage, and that a remote start signal has been received at the generator set. The running signal shall be based on actual sensed voltage and frequency on the output terminals of the generator set.
- The control shall include a flashing red lamp to indicate that the control is not in automatic state, and red common shutdown lamp.
- The control shall include an amber common warning indication lamp.

b. The generator set control shall indicate the existence of the warning and shutdown conditions on the control panel. All conditions indicated below for warning shall be field-configurable for shutdown. Conditions required to be annunciated shall include:
- low oil pressure (warning)
- low oil pressure (shutdown)
- oil pressure sender failure (warning)
- low coolant temperature (warning)
- high coolant temperature (warning)
- high coolant temperature (shutdown)

- high oil temperature (warning)
- engine temperature sender failure (warning)
- low coolant level (warning)
- fail to crank (shutdown)
- fail to start/overcrank (shutdown)
- overspeed (shutdown)
- low DC voltage (warning)
- high DC voltage (warning)
- weak battery (warning)
- low fuel-daytank (warning)
- high AC voltage (shutdown)
- low AC voltage (shutdown)
- under frequency (shutdown)
- over current (warning)
- over current (shutdown)
- short circuit (shutdown)
- ground fault (warning) (optional--when required by code or specified)
- over load (warning)
- emergency stop (shutdown)
- (4) configurable conditions

c. Provisions shall be made for indication of four customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above-specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

4. Engine Status Monitoring

a. The following information shall be available from a digital status panel on the generator set control:

- engine oil pressure (psi or kPA)
- engine coolant temperature (degrees F or C)
- engine oil temperature (degrees F or C)
- engine speed (rpm)
- number of hours of operation (hours)
- number of start attempts
- battery voltage (DC volts)

b. The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.

5. Engine Control Functions

   a. The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-second rest period between cranking periods.

   b. The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.

   c. The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.

   d. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.

   e. The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure conditions.

6. Alternator Control Functions

   a. The generator set shall include a full wave rectified automatic digital voltage regulation system that is matched, and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase line to neutral RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate and be capable of being curve-matched to the engine torque curve with adjustments in the field. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.
   b. Controls shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.

c. Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.

d. Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition (over load) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.

e. An AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

f. When required by National Electrical Code or indicated on project drawings, the control System shall include a ground fault monitoring relay. The relay shall be adjustable from 3.8-1200 amps, and include adjustable time delay of 0-10.0 seconds. The relay shall be for indication only, and not trip or shut down the generator set. Note bonding and grounding requirements for the generator set, and provide relay that will function correctly in system as installed.

7. Other Control Functions

a. The generator set shall be provided with a network communication module to allow LonMark compliant communication with the generator set control by remote devices. The control shall communicate all engine and alternator data and allow starting and stopping of the generator set via the network in both test and emergency modes.

b. A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 25VDC or more than 32 VDC. During engine cranking (starter engaged), the low voltage limit shall be disabled, and DC voltage shall be monitored as load is applied to the battery, to detect impending battery failure or deteriorated battery condition.

8. Control Interfaces for Remote Monitoring

a. The control system shall provide four programmable output relays. These relay outputs shall be configurable for any alarm, shutdown, or status condition monitored by the control. The relays shall be configured to indicate: (1) generator set operating at rated voltage and frequency, (2) common warning, (3) common shutdown, (4) load shed command.

b. A fused 10 amp switched 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator set is running.

c. A fused 10 amp 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit at all times from the engine starting/control batteries.

d. The control shall be provided with a direct serial communication link for the LonWorks communication network interface as described elsewhere in this specification and shown on the drawings.

2.5 OTHER EQUIPMENT TO BE PROVIDED WITH THE GENERATOR SET

A. Provide and install a 20-light LED type remote alarm annunciator with horn, located as shown on the drawings or in a location that can be conveniently monitored by facility personnel. The remote annunciator shall provide all the audible and visual alarms called for by NFPA Standard 110 for level 1 systems for the local generator control panel. Spare lamps shall be provided to allow future addition of other alarm and status functions to the annunciator. Provisions for labeling of the annunciator in a fashion consistent with the specified functions shall be provided. Alarm silence and lamp test switch(es) shall be provided. LED lamps shall be replaceable and indicating lamp color shall be capable of changes needed for specific application requirements. Alarm horn shall be switchable for all annunciation points. Alarm horn (when switched on) shall sound for first fault, and all subsequent faults, regardless of whether first fault has been cleared, in compliance with NFPA110 3-5.6.2. The interconnecting wiring between the annunciator and other system components shall be monitored and failure of the interconnection between components shall be displayed on the annunciator panel.

B. The annunciator shall include the following alarm labels, audible annunciation features, and lamp colors:

Condition	Lamp Color	Audible Alarm
Normal Power (to Loads)	Green	No
Genset Supplying Load	Amber	No
Genset Running	Green	No
Not in Auto	Red (Flashing)	Yes
High Battery Voltage	Red	Yes
Low Battery Voltage	Red	Yes
Charger AC Failure	Red	Yes
Fail to Start	Red	Yes
Low Engine Temperature	Amber	Yes
Pre-High Engine Temperature	Amber	Yes
High Engine Temperature	Red	Yes
Pre-Low Oil Pressure	Amber	Yes
Low Oil Pressure	Red	Yes
Overspeed	Red	Yes
Low Coolant Level	Amber	Yes
Low Fuel Level	Amber	Yes
Network OK	Green	Yes
(4) Spares	Configurable	Configurable

1. Low battery voltage lamp shall also be lighted for low cranking voltage or weak battery alarm.

C. Provide critical muffler & flex.

D. The generator set shall be provided with breakers as shown per one line diagram. The circuit breaker shall incorporate an electronic trip unit that operates to protect the alternator under all overcurrent conditions, or a thermal-magnetic trip with other overcurrent protection devices that positively protect the alternator under overcurrent conditions. The supplier shall submit time overcurrent characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided.

E. The generator set shall be provided with a utility grade protective relay, designed to provide thermal overload protection for the alternator, and performance certified for that purpose by a 3rd party testing organization. The supplier shall submit time overcurrent characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided. Relay shall be installed to allow shutdown of the generator excitation system on an alternator overload condition, with the engine operating for a cool-down period before shutdown. The relay shall not include an instantaneous trip function.

PART 3 - OPERATION

3.1 SEQUENCE OF OPERATION

A. Generator set shall start on receipt of a start signal from remote equipment. The start signal shall be via hardwired connection to the generator set control and a redundant signal over the required network connection.

B. The generator set shall complete a time delay start period as programmed into the control.

C. The generator set control shall initiate the starting sequence for the generator set. The starting sequence shall include the following functions:

D. The control system shall verify that the engine is rotating when the starter is signaled to operate. If the engine does not rotate after two attempts, the control system shall shut down and lock out the generator set and indicate “fail to crank” shutdown.

E. The engine shall fire and accelerate as quickly as practical to start disconnect speed. If the engine does not start, it shall complete a cycle cranking process as described elsewhere in this specification. If the engine has not started by the completion of the cycle cranking sequence, it shall be shut down and locked out, and the control system shall indicate “fail to start”.

F. The engine shall accelerate to rated speed and the alternator to rated voltage. Excitation shall be disabled until the engine has exceeded programmed idle speed and regulated to

prevent over voltage conditions and oscillation as the engine accelerates and the alternator builds to rated voltage.

G. On reaching rated speed and voltage, the generator set shall operate as dictated by the control system in isochronous state.

H. When all start signals have been removed from the generator set, it shall complete a time delay stop sequence. The duration of the time delay stop period shall be adjustable by the operator.

I. On completion of the time delay stop period, the generator set control shall switch off the excitation system and shall shut down.

J. Any start signal received after the time stop sequence has begun shall immediately terminate the stopping sequence and return the generator set to isochronous operation.

PART 4 - OTHER REQUIREMENTS

4.1 SUBMITTALS

A. Within 10 days after award of contract, provide six sets of the following information for review:

1. Manufacturer’s product literature and performance data, sufficient to verify compliance to specification requirements.
2. A paragraph by paragraph specification compliance statement, describing the differences between the specified and the proposed equipment.
3. Manufacturer's certification of prototype testing.
4. Manufacturer's published warranty documents.
5. Shop drawings showing plan and elevation views with certified overall dimensions, as well as wiring interconnection details.
6. Interconnection wiring diagrams showing all external connections required; with field wiring terminals marked in a consistent point-to-point manner.
7. Manufacturer's installation instructions.

4.2 FACTORY TESTING

A. The generator set manufacturer shall perform a complete operational test on the generator set prior to shipping from the factory. A certified test report shall be provided. Equipment supplied shall be fully tested at the factory for function and performance.

B. Factory testing may be witnessed by the owner and consulting engineer. Costs for travel expenses will be the responsibility of the owner and consulting engineer. Supplier is responsible to provide two weeks’ notice for testing.

C. Generator set factory tests on the equipment shall be performed at rated load and rated power factor. Generator sets that have not been factory tested at rated power factor will not be acceptable. Tests shall include: run at full load, maximum power, voltage regulation,

transient and steady-state governing, single step load pickup, and function of safety shutdowns.

4.3 INSTALLATION

A. Provide labor to disassemble generator into separate components for rigging into building. Cummins shall re-assemble rigged equipment in the room along with installing contractor's rigger/equipment. Refer to drawings for access coordination.

B. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

C. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

D. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.

E. Equipment shall be initially started and operated by representatives of the manufacturer.

F. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

4.4 ON-SITE ACCEPTANCE TEST

A. The complete installation shall be tested for compliance with the specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests.

B. Installation acceptance tests to be conducted on-site shall include a "cold start" test, a two hour full load test, and a one-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.

C. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.

4.5 TRAINING

A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner.

4.6 SERVICE AND SUPPORT

A. The manufacturer of the generator set shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.

B. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

C. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

4.7 WARRANTY

A. The generator set and associated equipment shall be warranted for a period of not less than 5 years from the date of commissioning against defects in materials and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

END OF SECTION 260875

SECTION 260880

PHOTOVOLTAIC SYSTEM

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

A. Section contains all components necessary for complete functioning, grid-tied photovoltaic system including but not limited to:

1. Photovoltaic Modules.
2. Inverters.
3. Solar Panel Mounting System including ballast requirements.
4. PV Array Wiring.
5. PV System Informational Display Kiosk.
6. AC Combiner boxes.
7. AC Disconnect Switches.
8. Engineering criteria.

B. The proposed photovoltaic systems shall have total size and components installed in locations as shown on plans. Provider shall be responsible for supplying and installing turn-key, grid-tie photovoltaic electric systems capable of meeting the design performance criteria.

1.2 REFERENCES

A. American National Standards Institute

1.	ANSI C2	National Electrical Safety Code
2.	ANSI/ASCE 7	Building Code Requirements for Minimum Design Loads in Buildings and Other Structures

B. Federal Communications Commission (FCC): Electromagnetic Interference (EMI) Part 15, Subparts A and B

C. Institute of Electrical and Electronics Engineers (IEEE)

1.	IEEE 519	Recommended Practice and Requirements for Harmonic Control in Electrical Power Systems
2.	IEEE 928	Recommended Criteria for Terrestrial PV Power Systems
3.	IEEE 929	Recommended Practice for Utility Interface of Residential and Intermediate PV Systems
4.	IEEE 1296	IEEE Recommended Practice for Qualification of Photovoltaic (PV) Modules

5. IEEE 1373 Recommended Practice for Field Test Methods and Procedures for Grid Connected PV Systems
6. IEEE 1374 Guide for Terrestrial PV Power System Safety
7. IEEE 1479 Recommended Practice for the Evaluation of Photovoltaic Module Energy Production
8. IEEE 1547 Standard for Interconnecting Distributed Resources with Electric Power Systems

D. International Electro technical Commission (IEC)

1. IEC 904-1 Measurement of PV I-V Characteristics
2. IEC 1173 Overvoltage Protection for PV Power Generating Systems
3. IEC 1277 Guide General Description of PV Power Generating System
4. IEC 61215 Crystalline silicon terrestrial photovoltaic (PV) modules - Design qualification and type approval
5. IEC 61730/1&2 Photovoltaic (Pv) Module Safety Qualification
6. IEC 1721 Susceptibility of a Module to Accidental Impact Damage (Resistance to Impact Test)
7. IEC 1727 PV Characteristics of the Utility Interface

E. National Fire Protection Association (NFPA)

1. NFPA 70 Article 690 Solar Photovoltaic Systems
2. NFPA 70 Article 705 Interconnected Electric Power Production Sources

F. Underwriters Laboratories (UL)

1. UL 1741 Static Inverters and Charge Controllers for use in PV Power Systems
2. UL 1703 Flat Plate PV Modules and Panels
3. UL 1998 Software in Programmable Components

G. General Codes and Standards

1. National Electrical Safety Code
2. Occupational Safety and Health Administration (OSHA)
3. International Building Code (IBC)
4. Insulated Cable Engineers Association (ICEA) Standards
5. New York State and Local Building Codes

H. Abbreviations used in this section have the following meanings:

A	Ampere (also I)
AC	Alternating current
AM 1.5	Air Mass 1.5
BOS	Balance of system
DC	Direct current
deg. or N	Degree
IMax	Maximum current
ISC	Short circuit current
J	Joule
Kg	Kilograms
kW	Kilowatt
kWh	Kilowatt hour
lbf	foot-pounds
min	minimum
mm	millimeter
MPPT	Maximum power point tracking
N	Newton
%	percent
PV	Photovoltaic
psi	Pounds per square inch
SI	Solar irradiance
V	Volt
Vmax	Maximum voltage
Voc	Open circuit voltage
W	Watt

1.3 SUBMITTALS – Coordinate with Division 1

A. Product Data: Include dimensions, size, voltage ratings, and current ratings for each type of product indicated.

B. Operation and Maintenance Data: For all components of installed photovoltaic system. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

C. Manufacturer's user training manuals.

1. Maintenance information.

2. Equipment warranty information.

3. Manufacturer's required maintenance related to system warranty requirements.

D. Shop Drawings: For photovoltaic system. Include plans, wiring diagrams, details, and attachments to steel structure, attachment of structure to roof and the following:

1. Expected AC output, projected monthly energy production (in kwh), projected annual energy production (in kwh). Show calculation including derate factors.

E. Field quality-control reports.

F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

G. Spares: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Two of each type installed in the system.
2. One Module and Two Inverters.

H. Engineering submittals prepared and sealed by a licensed Professional Engineer in the State of New York evidencing the following:

1. Wind Design Criteria: Wind loading is in accordance with the IBC 2012 and ASCE 7-02 requirements.
2. Basic Wind Speed – 100 mph (Need to confirm with Structural Engineer)
3. Importance Factor – 1.15 (Need to confirm with Structural Engineer)
4. Exposure Category - B
5. SEISMIC Design Criteria: Seismic loads are in accordance with the IBC 2012, New York State Building Code (2010) and ASCE 7-02 requirements.
6. Additional Design Criteria Submittal Requirements:

a. Ballast system and design along with load impacts.
b. Provide a structural analysis, including but not limited to module tilt angles and local wind conditions per code which will serve to justify that the solar PV modules will not slide/uplift/overturn.

I. Certificates: Submit certified evidence of installer's qualifications and experience record in installation of solar roof panel systems, or submit certification from manufacturer of solar roof panels that proposed installer has been trained by manufacturer's representatives.

1.2 QUALITY ASSURANCE

A. Qualifications

1. Manufacturer: Company specializing in solar roof panel system manufacturing with a minimum of 4 continuous years of documented experience.

2. Installer: Company with a minimum of 3 years documented experience in the installation of solar power and further with NYSERDA accreditation and NABCEP certification.
3. Submit a list of at least five 5 installations that have been in use for a minimum of two years using solar power systems as described in this document. Include contact name and phone numbers – a minimum of installations nominated shall be in the NYSERDA region.

B. Contractor shall provide written document including total system and itemized cost, size of system, system description and expected energy production as per this specification.

C. All systems and system components shall comply with applicable codes, licensing and permitting requirements including but not limited to the New York State Building Code, National Electric Code and local ordinances.

D. All equipment shall be UL listed.

E. Compliance with Regulatory Requirements: The installation of solar panels and electrical components shall be performed in compliance with IEEE 928, IEEE 929, IEEE 1374, IEC 1277, NFPA 70 Article 690 and 705, the National Electrical Safety Code, Occupational Safety and Health Administration (OSHA) regulations, International Building Code (IBC), state and local codes. Pre-Installation Meeting: After approval of submittals but prior to beginning installation of work of this Section, conduct a meeting at the site attended by Architect, Contractor, installers of solar panel system and related electrical work to be installed with the system, to describe in detail the installation process and to establish agreement, coordination, safety and responsibilities. Prepare a detailed report of this meeting and furnish copies to the Architect and all attendees. Also present at this meeting shall be a representative from the original roof manufacturer who holds the warranty which has not expired. The roof membrane manufacturer and warrantor is Carlisle and the information concerning same will be given to the Contractor in advance so as to allow for arrangements to be made.

1.2 SYSTEM STARTUP

A. Furnish the services of a trained representative of the solar installer to instruct the Owner's personnel in operation and routine maintenance of the solar panel system for a period of not less than one day at a time directed by Owner.

1.3 OWNER'S INSTRUCTIONS

A. Furnish a complete operation and maintenance manual to the Owner at time of system startup.

1.4 WARRANTY – Coordinate with Article 3.6 herein.

A. Provide certified copies of the following manufacturer's product warranty:

1. Solar panel manufacturer's 25 year warranty covering power output of panels, and 5 year warranty of rebated material and workmanship.

2. Inverter manufacturer’s warranty.

1.8 MAINTENANCE SERVICE – See Article 3.6 herein.

PART 2 - PRODUCTS

2.1 SOLAR PHOTOVOLTAIC SPECIFICATION

A. Modules

1. Modules to be Trina Solar 340 watt monocrystalline TSM-DD14A(II).

2. Modules may be replaced with comparable Tier 1 manufacturer with same or better specs.

B. Inverters

1. Inverters shall be Solar Edge SE10KUS & Solar Edge SE14.4KUS.

2. DC-DC optimizers Solar Edge P700.

C. Racking

1. Racking shall be DynoRaxx Evolution FR.

D. AC Combiner

1. AC Panelboard and subpanels by Square D or approved Equal.

E. Monitoring

1. Monitoring hardware is integral to each Solar Edge SE14.4KUS inverter. All Inverters are to be internet connected via a hardwired LAN connection, for web display of data.
2. Monitoring software to be SolarEdge Monitoring Platform, using Dashboard View for kiosk display.
3. Kiosk to be 42” LCD screen wall mounted. Final size shall be coordinated with owner. Must have CPU with web access or be “smart TV” with web browser.
4. CAT-5 Shielded Cable to Customer Supplied Port
5. String Level monitoring
6. Weather Station

F. Metering

1. Revenue Quality Meter

G. General Notes

1. Modules

a. Modules to be installed according to Trina Solar installation manual.

2. Inverters

a. To be installed according to Solar Edge installation manual.
b. All optimizers mounted to racking/rail per installation manual.

3. Mounting System

a. The solar panels shall be mounted on a 10-degree ballasted racking system, DynoRaxx Evolution FR. The racking system shall be suitable for mounting on flat roof surfaces. Structural Assessment shall be performed by Licensed Engineer to determine need for roof penetrations.

b. The racking system shall be wind tunnel tested and certified by a Licensed Engineer and compliant with ASCE 7-16, the IBC.

c. The racking system shall be non-corrosive, construction shall be fiberglass with 304 stainless steel clamps.

4. Racking Installation

a. Equipment shall be installed in accordance with the system installer's instructions and recommendations.

b. Equipment shall be installed at locations shown on the Contract Drawings. Install racking at available free roof space when accounting for both fire code and equipment access.

c. Slip Sheets shall be provided as required by roofing manufacturer

d. Coordinate roof warranty pre- and post-install inspections with Licensed Engineer and roofing manufacturer

3. Electrical

a. All circuits to be center tapped

b. EMT to be used from junction box on roof through to AC Combiner panel.

c. EPDM roof boot appropriate for roof type to be installed on roof penetration.

d. AC Combiner Circuits
   i. Refer to one line and schedules for details

e. All wiring to comply with NEC code and local jurisdiction.

f. All wiring to be done in a professional manner. Wire management such that no wires may be dangling below bottom of rail. Use stainless steel wire clips and/or UV stabilized wire ties.

4. Labeling

   a. Install all labels as per NEC 690 and local AHJ.
   b. Label to be appropriate for the environment – Hellerman Tyton or better

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Install devices and equipment in accordance with manufacturer's instructions and National Electric Code.

B. Contractor shall procure all materials, components and equipment necessary for a turn-key PV system as identified on the design drawings, specifications and approved final design.

3.2 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 GROUNDING

A. Ground photovoltaic system and associated circuits.

B. AC and DC grounding shall be provided as per National Electric Code, manufacturer's recommendations and local authority's requirements.

3.4 FIELD QUALITY CONTROL

A. Inspection - Representative from Solar Installation firm to perform a visual inspection of all major components.

B. System Commissioning

1. Perform 5 minute witness test.

2. Ensure system stays within guidelines for reactive current during 5 minute anti-islanding test.

3. Verify labeling.

4. Verify each inverter/module pair are reporting and performing within spec.

5. Provide Commissioning document signed off by solar installer representative.

3.5 MAINTENANCE

A. The installer shall provide maintenance for the PV system for a minimum of 2 years after system acceptance, including:

1. Installer shall perform general inspection of the PV system every 6 months during the contract.
2. Inspection shall include verification of inverter power output.
3. Visual inspection of all equipment including PV arrays.

3.6 PV SYSTEM WARRANTY

A. The PV system shall be covered by a 5-year full warranty and a 5-year warranty on the labor.

B. The warranty shall cover all components of the PV system against degradation of power output of more than 10% from the output at system acceptance.

3.7 DEMONSTRATION

A. Installer shall train Owner's maintenance personnel to perform basic inspection, proper method of clearing debris and perform visual inspection.

B. Installer shall train 1 Owner’s representative to understand system operation and equipment monitoring.

3.8 WASTE MANAGEMENT – Coordinate with Division 1

A. Separate and recycle materials and material packaging in accordance with Waste Management Plan and to the maximum extent economically feasible and place in designated areas for recycling.

B. Set aside and protect materials suitable for reuse and/or remanufacturing.

C. Separate and fold up metal banding; flatten and place along with other metal scrap for recycling in designated area.

D. DynoRaxx specific quotes/questions, please contact Scott Lewandowski at DynoRaxx, 716-568-8867. Turnkey installation quotes for the entire solar system can be sent to Bridgette Martin, 866.807.3639 - Ext 120. or other participating NYSERDA approved installer. sales@solarliberty.com, 1-866-807-3639.

END OF SECTION 260880

SECTION 260890

ELECTRICAL SYSTEMS COMMISSIONING

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section.

1.1 SUMMARY

A. Section includes commissioning process requirements for electrical systems, assemblies, and equipment.

B. Related Sections:

1. Section 01 9100 - General Commissioning Requirements.

1.2 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CxA: Commissioning Authority.

C. Integrated Systems: When referenced this encompasses all control, equipment and systems utilized in support of the facility.

D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.3 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA and as defined in the contract documents.

B. Attend construction phase commissioning meetings.

C. Attend test coordination meetings.

D. Participate in the electrical system maintenance orientation and inspection for assemblies and equipment as directed by the CxA.

E. Provide information requested by the CxA, including manufacturer cut sheets and shop drawings for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data and provide data acquisition equipment to record data for the complete range of testing for the required test period.

G. Provide detailed startup procedures.

H. Provide startup testing for all normal and emergency power equipment and shall coordinate and execute the electrical tasks for the commissioning checklists for all commissioned equipment.

I. Provide copies of all submittals as required including all changes thereto.

J. Facilitate the coordination of the commissioning and incorporate commissioning activities (the Commissioning Plan) into the Overall Project Schedule (OPS).

K. Ensure that all subcontractors and vendors execute their commissioning responsibilities according to the contract documents.

L. Provide training in the operation and maintenance of installed equipment for owner personnel.

M. Review and accept construction checklists provided by the commissioning authority.

N. Complete startup reports and construction checklists as work is completed and provide to the Commissioning Authority on a weekly basis.

O. Review and accept commissioning process test procedures provided by the Commissioning Authority.

P. Complete commissioning process test procedures (functional testing as detailed in functional testing checklists).

Q. Prepare O&M manuals, according to the contract documents, including clarifying and updating the original sequences of operation to as-built/as-tested conditions.

R. Cooperate with the CxA for resolution of issues recorded in the “Issues Log”.

1.4 CxA'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual electrical systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing and operational sequencing per design documents.

D. Provide a final written report outlining the commissioning process and including commissioning field documentation.

1.5 COMMISSIONING DOCUMENTATION

A. The contractor shall provide the following information to the CxA for inclusion in the commissioning plan:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for electrical systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
5. System startup reports.
6. Certificate of readiness certifying that electrical systems, subsystems, equipment, and associated controls are ready for testing.
7. Test and inspection reports and certificates.
8. Corrective action documents.
9. Verification of contractually required static and dynamic testing reports.

1.6 SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Certify that electrical systems, subsystems, and equipment have been installed, calibrated, and started, and that they are operating in the manner required by the Contract Documents.

B. Certify that electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify that testing and adjustments have been completed and that testing, and adjustment reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.
F. Check safety cutouts, alarms, and interlocks with life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as required and as directed by the CxA.

3.2 TESTING VERIFICATION

A. Prior to performance of testing, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notify the CxA at least (ten) 10 days in advance of testing execution and provide access for the CxA to witness testing procedures.

C. Provide technicians, instrumentation, and tools to verify testing of electrical systems at the direction of the CxA.

1. The CxA will notify the electrical contractor ten (10) days in advance of the date of field verification. Notice will not include data points to be verified.

2. The electrical contractor shall use the same instruments (by model and serial number) that were used when original data were collected.

3. Failure of an item includes operational sequence as determined in the contract documents including safeties, capacity, and operational integrity.

4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning tests at the direction of the CxA.

B. Scope of electrical system testing can include, but is not limited to, entire electrical power distribution installation from central distribution to branch circuit to individual equipment served. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of interface to the building automation system.

D. The CxA with coordination of a certified testing agency, shall prepare detailed testing plans, procedures, and checklists for electrical systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The CxA may direct that set points be altered when simulating conditions is not practical.

H. If tests cannot be completed because of a deficiency outside the scope of the electrical system, document the deficiency and report it to the Construction Management Representative. After deficiencies are resolved, reschedule tests.

I. Retesting: The CxA will direct the retesting of the equipment once at no “charge” to the Owner for their time. The CxA’s time and expenses incurred for a second retest, if required due to no fault of the CxA, will be reviewed by the Owner to determine the appropriate means of compensation to the CxA for extension of services. The functional testing shall include operating the system and components through each of the written sequences of operation, and other significant modes and sequences, including startup, shutdown, unoccupied mode, manual mode, staging, miscellaneous alarms, power failure, security alarm when impacted and interlocks with other systems or equipment. Sensors and actuators shall be calibrated during construction check listing by the installing contractors and spot-checked by the CxA during functional testing.

3.4 ELECTRICAL SYSTEMS, SUBSYSTEMS AND EQUIPMENT TESTING PROCEDURES

A. Electrical Installation and Verification: Testing requirements are specified in Division 26 Sections. Provide submittals, test data, inspection records to the CxA.

1. Insulation resistance testing, mechanical integrity tests and inspections, ground testing, continuity, transformer-specific tests, emergency power system and manufacturer startup according to contract, agency and authority having jurisdiction requirements as indicated in Division 26. Electrical contractor shall prepare supporting documentation for compliance for copy to the CxA.

B. The following equipment/systems will be commissioned in this project:

1. Lighting Controls.

END OF SECTION 260890

SECTION 260900

GUARANTEE

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

1.1 GUARANTEE

A. The Contractor shall remove, replace and/or repair at his own expense and at the convenience of the Owner, any defects in workmanship, materials, ratings, capacities and/or characteristics occurring in the work within one (1) year or within such longer period as may be provided in the Drawings and/or Section of the Specifications, which guarantee period shall commence with the final acceptance of the entire Contract in accordance with the guarantee provisions stated in the General Conditions, and the Contractor shall pay for all damage to the system resulting from defects in the work and all expenses necessary to remove, replace, and/or repair any other work which may be damaged in removing, replacing and/or repairing the work.

END OF SECTION 260900

SECTION 28 00 00

SECURITY SYSTEMS GENERAL CONDITIONS

1.01 GENERAL

a. Installation of Electronic Security System to include but not limited to:
   1. Closed Circuit Television (CCTV)
   2. Building Access Control
   3. Gates Access Control
   4. Perimeter Door Alarms
   5. Video Intercom
   6. Burglar alarm
   7. Additional interfaces: Building Lighting, electrified locks and Fire alarm systems

b. Electronic security related *equipment* such as cameras, card readers, controllers, goosenecks, power supplies, door contacts, motion detectors and others will be furnished to the bidder by the City of Yonkers (COY) / Yonkers Public Schools (YPS) authority and are *not* part of this contract. System commissioning, programming, and testing will be performed by owner's representatives and are not part of this contract. This bidder/ contractor ("contractor", "EC") is to provide all necessary labor, pipe, fasteners, wire and other electrical components needed to INSTALL AND TERMINATE owner's and/or other Prime Contractors provided materials AS WELL AS WORK WITH OWNER's REPRESENTATIVE DURING THE COMMISSIONING PROCESS and to provide the owner with a complete, turnkey system.

1. All wire, conduit, supporting devices, boxes, connections, stub ups and rough in will be furnished and installed by this bidding Electrical Contractor ("contractor", "EC"). EC shall connect and terminate and punch down the devices to the patch panel/ control panel designated in the SE-xxx Security drawings. EC shall machine label, tag on both ends, and test all connections for proper continuity. EC shall certify network cabling and provide supporting testing reports to the owner to ensure proper wire has been installed, proper installation and cable lengths. EC shall test for ground faults and wire integrity on card access, burglar alarm and door stations wiring prior to turn over to owner.

2. The EC shall provide firestopping for all penetrations required for work of their contract.

3. Electronics system's Commissioning shall be done by the Owner's representative. EC shall have a responsible electrician/foreman with knowledge of the project's on-site installation during commissioning to correct any installation faults as instructed by Owner's representative.

4. All burglar alarm device wiring is to be home-run to designated closet wall field device equipment. No cable splicing is allowed for any of the subsystems

c. Install system as per security drawing's set SE-xxx and follow specific notes regarding intent, means and methods

d. The general conditions for contracts of construction, referred to in the contract documents as the general conditions, together with the following articles of the specifications, which amend, modify and supplement various articles and provisions of the general conditions, are made part of the Contract and shall apply to all work under the Contract.

e. All articles or parts of articles of the general conditions not so amended, modified or supplemented by these specifications shall remain in full force and effect. Should any discrepancy become apparent between the general conditions and the specifications the Contractor shall notify Owner/Engineer, in writing and the Owner/Engineer shall interpret and decide such matters in accordance with the provisions of the General Conditions.

f. The Contractor shall comply with all applicable governmental regulations and with all Federal, State, County, City, and other applicable codes and ordinances.

g. These specifications call out certain duties of the Contractor and his suppliers. They are not intended as a material list of items required by the Contract.

h. This division of the specifications covers the security systems for the various schools and other city sites located in Yonkers, NY.

i. Contractor should note that it shall be necessary to coordinate with other contractors who will be working in the space at the same time as this work.

j. It is the intent of these specifications to provide complete and workable electronic security system ready for the Owner's use. Any item not specifically shown on the drawings or called for in the specifications, but normally required to conform with the intent, are to be considered as part of the Contract.

k. These specifications are equipment and performance specifications. Actual installation shall be as indicated on the Drawings. Any discrepancies found between the Specification and the Drawing shall be immediately brought to the attention of the Owner/Engineer.

1.02 DEFINITIONS

a. Certain terms such as "shall", "provide", "install", "complete", "startup" are not used in some parts of these specifications. This does not indicate that the items shall be less than completely installed or that systems shall be less than complete.

b. Utilize the following abbreviations for discernment on the Drawings and within the Specifications:

1.	NEC	National Electrical Code
2.	OSHA	Occupational Safety and Health Act
3.	ANSI	American National Standards Institute
4.	NFPA	National Fire Protection Association
5.	IEEE	Institute of Electrical and Electronics Engineers
6.	CCTV	Closed Circuit Television
7.	UL	Underwriters' Laboratories, Inc.
8.	ASTM	American Society of Testing Materials
9.	FCC	Federal Communications Commission
10.	FBO	Furnished by others
11.	EC	Bidding (electrical) contractor

c. Utilize the following definitions for discernment within the Specifications:

1. "PROVIDE" or "FURNISH" means to supply, purchase, transport, place, erect, connect, test and turn over to Owner, complete and ready for regular operation, the particular work referred to.

2. "SUPPLY" means to purchase, procure, acquire, and deliver complete with related accessories.

3. "INSTALL" means to move from property line, set in place, join, unite, fasten, link, attach, set up or otherwise connect together before testing and turning over to Owner of equipment supplied under another division. Installation to be complete and ready for regular operation, the particular work referred to.

4. "WIRING" or "CABLING," means the inclusion of all fittings, conductors, connectors, connections, terminations and termination hardware and all other items necessary and/or required in connection with such work.

5. “DATA GATHERING PANEL”, “iSTAR”, “CONTROLLERS” means the inclusion of installations all I/O hardware, power supplies, alarm controllers, reader controllers, output relays, communications devices,

and housings necessary to interface card readers, alarm contacts, door locking and control hardware, etc. to the system.

6. "CONDUIT" or "CABLE TRAY" or "LADDER RACK" means the inclusion of all fittings, hangers, supports, sleeves, etc.

7. "AS DIRECTED" means as directed by the Owner or his representative.

8. "CONCEALED," means embedded in masonry or other construction, installed behind wall furring or within double partitions, or installed within hung ceilings or under raised floors.

9. "EXPOSED" means not installed underground or "CONCEALED" as defined above.

10. "APPROVED," means as accepted and authorized, in writing, by the Owner or Engineer.

11. “COY”, “YPS” or "OWNER" means City of Yonkers, Yonkers Public Schools

12. "ENGINEER" or “AGENT” means owner or his designated representative

1.03 SCOPE OF WORK

a. The work covered by these specifications includes the installations described herein and illustrated on the SE Security drawings, including all labor necessary to perform and complete such construction, all materials and equipment incorporated in or to be incorporated in such installations and all services, facilities, tools and equipment necessary or used to perform and complete such installations.

b. The scope of work includes, but is not limited to, the work described herein and in the following specifications sections, as applicable:

1. Division 26 – Electrical Specifications

2. Preparation and submission of unit pricing sheets, shop drawings, testing reports, record drawings, and documentation.

3. Termination, connectorization, labeling, testing and documentation of all cables and components provided under these specification sections.

4. Tile cuts, as noted on the drawings and in the individual specification sections, under equipment racks, server racks, frames, cabinets, etc.

5. Fire stopping of all conduits, cable trays rated wall and floor penetrations, etc. as noted.

6. Furnish shop drawings to the Construction Manager and the Engineer and receive written approval prior to fabrication, assembly and installation. The shop drawing submission shall be within sufficient time to allow endorsement by the Engineer prior to commencement of the work.

7. Provide system's installation changes that were made due to field conditions to the owner. Documentation including copies of all relevant drawings and equipment manuals.

8. Provide warranty services for bidder's work portion only for the specified period from the date of acceptance.

9. Remove and dispose of all refuse related to the security system installation from site.

10. Panduit Laser *Machine Labeling* and documentation of all cables, wiring boxes, equipment cabinets, pull boxes and termination strips installed under this contract. Use of hand label machines such as 'Brother-P-Touch' is <u>not</u> acceptable

11. Installation, final connections and terminations of all security cabling and owner's provided equipment.

12. Position cameras in the direction that is acceptable to the owner and follow owner's instruction for camera views. Be present and work with Owner's representative during commissioning and re-point cameras as needed to the owner's

13. Be present at and work with owner's commissioning agent during system's turn on. Remedy all installation and wiring faults as per agent's direction.

c. Bidding Contractor - Provided under this contract. Follow Division 26 for additional scope instructions

1. 120 VAC power wiring. Connection between 120 VAC power sources and all security equipment panels and equipment cabinets.

2. Conduits, electrical, and pull boxes (provided under electrical work). NEMA Type 1 enclosure for all junction boxes provided under this work.

3. Fire-stopping of all rated wall and floor penetrations.

1.04 MATERIALS SUPPLIED BY OTHERS AND INSTALLED UNDER THIS WORK

a. Electronic Equipment noted on drawings SE-xxx Security Drawings

1.05 SITE VISIT

a. Prior to bid submission, the Contractor shall visit the site and examine the drawings of other trades to determine the existing design conditions that may affect the work. The Contractor shall be held responsible for any assumptions in regard thereto.

b. The Contractor shall verify all dimensions and distances in the field and/or other provided document the cable lengths and materials to be furnished and installed. The provision and installation of non-specified miscellaneous hardware, i.e., nuts, bolts, tie wraps, etc., and shall be the Contractor's responsibility.

c. Contractor should note this is an existing facility under construction. Existing site conditions, other contract documents and the overall construction schedule must be carefully reviewed to determine all required interfacing and timing of the work.

d. Existing Contract Documents for all other trades shall be made available for review through the General Contractor.

1.06 CONTRACTOR QUALIFICATIONS

a. The Contractor shall provide Contractor Qualifications to include name/address of three (3) similar security projects performed in the past 5 years.

1.07 BIDDING

a. The bidder’s submittal shall include detailed labor costs break down for installation of the provided equipment including the ADD/DEDUCT form. ADD/DEDUCT form to have a single dollar amount to be applied to either adding or deleting an item.

b. Materials costs shall reflect all miscellaneous hardware, connectors, and materials required and shown as a separate cost.

c. Material, labor, documentation, and shipping totals shall be entered in a Master Costs forms.

d. Substitute Equipment

1. All cable and fiber (where applicable) shall be bid as specified.

2. Equivalency in quality, performance, construction, and function shall be demonstrated by submitting, as applicable or required by the Engineer, the following:

a) Specifications.

b) Laboratory test data.

c) List of advantages to the Owner and the Engineer.

d) Cost differences compared to the "as specified" bid package.

3. The drawings and specifications are based on specific equipment, functions, and arrangements. Additions or revisions to equipment, materials, and labor may be necessary for the proper fit and function of any proposed substitute items to the purpose, arrangement and intent originally indicated. It is the responsibility of the Bidder to determine the electrical needs for such additions and/or revisions and identify them in the Bidder's submittal.

4. Costs for any additional labor and additions or revisions to wiring, space requirements, equipment, or other materials, required for the use of substitute equipment shall be included by the Bidder without claim for subsequent additional payment.

5. Consideration in the Bidding for a proposed substitute will be given only if, in the opinion of the Engineer, the substitute is equal to and/or offers significant advantage to the project over the specified item.

e. Installation materials supplied shall be complete, model numbers accurate, and the performance shall conform to manufacturer's specifications.

f. All materials shall be new and shall conform to applicable codes.

g. Repair or replace any items damaged during installation.

h. Procure and pay for all necessary permits, licenses, inspections, and observe any requirements stipulated therein.

i. Comply with all applicable labor regulations and applicable union and trade regulations.

j. The installation shall conform to the latest safety codes and regulations. Where conflicts exist, the most stringent code or regulation shall apply.

k. Adhere to all Quality Assurance items in the Sub-Contract Agreement issued by the Owner/Engineer.

1.08 SUBMITTALS

a. As directed by the Owner/Engineer and the Construction Program, submit hand marked detailed field changes so that they can be incorporated onto the final as-built set (by others)

b. Shop drawings shall be based on actual equipment, installation, and field conditions. Note however, that locations and other information provided herein are only approximate. Therefore, where possible, make equipment and field

measurements prior to the preparation of shop drawings, fabrication, and installation to ensure proper fit and function of the equipment. However, this requirement shall not delay the progress of the work. Allow for trimming and fitting wherever the taking of field, or other measurements, before fabrication might delay the work. Costs for failure to coordinate equipment details with site conditions and designated equipment locations shall be borne by the Security Contractor.

c. The review and approval of shop drawings shall be general only and shall not relieve the Contractor from responsibility for proper installation or for deviations from the specifications or drawings due to field conditions; conflict with the work of others that may result from such deviations; or for errors of any sort.

d. Shop drawings shall include and clearly indicate any proposed modification of the specifications or drawings.

e. Shop drawings shall include and clearly indicate the addition of any items not detailed herein, but necessary to provide a properly functioning and complete system.

f. Changes to riser diagrams for power and grounding, Security systems cabling and fiber optic/patch panel, data gathering panels, power supplies interconnections, and all Security field devices.

1.09 DELVERY, STORAGE AND HANDLING

a. Delivery of Materials: Coordinate with owner’s designated agent

b. Storage of Materials, Equipment and Fixtures: Store materials suitably sheltered from the elements, but readily accessible for inspection until installed. Store all items subject to moisture damage in dry, heated spaces. Provide space requirements for storage in submittals list. The General Contractor shall assign storage space.

c. Store all materials in a secure fashion to prevent the loss of these materials due to pilferage or theft.

1.10 COORDINATION OF WORK

a. Carefully check space requirements and the physical confines of the area of work to ensure that all material can be installed in the spaces allotted thereto, including equipment racks, and cable supports.

b. Transmit to other trades in a timely manner all information required for work to be provided under their respective Sections in ample time for installation.

c. Wherever work interconnects with or contacts the work of other trades, coordinate with other trades to ensure that all trades have the information necessary so that they may properly install all the necessary connections and

equipment. Identify all items of work that require access so that the floor tile trade shall know where to install tile cutouts.

d. Attend all construction meetings, at the project site or at other location, as requested by the Owner or General Contractor.

e. When directed by the Owner, the Contractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper compliance with the design intent.

1.11 CODES, REGULATIONS AND STANDARDS

a. The installation shall be in compliance with the requirements of the National Electrical Code, OSHA, recommendations and the rules, regulations and requirements of all state and federal codes.

b. The installation shall comply fully with all County, city, and state laws and ordinances, regulations, and codes applicable to the installation.

c. All equipment shall be equal to or exceed the minimum requirements of NEMA, IEEE, ASME, ANSI and Underwriters' Laboratories.

1.12 SPECIAL CONDITIONS

a. The requirements and recommendations of all standards, specifications and codes referred to herein, including the security systems drawings, shall be considered a part of these specifications.

b. All local fees, permits, and services of inspection authorities shall be obtained and paid for by the Contractor. The Contractor shall cooperate fully with local utility companies with respect to their services. Contractor shall include in his price, all costs to be incurred relative to the installation of the system described herein.

1.13 WARRANTY

a. For a period of 1 year after full acceptance, Contractor to Repair/Replace any defects in its work/materials to remedy the condition.

1.14 MATERIALS

a. Where specific items are called out in the specification or indicated on the drawings for a specific application, use those products or materials. Otherwise, use first class products and materials that have been approved by the owner/engineer at the time of bid. Materials substituted after the time of bid a subject to prior approval by the Owner/Engineer.

1.15 GENERAL INSTALLATION

a. Requirements herein referring to materials, or work related to, or that may affect the system but not within the work scope of this specification, shall apply to the supplying and/or installing contractor who shall comply with said requirements. Where conflict exists with other specifications concerning such work, this specification takes precedence unless otherwise approved in writing by the Owner/Engineer.

b. Follow manufacturers' instructions for installing, connecting, and adjusting all equipment and cabling.

c. The locations of equipment, power outlets, boxes, devices, etc. 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. Exercise particular caution with reference to the location of all field devices they have precise and definite locations accepted by the Owner/Engineer before proceeding with the installation.

e. Maintain a current copy of this bid specification at the job site at all times.

f. 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 Owner/Engineer at his request.

g. 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.

h. Ensure that safe ingress and egress from all work sites is maintained during movement and installation of materials.

i. Clean up all debris generated by installation activities. Always keep all work areas free of debris.

j. Perform all tests required by local authorities in addition to tests specified herein.

k. At all times during the construction, protect all equipment from damage and theft. Equipment in the equipment room shall not be installed until such time as other trades have completed their work in that area so that the equipment will not be moved or damaged.

l. Upon project completion, provide hand corrected as-built drawings and documentation as defined herein.

1.16 STAFFING

a. The Contractor shall keep a qualified foreman in charge of the work at all times. The foreman shall be present in the field at all times during the performance of the work. Such foreman shall be replaced if deemed unsatisfactory by the Owner.

b. The Contractor shall provide a supervisory work force sufficient to efficiently execute the Contractor's responsibilities.

c. The Contractor shall provide the level of manpower necessary to meet all construction schedules.

d. The Contractor shall use only skilled, experienced, and reliable workers and shall discontinue the services of anyone employed on this project upon written request of the Owner.

e. Manufacturer's installation instructions shall be used for in-process quality control and final acceptance of the work installation.

f. Craft personnel shall be required to provide and use the proper tools and test equipment in the performance of each activity. Tools must be in good working order and test equipment must be properly calibrated. Contractor is responsible for safe storage of tools and is responsible for their security.

1.17 COMPONENT INSTALLATION

a. Location of Equipment

1. The specifications describe only approximate locations of the work. Verify all locations in the field.

2. Bidder is to wire electrified locks (door hardware provided by General Contractor) as needed for both new and existing doors.

3. Locate equipment and accessories to provide easy access for proper service and maintenance.

b. Conduit and Raceway System

1. Security cabling shall be in ferrous conduit, as shown on the drawings and described in the electrical and conduit specifications.

a) With Owner’s prior approval, properly supported exposed security cabling shall be permitted above an accessible finished ceiling within the secure areas.

b) All security wiring installed in an inaccessible area shall be installed in appropriate metallic conduit.

2. Exposed conduit shall be parallel with, or at right angles to, walls and ceilings. It shall be adequately supported by means of approved galvanized iron clamps or hangers.

3. Conduit fill shall not exceed 40% of conduit cross-sectional area.

4. Nominal trade sizes for conduit shall be 3/4-inch minimum and 4-inch maximum.

5. All junction boxes and pull boxes utilized in the raceway system shall be installed.

c. Mounting Boxes/Enclosures

1. Mounting boxes and enclosures shall be rigidly and securely mounted to the building structure. Wiring contained in them shall be accessible. Install blanking devices or threaded plugs in all unused holes.

2. Clean all interiors thoroughly before installing plates, panels or covers.

d. Electrical Power 120 VAC

1. Any Electrical work to be provided and installed by the Contractor as described herein, shall be performed in accordance with all applicable electrical codes.

2. Review and coordinate electrical power system installation with the Electrical Trade Contractor to ensure proper function and operation of the Security systems.

3. Verify that all power circuits designated for Security equipment, both fixed-in-place and portable, are properly wired, phased and grounded. Report any discrepancies found to the Engineer and the Owner/Engineer so that appropriate corrective action can be taken.

4. Provide distribution of electrical power within all equipment racks, enclosures, and consoles. For each branch circuit provide a minimum of two (2) spare receptacles in each plugmold strip. Provide a minimum of one (1) unswitched receptacle power strip (rack mounted) per each equipment rack cabinet group.

e. Finishes

1. All enclosures, housings and supporting structures supplied by the Contractor not having a standard factory protective finish shall be painted. Paint specifications will be supplied by the Owner/Engineer or indicated herein.

2. Any equipment or materials supplied, which are exposed to public view, shall be approved by the Owner/Engineer. Provide, as may be required by the Owner/Engineer, custom color and/or finish for all such items. This does NOT exclude equipment or materials that are supplied with standard colors or finishes as specified herein.

3. Finish and color of blank, perforated vent, and custom rack panels shall match each other as closely as possible.

f. Installation of Cabling

1. Run all wiring in compliance with the requirements of the electrical specification and in accordance with authorities and codes having jurisdiction. Provide separate conduit for control wiring under this Section. Follow manufacturers' instructions for installing, connecting, and adjusting all equipment and cabling.

2. Installation of all wire and cable shall include ensuring proper:

a) Types

b) Lengths

c) Routing

d) Quantities

e) Pulling tensions

f) Circuit identification

g) Wire/cable group separations

3. Do not pull through any box, enclosure, or fitting where change of conduit or raceway alignment or direction occurs. Do not bend conductors to less than recommended radius. Employ temporary guides, sheaves, rollers, and other necessary items to protect cables from excess tension, abrasion, or damaging bending during pulling.

4. Provide wire pulling lubricants and pulling tensions strictly in accordance with wire and cable manufacturer's recommendations.

5. Cover edges of cable pass through holes in chassis, racks, boxes, plates, etc. with rubber grommets or Heyco or Brady GRNY nylon grommets.

6. Use Velcro-type cable ties for bundling cabling as required and securing cable bundles to racks as required. Use integral brass grommets for screw attachment. Attach to backboards using flat-headed screws with

rigid support. Lengths vary as required. Types vary as required.

7. Provide ample service loops at each termination so that plates, panels, and equipment can be de-mounted for inspection, service, and so equipment in drawers or on slides can move freely.

8. Permanently identify all wires and cables at each end by labeling with Panduit or Brady (for example, not Brother P Touch type) wire markers printed on LaserJet or dot matrix printer via computer software program. Labeling information shall include the following:

   a) Cable prefixes and cable numbers as per Security Wiring Riser and CCTV Wiring Riser drawings.

   b) Descriptive information related to the cable's equipment source.

   c) Descriptive information related to the cable's equipment destination.

   d) Enter all identifications on wire/cable run schedules and/or as part of the shop drawings.

9. Use the same wire color coding for the same circuit, circuit functions, or phasing throughout the system. No splices shall exist in any length of wire run except where noted on specification drawings or approved by the Engineer.

10. Exercise care in wiring to avoid damage to cables. Cables shall be well supported and neatly dressed between racks, cabinets, consoles, or modules. Make all connections to jacks and connectors with rosin-core solder. Soldering shall be neat and shall not exhibit "cold" solder joints. Avoid "solder splatter" which can cause shorts in exposed terminals or wiring.

11. Connections made with screw actuated pressure type terminal strips shall be made by stripping approximately 6mm of insulation from the stranded conductor, inserting the un-tinned wire into the pressure terminal, and tightening the terminal screw using a small screwdriver which securely fits the screw head.

12. All exposed shielded drain wires shall be sheathed in properly sized clear tubing, clear shrink tube, or white "spaghetti". Floating shields (at device outputs) shall be insulated using the proper size heat shrink tubing and completely protected against shorting to any other conductors or connector shell.

13. CAT-6/5E for CCTV, Intercoms and other connections shall only be using proper crimp type connectors of appropriate for the equipment or device

terminations.

14. Cable Separation

a) Cabling shall be bundled separately from other system cabling. Each cable bundle shall be tie wrapped and supported J - hooks every 5-feet.

b) Separate cables running parallel to electrical cables/conduits by a minimum of 12-inches. Maintain at least 18-inch separation from all lighting ballasts and fixtures.

c) Cables, which must cross-electrical cables/conduits, shall do so only at 90-degree angles.

g. Installation of Security Equipment Panels

1. Provide security equipment panel installation in accordance with the provided SE series drawings.

h. Installation of Security Equipment Racks and Cabinets

1. Provide security equipment rack and cabinet installation in accordance with industry expected standards and per provided SE drawings.

1.18 IDENTIFICATION

a. Furnish a nameplate for each security equipment panel, NEMA and power supply enclosures provided under this work. Plates shall be Panduit, self-laminating or 2 1/4" lamacoid or aluminum with a black enamel background with etched or engraved upper case 1/4” white letters or black and white laminated Bakelite plate with beveled edges. Coordinate labeling and nameplate requirements with the Owner/Engineer prior to installation. Nameplates shall be screwed on with countersunk screws.

b. All cables and terminal strips shall be labeled with machine generated black uppercase lettering on a permanent adhesive label stock, covered with a permanent water resistant sealer. Labels shall be placed on both ends of the cable and no more than 6" from the point at which the cable is broken out into individual copper pairs or from the connector or terminal block. All labels shall be readily visible.

c. Hand lettered label stock shall not be accepted for final installation. Hand lettered stock is only acceptable for use with temporary labeling required during construction phases.

d. If at any time during the project, the cable label becomes illegible or removed, the Contractor shall immediately replace it with a duplicate pre-printed cable label.

e. All cable IDs shall be both physically and visually accessible upon completion of the project.

1.19 FIRE STOP PENETRATION SEALANT

a. Provide fire-resistant materials of a type and composition necessary to restore fire ratings to all wall or floor or ceiling penetrations. Material must be properly classified and meet national and local codes.

b. All penetrations through fire rated floors and walls shall be sealed to prevent the passage of cold smoke, fire, toxic gas or water through the penetration either before, during or after a fire. 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 Electrical Code.

c. No flammable material may be used to line the chase or hole in which the fire stop material is to be installed.

d. When damming materials are to be left in place after the seal is complete, and then all such materials shall be non-flammable.

e. When damming materials are to be left in place after the seal is complete, and then all such materials shall be non-flammable.

f. The sealant shall remain resilient and pliable to allow the removal and/or addition of cable without the necessity of drilling holes. It shall adhere to itself perfectly 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.

g. When sealant is injected into a penetration, the material shall expand to surround all the items within the penetration and maintain pressure against the walls of the penetration as well as the pass- through items. The material shall cure within five minutes. No heat shall be required to further expand the material to prevent the passage of fire and smoke or water.

h. The materials 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 fire stop material shall have also been subjected to the hose stream test in accordance with UL 10B.

1.20 GROUNDING

a. Grounding and shielding shall conform to the following procedures. AC grounding applies only to power circuits intended for powering Security equipment.

b. It is the primary intent of the following procedures to provide a safe system for personnel to operate.

c. The power cord from active equipment shall not have its third prong-grounding conductor defeated.

d. To reduce noise voltages in the system it is intended that only one ground connection path exist between two pieces of equipment.

e. Where mounting hardware is indicated as a means of grounding, ensure both a solid electrical and mechanical connection is made.

f. Cable shields shall be considered grounded if connected to the shield connection points provided by the manufacturer of active equipment.

g. Conduit/mounting boxes:

1. Permanently and effectively, bond to building earth ground per applicable codes. Insulated connections between conduit and wall boxes, junction boxes, or wireways are not permitted.

h. Passive Equipment Chassis: Connect an appropriately sized (green) insulated ground cable to the copper ground terminal block (provided under the electrical contract), to the ground bus bar within each equipment rack. This ground bus bar shall be bonded to bright metal of each equipment rack with the appropriate antioxidant employed at the copper to rack interface. Each adjacent equipment rack shall have its grounding conductor homerun to the copper ground terminal block.

1.21 SYSTEM PROGRAMING AND INITIALIZATION

a. Programming, software, and materials necessary for initial configuration, programming and start-up of access control and CCTV systems is by others.

1. Provide all labor and materials necessary to during system's commissioning.

2. Provide labor to attend weekly project meetings for the duration of the project.

1.22 TRAINING

a. Allow a minimum of 8 hours to walk the site with the owner for needed training on provided materials and installations to show location of junction boxes, breaker panels etc.

1.23 INSPECTIONS AND TESTING

a. Help perform field I/O calibration and commissioning, system commissioning and integrated system program commissioning. Document all commissioning information on commissioning data sheets that shall be submitted prior to acceptance testing. Notify the Owner/Engineer in writing of the testing schedule so that operating personnel may observe calibration and commissioning.

1. Inspections and Cable Testing

2. System Programming

3. System Operation

4. Component Commissioning

5. Primary Power Failure

6. Fire alarm Interface Test

b. After the installation is complete, in addition to any other required testing as described herein, and at such times as the Owner/Engineer directs, be present while the Owner/Engineer conducts an operating test for approval. The installation shall be demonstrated to be in accordance with the requirements of this specification. Any defects revealed shall be corrected promptly at the Contractor's expense and the tests performed again.

c. As a minimum, test, as described below, all cables installed under these specifications.

1. Conduct cable testing as described below upon completion of installation. Test fully completed systems only.

2. Multi-conductor metallic cables: End-to-end testing of each cable pair/conductor for continuity ground fault, proper termination, shorts and crossed pairs.

3. If a bad conductor is found, replace the entire cable. Remove any cables that contain a defective conductor from ceiling and/or floor duct. Do not abandon defective cables in place.

d. The Owner/Engineer reserves the right to observe of any or all portions of the testing process.

e. The Owner/Engineer further reserves the right to conduct, using contractor equipment and labor, a random re-test of 10% of the cables to confirm documented test results. Such retests may be observed and reported on by a third-party contractor retained by the Owner/Engineer.

f. All test results and corrective procedures are to be documented and submitted to the Owner/Engineer within five (5) working days of test completion

1.24 ACCEPTANCE

a. Submit a detailed acceptance procedure designed to demonstrate compliance with contract installation requirements at least 2 weeks before the start of testing. This procedure to be approved prior to the start of the testing.

b. During acceptance testing, provide services to owner's security systems technician.

c. Coordinate testing period so that free access, work lighting and electrical power are available on site.

d. Furnish three portable VHF or UHF business band, two-way radios with sufficient range to cover the entire project. Include extra rechargeable batteries, battery charger and belt "holsters".

e. Ensure that technical areas are in a clean and orderly condition, ready for acceptance testing.

1.25 RECORD DRAWINGS

a. During construction, the Contractor shall keep an accurate record of all deviations between the work as shown on the drawings and that, which is accurately installed.

END OF SECTION

SECTION 31 10 00 – SITE CLEARING

PART 1-GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Division 01 General Requirements and Section 01 50 00 Temporary Facilities and Controls apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
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 or abandoning site utilities in place.
7. Temporary erosion and sedimentation control measures.

1.3 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally 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 (50 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.

F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain on the Site, cleared materials shall become Contractor's property and shall be removed from the Site.

1.5 SUBMITTALS

A. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations per applicable Highway Permits, Division 01 General Requirements, and Drawings.

B. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

C. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or other digging unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

D. Do not direct vehicle or equipment exhaust towards protection zones.

E. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

F. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2-PRODUCTS

2.0 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Division 31 Section "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3-EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Flag each tree trunk at 54 inches (1372 mm) above the ground.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide in accordance with Drawings and Section 01 50 00 Temporary Facilities and Controls.

3.3 TREE AND PLANT PROTECTION

A. General: Protect trees and plants remaining on-site according to Drawings.

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Landscape Architect.

3.4 EXISTING UTILITIES

A. Contractor (with consent of owner) shall arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.
2. Owner will arrange to shut off indicated utilities when requested by Contractor.

C. Locate, identify, and disconnect utilities indicated to be abandoned in place.

D. Interrupting 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 Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

E. Excavate for and remove underground utilities indicated to be removed.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, 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. Grind down stumps and/or remove stumps, roots, obstructions, and debris to a depth of 24 inches below exposed subgrade.
3. Use only hand methods for grubbing within protection zones.
4. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.

C. Top soil material shall be screened to be 1” minus and stockpiled onsite. Topsoil shall be in accordance with Section 2.2 of Turfs and Grasses Section 32 92 00

D. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches, unless otherwise authorized by Engineer.
2. Do not stockpile topsoil within protection zones.
3. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and 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 along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off the Site.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 31 10 00

SECTION 31 20 00 –EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Division 01 General Requirements and Section 01 50 00 Temporary Facilities and Controls apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for curbs, walks, pavements, lawns, and plantings.
2. Excavating and backfilling for stormwater practices and utility structures.
3. Subbase course for concrete walks and pavements.
4. Excavating and backfilling trenches for buried utilities and pits for buried utility structures.
5. Excavation for mass grading of site.

1.3 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

C. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

D. Excavation: Removal of material encountered above subgrade elevations.

1. Additional Excavation: Excavation below subgrade elevations as directed by Engineer.
2. Bulk Excavation: Excavations more than 10 feet (3 m) in width and pits more than 30 feet (9 m) in either length or width.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.

E. Fill: Soil materials used to raise existing grades.

1. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material exceeding 1 cu. yd. (0.76 cu. m) in place that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted. Excavation of Trenches and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch-(1065-mm-) wide, short-tip-radius rock bucket; rated at not less than 120-hp (89-kW) flywheel power with bucket-curling force of not less than 25,000 lbf (111 kN) and stick-crowd force of not less than 18,700 lbf (83 kN); measured according to SAE J-1179.
2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp (157- kW) flywheel power and developing a minimum of 45,000-lbf (200-kN) breakout force; measured according to SAE J-732.

F. Structures: Slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

G. Subbase Course: Layer placed between the subgrade and asphalt paving, or layer placed between the subgrade and a concrete pavement or walk.

H. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

I. Utilities: include on-site underground pipes, conduits, ducts, and cables, as well as underground services within 5 feet of the building.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Each type of detectable warning tape.
2. Drainage fabric.
3. Separation fabric.

B. Blasting plan approved by authorities having jurisdiction, for record purposes.

1.5 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Engineer 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.

2. Do not proceed with utility interruptions without Engineer's written permission.
3. Contact utility-locator service for area where Project is located before excavating.

B. Demolish and completely remove from site existing underground utilities indicated to be re- moved. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not avail- able from excavations.

B. Satisfactory Soils: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Backfill and Fill: Satisfactory soil materials.

E. Subbase: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; meeting the requirements of NYSDOT Item # 304.12.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (38-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

G. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

H. Crushed Stone: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; meeting the requirements of NYSDOT Item # 623.12 and gradation requirements of NYSDOT Item # 605.0901.

I. Rip Rap: Medium stone fill of crushed or uncrushed rock meeting the requirements of

NYSDOT Item # 620.04, unless otherwise specified on the Drawings.

J. Bank Run Gravel: Naturally graded mixture of natural sand or sand and gravel, meeting ASTMD 2487 Soil Classification Groups GW, GP, or GM (Gravelly Soils), or SW, SP, or SM (Sandy Soils).

K. Controlled Fill: Refer to pages 5 through 8 of the Geotechnical Report prepared by Gifford Associates, dated October 2018 for specifications for Controlled Fill.

2.2 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

B. Drainage Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:

1. Grab Tensile Strength: 110 lbf (490 N); ASTM D 4632.
2. Tear Strength: 40 lbf (178 N); ASTM D 4533.
3. Puncture Resistance: 50 lbf (222 N); ASTM D 4833.
4. Water Flow Rate: 150 gpm per sq. ft. (100 L/s per sq. m); ASTM D 4491.
5. Apparent Opening Size: No. 50 (0.3 mm); ASTM D 4751.

C. Separation Fabric: Woven geotextile, specifically manufactured for use as a separation geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum proper- ties determined according to ASTM D 4759 and referenced standard test methods:

1. Grab Tensile Strength: 200 lbf (890 N); ASTM D 4632.
2. Tear Strength: 75 lbf (333 N); ASTM D 4533.
3. Puncture Resistance: 90 lbf (400 N); ASTM D 4833.
4. Water Flow Rate: 4 gpm per sq. ft. (2.7 L/s per sq. m); ASTM D 4491.
5. Apparent Opening Size: No. 30 (0.6 mm); ASTM D

4751. 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 created by earthwork operations.

B. Protect subgrades and foundation soils 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 waterways.

3.2 DEWATERING

A. Provide in accordance with Section 01 50 00 Temporary Facilities and Controls.

3.3 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of sur- face and subsurface conditions encountered, including rock, soil materials, and obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.4 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Equipment Pads: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or mi- nus 1 inch (25 mm). Do not disturb bottom of excavations intended for bearing surface.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: As indicated.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches (150 mm) in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
3. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.7 APPROVAL OF SUBGRADE

A. Notify Engineer when excavations have reached required subgrade.

B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer.

3.8 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by Engineer.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Engineer.

3.9 STORAGE OF SOIL MATERIALS

A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to pre- vent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
2. Soil material shall be screened to be 3” minus and stockpiled on site. Soil material shall be in accordance with section 2.1 of Earth Moving 31 20 00.
3. Top soil material shall be screened to be 1” minus and stockpiled onsite. Topsoil shall be in accordance with Section 2.2 of Turfs and Grasses Section 32 92 00.

3.10 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for record documents.
3. Inspecting and testing underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.11 UTILITY TRENCH BACKFILL

A. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fit- tings, and bodies of conduits.

B. Backfill trenches excavated under footings and within 18 inches (450 mm) of bottom of footings; fill with concrete to elevation of bottom of footings.

C. Place and compact initial backfill of subbase material, free of particles larger than 1 inch (25 mm), to a height of 12 inches (300 mm) over the utility pipe or conduit.

1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

D. Coordinate backfilling with utilities testing.

E. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is re- moved.

F. Place and compact final backfill of satisfactory soil material to final subgrade.

G. Install warning tape directly above utilities, 18 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.12 FILL

A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.

B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal, so fill material will bond with existing material.

C. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.

3.13 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.14 COMPACTION OF BACKFILLS AND FILLS

A. Place backfill and fill materials in layers not more than 8 inches (200 mm) in loose

depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under utility structures and paved shoulders, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill material at 92 percent.
3. Under lawn or unpaved areas, scarify and recompact top 6 inches (150 mm) below sub- grade and compact each layer of backfill or fill material at 90 percent.

3.15 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 adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch (25 mm).
2. Walks: Plus or minus 1 inch (25 mm).
3. Pavements: Plus or minus 1/2 inch (13 mm).

3.16 SUBBASE AND BASE COURSES

A. Under pavements and walks, place subbase course on prepared subgrade and as follows:

1. Place base course material over subbase.
2. Compact subbase and base courses at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.
3. Shape subbase and base to required crown elevations and cross-slope grades.
4. When thickness of compacted subbase or base course is 6 inches (150 mm) or

less, place materials in a single layer.

5. When thickness of compacted subbase or base course exceeds 6 inches (150 mm), place materials in equal layers, with no layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick when compacted.

B. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches (300 mm) wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.17 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. (186 sq. m) or less of paved area, but in no case fewer than three tests.
2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet (46 m) or less of trench length, but no fewer than two tests.

D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.18 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, back- fill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Transport surplus satisfactory soil offsite.

1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dis- pose of it offsite.

END OF SECTION 31 20 00

SECTION 31 23 16.26 - ROCK REMOVAL

PART 1-GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Section 31 20 00 Earth Moving, and Division 01 General Requirements apply to this Section.

1.2 SUMMARY

A. This Section includes rock removal for site utilities and to the grades shown on the Drawings including the loosening, removing, transporting, storing and disposal of all materials requiring blasting, barring, or wedging for removal from their original beds, and backfill of rock excavations with acceptable materials.

1.3 SUBMITTALS

A. The following items shall be submitted:

1. Blasting plan conforming to the Town ordinances.

2. Before any drilling or blasting operations begin the Contractor shall obtain all permits and licenses required.

3. Seismic Survey Report: Owner to provide for record purposes; from seismic survey agency.

4. Preexcavation Photographs or Videotape: In addition to what is required in Division 01 General Requirements, show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earthwork operations. Submit before earthwork begins.

1.4 DEFINITIONS

A. Rock

1. See Section 31 20 00 Earth Moving.

1.5 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Blasting: Comply with applicable requirements in NFPA 495, "Explosive Materials Code," and prepare a blasting plan reporting the following:

Types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.

C. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:

1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
2. Seismographic monitoring during blasting operations.

D. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

E. Preexcavation Conference: Conduct preexcavation conference at the Site.

F. Any Blasting shall be performed in small and controlled blasts so as not to cause disruption or damage to the adjacent roadway, its user, or adjacent residences. Any damage to the adjacent road and / or users, the residences within the vicinity of blasting (distance to monitor structures for damage per the Laws and Regulations for blasting) or belongings of the inhabitants shall be replaced by the contractor at no additional expense to the Owner.

PART 2-PRODUCTS

NOT USED

PART 3-EXECUTION

3.1 BLASTING

A. General

1. Handling of explosives and blasting shall be done only by experienced persons.

2. Handling and blasting shall be in accordance with all Federal, State and local laws, rules and regulations relating to the possession, handling, storage and transportation and use of explosives.

3. All blasts in open cut shall be properly covered and protected with approved blasting mats.

4. Charges shall be of such size that the excavation will not be unduly large and shall be so arranged and timed that adjacent rock, upon or against which pipelines or structures are to be built, will not be shattered.

5. Blasting will not be permitted within 25 feet of pipelines or structures, unless approved by engineer.

6. All existing pipes or structures exposed during excavation shall be adequately protected from damage before proceeding with the blasting.

B. Repair of Damages Due to Blasting

1. Any injury or damage to the work or to existing pipes or structures shall be repaired or rebuilt by the Contractor at his expense.

2. Whenever blasting may damage adjacent rock, pipes or structures, blasting shall be discontinued and the rock removed by drilling, barring, wedging or other methods.

3. The contractor shall be responsible for repairing/replacing any damage caused by blasting to the adjacent roads, its users, or structures within the vicinity of blasting as required by the Laws and Regulations. This includes the personal property of the inhabitants.

C. Explosives

1. At no time shall an excessive amount of explosives be kept at the site of the work. Such explosives shall be stored, handled and used in conformity with all applicable laws and regulations.

2. Accurate daily records shall be kept showing the amounts of explosives on hand, both at the site and at any storage magazine, the quantities received and issued, and the purpose for which issued.

3. The Contractor shall be responsible for any damage or injury to any persons, property or structures as a result of his handling, storage or use of explosives.

D. Rock Clearance in Trenches

1. Ledge rock, boulders and large stones shall be removed from the sides and bottom of the trench to provide clearance for the specified embedment of each pipe section, joint or appurtenance; but in no instance shall the clearance be less than 6 inches. Additional clearance at the pipe bell or joint shall be provided to allow for the proper make-up of the joint.

2. At the transition from an earth bottom to a rock bottom the minimum bottom clearance shall be 12 inches for a distance of not less than 5 feet.

3.2 EXCAVATION AND BACKFILL

A. Rock removal and backfilling shall be performed in accordance with the applicable provisions of the Section 31 20 00 Earth Moving.

B. The rock excavated shall be disposed of as spoil and no rock processing is permitted on the subject property.

END OF SECTION 31 23 16.26

SECTION 31 23 19 - DEWATERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Dewatering system.
2. Surface water control system.
3. System operation and maintenance.
4. Water disposal.

B. Related Requirements:

1. Available Project Information: Subsurface investigation report, indicating boring logs, soil profiles, ground water levels.

2. Contractor to coordinate and gain approval from the with City of Yonkers Plumbing Inspector for discharge locations for dewatering operations during demolition operations.

1.2 DEFINITIONS

A. Dewatering:

1. Lowering of ground water table and intercepting horizontal water seepage to prevent ground water from entering excavations.
2. Disposing of removed water.

B. Surface Water Control: The removal of surface water within open excavations.

1.3 COORDINATION

A. Coordinate Work of this Section to permit following construction operations to be completed on dry and stable substrate:

1. Excavation for structures as specified in Section 31 20 00 – Earth Moving.

1.4 SEQUENCING

A. Sequence Work of this Section to obtain required permits before start of dewatering operations. Contractor to procure approval of the City of Yonkers Plumbing Inspector for pump discharge locations as part of the demolition permit.

1.5 SUBMITTALS

A. Product Data:

1. Submit sizes, capacities, priming method, and motor characteristics for dewatering pumps.
2. Submit pumping equipment for control of surface water within excavation.

B. Shop Drawings:

1. Indicate dewatering system layout, well depths, well screen lengths, dewatering pump locations, pipe sizes and capacities, grades, filter sand gradations, surface water control devices, valves, and water disposal method and location.
2. Indicate primary power system location and capacity.
3. Include detailed description of dewatering and monitoring system installation procedures and maintenance of equipment.
4. Include description of emergency procedures to follow when problems arise.

1.6 QUALITY ASSURANCE

A. Comply with the City of Yonkers for following:

1. Water discharge and disposal from pumping operations.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Furnish dewatering and surface water control systems to permit Work to be completed on dry and stable subgrade.

B. Install sump pit to dewater and relieve hydrostatic pressure within the work area.

C. Standby Equipment:

1. Store at Site and ready for immediate use upon failure of dewatering equipment.

2.2 PERFORMANCE AND DESIGN CRITERIA

A. Design:

1. Lower water table within areas of excavation to permit Work to be completed on dry and stable subgrade.
2. Relieve hydrostatic pressures in confined water bearing strata below excavation to eliminate risk of uplift or other instability of excavation.
3. Prevent damage to adjacent properties, buildings, structures, utilities, and other facilities from construction operations.

4. Maintain stability of sides and bottoms of excavations.
5. Surface Water Control System: Collect and remove surface water and seepage entering excavation.

2.3 DEWATERING EQUIPMENT

A. Furnish dewatering equipment to appropriately dewater the work area during demolition if required due to site conditions in accordance with the project plans and requirements of the City of Yonkers.

2.4 ACCESSORIES

A. Valves and Fittings: Furnish valves and fittings as required connect the pump to the discharge location.

B. Filtering materials to ensure that only water is pumped from the site to the discharge locations, in accordance with the City of Yonkers requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Utility Service Locator:
1. Request that underground utilities be located and marked within and immediately surrounding the site.
2. City of Yonkers to determine the acceptability of the existing building sewer connections to the combined storm sewer for dewatering discharge location.

3.2 PREPARATION

A. Protect existing adjacent buildings, structures, and improvements from damage that may be caused by dewatering operations.

3.3 DEWATERING SYSTEM

A. Install dewatering system according with project plans and requirements of the City of Yonkers demolition permit.

B. Locate system components to allow continuous dewatering operations without interfering with installation of permanent Work and existing public rights-of-way, sidewalks, and adjacent buildings, structures, and improvements.

C. Pumps:

1. Install according to manufacturer instructions.

2. Connect pumps to discharge location.
3. Install valves to permit pump isolation.

3.4 SURFACE WATER CONTROL SYSTEM

A. Provide ditches, berms, and other devices to divert and drain surface water from excavation area, as specified in Section 31 25 00 - Erosion and Sedimentation Control.

B. Divert surface water and seepage water within excavation areas into sumps and pump water into locations designated by the City of Yonkers.

C. Control and remove unanticipated water seepage into excavation.

3.5 SYSTEM OPERATION AND MAINTENANCE

A. Operate dewatering system as needed to dewater excavations during the demolition project.

B. Dewatering operations to continue on an as needed basis until the time of the building construction commences, as necessary and in accordance with the requirements of the City of Yonkers.

C. Monitoring:

1. Conduct daily observation of dewatering system and monitoring system.
2. Make required repairs and perform scheduled maintenance.

D. Start emergency generators at least twice each week to check operating condition.

E. System Failure:

1. If dewatering system cannot control water within excavation, notify Engineer and stop excavation Work.

F. Modify dewatering and surface water control systems if operation causes or threatens to cause damage to new construction, existing Site improvements, adjacent property, or adjacent water wells.

G. Correct unanticipated pressure conditions affecting dewatering system performance.

H. Do not discontinue dewatering operations without approval of Engineer.

3.6 WATER DISPOSAL

A. City of Yonkers to determine ultimate discharge location of the dewatering line as part of the demolition permit.

3.7 SYSTEM REMOVAL

A. Remove dewatering and surface water control systems after dewatering operations are discontinued.

B. Repair damage caused by dewatering and surface water control systems or resulting from failure of systems to protect property.

3.8 PROTECTION

A. Protect sump pits and dewatering equipment from damage by construction operations.

END OF SECTION 312319

SECTION 31 23 33 – TRENCHING AND BACKFILLING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes excavation and backfill as required for pipe installation or other construction in the trench, and removal and disposal of water, in accordance with the applicable provisions of Section 31 20 00 Earth Moving and Section 31 50 00 Excavation Support and Protection unless modified herein.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 EXCAVATION

A. The trench excavation shall be located as shown on the Drawings or as specified. Under ordinary conditions, excavation shall be by open cut from the ground surface. Where the depth of trench and soil conditions permit, tunneling may be required beneath cross walks, curbs, gutters, pavements, trees, driveways, railroad tracks and other surface structures. No additional compensation will be allowed for such tunneling over the price bid for open cut excavation of equivalent depths below the ground surface unless such tunnel excavation is specifically provided for in the Bidding Documents.

B. Trenches shall be excavated to maintain the depths as shown on the Drawings or as specified for the type of pipe to be installed.

C. The alignment and depth shall be determined and maintained by the use of a string line installed on batter boards above the trench, a double string line installed along side of the trench or a laser beam system.

D. The minimum width of trench excavation shall be 12 inches on each side of the pipe hub.

E. Trenches shall not be opened for more than 300 feet in advance of pipe installation nor left unfilled for more than 100 feet in the rear of the installed pipe when work is in progress without the consent of the Engineer. Open trenches shall be protected and barricaded as required. No trench shall be left open over night unless an adequate road plan is provided.

F. Bridging across open trenches shall be constructed and maintained where required. Provide shop drawing of bridging or road plate system designed and stamped by NYS Licensed Professional Engineer.

3.2 SUBGRADE PREPARATION FOR PIPE

A. Where pipe is to be laid on undisturbed bottom of excavated trench, mechanical excavation shall not extend lower than the finished subgrade elevation at any point.

B. Where pipe is to be laid on special granular material the excavation below subgrade shall be to the depth specified or directed. The excavation below subgrade shall be refilled with special granular material as specified or directed, shall be deposited in layers not to exceed 6 inches and shall be thoroughly compacted prior to the preparation of pipe subgrade.

C. The subgrade shall be prepared by shaping with hand tools to the contour of the pipe barrel to allow for uniform and continuous bearing and support on solid undisturbed ground or embedment for the entire length of the pipe.

D. Pipe subgrade preparation shall be performed immediately prior to installing the pipe in the trench. Where bell holes are required they shall be made after the subgrade preparation is complete and shall be only of sufficient length to prevent any part of the bell from becoming in contact with the trench bottom and allowing space for joint assembly.

3.3 STORAGE OF MATERIALS

A. Traffic shall be maintained at all times in accordance with the applicable Highway Permits, Division 01 General Requirements, and Drawings.

B. Where conditions do not permit storage of materials adjacent to the trench, the material excavated from a length as may be required, shall be removed by the Contractor, at his cost and expense, as soon as excavated. The material subsequently excavated shall be used to refill the trench where the pipe had been built, provided it be of suitable character. The excess material shall be removed to locations selected and obtained by the Contractor.

1. The Contractor shall, at his cost and expense, bring back adequate amounts of satisfactory

excavated materials as may be required to properly refill the trenches.

C. If directed by the Engineer, the Contractor shall refill trenches with satisfactory soil materials or other suitable materials and excess excavated materials shall be disposed of offsite by the contractor.

3.4 REMOVAL OF WATER AND DRAINAGE

A. The Contractor shall at all times provide and maintain proper and satisfactory means and devices for the removal of all water entering the trench, and shall remove all such water as fast as it may collect, in such manner as shall not interfere with the prosecution of the work.

B. The removal of water shall be in accordance Section 01 50 00 Temporary Facilities and Controls.

3.5 PIPE EMBEDMENT

A. All pipe shall be protected from lateral displacement and possible damage resulting from superimposed backfill loads, impact or unbalanced loading during backfilling operations by being adequately embedded in suitable pipe embedment material. To ensure adequate lateral and vertical stability of the installed pipe during pipe jointing and embedment operations, a sufficient amount of the pipe embedment material to hold the pipe in rigid alignment shall be uniformly deposited and thoroughly compacted on each side, and back of the bell, of each pipe as laid.

B. Concrete cradle and encasement of the class specified shall be installed where and as shown on the Contract Drawings or ordered by the Engineer. Before any concrete is placed, the pipe shall be securely blocked and braced to prevent movement or flotation. The concrete cradle or encasement shall extend the full width of the trench as excavated unless otherwise authorized by the Engineer. Where concrete is to be placed in a sheeted trench it shall be poured directly against sheeting to be left in place or against a bond-breaker if the sheeting is to be removed.

C. Embedment materials placed above the centerline of the pipe or above the concrete cradle to a depth of 12 inches above the top of the pipe barrel shall be deposited in such manner as to not damage the pipe. Compaction shall be as required for the type of embedment being installed.

3.6 BACKFILL ABOVE EMBEDMENT

A. The remaining portion of the pipe trench above the embedment shall be refilled with suitable materials compacted as specified.

1. The trench shall be refilled in horizontal layers not more than 8 inches in thickness, and compacted per Section 31 20 00 Earth Moving.

2. Hand tamping shall be required around buried utility lines or other subsurface features that could be damaged by mechanical compaction equipment.

B. Backfilling of trenches beneath, across or adjacent to drainage ditches and water courses shall be done in such a manner that water will not accumulate in unfilled or partially filled trenches and the backfill shall be protected from surface erosion by adequate means.

1. Where trenches cross waterways, the backfill surface exposed on the bottom and slopes thereof shall be protected by means of stone or concrete rip-rap or pavement.

C. All settlement of the backfill shall be refilled and compacted as it occurs.

D. Temporary pavement shall be placed as required by the Highway Work Permits and all Laws and Regulations.

END OF SECTION 31 23 33

SECTION 31 25 00 - EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

B. New York State Department of Environmental Conservation SPDES General Permit for Stormwater Discharges from Construction Activity Permit No. GP-0-20-001.

1.2 SUMMARY

A. This section includes furnishing, installing, maintaining, and removing temporary erosion and sediment control measures as shown on the contract documents or as ordered by the Engineer throughout the life of the contract to control soil erosion, sediment and water pollution through the use of temporary swales, check dams, bales, sediment traps, and silt fences.

B. Related Sections include other Division 2 Sections.

1.3 REFERENCES

A. Materials installation, maintenance, inspection and removal shall be in accordance with the *New York Standards and Specifications for Erosion and Sediment Control*.

1.4 SUBMITTALS

A. Submittals shall be submitted in accordance with the provisions set forth in the General Specifications.

B. Submittal shall contain source and supplier of material showing its compliance with specifications and associated standards.

1. Samples of any kind shall be submitted upon Engineer’s request.

C. The Contractor shall submit schedules for the accomplishment of temporary sediment control work.

PART 2 - PRODUCTS

2.1 GENERAL

A. Products shall be as specified on the contract drawings and as stated in *New York Standards and Specifications for Erosion and Sediment Control*.

PART 3 - EXECUTION

3.1 INSTALLATION

A. In the event of conflict between these specification requirements and pollution control laws, rules or regulations by other federal, state or local government agencies, the more restrictive rules and regulations shall apply.

B. Temporary erosion and sediment control measures shall be inspected by the Contractor and maintained during the life of the project, and such maintenance and inspection shall continue until permanent stabilization measures are in place and the temporary control measures are ordered to be removed by the Engineer, and the disturbed area returned to its intended stabilized condition.

C. The Engineer has the authority to limit the surface area of erodible earth material exposed by excavation, borrow and fill operations and to direct the Contractor to provide immediate permanent or temporary erosion and sediment control measures to minimize damage to adjacent property.

D. The Contractor shall submit schedules for the accomplishment of temporary and permanent erosion and sediment control work to the Engineer for acceptance. All work done under this section shall be included as part of the construction schedule submitted by the Contractor.

E. Maintenance shall be performed as directed by the Engineer. All sediment deposits shall be considered unsuitable material and properly disposed of.

F. The Contractor shall immediately repair or replace defective or damaged portions of the erosion and sediment control facilities.

G. Erosion and sediment control measures shall be installed where necessary and shall remain in place until the area is permanently stabilized or the Engineer directs that it be removed. Upon removal, the Contractor shall remove and dispose of any sediment accumulations and restore the area as directed by the Engineer. The removed facilities and materials shall become the property of the Contractor and be removed from the site.

END OF SECTION 31 25 00

SECTION 31 50 00 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and Division 01 General Requirements apply to this Section.

1.2 SUMMARY

A. Section includes temporary excavation support and protection systems.

1.3 PERFORMANCE REQUIREMENTS

A. Design, provide, 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 per Division 01 General Requirements.
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. Existing Conditions: per Division 01 Requirements.
2. Record Drawings: Identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions.

a. Note locations and capping depth of wells and well points.

1.5 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Pre-installation Conference: Conduct a pre-installation conference per Division 01 General Requirements.

1. Review methods and procedures related to excavation support and protection system including, but not limited to, the following:

a. Geotechnical report.
b. Existing utilities and subsurface conditions.
c. Proposed excavations.
d. Proposed equipment.
e. Monitoring of excavation support and protection system.
f. Working area location and stability.
g. Coordination with waterproofing.
h. Abandonment or removal of excavation support and protection system.

1.6 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 and Owner no fewer than two days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Owner's/Engineer's written permission.

B. 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.

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.

1. Corners: Site-fabricated mechanical interlock or Roll-formed corner shape with continuous interlock.

D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

E. Tiebacks: Steel bars, ASTM A 722/A 722M.

F. Tiebacks: Steel strand, ASTM A 416/A 416M.

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 SOLDIER PILES AND LAGGING

A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches (50 mm) from a horizontal line and not more than 1:120 out of vertical alignment.

B. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.

C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.3 SHEET PILING

A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Accurately place the piling, using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 60 inches (1500 mm). Accurately align exposed faces of sheet piling to vary not more than 2 inches (50 mm) from a horizontal line and not more than 1:120 out of vertical alignment. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

A. Tiebacks: Drill, install, grout, and tension tiebacks. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.

1. Test loading shall be observed by a qualified professional engineer responsible for design of excavation support and protection system.
2. Maintain tiebacks in place until permanent construction is able to withstand lateral soil and hydrostatic pressures.

3.5 BRACING

A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.

1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.
2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 REMOVAL AND REPAIRS

A. Remove 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 (1200 mm) below overlaying construction and abandon remainder.
2. Fill voids immediately with approved backfill compacted to density specified in Section 31 20 00 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 31 50 00

SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and Division 01 General Requirements, Section 31 20 00 Earth Moving, apply to this Section.

B. This Section applies to all asphalt paving.

1.2 SUMMARY

A. This Section includes the following:

1. Hot-mix asphalt paving.
2. Hot-mix asphalt patching.

B. Scheduling of Asphalt Paving:

1. The contractor shall have substantially completed site work in the vicinity of paving and obtain the Engineer's approval prior to placement of the binder course of asphalt.
2. The contractor shall have substantially completed construction and obtain the Engineer's approval prior to placement of the top course of asphalt.

1.3 SYSTEM DESCRIPTION

A. Provide hot-mix asphalt paving according to materials, workmanship, and other applicable requirements of the standard specifications of the state or authorities having jurisdiction.

1. Standard Specification: New York State Department of Transportation.
2. Measurement and payment provisions and safety program submittals included in NYSDOT Standard Specifications do not apply to this Section.

1.4 SUBMITTALS

A. Product Data: For each product specified. Include technical data and tested physical and performance properties.

B. Job-Mix Designs: For each job mix proposed for the Work.

C. Material Test Reports: Indicate and interpret test results for compliance of materials with requirements indicated.

D. Material Certificates: Certificates signed by manufacturers certifying that each material complies with requirements.

1.5 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Installer Qualifications: Engage and experienced installer who has completed hot-mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

C. Manufacturer Qualifications: Engage a firm experienced in manufacturing hot-mix asphalt similar to that indicated for this Project and with a record of successful in-service performance.

1. Firm shall be a registered with and approved paving mix manufacturer with authorities having jurisdiction or the DOT of the state in which Project is located.

D. Regulatory Requirements: Conform to applicable standards of authorities having jurisdiction for asphalt paving work on public property.

E. Asphalt-Paving Publication: Comply with AI's , "The Asphalt Handbook," except where more stringent requirements are indicated.

F. Pre-installation Conference: Conduct Pre-installation conference at the Site per Division 01 General Requirements. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

1. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
2. Review condition of substrate and preparatory work performed by other trades.
3. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
4. Review and finalize construction schedule for paving and related work. Verify availability of materials, paving Installer's personnel, and equipment required to execute the Work without delays.
5. Review inspection and testing requirements, governing regulations, and proposed installation procedures.
6. Review forcasted weather conditions and procedures for coping with unfavorable conditions.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if substrate is wet or excessively damp or if the following conditions are not met:

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1. Asphalt Base Course: Minimum surface temperature of 40 deg F (4 deg C) and rising at time of placement.
2. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.5 deg C) at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: Sound; angular crushed stone, crushed gravel, or properly cured, crushed blast-furnace slag; complying with ASTM D 692.

C. Fine Aggregate: Sharp-edged natural sand or sand prepared from stone, gravel, properly cured blast-furnace slag, or combinations thereof, complying with ASTM D 1073

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: Rock or slag dust, hydraulic cement, or other inert material complying with ASTM D 242.

2.2 ASPHALT MATERIALS

A. Asphalt Cement: ASTM D 3381 for viscosity-graded material

B. Undersealing Asphalt: ASTM D 3141, pumping consistency.

C. Water: Potable.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Sand: ASTM D 1073, Grade Nos. 2 or 3.

2.4 MIXES

A. Hot-Mix Asphalt: Provide dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction**;** designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Base Course: As indicated.
3. Surface Course: As indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.

B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.

C. Notify Engineer in writing of any unsatisfactory conditions. Do not begin paving installation until these conditions have been corrected.

3.2 PATCHING AND REPAIRS

A. Patching: Saw cut perimeter of patch and excavate existing pavement section to sound base. Recompact new subgrade. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically.
1. Tack coat faces of excavation and allow to cure before paving.
2. Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

B. Leveling Course: Install and compact leveling course consisting of dense-graded, hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch (25 mm) in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches (75 mm) thick.

C. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch (6 mm). Refill with asphalt joint-filling material to restore watertight condition. Remove excess filler that has accumulated near cracks or joints.

D. Tack Coat: Apply uniformly to surfaces of existing pavement of previously constructed asphalt or portland cement concrete paving and to surfaces abutting or projecting into new, hot-mix asphalt pavement. Apply at a uniform rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m) of surface.

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 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.

1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

3.4 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 (121 deg C).
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 (3 m) 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.

3.5 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 (150 mm).
3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
4. Construct transverse joints by bulkhead method or sawed vertical face method as described in AI's, "The Asphalt Handbook".
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.

3.6 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 vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).

2. Use at minimum a 10-ton roller.

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 1559, but not less than 94 percent nor greater than 100 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.

3.7 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch (13 mm).
2. Surface Course: Plus 1/4 inch (6 mm), no minus.

B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch (6 mm).
2. Surface Course: 1/8 inch (3 mm).
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall engage a qualified independent testing agency to perform field quality-control testing.

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. Revise methods of verifying field compaction if using the Superpave mix design system. Consult state or local DOT for methods that have been successfully used.

E. 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 18 16– PLAYGROUND SURFACING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes playground surfacing meeting the recommendations set forth by Consumer Product and Safety Commission, ASTM standards, and the Americans with Disabilities Act.

1.2 REFERENCES

A. Materials and installation shall be in accordance with the latest revisions of the following codes, standards and specifications, except where more stringent requirements have been specified herein:

1. American Society for Testing and Materials (ASTM)

   a. F1292-13 Standard Specification for Impact Attenuation of Surfacing Materials Within the Use Zone Playground Equipment

   b. F1951-08 Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment

   c. D2047-13 Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine

2. Americans with Disabilities Act Accessibility Guidelines

3. Uniform Federal Accessibility Standards (UFAS) FED-SD-795

4. Architectural and Engineering Instructions (9AI) Design Criteria

1.3 SUBMITTALS

A. In addition to those submittals identified in the General Provisions, the following items shall be submitted:

1. One original hard copy of the submittal package will be provided upon request.
2. Manufacturer’s descriptive data and installation instructions.
3. Manufacturer’s details showing depths of wear course, sub-base materials and edge details.
4. Upon request, a listing of as least three installations where products similar to those proposed for use have been installed and have been in service for

a minimum of three years. This list shall include address of installation, date of installation, contact person and phone number.

5. A signed statement by an authorized official certifying that the surfacing system meets the requirements of ASTM F 1292-13 for a head first fall from the highest accessible play surface.
6. A signed statement from the manufacturer of the poured-in-place surfacing attesting that all materials under this section shall be installed only by the Manufacture's Trained Installers.
7. A certificate of insurance shall be provided by the manufacturer / installer for poured-in-place surfacing for use as playground safety surfacing covering both general and product liability, of not less than $1,000,000 for each occurrence, $2,000,000 general aggregate. The issuing underwrite shall be AA rated.
8. Upon request, a 3" round sample of the material for this project.

B. Samples of any material shall be submitted at the Engineers request.

1.4 PERFORMANCE REQUIREMENTS

A. Area Safety: Poured-in-place surfacing within playground equipment use zones shall meet or exceed the performance requirements of ADA, CPSC, and Fall Height Test ASTM F 1292-13. The surface must yield both, a peak deceleration of no more than 200 G-max and a Head Injury Criteria (HIC) value of no more than 1,000 for a head first fall from the highest designated play surface of the play equipment being installed.

B. Accessibility Note: Children's outdoor play areas shall be in compliance with the Uniform Federal Accessibility Standards (UFAS) FED-STD-795 and the Architectural and Engineer Instructions (9AEI) Design Criteria. The requirements of the Americans with Disabilities Act Accessibility Guidelines (ADAAG) 28 CFR Part 36 that provide equal or greater accessibility than the requirements of UFAS must also be met in the children's outdoor play areas.

C. Surface intends to serve as an accessible path of travel for persons with disabilities shall be firm, stable and slip resistant, and shall meet the requirements of ASTM 1951-08, ASTM 1292-13, and ASTM D2047.

D. Surfaces shall be manufactured and installed by trained, experienced company employees.

1.5 DELIVERY, STORAGE AND HANDLING.

A. All materials and equipment shall be delivered and stored in accordance with the manufacturer's recommendations.

1.6 PROJECT SITE CONDITIONS

A. Poured-in-place surfacing must be installed on a dry 2” asphalt binder course, with no prospect of steady or heavy rain within the initial drying period, and within the recommended temperature range of the manufacturer. Installation in weather conditions of extreme heat, cold (less than 45 degree F), and/or high humidity may affect cure time, and the structural integrity of the final product. Immediate surrounding sites must be reasonably free of dust conditions or this could affect the look of the final surface.

B. Sequencing and Scheduling: Poured-in-place surfacing shall be installed after all playground equipment, shade structures, signs and any other items that will be within the surfacing area. Surface installation will be coordinated by an approved installer.

1.7 WARRANTY

A. Poured-in-place surface shall maintain required impact attenuation characteristics and be guaranteed against defects in workmanship and materials for a limited five (5) year period or as specified and agreed upon per alternate contract. Warranty will be specific to maintenance requirements and performance standards of completed product.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. The following manufacturers are named to establish a standard of quality necessary for the Project.

1. Soft Fusion manufactured by A & D Recreation, Inc. (Mamaroneck, NY)
2. Or equal

2.2 PRODUCT SCOPE

A. Poured-in-place surface shall consist of 100% recycled SBR rubber material mixed with a polyurethane binder and capped with EPDM or TPV granule mixed with a polyurethane binder. It shall consist of a uniform material manufactured in such a way that the top portion meets the requirements specified herein for wear surface. The type of safety surfacing shall be a poured-in-place system and shall be indicated on the drawings.

2.2 CUSHION LAYER SECTION

A. Impact Attenuating Cushion Layer: Cushion Layer consists of shredded styrene butadiene rubber (SBR) adhered with a 100% solids polyurethane binder to form a resilient porous material. Strands of SBR may vary from 0.5 mm to 2.0 mm in

thickness by 3.0 mm to 20mm in length. Foam or standard rubber granules are not to be permitted in Cushion Layer.

B. Binder shall be between 12-14% of the total weight of the material, and shall provide 100% coating of the SBR particles. The Cushion Layer shall be compatible with the Wear Course and must meet requirements herein for impact attenuation.

2.3 WEAR COURSE

A. Wear Course shall consist of Ethylene Propylene Diene Monomer (EPDM) or Thermal Plastic Vulcanized (TPV) granules with a polyurethane binder formulated to produce a porous, uniform, seamless surface up to 2,000 square feet.

B. EPDM shall be peroxide cured with an EPDM content of 26% and shall include a Processing aid to prevent hardness with 26% poly content to maintain dynamic testing characteristics, weatherization and UV stability.

C. ASTM D 2240 (Shore A) hardness of 55-65, not less than 26% rubber hydrocarbons.

D. Size of EPDM granules shall be 2-4mm across. Binder shall be not less than 20% of total weight of rubber used in the Wear Course, and shall provide 100% coating of the EPDM particles.

E. TPV shall be angular granules with a (Shore A) hardness of 55-65 and particle size between 1-4mm. Binder shall be not less than 20% of total weight of rubber used in the Wear Course, and shall provide 100% coating of the EPDM particles.

F. Thickness of Wear course shall be ½".

G. Coefficient of Friction, when wet: 0.80, minimum, when tested in accordance with ASTM D2047.

2.4 BINDER

A. No Toluene Diphenel Isocyanate (TDI) shall be used.

B. No filler materials shall be used in urethane such as plasticizers and the catalyzing agent shall contain no heavy metals.

C. Weight of polyurethane shall be no less than 8 ½ lbs. /gal and no more than 9 ½ lbs. /gal.

D. Manufacturer is permitted to modify the type of urethane required to match extreme weather conditions.

E. Substitutions must be equal to or exceed original quality.

2.4 MATERIALS

A. Materials shall be or equal to:

Wear Course- EPDM Granules
Manufacturer- Midwest Elastomers,Inc.
As Distributed by- A & D Recreation, Inc.
Location Used- Playground Area

Wear Course- TPV Granules
Manufacturer- American Rubber
As Distributed by- A & D Recreation, Inc.
Location Used- Playground Area

Cushion Layer- Shredded SBR
Manufacturer- Midwest Elastomers,Inc. or American Rubber
As Distributed by- A & D Recreation, Inc.
Location Used- Playground Area

Binder- Stobielast S 136.00- Normal Weather Conditions
Manufacturer- Stockmeier Urethanes
As Distributed by- A & D Recreation, Inc.
Location Used- Playground Area

Binder- Stobielast S 106.00- Extreme Heat and Humidity
Manufacturer- Stockmeier Urethanes
As Distributed by- A & D Recreation, Inc.
Location Used- Playground Area

Binder- Stobielast S 36.99- Cold and Arid Conditions
Manufacturer- Stockmeier Urethanes
As Distributed by- A & D Recreation, Inc.
Location Used- Playground Area

Binder- Stobielast S 151.99- Aliphatic
Manufacturer- Stockmeier Urethanes
As Distributed by- A & D Recreation, Inc.
Location Used- Playground or Water Play Areas

PART 3 EXECUTION

3.1 SITE PREPARATION

A. Finished Grade/Slope: Verify that finished elevations of adjacent areas are as indicated on the architectural or site plans, that the appropriate sub-grade elevation has been established for the particular safety surface to be installed, and that the subsurface has been installed per architectural, site or equipment plans while meeting accessibility and use zone requirements.

B. Sub Base: Sub base may be asphalt, concrete, or aggregate. Tolerance of sub base shall be within 1/8” in 10’. Verify that aggregate sub base has been fully compacted in 2” watered lifts to 95% or greater.

C. Curing of Asphalt and Concrete: If poured-in-place surfacing is installed, verify that concrete sub base has cured (all areas appear white in color usually between 3-7 days) and that all concrete curing compound and other deleterious substances that might adversely affect adhesion have been removed. Surface shall be clean and dry. Asphalt cure time requires 14 days. Once the new asphalt has cured, it must be pressure washed prior to the surfacing being installed. The contractor shall be responsible for flooding the pad to insure proper slope and tolerance. Any Areas holding enough water to cover a flat nickel shall be patched prior to arrival of our installation crews.

D. Drainage: Verify that sub-surfacing drainage, if required, has been installed to provide positive drainage.

3.2 INSTALLATION

A. Poured-in-Place Surfacing: Components of the poured-in-place surfacing shall be mixed on site in a rotating tumbler to ensure components are thoroughly mixed and are in accordance with manufacturer’s recommendations. Installation of surfacing shall be seamless up to 2,000 square feet per day and completely bonded to sub base. Material shall cover all foundations and fill around all elements penetrating the surface.

B. Cushion Layer: Whenever practical, cushion layer of surfacing material shall be installed in one continuous pour on the same day of up to 2,000 square feet. When a second pour is required, step the seam and fully coat the step of the previous work with polyurethane binder to ensure 100% bond with new work. Apply adhesive in small quantities so that new cushion layer can be placed before the adhesive dries.

C. Wear Course: Wear Course must be either high quality peroxide cured EPDM or TPV granules. Wear surface shall be bonded to Cushion Layer. If necessary, additional primer will be used between the Cushion Layer and Wear Course. Apply adhesive to Cushion Layer in small quantities allowing the Wear Course to be applied before the adhesive dries. Surface shall be hand troweled to a smooth, even finish. Except where the Wear Course is composed of differing color patterns, pour shall be

continuous and seamless up to 2,000 square feet per day. Where seams are required due to color change, size, or adverse weather, a step configuration will be constructed to maintain Wear Course integrity. The edge of initial pour shall be coated with adhesive and wearing surface mixture shall be immediately applied. Pads with multiple seams are encouraged to include a top coat of urethane binder before being placed into use. Butt joint seams are not acceptable except for repairs. Under special conditions and with owner's written approval, seams may be permitted in the same color pad. Consult with manufacturer for specific applications.

D. Perimeter: For installations over new or existing concrete, the perimeter must be saw cut to provide a keyway 1" deep by 1" wide, or formed during pour, with surfacing rolled down inside void. Primer adhesive must be applied to all sides of the void. When connecting to a concrete curb or border the inside vertical edge shall be primed with adhesive and the final 2" of the Cushion Layer shall be tapered to allow the wear surface material to be 1 1/5" to 2" thick where it joins the concrete edge.

E. For installations over new or existing asphalt, a curb or other type of border must be installed around the entire pad. Primer adhesive must be applied to the inside vertical edge of the border before poured-in-place surfacing installation.

F. Thickness: Construction methods, such as the use of measured screeds or guides shall be employed to ensure that the full depth of specified surfacing material is installed. Surfacing system thickness throughout the playground equipment use zone shall be as required to meet the impact attenuation requirements specified herein.

G. Clean up: Manufacturer's installers shall work to minimize excessive adhesive on adjacent surfaced or play equipment. Spills of excess adhesive shall be promptly cleaned.

H. Protection: The safety surface shall be allowed to fully cure in accordance with the Manufacturer's instructions. The surfacing shall be protected by the owner from all traffic during the curing period of 48 hours or as instructed by the manufacturer.

END OF SECTION 32 18 16

SECTION 32 31 13 – CHAIN LINK FENCE

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes fence framework, fabric, gates, steel posts and channels as shown on the Contract Drawings, complete with accessories.

1.2 REFERENCES

A. Materials and installation shall be in accordance with the latest revisions of the following codes, standards and specifications, except where more stringent requirements have been specified herein:

1. American Society for Testing and Materials (ASTM)

a. A90 Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles

b. A121 Specification for Zinc-Coated (Galvanized) Steel Barbed Wire

c. A392 Specification for Zinc-Coated Steel Chain-Link Fence Fabric

d. A428 Test Method for Weight of Coating on Aluminum-Coated Iron or Steel Articles

e. A491 Specification for Aluminum-Coated Steel Chain-Link Fence Fabric

f. A569 Specification for Steel, Sheet and Strip, Carbon (0.15 Maximum Percent). Hot-Rolled, Commercial Quality

g. A585 Specification for Aluminum-Coated Steel Barbed Wire

h. A817 Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric

i. A824 Specification for Metallic-Coated Steel Marcelled Tension Wire for Use with Chain-Link Fence

j. B117 Method of Salt Spray (Fog) Testing

k. C94 Ready-Mixed Concrete

l. F567 Standard Practice for Installation of Chain-Link Fence

m. F626 Specification for Fence Fittings

n. F669 Standard Specification for Strength Requirements of Metal Posts and Rails

o. F083 Standard Specification for Pipe, Steel and Hot Dipped Zinc Coated, Welded, for Fence Structures

1.3 SUBMITTALS

A. In addition to those submittals identified in the General Provisions, the following items shall be submitted:

1. Manufacturers certification that all materials furnished are in compliance with the applicable requirements of the referenced standards and this specification.

B. Samples of any material shall be submitted at the Engineers request.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. The following manufacturers are named to establish a standard of quality necessary for the Project.

1. Allied Tube & Conduit Corp.
2. Anchor Fence, Inc.
3. Page Aluminized Steel Corp.
4. Or equal

2.2 GENERAL

A. Framework: Type I or Type II Steel Pipe.

1. Type I - Schedule 40 steel pipe with 1.8 ounces of zinc coating per square foot of surface area conforming to Standard Specification ASTM F1083; or

2. Type II - pipe manufactured from steel conforming to ASTM A 569 or F 669, cold-formed, high frequency welded and having a minimum yield strength of 50,000 PSI. External surface triple coated with 1.0 ounce +- 0.1 ounce of zinc per square foot, 30 +- 15 micrograms of chromate per square inch and 0.5 +- 0.2 mils of clear, cross linked polyurethane. Internal surface coated, after welding, with a zinc-rich based organic coating having an 87% zinc powder loading capable of providing galvanic protection.

3. Pipe shall be straight, true to section and conform to the following weights:

Pipe Size Outside Diameter	Type I Weight Lbs./Ft.	Type II Weight Lbs./Ft.
1 5/8"	2.27	1.84
2"	2.72	2.28
2 1/2"	3.65	3.12
3"	5.79	4.64
3 1/2"	7.58	5.71
4"	9.11	6.56

4. Channel shall be Unistrut, model P1001A, 1 ⅝” x 3 ¼”, 12 ga. galvanized steel channel, or approved equal.

B. Fittings:

1. Pressed steel or cast iron, galvanized with a minimum of 1.2 ounces of zinc per square foot of surface area, or cast aluminum alloy, all conforming to ASTM F 626.

2.3 CONCRETE MIX

A. ASTM C 94 Portland Cement concrete with maximum 3/4" aggregate having a minimum compressive strength of 2,500 PSI at 28 days.

2.4 MATERIALS AND CONSTRUCTION

A. Fence Posts

1. Fence posts shall be 3.5” O.D.

B. Gate and Electric Equipment Mounting Posts

1. Gate and electric equipment mounting posts shall be sized as follows:

Single Gate Width	Double Gate Width	Post O.D. Type I	Post O.D. Type II
Up to 6'	Up to 12’	4"	3”
7' to 12'	13' to 25'	4"	3.5"
13' to 18'	25' to 36'	6 5/8"	---

Electrical Equipment Mounting Span

Up to 5 4 4

C. Rails and Braces

1. Rails and braces shall be 1.66" O.D.

D. Fabric

1. Fabric shall be black vinyl-coated steel wire, 9 gage, woven in a 2-inch diamond mesh with top knuckled selvage twisted and barbed and bottom selvage knuckled. Fence heights up to 12 feet shall be one-piece widths.

E. Gates

1. Gates shall have frame assembly of 2 inches O.D., Type I or Type II pipe with welded joints. Weld areas repaired with zinc-rich coating applied per manufacturer's directions. Fabric shall match fence. Gate accessories, hinges, latches, center stops, keepers and necessary hardware shall be of quality required for industrial and commercial application. Latches shall permit padlocking of gate.

F. Channels

1. Channel shall be Unistrut, model P1001A, 1 ⅝” x 3 ¼”, 12 ga. galvanized steel channel, or approved equal.

G. Fittings

1. Post caps shall be pressed steel, cast iron or cast aluminum alloy designed to fit snugly over posts to exclude moisture. Supply cone type caps for terminal posts and loop type for line posts.

2. Rail and brace ends shall be pressed steel, cast iron or cast aluminum alloy, cup-shaped to receive rail and brace ends.

3. Top rail sleeves shall be tubular steel, 0.051 thickness by 7 inches long, expansion type.

4. Tension bars shall be steel strip, 5/8 inch wide by 3/16 inch thick.

5. Tension bands shall be pressed steel, 14 gage thickness by 2 inch wide.

6. Brace bands shall be pressed steel, 12 gage thickness by 2 inch wide.

7. Truss rods shall be steel rod, 3/8 inch diameter merchant quality with turnbuckle.

8. Channel mounting bolts shall be hot dip galvanized meeting ASTM F 1554, Grade 36, with nuts meeting ASTM A563 and flat washers.

G. Tension Wire

1. Tension wire shall be marcelled 6 gage steel wire with minimum coating of 0.80 ounces of zinc or 0.40 ounces of aluminum per square foot of wire surface and conforming to ASTM A 824.

H. Tie Wires

1. Tie wires shall be aluminum 6 gage, alloy 1100-H4, A58 self locking fabric bands or equal.

I. Hog Rings

1. Hog rings shall be steel wire, 11 gage with a minimum zinc coating of 0.80 ounces per square foot of wire surface.

PART 3 EXECUTION

3.1 INSTALLATION

A. Fence installation shall conform to requirements of ASTM F 567.

B. Provide fence heights as shown on Contract Drawings.

C. Space line posts at intervals not exceeding ten feet.

D. Set terminal, gate and line posts plumb in concrete footings as shown on Contract Drawings. Top of footing shall be 2 inches above grade and sloped to direct water away from posts.

E. Brace gate and terminal posts back to adjacent line posts with horizontal brace rails and diagonal truss rods.

F. Install top rail through line post loop caps connecting sections with sleeves to form a continuous rail between terminal posts. Fasten top rail to terminal posts.

G. Stretch bottom tension wire between terminal posts 6" above grade and fasten to outside of line posts with tie wires.

H. Pull fabric taut to provide a smooth uniform appearance, free from sag, with bottom selvage 2" above grade. Fasten to terminal posts with tension bars threaded through mesh and secured with tension bands at maximum 18" intervals. Tie to line posts and top rails with tie wires spaced at maximum 14" on posts and 24" on rails. Attach to bottom tension wire with hog rings at maximum 24" intervals.

I. Install gates plumb, level and secure for full opening without interference. Anchor center stops and keepers in concrete. Adjust and lubricate hardware for smooth operation.

J. Install nuts for fittings, bands and hardware bolts on inside of fence. Peen ends of bolts or score threads to prevent removal.

END OF SECTION 32 31 13

SECTION 323119 - ORNAMENTAL METAL FENCING AND GATES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Ornamental steel perforated metal panel fencing
2. Ornamental steel picket metal fencing
3. Ornamental steel picket swing gates
4. Ornamental steel picket sliding cantilever gates.
5. Electric operators for steel picket sliding cantilever gates.

B. Related Work Specified Elsewhere:

1. Card operators for sliding cantilever gates are specified in Division 08 Section “Door Hardware.”

1.2 ACTION SUBMITTALS

A. Product data in the form of manufacturer's technical data, specifications, and installation instructions for railings posts, railing panels, gate posts, cantilever gates, hardware, electric operators, and accessories.

1. Provide certification of cantilever gate design performance criteria.

B. Shop drawings showing location of fence, gates, each post, and details of post installation, gate swing, sliding gate track and fittings, hardware, and accessories.

1. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
2. Wiring Diagrams: Power and control wiring and access-control features.

C. Samples for verification of minimum 6-inch by 6-inch squares of metal perforated panel fence material with applied finish for each color to be provided.

1.3 INFORMATIONAL SUBMITTALS

A. Maintenance Data: For the following to include in maintenance manuals:

1. Gate operator

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has at least three years' experience and has completed at least twenty fence projects and at least twenty cantilever gate projects with with same material and of similar scope to that indicated for this Project with a successful construction record of in-service performance.

B. Single-Source Responsibility: Obtain each type of fencing and gates, including accessories, fittings, and fastenings, from a single source.

1. Obtain all components of cantilevered gates, including operators, tracks, accessories, fittings, and fastenings, from a single source.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. UL Standard: Provide gate operators that comply with UL 325.

E. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for automatic gate operators serving as a required means of access.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify layout information for fences and gates shown on the Drawings in relation to the property survey and existing structures. Verify dimensions by field measurements.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fencing and gates that fail in materials or workmanship within the following warranty periods:

1. Picket Fencing and Swing Gates: Ten years from date of Substantial Completion.
2. Cantilever Sliding Gates: One year from date of Substantial Completion
3. Gate Operator: Two years from date of Substantial Completion. Failures include, but are not limited to faulty operation of gate operators and controls.

1.7 EXTRA MATERIALS

A. Provide touch-up paint kit for each color and type of factory applied paint used on fences and gates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Products, Picket Fencing: Provide fencing, swinging gates and cantilever sliding gate system manufactured by Ameristar Fence Products or equal products manufactured by one of the following:

1. Ametco Manufacturing Corporation
2. Jerith Manufacturing Corporation

B. Basis of Design Product, Perforated Steel Panel Fencing: Provide specified products of Maglin Site Furniture, or equal.

2.2 MISCELLANEOUS MATERIALS

A. Fasteners: Stainless steel.

B. Concrete Fill for Anchoring Posts: Provide concrete in accordance with Division 03 Section "Cast-in-Place Concrete."

C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers.

2.3 FABRICATION

A. General: Fabricate fencing and gate systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of hollow members, post spacings, and anchorage, but not less than that recommended by the manufacturer.

B. Assemble fencing and gate systems in shop to the greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Ornamental Steel Perforated Metal Panel Fencing: System consists of perforated steel panels mounted to tubular posts, as follows:

1. Perforated Steel Panels: 4'-0" w x 6'-0" h 11 gauge galvanized steel panels with decorative perforations in “Fusion” pattern.
2. Posts and Top Frame: Post inner tube constructed from steel with 3/16" wall thickness; with aluminum outer sleeve. Posts 2-1/2" x 3-1/2" tube, 6'-0" high.
3. Post Installation Method: Direct burial, drilled into concrete wall.
4. Performance: Engineered to wind load V=115 mph Exposure C and V=140 mph Exposure B
5. Fence and Gate Height: 8'-0"
6. Colors:
    a. Posts: Gloss Gunmetal.
    b. Panel 1: Gloss Turquoise RAL 5018.
    c. Panel 2: Gloss Green RAL 6037
    d. Panel 3: Gloss Green RAL 6018.

7. Finish: Powder coat paint.
8. Basis of Design Product: Provide FLEXX Fencing, FUSION pattern, by Maglin Site Furniture or equal, with the following components:
   a. Panels: MPA-2600-00007
   b. End Posts (drilled one side): MPA-2600-00030.
   c. Intermediate Posts (drilled 2 sides): MPA-2600-00033.

D. Ornamental Steel Picket Metal Fencing and Swing Gates: System consists of steel tubular pickets mounted to tubular rails and posts, as follows:

1. Pickets, rails and posts shall be fabricated from galvanized steel meeting ASTM A653/A653M, Coating Designation G-90.
2. Tubular Components:
   a. Pickets: 1" square x 14 gauge
   b. Rails: 1.75" square x 14 gauge
   c. Posts: 3" square x 12 gauge.

3. Picket Style: Spear top
4. Fence Height:
   a. 4'-0" on top of masonry wall at front of school
   b. 6'-0" at playground

5. Number of Rails: 3
6. Picket rail hole spacing shall be 4.715" o.c.
7. Performance: Completed sections (i.e., panels) shall be capable of supporting a 600 lb. load applied at midspan without permanent deformation. Panels shall be biasable to a 25% change in grade
8. Swing Gate Components:
   a. Pickets: 1" square x 14 gauge
   b. Rails: 1.75" square x 14 gauge
   c. Gate Ends: 2" square x 12 gauge.

9. Swing Gate Sizes:
   a. On top of masonry wall at front of school: 6'-0" high; one double gate with 3'-0" leafs and three single gates with 3'-0" leafs
   b. At playground: 6'-0" high; one double gate with 4'-0" leafs and one single gates with 4'-0" leafs

10. Gate Hardware: Integrated hinge closer set shall be self-closing, ADA compliant, externally mounted with tamper-resistant security fasteners, with full range of vertical and horizontal adjustability. Hardware shall operate in temperatures of negative 20 F to 200 F degrees, and swings to negative 2 degrees to ensure reliable final lock engagement.
11. Color: Black
12. Finish: Powder coat paint.
13. Basis of Design Product: Provide Ameristar Aegis II in Classic design by Ameristar Fence Products, Inc. or equal.

E. Ornamental Steel Picket Sliding Cantilever Gates: Gates consist of steel tubular pickets mounted to tubular rails and posts, with tubular uprights and diagonal bracing and enclosed tracks, as follows:

1. Pickets and fence posts shall be fabricated from galvanized steel meeting ASTM A653/A653M, Coating Designation G-90.
2. Gate uprights, diagonal bracing and enclosed track shall be fabricated from aluminum meeting ASTM B221 Designation 6063-T6.
3. Tubular Components:
   a. Pickets: 1" square x 16 gauge
   b. Gate Uprights and Diagonal Bracing: 2" square x 1/4" wall thickness
   c. Fence Posts: 4" square x 11 gauge.
   d. Enclosed Track Extrusion, Single Track: 2" x 5" channeled support with integrated 2" x 2" enclosed-track raceway.
4. Picket Style: Spear top
5. Picket rail hole spacing shall be 5" o.c.
6. Gate Height: 6'-0"
7. Gate Width: 20'-0"
8. Gate Travel Direction (as viewed from the street):Slides left to right.
9. Gate Hardware: Suspension rollers for enclosed tracks shall be used at each support post to track connection. Each truck assembly shall be capable of being adjusted vertically via threaded rod for fine-tune adjustment. Truck assembly shall be constructed in a way so that the primary housing for the truck rollers shall pivot via ball-bearing connection to threaded rod.
10. Gate Operator: Electric motor, key-card operated.
11. Color: Black
12. Finish: Powder coat paint.
13. Basis of Design Product: Provide Ameristar TransPort II in Classic design by Ameristar Fence Products, Inc. or equal.

F. Sliding Gate Operator: LEPUS Rack Industrial Fast gear rack sliding motor in oil bath with UNIGATE control board by SEA USA, or equal.

1. Motor: 1/3 HP. Opening time 1.5 foot per second.
2. Power: 120 volt, 50/60 Hz, 3 amp
3. Capacity: Operates gates up to 3800 lbs. in weight and 40 ft. long
4. Accessories: Warning signboard, receiver, remote control.
5. Actuator: Owner’s card reader, refer to Section 087100.

2.4 ALUMINUM AND STEEL FINISH

A. Pretreat metal components with 3 stage non-chrome pretreatment.

B. Polyester Powder-Coat Finish: Manufacturer's standard.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install fencing, swing gates, cantilever gate and electric operator to comply with manufacturer's instructions and performance criteria indicated. Do not begin installation and erection before concrete walk ways and asphalt paving are completed, unless otherwise permitted.

B. Corrosion Protection: Coat concealed surfaces of aluminum alloys that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

C. Excavation: Drill or hand-excavate (using post-hole digger) holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.

1. If not indicated on Drawings, excavate holes for each post to minimum diameter recommended by cantilever gate manufacturer, but not less than four times the largest cross section of post.
2. Unless otherwise indicated, excavate hole depths approximately 3 inches lower than post bottom, with bottom of posts set not less than 36 inches below finish grade surface.

D. Setting Posts: Center and align posts in holes 3 inches above bottom of excavation. Space as indicated on drawings.

1. Anchor posts by setting in concrete.
2. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.

E. Brace Assemblies: Install braces at end posts when required by gate manufacturer

3.2 GATE INSTALLATION

A. Install gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary. Install gates according to manufacturer's instructions, plumb, level, and secure.

3.3 ADJUSTING AND CLEANING

A. Gates: After repeated operation of completed installation equivalent to 3 days use by normal traffic, readjust gates for optimum operating condition and safety. Lubricate operating equipment and clean exposed surfaces.

B. Touchup Painting: Immediately after erection, clean bolted connections, and abraded areas of paint finish, and paint exposed areas with same material as used for shop painting.

1. Apply by brush or spray to provide a 2.0-mil (0.05-mm) minimum dry film thickness.

END OF SECTION 323119

SECTION 32 92 00 - TURFS AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Division 01 General Requirements and Section 01 50 00 Temporary Facilities and Controls apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Seeding.
2. Meadow grasses and wildflowers.

B. Related Sections include Section 01 50 00 Temporary Facilities and Controls for Temporary Seeding.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

C. 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. 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.

B. Product Certificates: For soil amendments and fertilizers, signed by product manufacturer.

C. Qualification Data: For landscape Installer.

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 and meadow establishment.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.

B. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; deleterious material; pH; and mineral and plant-nutrient content of topsoil.

1. Report suitability of topsoil for lawn growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce a satisfactory topsoil.

C. Pre-installation Conference: Conduct pre-installation conference at the Site per Division 01 General Requirements.

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. Planting: April 1 to September 15 or as approved by Engineer.

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. Seeded Lawns: 60 days 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.

C. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawn uniformly moist to a depth of 4 inches (100 mm).
1. Water lawn at a minimum rate of 1 inch (25 mm) per week.

D. Mow lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 40 percent of grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
1. Mow grass 1 to 2 inches (25 to 50 mm) high.

E. Lawn Post-fertilization: Apply fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) to lawn area.

1.9 MEADOW MAINTENANCE

A. Begin maintenance immediately after each area is planted and continue until acceptable meadow is established, but for not less than 40 days from date of Substantial Completion.

B. Maintain and establish meadow by watering, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch.

C. Watering: Provide lawn-watering equipment to convey water from sources and to keep meadow uniformly moist.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch.
2. Water meadow at a minimum rate of 1/2 inch (13 mm) per week for 6 weeks after planting.

PART 2 - PRODUCTS

2.1 SEED

A. Seed Species:

1. Seed Mix #1 (Lawn Areas)
   a. Provide seed mix at a rate of 100 pounds per acre containing the following mixture:
      1) Kentucky Bluegrass (20%).

2) Creeping Red Fescue (40%).
3) Perennial Ryegrass (20%).
4) Annual Ryegrass (20%).

2. Seed Mix #2 (Meadow Areas)
   a. Provide Showy Northeast Native Wildflower & Grass Mix (ERNMX-153) at a rate of 20 pounds per acre as provided by Ernst Conservation Sees, Inc. or approved equal.

2.2 TOPSOIL

A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 4 percent organic material content; free of stones 1 inch (25 mm) or larger in any dimension and other extraneous materials harmful to plant growth.

1. Topsoil Source: Reuse surface soil stockpiled on-site. Verify suitability of stockpiled surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

   a. Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from agricultural land, bogs or marshes.

2.3 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent and as follows:

1. Class: Class T, with a minimum 99 percent passing through No. 8 (2.36-mm) sieve and a minimum 75 percent passing through No. 60 (0.25-mm) sieve.

B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum 99 percent passing through No. 6 (3.35-mm) sieve and a maximum 10 percent passing through No. 40 (0.425-mm) sieve.

C. Aluminum Sulfate: Commercial grade, unadulterated.

D. Perlite: Horticultural perlite, soil amendment grade.

E. Sand: Clean, washed, natural or manufactured, free of toxic materials.

2.4 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through [3/4-inch (19-mm)] sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.

B. Peat: Sphagnum peat moss, partially decomposed, finely divided or granular texture, with a pH range of 3.4 to 4.8.

C. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.5 PLANTING ACCESSORIES

A. Selective Herbicides: EPA registered and approved, of type recommended by manufacturer for application.

2.6 FERTILIZER

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. 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: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.7 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

2.8 EROSION-CONTROL MATERIALS

A. Erosion-Control Blankets: per Section 01 50 00 Temporary Facilities and Controls.

2.9 PLANTING SOIL MIX

A. Planting Soil Mix: Mix topsoil with soil amendments and fertilizers recommended by the qualified soil testing laboratory.

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 hydroseeding 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. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 6 inches (150 mm). Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Thoroughly blend planting soil mix off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil mix.

a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.

2. Spread planting soil mix to a depth of 4 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

C. 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 (13 mm) 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.

D. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

E. 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 (8 km/h). 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 of 3 to 4 lb/1000 sq. ft. (1.4 to 1.8 kg/92.9 sq. m).

C. Rake seed lightly into top 1/8 inch (3 mm) of topsoil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre (42 kg/92.9 sq. m) to form a continuous blanket 1-1/2 inches (38 mm) in loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.

3.5 HYDROSEEDING

A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Mix slurry with nonasphaltic tackifier.
2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply mulch at a minimum rate of 1500-lb/acre (15.3-kg/92.9 sq. m) dry weight but not less than the rate required to obtain specified seed-sowing rate.

3.6 SATISFACTORY LAWNS

A. Satisfactory Seeded Lawn: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm).

B. Reestablish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.

3.7 MEADOW

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). 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 net rate as recommended by manufacturer.

C. Brush seed into top 1/16 inch (1.6 mm) of topsoil, roll lightly, and water with fine spray.

D. Water newly planted areas and keep moist until meadow is established.

3.8 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by lawn work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period and remove after lawn is established.

C. Remove erosion-control measures after grass establishment period.

END OF SECTION 32 92 00

SECTION 33 14 00 - WATER UTILITY TRANSMISSION AND DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Division 01 General Requirements, Section 31 20 00 Earth Moving, Section 31 23 33 Trenching and Backfilling, and Section 31 50 00 Excavation Support and Protection.

1.2 SUMMARY

A. This Section includes piping and specialties for potable-water and fire-protection water service for the subdivision.

1.3 DEFINITIONS

A. The following are industry abbreviations for plastic and rubber materials:

1. DIP: Ductile Iron Pipe.
2. NP: Nylon.
3. PE: Polyethylene.
4. PP: Polypropylene.
5. PTFE: Polytetrafluoroethylene.
6. PVC: Polyvinyl chloride.

1.4 SUBMITTALS

A. Product Data: For the following:
1. Pipe and fittings.
2. Flexible pipe fittings.
3. Valves.
4. Fire department connections.
5. Meter pit and appurtenances.

B. Record Drawings: per Division 01 General Requirements.

C. Test Reports: As specified in "Field Quality Control" Article in Part 3.

D. Purging and Disinfecting Reports: As specified in "Cleaning" Article in Part 3.

1.5 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Product Options: Drawings indicate size, and dimensional requirements of water-service piping specialties and are based on specific types and models indicated.

C. Comply with standards of authorities having jurisdiction for potable water-service piping. Include materials, installation, testing, and disinfection.

D. Comply with NSF 61, "Drinking Water System Components--Health Effects," for materials for potable water.

E. Comply with NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances," for materials, installations, tests, flushing, and valve and hydrant supervision.

F. Comply with NFPA 70, "National Electrical Code," for electrical connections between wiring and electrically operated devices.

G. Provide listing/approval stamp, label, or other marking on piping and specialties made to specified standards.

H. Listing and Labeling: Provide electrically operated specialties and devices specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 Requirements.

B. Preparation for Transport: Prepare valves according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves according to the following:

4. Do not remove end protectors, unless necessary for inspection; then reinstall for storage.
5. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

B. Handling: Use sling to handle valves whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use handwheels or stems as lifting or rigging points.

C. Deliver piping with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

D. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

E. Protect flanges, fittings, and specialties from moisture and dirt.

F. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Verify that water-service piping may be installed to comply with original design and referenced standards.

C. Site Information: Reports on subsurface condition investigations made during design of Project are available for informational purposes only; data in reports are not intended as representations or warranties of accuracy or continuity of conditions between soil borings. Owner assumes no responsibility for interpretations or conclusions drawn from this information.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Sleeves, and Corporation Stops:

   a. Ford Meter Box Co., Inc.
   b. Grinnell Corp.; Mueller Co.; Water Products Div.
   c. Lee Brass Co.

2. Gate Valves:

   a. Grinnell Corp.; Grinnell Supply Sales Co.
   b. Grinnell Corp.; Mueller Co.; Water Products Div.
   c. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa)
   d. McWane, Inc.; Kennedy Valve Div.
   e. Nibco, Inc.
   f. Pratt: Henry Pratt Co.

2.2 PIPES AND TUBES

A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.

B. Copper Tube: ASTM B 88 (ASTM B 88M), seamless water tube, annealed temper.

C. Ductile/PVC Plastic, AWWA C900, pressure class 200 with a DR not to exceed 14. Include elastomeric seal according to ASTM F 477.

D. Pipe shall be furnished in standard 20 foot lengths with no more than 15 percent furnished in random lengths exceeding 10 feet each.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Restrained joint pipe shall be ductile iron manufactured in accordance with the requirements of ANSI/AWWA C151/A21.51. Push-on joints for such pipe shall be in accordance with ANSI/AWWA C111/A21.11 “Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings”. Pipe thickness shall be designed in accordance with ANSI/AWWA C150/A21.50 “Thickness Design of Ductile-Iron Pipe” Class 54.

B. Restrained joint fittings and the restraining components shall be ductile iron in accordance with applicable requirements of ANSI/AWWA C110/A21.10 and/or C153/A21.53. Push-on joints for such fittings shall be in accordance with ANSI/AWWA C111/A21.11.

C. Restrained joint pipe and fittings shall be Field Lok 350 gaskets.

D. Cement mortar lining and seal coating for pipe and fittings shall be in accordance with ANSI/AWWA C104/A21.4. Asphaltic outside coating shall be in accordance with ANSI/AWWA C151/A21.51 for pipe and ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53 for fittings.

E. Restrained push-on joints for pipe and fittings shall be designed for a water working pressure of 350 psi for sizes 4-inch through 24-inch.

F. Restrained push-on joint pipe and fittings shall be capable of being deflected after assembly.

2.4 PIPE AND TUBE FITTINGS

A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.

C. Copper Fittings: ASME B16.22; wrought-copper, solder-joint pressure type.

D. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150 or 300, as required for system operating pressure.

E. Ductile-Iron, Flexible Expansion Joints: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Units have 2 gasketed ball-joint sections and 1 or more gasketed sleeve sections. Include 250-psig (1725-kPa) minimum working-pressure rating; epoxy, interior coating according to AWWA C550; length for offset and expansion indicated; and glands, rubber gaskets, and bolts and nuts according to AWWA C111.

F. Ductile-Iron, Deflection Fittings: Compound coupling fitting with sleeve and flexing sections, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include 250-psig (1725-kPa) minimum working-pressure rating; cement-mortar lining or epoxy, interior coating according to AWWA C550; deflection of at least 20 degrees (0.34 radians); and glands, rubber gaskets, and bolts and nuts according to AWWA C111.

G. Ductile-Iron Fittings: AWWA C110, ductile-iron or cast-iron; or AWWA C153, ductile-iron, compact type; push-on- or mechanical-joint type. Include dimensions matching pipe, cement-mortar lining and seal coat according to AWWA C104, and rubber compression gaskets according to AWWA C111.

H. Mechanical joint restraining glands shall be “megalug 2000 PV” as manufactured by Ebaa Iron Sales, Inc. or approved equal.

2.5 PIPING SPECIALITIES

A. Dielectric Fittings: Assembly or fitting with insulating material isolating joined dissimilar metals to prevent galvanic action and corrosion.

1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weldneck end types and matching piping system materials.

2. Dielectric Unions: Factory-fabricated union assembly, designed for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C). Include insulating material isolating dissimilar metals and ends with inside threads according to ASME B1.20.1.

3. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum pressure to suit system pressures.

4. Dielectric-Flange Insulation Kits: Field-assembled companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

a. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure to suit system pressures.

5. Dielectric Couplings: Galvanized-steel couplings with inert and noncorrosive thermoplastic lining, with threaded ends and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

6. Dielectric Nipples: Electroplated steel nipples with inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300-psig (2070-kPa) working pressure at 225 deg F (107 deg C).

2.6 VALVES

A. Nonrising-Stem, Resilient-Seated Gate Valves, 3-Inch NPS (DN80) and Larger: AWWA C509, gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut. Include 200-psig (1380-kPa) minimum working-pressure design, interior coating according to AWWA C550, and push-on- or mechanical-joint ends.

B. Valve Boxes: Cast-iron box with top section and cover with lettering "WATER," bottom section with base of size to fit over valve and barrel approximately 5 inches (125 mm) in diameter, and adjustable cast-iron extension of length required for depth of bury of valve.

1. Provide steel tee-handle operating wrench with each valve box. Include tee handle with one pointed end, stem of length to operate valve, and socket-fitting valve-operating nut.

C. Curb Stops: Bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet to match service piping material.

D. Service Boxes for Curb Stops: Cast-iron box with telescoping top section of length required for depth of bury of valve. Include cover with lettering “WATER”, and bottom section with base of size to fit over curb-stop and barrel approximately 3 inches (75 mm) in diameter.

1. Provide steel tee-handle shutoff rod with each service box. Include tee handle with one pointed end, stem of length to operate curb stop, and slotted end fitting curb-stop head.

E. Service Clamps and Corporation Stops: Complete assembly, including service clamp, corporation stop, and bolts and nuts. Include service clamp and stop compatible with drilling machine.

1. Service Clamp: Cast iron or ductile iron with gasket and AWWA C800 threaded outlet for corporation stop, and threaded end straps.

2. Corporation Stops: Bronze body and ground-key plug, with AWWA C800 threaded inlet and outlet matching service piping material.

2.7 FIRE HYDRANTS

A. Fire hydrants shall meet UL 262, FM 1120/1130, and ANSI/AWWA C502 standards. The main valve opening shall be 5 ¼" with two hose nozzles and one pumper nozzle. Hydrant shall be Super Centurion 250#A-423 as manufactured by Mueller or approved equal.

2.8 ANCHORAGES

A. Clamps, Straps, and Washers: ASTM A 506, steel.

B. Rods: ASTM A 575, steel.

C. Rod Couplings: ASTM A 197 (ASTM A 197M), malleable iron.

D. Bolts: ASTM A 307, steel.

E. Cast-Iron Washers: ASTM A 126, gray iron.

F. Concrete Reaction Backing: Portland cement concrete mix, 3000 psig (20.7 MPa).

1. Cement: ASTM C 150, Type I.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

2.9 IDENTIFICATION

A. Use detectable warning tapes made of solid blue film with metallic core and continuously printed black-letter caption "CAUTION--WATER LINE BURIED BELOW."

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications:

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.

C. Do not use flanges or keyed couplings for underground piping.

1. Exception: Piping in boxes and structures, but not buried, may be joined with flanges or keyed couplings instead of joints indicated.

D. Flanges, keyed couplings, and special fittings may be used on aboveground piping.

3.2 JOINT CONSTRUCTION

A. Copper Tubing, Brazed Joints: According to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

B. Copper Tubing, Soldered Joints: According to CDA's "Copper Tube Handbook."

C. PVC Piping, Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.

D. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, OD, and system working pressure. Refer to "Piping Systems - Common Requirements" Article below for joining piping of dissimilar metals.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe, pump sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.

B. Install components with pressure rating equal to or greater than system operating pressure.

C. Install piping free of sags and bends.

D. Install fittings for changes in direction and branch connections.

E. Piping Connections: Unless otherwise indicated, make piping connections as specified below:

1. Install unions, in piping 2-inch NPS (DN50) and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS (DN50) or smaller threaded pipe connection.

2. Install dielectric fittings to connect piping of dissimilar metals.

3.4 PIPING INSTALLATION

A. Make connections, 2-inch NPS (DN50) and smaller, according to the following:

1. Install service clamps and corporation stops in size, quantity, and arrangement required and according to manufacturer's written instructions.

2. Install curb stop in service piping with head pointing up and with cast-iron service box.

B. Comply with NFPA 24 for fire-protection water-service piping materials and installation.

C. Install copper tube and fittings according to CDA's "Copper Tube Handbook."

D. Install AWWA PVC plastic pipe according to AWWA M23 and ASTM F 645.

E. Bury piping with depth of cover over top at least 48 inches.

F. Install piping under streets and other obstructions that cannot be disturbed, by tunneling, jacking, or combination of both.

3.5 ANCHORAGE INSTALLATION

A. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Gasketed-Joint, PVC Potable-Water Piping: According to AWWA M23.
2. Fire-Service Piping: According to NFPA 24.

B. Apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of installed ferrous anchorage devices.

3.6 VALVE INSTALLATION

A. General Application: Use mechanical-joint-end valves for 3-inch NPS (DN80) and larger underground installation. Use threaded- and flanged-end valves for installation in pits. Use non-rising-stem UL/FM gate valves. Use bronze corporation stops and valves, with ends compatible with piping, for 2-inch NPS (DN50) and smaller installation.

B. UL/FM-Type Gate Valves: Comply with NFPA 24. Install underground valves and valves in pits with stem pointing up and with vertical cast-iron indicator post.

C. Bronze Corporation Stops and Curb Stops: Comply with manufacturer's written instructions. Install underground curb stops with head pointed up and with cast-iron curb box.

3.7 IDENTIFICATION INSTALLATION

A. Install continuous detectable underground warning tape during back-filling of trench for underground water-service piping. Locate 18 inches (300 mm) below finished grade, directly over piping.

3.8 PRESSURE TEST

A. Pressure and leakage tests shall be performed in accordance with the latest revision of AWWA C600, Section 7.3, HYDROSTATIC TESTING.

B. Final tests must be performed in the presence of the certifying Engineer and prior to disinfecting. Do not conduct any hydrostatic tests until after all associated concrete work has set for a minimum of 7 days for standard concrete or at least 36 hours for high early strength concrete.

C. The test pressure shall be 150 percent of the maximum working pressure or 150 psi., whichever is greater.

D. The allowable leakage will be determined by the following formula.

$$L = \frac{SD \surd P}{148{,}000}$$

Where:

L = testing allowance (makeup water), in gallons per hour
S = length of pipe tested in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the hydrostatic test, in pounds per square inch (gauge)

E. All visible leakage must be repaired.

F. Following disinfecting, conduct operating tests in the presence of the certifying Engineer to verify all valves and hydrants are in proper working condition.

3.9 CLEANING

A. Clean and disinfect water distribution piping as follows:

1. Purge new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and continuous feed method disinfecting procedure only as described in the latest revision of AWWA C651.
   a. All work under this section shall be performed in the presence of the Design Engineer, and a representative of the public health authority having jurisdiction, as required.
   b. Chlorination shall be scheduled such that sampling and flushing will be performed during normal daylight working hours. The contractor shall provide acceptable backflow prevention on all supply water to prevent any potential backflow contamination or cross connection.
   c. Chlorination shall be by the use of a solution of water and liquid chlorine, calcium hypochlorite or sodium hypochlorite and the solution shall be contained in the pipe or structure as specified.
   d. Prior to chlorination, all dirt and foreign matter shall be removed by a thorough cleaning and flushing of the pipeline or structure.
   e. The chlorine solution shall be introduced to pipelines through corporation stops placed in the horizontal axis of the pipe, to structures by means of tubing extending directly into the structure, or other approved methods.
   f. The application of the chlorine solution shall be by means of a controlled solution feed device. The rate of chlorine solution flow shall be in such proportion to the rate of water entering the pipe or structure that the resulting free chlorine residual shall be between 25 and 50 parts per million (PPM), milligrams per liter (mg/l).

g. The chlorine treated water shall be retained in the pipe or structure at least 24 hours, unless otherwise directed. During the retention period, all valves and hydrants within the treated sections shall be operated.

h. The chlorine residual shall be not less than 10 PPM (mg/l) at any point in the pipe or structure at the end of the 24-hour retention period.

i. When making repairs to, or when specified, structures and portions of pipelines shall be chlorinated by a concentrated chlorine solution containing not less than 200 PPM (mg/l) of free chlorine. The solution shall be applied with a brush or sprayed on the entire inner surface of the empty pipes or structures. The structures disinfected shall remain in contact with the strong chlorine solution for at least 30 minutes.

j. After the required retention of chlorinated water in the pipe or structures, they shall be thoroughly flushed until the replacement water shall, upon test, both chemically and bacteriological, be proven equal to water quality served by the public from the existing water supply system.

k. The disposal of chlorinated water from any pipe or structure shall be such that it will not cause damage to any vegetation, fish, or animal life.

l. The Contractor shall make all arrangements for the testing of water quality by an approved independent laboratory. Two acceptable bacteriological test, taken at least 24 hours apart, shall be collected from the new watermain. At least 1 set of samples must be collected from every 1,000 LF of the new watermain, plus one set from the end of the line and at least one set from each branch. The results for all test shall be forwarded to the Design Engineer and the public health authority having jurisdiction.

m. All water quality requirements shall be fulfilled prior to the passage of any water through the new system to a public supply or the use of the new system.

B. Prepare reports for purging and disinfecting activities.

END OF SECTION 33 14 00

SECTION 33 30 00 - SANITARY SEWERAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Division 01 General Requirements, Section 31 20 00 Earth Moving, Section 31 23 33 Trenching and Backfilling, and Section 31 50 00 Excavation Support and Protection.

1.2 SUMMARY

A. This Section includes sanitary sewerage outside the building.

1.3 DEFINITIONS

A. PE: Polyethylene plastic.

B. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

B. Pressure rated pipe and fittings, 200 psi pressure rating.

1.5 SUBMITTALS

A. Shop Drawings: Include plans, elevations, details, and attachments for the following:

1. Precast concrete tanks and manholes, including cast iron frames and covers.

2. Pipe and fittings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Do not store plastic structures, pipe, and fittings in direct sunlight.

C. Protect pipe, pipe fittings, and seals from dirt and damage.

D. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Locate existing structures and piping to be closed and abandoned.

C. 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.
2. Do not proceed with utility interruptions without Engineer's written permission.

PART 2 - PRODUCTS

2.1 PIPES AND FITTINGS

A. PVC Sewer Pipe and Fittings: According to the following:

1. PVC Sewer Pipe and Fittings, NPS 12 (DN375) and Smaller: ASTM D 3034, SDR-35, for solvent-cemented joints or gasketed joints.

a. Gaskets: ASTM F 477, elastomeric seals.

2. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D 2241, SDR 21, for solvent- cemented or gasketed joints.

a. Gaskets: ASTM F 477, elastomeric seals.

B. Ductile-Iron Pipe and Fittings:

1. Restrained joint pipe shall be ductile iron manufactured in accordance with the requirements of ANSI/AWWA C151/A21.51. Push-on joints for such pipe shall be in accordance with ANSI/AWWA C111/A21.11 "Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings". Pipe thickness shall be designed in accordance with ANSI/AWWA C150/A21.50 "Thickness Design of Ductile-Iron Pipe" Class 52.

2. Restrained joint fittings and the restraining components shall be ductile iron in accordance with applicable requirements of ANSI/AWWA C110/A21.10 and/or C153/A21.53. Push-on joints for such fittings shall be in accordance with ANSI/AWWA C111/A21.11.

3. Restrained joint pipe and fittings shall be U.S. Pipe's Tyton Joint Pipe with

Field Lok 350 gaskets or approved equal.

4. Cement mortar lining and seal coating for pipe and fittings shall be in accordance with ANSI/AWWA C104/A21.4 Asphaltic outside coating shall be in accordance with ANSI/AWWA C151/A21.51 for pipe and ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53 for fittings.

5. Restrained push-on joints for pipe and fittings shall be designed for a water working pressure of 350 psi for sizes 4-inch through 24-inch.

6. Restrained push-on joint pipe and fittings shall be capable of being deflected after assembly.

2.2 SPECIAL PIPE COUPLINGS AND FITTINGS

A. Sleeve-Type Pipe Couplings: ASTM C 1173, rubber or elastomeric sleeve and band assembly fabricated to mate with OD of pipes to be joined, for nonpressure joints.

1. Sleeve Material for Plastic Pipe: ASTM F 477, elastomeric seal.
2. Sleeve Material for Dissimilar Pipe: Compatible with pipe materials being joined.
3. Bands: Stainless steel, at least one at each pipe insert.

B. Pipe and Tube Fittings:

1. Ductile-Iron, Flexible Expansion Joints: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Units have 2 gasketed ball-joint sections and 1 or more gasketed sleeve sections. Include 250-psig (1725-kPa) minimum working-pressure rating; epoxy, interior coating according to AWWA C550; length for offset and expansion indicated; and glands, rubber gaskets, and bolts and nuts according to AWWA C111.
2. Ductile-Iron, Deflection Fittings: Compound coupling fitting with sleeve and flexing sections, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include 250-psig (1725-kPa) minimum working-pressure rating; cement- mortar lining or epoxy, interior coating according to AWWA C550; deflection of at least 20 degrees (0.34 radians); and glands, rubber gaskets, and bolts and nuts according to AWWA C111.
3. Ductile-Iron Fittings for PVC Pipe: AWWA C110, ductile-iron or cast-iron; or AWWA C153, ductile-iron, compact type; push-on- or mechanical-joint type. Include dimensions matching PVC pipe, cement-mortar lining and seal coat according to AWWA C104, and rubber compression gaskets according to AWWA C111.
4. Mechanical joint restraining glands shall be “megalug 2000 PV” as manufactured by Ebaa Iron Sales, Inc. or approved equal.

2.3 MANHOLES

A. Normal-Traffic Precast Concrete Manholes: ASTM C 478 (ASTM C 478M), precast, rein- forced concrete, of depth indicated, with provision for rubber gasketed joints.

1. Diameter: 48 inches (1200 mm) minimum, unless otherwise indicated. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
2. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 5-inch (125-mm) minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
3. Riser Sections: 5-inch (125-mm) minimum thickness, and lengths to provide depth indicated.
4. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
5. Gaskets: ASTM C 443 (ASTM C 443M), rubber.
6. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch (150- to 229- mm) total thickness, that match 24-inch- (610-mm-) diameter frame and cover.
7. Steps: Fiberglass individual steps. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into base, riser, and top section sidewalls with steps at 12-inch (300-mm) intervals.
8. Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section.
9. Shall be designed for H-20 loading.

B. Manhole Frames and Covers: ASTM A -48, Class 35B, gray iron castings designed for heavy- duty service. Include 22⅜-inch ID by 6-inch (150-mm) riser with 4-inch (100-mm) minimum width flange, and 24-inch- diameter cover. Include indented top design with lettering "SEWER" cast into cover.

2.4 CONCRETE

A. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water- cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (Grade 400), deformed steel.

B. Structure Channels and Benches: Factory or field formed from concrete. Portland cement de- sign mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water-cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

a. Invert Slope: 2 percent through manhole.

2. Benches: Concrete, sloped to drain into channel.

a. Slope: 4 percent.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with

1. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
2. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 5-inch (125-mm) minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
3. Riser Sections: 5-inch (125-mm) minimum thickness, and lengths to provide depth indicated.
4. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
5. Gaskets: ASTM C 443 (ASTM C 443M), rubber.
6. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch (150- to 229- mm) total thickness, that match 24-inch- (610-mm-) diameter frame and cover.
7. Steps: Fiberglass individual steps. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into base, riser, and top section sidewalls with steps at 12-inch (300-mm) intervals.
8. Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section.
9. Shall be designed for H-20 loading.

D. Manhole Frames and Covers: ASTM A -48, Class 35B, gray iron castings designed for heavy- duty service. Include 22⅜-inch ID by 6-inch (150-mm) riser with 4-inch (100-mm) minimum width flange, and 24-inch- diameter cover. Include indented top design with lettering "SEWER" cast into cover.

2.5 CONCRETE

A. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water- cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (Grade 400), deformed steel.

B. Structure Channels and Benches: Factory or field formed from concrete. Portland cement de- sign mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water-cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with

height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

a. Invert Slope: 2 percent through manhole.

2. Benches: Concrete, sloped to drain into channel.

a. Slope: 4 percent.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water-cementitious materials ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (Grade 400), deformed steel.

2.6 PROTECTIVE COATINGS

A. Description: One-coat, coal-tar epoxy; 15-mil (0.38-mm) minimum thickness, unless otherwise indicated; factory or field applied to the following surfaces:

1. Concrete Manholes: On exterior surface.

2.7 CLEANOUTS

A. PVC Cleanouts: PVC body with PVC threaded cap. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping. Cleanout to be encased in minimum 6” I.D. Valve box cover with “sewer” stamped on cover.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 31 20 00 Earth Moving and Section 31 23 33 Trenching and Backfilling.

3.2 IDENTIFICATION

A. Materials and their installation are specified in Section 31 20 00 Earth Moving for installing green warning tape directly over piping buried 18” from finished grade.

3.3 PIPING APPLICATIONS

A. General: Include watertight joints.

B. Gravity-Flow Piping: Use the following:

1. NPS 4, NPS 6 and NPS 8 (DN100 and DN200): PVC, SDR 35, sewer pipe and fittings; solvent- cemented joints; or gaskets and gasketed joints.

3.4 SPECIAL PIPE COUPLING AND FITTING APPLICATIONS

A. Special Pipe Couplings: Use where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.

1. Use the following pipe couplings for nonpressure applications:

a. Sleeve type to join piping, of same size, or with small difference in OD.
b. Increaser/reducer-pattern, sleeve type to join piping of different sizes.

2. Use the following pipe couplings for pressure applications:

a. Sleeve type solvent cement of same size.

B. Special Pipe Fittings: Use where indicated.

3.5 INSTALLATION, GENERAL

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

D. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

3.6 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. General: Join and install pipe and fittings according to installations indicated.

B. Hub-and-Spigot, Cast-Iron Soil Pipe and Fittings: With rubber gaskets according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook." Use gaskets that match

class of pipe and fittings.

C. DIP Piping, Gasketed Joints: Use joining materials according to ANSI/AWWA C111/A21.11. Construct joints with elastomeric seals and lubricant according to AWWA C600 or AWWA M41 and pipe manufacturer's written instructions.

D. PVC Pressure Pipe and Fittings: Join and install according to AWWA M23.

E. PVC Sewer Pipe and Fittings: As follows:

1. Join pipe and gasketed fittings with gaskets according to ASTM D 2321.
2. Join profile sewer pipe fittings with gaskets according to ASTM D 2321 and manufacturer's written instructions.
3. Install according to ASTM D 2321.
4. Join pipe with solvent cement fittings according to ASTMD 2855.

F. System Piping Joints: Make joints using system manufacturer's couplings, unless otherwise indicated.

G. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.

3.7 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Form continuous concrete channels and benches between inlets and outlet. Channels shall be Trowel finished with smooth surface, benches shall have a broom finish.

C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3" above finished surface elsewhere, unless otherwise indicated.

D. Install precast concrete manhole sections with gaskets according to ASTM C 891.

3.8 CLEANOUT INSTALLATION

A. Set cleanout frames and covers flush with surrounding grade or as indicated on plans.

B. Set cleanout frames and covers in pavement areas with tops flush with pavement surface.

3.9 TAP CONNECTIONS

A. Make connections to existing piping and underground structures so finished Work

complies as nearly as practical with requirements specified for new Work.

B. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch (150-mm) overlap, with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).

C. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN100 to DN500). Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).

D. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.10 FIELD QUALITY CONTROL

A. Clear interior of piping and structures of dirt and superfluous material as work progresses.

1. Place plug in end of incomplete piping at end of day and when work stops.
2. Flush piping between manholes and other structures to remove collected debris, if re- quired by authorities having jurisdiction.

B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 95 percent of piping diameter.
    c. Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Re-inspect and repeat procedure until results are satisfactory.

C. Test new piping systems, and parts of existing systems that have been altered, extended, or re- paired, for leaks and defects.

1. Do not put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least

24 hours' advance notice.

4. Submit separate reports for each test.
5. Manholes and Sanitary Sewerage: Perform manhole vacuum testing in accordance with the latest revision of ASTM C1244-02. Perform low-pressure air testing of piping in accordance with the latest revision of ASTM F1417-92, Section 8.2.2, Time-Pressure Drop Method for a 0.5 psi drop.
6. Sewer Forcemain: Perform pressure and leakage test hydrostatically. Each forcemain test shall be for a minimum of 2 hours and at a minimum test pressure of 1.5 times operation pressure or 50 psi, whichever is greater. Allowable leakage for each forcemain is 0.5 gallons per 1,000 feet for 30 minutes.

END OF SECTION 33 30 00

SECTION 33 41 00 - STORM UTILITY DRAIN PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Division 01 General Requirements, Section 31 20 00 Earth Moving, Section 31 23 33 Trenching and Backfilling, and Section 31 50 00 Excavation Support and Protection.

1.2 SUMMARY

A. This Section includes storm drainage as shown on the project drawings.

1.3 DEFINITIONS

A. HDPE: High-Density Polyethylene plastic.

B. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Shop Drawings: Include plans, elevations, details, and attachments for the following:

1. Precast concrete inlets, catch basins, and other structures, including frames, covers, and grates.

2. Drainage Piping.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 Requirements.

B. Do not store plastic structures, pipe, and fittings in direct sunlight.

C. Protect pipe, pipe fittings, and seals from dirt and damage.

D. Handle precast concrete inlets and other structures according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Locate existing structures and piping to be closed and abandoned.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.2 PIPES AND FITTINGS

A. Corrugated PE Drainage Tubing and Fittings: AASHTO M 252, Type S, with smooth waterway for coupling joints.

1. Soiltight Couplings: AASHTO M 252, corrugated, matching tube and fittings to form soiltight joints.

B. Corrugated PE Pipe and Fittings: AASHTO M 294, Type S, with smooth waterway for coupling joints.

1. Soiltight Couplings: AASHTO M 294, corrugated, matching pipe and fittings to form soiltight joints.

C. PVC Type PSM Solid and Perforated Piping:

1. Pipe: ASTM D 3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends
3. Gaskets: ASTM F 477, elastomeric seals
4. Perforations: ASTM F758 / AASHTO M278 Hole Pattern

2.3 STORMWATER INLETS

A. Yard Drain Inlets: Made with horizontal gutter opening, of materials and dimensions according to the project drawings. Include heavy-duty frames and grates.

B. Catch Basins: Made with vertical curb and horizontal gutter openings, of materials and dimensions according to project drawings. Include heavy-duty frames and grates.

C. Drain Inlets: Made with horizontal gutter opening, of materials and dimensions according to the project drawings. Include heavy-duty frames and grates.

D. Frames and Grates: Dimensions, opening pattern, free area, and other attributes as indicated on the project drawings.

1. Material: ASTM A 536, Grade 60-40-18 minimum, ductile-iron casting.

2.4 CONCRETE

A. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water-cementitious ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.

2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, (Grade 420) deformed steel.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 31 20 00 Earth Moving and Section 31 23 33 Trenching and Backfilling.

3.2 PIPING APPLICATIONS

A. General: Include watertight, silttight, or soiltight joints.

B. Refer to Part 2 of this Section for detailed specifications for pipe and fitting products listed below. Use pipe, fittings, and joining methods according to applications indicated.

C. Gravity-Flow Piping: Use the following:

1. NPS 4 and NPS 6 (DN100 and DN150): Corrugated PE drainage tubing and fittings, silttight couplings, and coupled joints.
2. NPS 8 to NPS 15 (DN200 to DN375): Corrugated PE drainage tubing and fittings, soiltight couplings, and coupled joints in NPS 8 and NPS 10 (DN200 and DN250). Use corrugated PE pipe and fittings, soiltight couplings, and coupled joints in NPS 12 and NPS 15 (DN300 and DN375).

3.3 SPECIAL PIPE COUPLING AND FITTING APPLICATIONS

A. Special Pipe Couplings: Use where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.

1. Use the following pipe couplings for nonpressure applications:

a. Sleeve type to join piping, of same size, or with small difference in OD.
b. Increaser/reducer-pattern, sleeve type to join piping of different sizes.

3.4 INSTALLATION, GENERAL

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

D. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Extend storm drainage piping and connect to building's storm drains, of sizes and in locations indicated. Terminate piping as indicated.

F. PE Pipe and Fittings: As follows:
1. Join Pipe, tubing, and fittings with couplings for soiltight joints according to manufacturer’s written instructions.
2. Install according to ASTM D 2321 and manufacturer’s written instructions.
3. Install corrugated piping according to the Corrugated Polyethylene Pipe Association’s “Recommended Installation Practices for Corrugated Polyethylene Pipe and Fittings”.

G. System Piping Joints: Make joints using system manufacturer’s couplings, unless otherwise indicated.

H. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems’ materials and dimensions.

3.5 STORMWATER INLET INSTALLATION

A. Construct inlets to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.6 FIELD QUALITY CONTROL

A. Clear interior of piping and structures of dirt and superfluous material as work progresses.

1. Place plug in end of incomplete piping at end of day and when work stops.
2. Flush piping between inlets and other structures to remove collected debris, if required by authorities having jurisdiction.

B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    c. Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate reports for each test.

END OF SECTION 33 41 00

SECTION 334600 - SUBDRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Perforated-wall pipe and fittings.
2. Geotextile filter fabrics.

B. Related Sections Include the Following:

1. Division 07 Sections "Self-Adhering Sheet Waterproofing" for molded-sheet drainage panels installed with subdrainage.

1.2 SUBMITTALS

A. Product Data:

1. Geotextile filter fabrics.

PART 2 - PRODUCTS

2.1 PERFORATED-WALL PIPES AND FITTINGS

A. Perforated PVC Sewer Pipe and Fittings: meeting the requirements of AASHTO M278, Class PS46 PVC pipeing system for subsurface drainage of transportation facilities. Provide ASTM D 2729, Schedule 40, rigid PVC pipe in 6 inch diameter, with bell-and-spigot ends, for loose joints.

2.2 SOIL MATERIALS

A. Soil materials are specified in Section 312000 "Earthmoving."

2.3 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. (4480 to 13 440 L/min. per sq. m) when tested according to ASTM D 4491.

B. Structure Type: Nonwoven, needle-punched continuous filament.

1. Survivability: AASHTO M 288 Class 2.
2. Styles: Flat and sock.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.

B. Verify that drainage panels installed as part of foundation wall waterproofing is properly positioned to drain into subdrainage system.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earthmoving."

3.3 FOUNDATION DRAINAGE INSTALLATION

A. Place impervious fill material on subgrade adjacent to bottom of footing after concrete footing forms have been removed. Place and compact impervious fill to dimensions indicated, but not less than 6 inches (150 mm) deep and 12 inches (300 mm) wide.

B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches (100 mm).

D. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive or tape.

E. Install drainage piping as indicated in Part 3 "Piping Installation" Article for foundation subdrainage.

F. Add drainage course to width of at least 6 inches (150 mm) on side away from wall and to top of pipe to perform tests.

G. After satisfactory testing, cover drainage piping to width of at least 6 inches (150 mm) on side away from footing and above top of pipe to within 12 inches (300 mm) of finish grade.

H. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.

I. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches (100 mm).

J. Install drainage panels on foundation walls as follows:

1. Coordinate placement with other drainage materials.

2. Lay perforated drainage pipe at base of footing. Install as indicated in Part 3 "Piping Installation" Article.
3. Separate 4 inches (100 mm) of fabric at beginning of roll and cut away 4 inches (100 mm) of core. Wrap fabric around end of remaining core.
4. Attach panels to wall beginning at subdrainage pipe. Place and secure molded-sheet drainage panels, with geotextile facing away from wall.

K. Place backfill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches (150 mm). Thoroughly compact each layer. Final backfill to finish elevations and slope away from building.

3.4 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. Foundation Subdrainage: Install piping level and with a minimum cover of 36 inches (915 mm) 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 thermoplastic piping according to ASTM D 2321.

3.5 PIPE JOINT CONSTRUCTION

A. Join perforated PVC sewer pipe and fittings according to ASTM D 3212 with loose bell-and-spigot, push-on joints.

B. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.

3.6 BACKWATER VALVE INSTALLATION

A. Comply with requirements for backwater valves specified in Section 334100 "Storm Utility Drainage Piping."

B. Install horizontal backwater valves in header piping downstream from perforated subdrainage piping.

C. Install horizontal backwater valves in piping where indicated.

3.7 CLEANOUT INSTALLATION

A. Comply with requirements for cleanouts specified in Section 334100 "Storm Utility Drainage Piping."

B. Cleanouts for Foundation Subdrainage:

1. Install cleanouts from piping to grade. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.
2. In vehicular-traffic areas, use NPS 4 (DN 100) cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 18 by 18 by 12 inches (450 by 450 by 300 mm) deep. Set top of cleanout flush with grade.
3. In nonvehicular-traffic areas, use NPS 4 (DN 100) PVC pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 12 by 12 by 4 inches (300 by 300 by 100 mm) deep. Set top of cleanout 1 inch (25 mm) above grade.
4. Comply with requirements for concrete specified in Section 033000 "Cast-in-Place Concrete."

3.8 CONNECTIONS

A. Comply with requirements for piping specified in Section 334100 "Storm Utility Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect low elevations of subdrainage system to solid-wall-piping storm drainage system.

3.9 IDENTIFICATION

A. Arrange for installation of green warning tapes directly over piping. Comply with requirements for underground warning tapes specified in specified in Section 312000 "Earthmoving."

1. Install detectable warning tape over nonferrous piping and over edges of underground structures.

3.10 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling.
2. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

B. Drain piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.11 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 334600