FAIRVIEW CAMPUS

New Middle School and High School

Tony Marchio Drive
Townsend, DE 19734

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BID PAC 'E'

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SECTION 21 0170

FIRE SUPPRESSION SPRINKLER SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Codes and Standards listed below, apply to work indicated on the drawings and in the specifications.

1. National Fire Protection Association (NFPA)
2. Delaware State Fire Prevention Regulations (DSFPR)
3. American National Standards Institute (ANSI)
4. American Society for Testing Materials (ASTM)
5. National Electrical Manufacturer's Association (NEMA)
6. Underwriters' Laboratories (UL)

1.2 SUMMARY

A. This Section includes fire-suppression sprinklers, piping, and equipment for the following building systems:

1. Wet-pipe and dry-pipe fire-suppression sprinkler systems, including piping, valves, specialties and automatic sprinklers.

B. Additional work includes, but is not limited to the following:

1. Obtain and pay for all permits, licenses, approvals, reviews, utility shutdowns, water flow testing, pressure tests and acceptance inspections.
2. Pipe sleeves through floors, walls and structural elements of the building, set in coordinated locations. Penetrations created in fire rated walls and floors, shall have their smoke stopping and fire rating integrity restored with the use of fire tested, U.L. listed details, that have prior approval of the local Fire Prevention Bureau.
3. All cutting, coring and patching of general construction as necessary for installation of the work specified.
4. Coordinated working drawings and hydraulic calculations from water flow test data less than one year old; submit and obtain approval by the local Fire Prevention Bureau and Owner's Insurance Underwriter, and State Fire Marshal.
5. Clean-up, on a daily basis, of all debris associated with the installation of this work, as necessary to maintain the premises in a broom swept condition.
6. Testing, adjusting, retesting, re-adjusting as may be required to obtain system acceptance by the local Fire Prevention Bureau, Owner's Insurance Underwriter, State Fire Marshal and Owner's Representative. Fire Protection Contractor shall remain responsible for the fire protection systems until all approvals are obtained.
7. Provide equipment manuals, record drawings, valve tag schedules and personnel instruction, prior to system turnover to the Owner.
8. Provide fire protection on all floors during construction, fire extinguishers, according to the requirements of the authority having jurisdiction.
9. Performance of all work specified in this Section shall be in compliance with the requirements of the Occupational Safety and Health Act and Construction Safety Standards.

C. The work in this Section includes providing all labor, materials, specialty products testing and services for, and reasonably incidental to, the satisfactory completion of the Fire Protection systems, as indicated on the Contract Drawings, in the Specification Sections, and as required by the applicable Codes and Standards.

D. The following related work is specified in other Divisions and Sections of the specification.

1. Electrical power supply to water flow switches, tamper switches, low air switches, and air compressor.
2. Fire extinguishers and cabinets.

E. Related Sections include the following:

1. Division 26 Section "Fire Alarm Systems" for alarm devices not in this Section.
3. Division 22 Section “General Provisions – Plumbing/Fire Protection
4. Division 10 Section “Fire Protection Specialties” for cabinets and fire extinguishers.
5. Division 7 Section “Fire Stopping”

1.3 DEFINITIONS AND INTERPERTATIONS

A. Specific terminology used in the Design Drawings and Specifications shall have the following meanings;

1. “Piping” includes pipe, fittings, flanges, valves, controls, hangers, supports, vents, drains and other customarily required items required in connection with the transfer of gases and fluids.
2. “Install” includes unloading at the delivery point for the project and performing all tasks necessary to establish a secure mounting and correct operation, for items and assemblies furnished by other trades or the Owner.
3. “Furnish” includes purchase and delivery to the project site, of items and assemblies, complete with every necessary appurtenance.
4. “Provide” shall mean “Furnish and Install”
5. “Concealed” when used in connection with the installation of piping, shall mean hidden from view behind chases, furred spaces, pipe shafts, or above suspended ceilings.
6. “Concealed Spaces of Combustible Construction shall be as defined in NFPA#13, Section 8.15.1.
7. “Contractor” shall mean the Fire Protection contractor and his vendors, fabricators or subcontractors.
8. “Design Drawings” shall mean documents, including drawings and written specifications, prepared by the Architects and Engineers, to obtain building permits and competitive bid proposals from contractors, for construction of the specified fire protection systems.
9. “Working Plans” shall mean documents, including calculations, drawings and material specifications prepared by the fire protection contractor, according to NFPA#13, for obtaining approval from the authority having jurisdiction, Owner’s insurance underwriter, Architect/Engineer and the State Fire Marshal.
10. “NPS” shall mean nominal pipe size, in inches.
11. “CPVC” shall mean Chlorinated polyvinyl chloride plastic.
12. “Owner” shall mean Appoquinimink School District.
13. “Architect” shall mean the Architect of Record as denoted in this package.
14. “Engineer” shall mean the Engineer of Record as denoted in this package.
15. “UL” means Underwriter’s Laboratories

16. "FM" means Factory Mutual.
17. "Sprinkler System" shall mean piping and sprinklers under the individual control of a supervised control valve, with provisions for alarm annunciation, alarm testing and system drainage.
18. Reference applicable NFPA Standards for additional definitions that shall apply to work under this Section.

B. The use of the Design Drawings and Specifications by the contractor, for Bid Proposal and Working Drawing preparation, shall include the following understandings:

1. The information included in the drawings and specifications is given as a guide only, to indicate general design feasibility and to show an acceptable arrangement of system zones, system types, sprinkler positions, main piping location and equipment layout.
2. The design drawings utilize symbols and diagrams to indicate required work, representing only the sequence of items to be installed, which have no dimensional significance and do not indicate every required item to be provided. The work shall be installed in accordance with the diagrammatic intent expressed on the drawings, in conformity with the dimensions indicated on the final architectural and structural working drawings, and final equipment shop drawings. Information regarding general construction shall be derived only from the Architectural and Structural Design Drawings and Specifications.
3. The drawings and specifications are complementary and are to be utilized together for a complete interpretation of the work intended. The higher capacity or standard shall be provided, where conflicts between the drawings and specifications, or conflicts within themselves, occur.
4. The limitations of the language used on the drawings and specifications shall not be interpreted as meaning that accessories and appurtenances, required for completion of work, are to be excluded. The description of any item, on the drawings or in the specifications or both, requires the installation of all it's necessary components for approved, satisfactory operation. These drawings do not indicate sprinkler head locations. The Contractor shall reference the architectural reflected ceiling plans. The intent is to establish an architecturally acceptable arrangement of sprinklers with other ceiling elements including lights, diffusers, speakers etc., to be repeated in similar areas. Provide sprinklers according to the NFPA#13 occupancy hazard classification and spacing rules, for unfinished ceiling area.
5. Submission of a bid proposal requires the contractor to review all project documents and visit the construction site, to be thoroughly familiar with all requirements for the project, and identify in his bid, conditions that may affect the efficient and satisfactory performance of the work. Claims for additional compensation shall be denied if the above procedures are not followed and the disputed conditions may have been identified by the completion of these required tasks.
6. The information shown on the design drawings and written in the specifications shall not be interpreted as to instruct the contractor to not follow the applicable codes or local amendments. Where the information provided is believed not to be in conformance with the code requirements, the contractor shall notify the Architect and Engineer for clarification prior to the submission of his bid proposal.
7. References to providing sprinklers per the NFPA#13 Standard mandates that all building areas shall be provided with complete, full sprinkler protection, unless specific notation is made to the contrary on the drawings or in the specification.
8. References in this Specification to NFPA Standards as design and installation guidance of fire protection systems, invoke all of the Sections, Subsections, Exceptions and Advisory

Provisions of the Standard that are applicable to the Project's requirements; they are hereby included in this Specification as if repeated in their entirety, and are referenced to convey the minimum acceptable performance and installation requirements acceptable.

1.4 SPRINKLER SYSTEM PERFORMANCE REQUIREMENTS

A. Design sprinkler system piping according to the following requirements and obtain approval from authorities having jurisdiction, Owner's insurance underwriter, Architect, Engineer and Fire Marshal. Refer to Section 1.7 QUALITY ASSURANCE, paragraph I., Working Plans and Hydraulic Calculations, and Section 3.1 PREPARATION WORKING OF PLANS, for additional system performance related design requirements.

B. Design sprinkler system piping according to the following:

1. Include 10 psi cushion pressure as a margin of safety in available water flow and pressure calculations.
2. Include losses from point of connection to city water main, through water-service entrance, backflow preventer, sprinkler system piping, including all valves, fittings and devices.
3. Maximum piping velocity shall be limited to 20 fps.
4. Sprinkler Occupancy Hazard Classifications shall be as follows:
   a. Classrooms, Art Rooms, Music Rooms, Multi-Purpose Room: Light Hazard
   b. Offices, Corridors, Toilet rooms, Locker rooms, Public Areas, Cafeteria Seating Areas: Light Hazard
   c. Building Service Areas, Kitchen, Janitor's Closets, Electrical and Telephone Equipment Rooms and Closets, Mechanical Equipment Rooms: Ordinary Hazard, Gp. 1.
   d. General Storage Areas, Stage Loading Docks: Ordinary Hazard, Gp. 1.
   e. Combustible construction and Combustible concealed spaces: Light Hazard.
   f. All other occupancies and hazards not noted, shall be in accordance with NFPA.
5. Minimum Density for Automatic-Sprinkler Piping Design shall be as follows:
   a. Light Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area unless otherwise indicated on drawing data schedule.
   b. Ordinary Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area unless otherwise indicated on drawing data schedule.
   c. Ordinary Hazard, Group 2 Occupancy: 0.20 over 1,500 sq. ft. area unless otherwise indicated on drawing data schedule.
   d. Combustible construction and Combustible concealed spaces: 0.10 gpm over 1500-sq. ft. area unless otherwise indicated on drawing data schedule.
   e. Special Occupancy Hazard: As determined by authorities having jurisdiction.
   f. For light and ordinary hazard occupancies, where the requirements of NFPA 13 are met, design are reduction for quick response sprinklers may be used.

C. Components and Installation shall be capable of producing piping systems with 175-psig minimum working-pressure rating, unless otherwise indicated.

1.5 SUBMITTALS

A. The contractor shall provide Submittals according to Section 220010, with all required drawings, calculations and product data for complete review of the proposed system installation submitted at the same time. Incomplete submittals shall be returned unreviewed. When resubmittals are

required, all changes from the original submittal shall be clearly identified with revision triangles and clouds.

B. Product Data shall be provided for the following:

1. Pipe and fitting materials and methods of joining for sprinkler piping.
2. Pipe hangers and supports.
3. Valves, including specialty valves, accessories, and devices.
4. Alarm devices. Include electrical data.
5. Air compressors. Include electrical data.
6. Fire department connections. Include type; number, size, and arrangement of inlets; caps and chains; size and direction of outlet; escutcheon and marking; and finish.
7. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
8. Fire stopping product materials and U.L. listed installation details for penetrations of fire-rated walls and floors.

C. Fire-Hydrant Flow Test has been executed for the project on 7/15/17 and data is recorded on the drawing.

D. Sprinkler and Standpipe Piping Drawings: Working plans and hydraulic calculations, shall be prepared according to NFPA #13, and submitted to the authorities having jurisdiction, Owner's insurance agent, Architect, Engineer, and State Fire Marshal for approval.

E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA #13, including the "Contractor's Material and Test Certificate for Aboveground Piping" for each system.

F. Maintenance Data: shall be submitted for each type of sprinkler component and specialty, and included in the maintenance manuals, specified in Division 1.

G. Record Drawings: Refer to Division 1 for requirements. An up to date set of working drawings shall be kept at the site to record minor change in the intended system installation, as as-built conditions. Provide the required copies of final working drawings, corrected to show all as-built conditions, to the Owner, and the Owner's insurance agent upon completion of the project.

H. System Diagram and Operating Instructions: Provide at the completion of work, a color coded, neatly drawn small scale plan, mounted in a substantial glass enclosed frame, showing the locations of all sprinkler system control valves, auxiliary low point drains and inspector's test connections. Provide a minimum of two (2) copies of the current edition of NFPA#25, "Standard for the Inspection, Testing, and Maintenance of Water Based Fire Protection Systems".

I. Guarantee: The contractor shall submit a written guarantee of all materials and workmanship for a period of one (1) year, beginning at the date of final acceptance or beneficial use to the Owner, which includes emergency repair service for sprinkler systems, within four (4) hours, on a twenty-four (24) hour, seven (7) day a week basis, upon request for repair service by the Owner.

1.6 QUALITY ASSURANCE

A. All materials, specialty products, equipment, methods of installation, and the application of materials and products in specific situations, shall be in strict accordance with the applicable requirements of NFPA #13, and have the prior approval of the authority having jurisdiction. All materials and equipment shall be U.L. labeled and/or F.M. approved, and installed in accordance with their listings.

B. Installer Qualifications: An experienced installer who has designed and installed fire-suppression systems similar to that indicated for this Project and obtained design approval and inspection approval from authorities having jurisdiction.

C. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL's and/or Fire Marshal's "Fire Protection Equipment Directory" and that comply with other requirements indicated.

D. Sprinkler Components: Listing/approval stamp, label, or other marking by a testing agency acceptable to authorities having jurisdiction.

E. Working Plans and Hydraulic Calculations

1. Design the specified sprinkler systems and standpipe systems utilizing hydraulic calculations and indicate the intended installation of systems accurately on minimum 1/8"scale plans, with ¼" scale details which include the following:

   a. Building section/elevation details, with all necessary elevation data shown.

   b. Riser diagram of system water supply and backflow prevention.

   c. All pipe lengths, diameters, fittings, hangers locations and details, earthquake bracing and restraints, valves and devices with piping details.

   d. A site plan indicating project location, site elevations, north arrow, street intersections, Fire Department access lane(s), location of Fire Department connection(s), and size, material and location of public, and private fire water service mains and their appurtenances. The site plan shall be scaled or indicate dimensions and distances (of mains) and show location of water flow test(s).

   e. Hydraulically most remote design area(s) with hydraulic nodes on plans corresponding to hydraulic calculations.

2. Provide hydraulic calculations utilizing Hazen-Williams formula for determining piping friction losses, to prove the intended design, according to the requirements NFPA#13, using "C" values therein, which include the following:

   a. Each type of pipe and joining method to be used, including weight, schedule, wall thickness, exact internal diameters, wall thicknesses and corrosion resistance ratio (CRR), for pipes other than Sch. 40.

   b. The K-factor, orifice diameter, and minimum operating pressure required, for each flowing sprinkler in the hydraulically most remote area(s), according to the worst case requirements of either NFPA#13, the local Fire Dept., or the appropriate approval/U.L. listing pressure required, to deliver the required minimum water distribution. Flows shall be calculated to the nearest 1/10 gallon.

   c. Piping friction losses calculated to the nearest foot for all pipe lengths over (1) foot; all vertical lengths shall be included to show loss or gain of elevation pressures. Pressures shall be calculated to the nearest 1/100 psi.

   d. Pressure losses for dry valves, deluge valves, backflow preventers etc., shall be clearly indicated as a device, and expressed as additional feet of pipe.

   e. Velocity in all piping to be 20 feet per second or less. Velocity pressure may be ignored in hydraulic calculations.

   f. Provide hydraulic calculations in an "easily reviewable" format, similar to the traditional NFPA#13 presentation, including the name of the hydraulic calculation program used, if applicable. The order of entry shall follow the flow of water from the most remote design sprinkler back to the riser, with flows added and subtracted at the cross main; order entry based upon only a sequential ordering of the node numbers, which could result in jumps

from one pipe segment to a disjunct segment, is not "easily reviewable", and therefore is not an acceptable submittal format.

g. All notes in the hydraulic calculations corresponding to the calculated results shall be clearly identified on the plans, including the site plan.

1.7 EXTRA MATERIALS

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. Sprinkler Cabinets: Finished, wall-mounting steel cabinet and hinged cover, with space spare sprinklers plus sprinkler wrench. Include the minimum number of each type of sprinkler in the project, as required by NFPA #13.

1.8 LEAK DAMAGE

A. The fire protection contractor shall be responsible during the installation and testing of the sprinkler and standpipe system(s), for damage to building, it's contents, the work of other trades etc., caused by leaks or overflow from equipment, defective valves, disconnected or unplugged pipes, fittings etc., and shall pay for the repair or replacement of work or facilities damaged by such leaks.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Specialty Valves and Devices:

   Vicatulic Company

   Tyco Fire Suppression & Building Products

   Reliable Automatic Sprinkler Co., Inc.

   Viking Corp.

2. Water-Flow Indicators and Supervisory Switches/and Electrical Bells:

   Tyco Fire Suppression & Building Products

   Potter Electric Signal Co.

   Reliable Automatic Sprinkler Co., Inc.

   Viking Corp.

3. Sprinkler, Drain and Alarm Test Fittings:

   Tyco Fire Suppression & Building Products

   Fire-End and Croker Corp.

   Victaulic Company

   AFG Manufacturing

4. Sprinkler, Branch-Line Test Fittings:

   Elkhart Brass Mfg. Co., Inc.

   Fire-End and Croker Corp.

   Smith Industries, Inc.; Potter-Roemer Div.

AFG Manufacturing

5. Sprinkler, Inspector's Test Fittings:
   Fire-End and Croker Corp.
   G/J Innovations, Inc.
   Triple R Specialty of Ajax, Inc.
   AFG Manufacturing
6. Fire Department Connections:
   Potter-Roemer
   Elkhart Brass Mfg. Co., Inc.
   Fire-End and Croker Corp.
   Tyco Fire Suppression & Building Products
   Guardian Fire Equipment, Inc.
   Reliable Automatic Sprinkler Co., Inc.
7. Sprinklers:
   Tyco Fire Suppression & Building Products
   Reliable Automatic Sprinkler Co., Inc.
   Viking Corp.
   Victaulic Company
8. Fire-Protection-Service Valves:
   Tyco Fire Suppression & Building Products
   Central Sprinkler Corp.
   Nibco, Inc.
   Stockham Valves & Fittings, Inc.
   Victaulic Company
9. Keyed Couplings for Steel Piping: (Grooved Fittings)
   Tyco Fire Suppression & Building Products
   Victaulic Company
   Viking Corp.
   Anvil International Grulok
10. Fire Protection Backflow Prevention Valve Assemblies (including RPZ Type).
    Ames Fire & Waterworks
    Watts Regulator Company
    Apollo Valves (Conbraco)

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials in specific fire protection services. All piping shall be permanently marked continuously along its length by the manufacturer, properly identifying the type of pipe. All fittings shall be stamped or embossed by the manufacturer, indicating the size, pressure rating, and U.L. listing or F.M. approval.

2.3 PIPES AND TUBES

A. Standard-Weight Steel Pipe: ANSI/ASTM A 53, ASTM A 135, or ASTM A 795; Schedule 40 in NPS 6" and smaller, and Schedule 30 in NPS 8" and larger, may be joined with threads or cut-groove couplings and fittings, for pressures up to 300 psi.

B. Schedule 30 Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and equal to or greater than Schedule 30, or ASTM A 795 and ASME B36, 10M, Schedule 30 wrought-steel pipe, may be joined by welding or roll-groove couplings and fittings, for pressures up to 300 psi.

C. Schedule 10 Steel Pipe: ASTM A 135 Schedule 10 in NPS 5" and smaller and NFPA #13 specified wall thickness in NPS 6" to NPS 10", may be joined by welding or roll-groove couplings and fittings, for pressures up to 300 psi.

D. "THINWALL/SCHEDULE 10," "XL" AND CPVC piping shall not be permitted on this project.

2.4 PIPE AND TUBE FITTINGS

A. Cast-Iron Threaded Flanges: ASME B16.1.

B. Cast-Iron Threaded Fittings: ASME B16.4.

C. Malleable-Iron Threaded Fittings: ASME B16.3.

D. Steel, Threaded Couplings: ASTM A 865.

E. Steel Welding Fittings: ASTM A 234/A 234M, ASME B16.9, or ASME B16.11.

F. Steel, Grooved-End Fittings: UL-listed and approved, ASTM A 47, malleable iron or ASTM A 536, ductile iron; with dimensions matching steel pipe and ends factory grooved according to AWWA C606.

2.5 JOINING MATERIALS

A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for pipe-flange gasket materials and welding filler metals.

B. Steel, Keyed Couplings: UL 213 and AWWA C606, for steel-pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gaskets, and steel bolts and nuts. Include listing for dry-pipe service for couplings for dry piping.

2.6 FIRE-PROTECTION-SERVICE VALVES

A. General: UL listed and approved, with minimum 175-psig nonshock working-pressure rating. Valves for grooved-end piping may be furnished with grooved ends instead of type of ends specified.

B. Gate Valves, NPS 6" and Smaller: UL 262; cast-bronze, threaded ends; solid wedge; OS&Y; and rising stem.

C. Indicating Valves, NPS 3" and Smaller: UL 1091; butterfly or ball-type, bronze body with threaded ends; and integral indicating device.

Indicator: Visual.

Indicator: Electrical 115-V ac, prewired, two-circuit, supervisory switch.

D. (Optional Section) Gate Valves, NPS 4" and Larger: UL 262, iron body, bronze mounted, taper wedge, OS&Y, and rising stem. Include replaceable, bronze, wedge facing rings and flanged ends.

E. Swing Check Valves, NPS 2" and Smaller: UL 312 or MSS SP-80, Class 150; bronze body with bronze disc and threaded ends.

F. Swing Check Valves, NPS 2-1/2" and Larger: UL 312, cast-iron body and bolted cap, with bronze disc or cast-iron disc with bronze-disc ring and flanged ends.

G. Split-Clapper Check Valves, NPS 4" and Larger: UL 312, cast-iron body with rubber seal, bronze-alloy discs, and stainless-steel spring and hinge pin.

2.7 SPRINKLERS

A. Utilize quick-response sprinklers throughout Light and Ordinary Hazard occupancies

B. Automatic Sprinklers: shall have heat-responsive element complying with the following:

UL 199, for applications except residential.

UL 1767, for early suppression, fast-response applications.

C. Sprinkler Types and Categories: Nominal 1/2-inch standard orifice, unless otherwise indicated or required by application.

D. Sprinkler types, features, and options include the following:

Dry upright sprinklers

Dry pendent sprinklers

Horizontal Dry/Sidewall sprinklers

Pendent sprinklers (Flush, recessed and/or concealed)

Quick-response sprinklers

Sidewall sprinklers

Upright sprinklers

E. Sprinkler Finishes: Upright bronze, and "white" painted pendents and sidewalls.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

Ceiling Mounting: White-plated steel, two piece, flat.

Ceiling Mounting: Metal, white finish, two piece, flat.

Sidewall Mounting: White-plated steel, two piece, flat.

Sidewall Mounting: Metal, white finish, two piece, flat.

G. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

H. Sprinkler Water Shields: Shield for protecting sprinkler, heat-sensing operating element from other sprinkler water discharge (pendent and/or upright sprinkler water shield.

2.8 SPECIALTY SPRINKLER FITTINGS

A. Specialty Fittings: UL listed and approved; made of steel, ductile iron, or other materials compatible with piping.

B. Locking-Lug Fittings: UL 213, ductile-iron body with locking-lug ends.

C. Mechanical-T Fittings: UL 213, ductile-iron housing with pressure-responsive gasket, bolts, and threaded or locking-lug outlet.

D. Mechanical-Cross Fittings: UL 213, ductile-iron housing with pressure-responsive gaskets, bolts, and threaded or locking-lug outlets.

E. Drop-Nipple Fittings: UL 1474, with threaded inlet, threaded outlet, and seals; adjustable.

F. Sprinkler, Drain and Alarm Test Fittings: UL-listed, cast- or ductile-iron body; with threaded inlet and outlet, test valve, and orifice and sight glass.

G. Sprinkler, Branch-Line Test Fittings: UL-listed, brass body; with threaded inlet and capped drain outlet and threaded outlet for sprinkler.

H. Sprinkler, Inspector's Test Fittings: UL-listed, cast- or ductile-iron housing; with threaded inlet and drain outlet and sight glass.

2.9 FIRE DEPARTMENT CONNECTIONS

A. Confirm with the local Fire Department for type of connection requirement: Storz or Siamese.

B. Wall, Fire Department Connections: UL 405; cast-brass body with brass, wall, escutcheon plate; brass, lugged caps with gaskets and brass chains; and brass, lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking "AUTO SPKR"/"STANDPIPE AND AUTO SPKR".

Type:	Flush mounting.
Escutcheon Plate:	Rectangular.
Finish:	Polished chrome-plated.

2.10 ALARM DEVICES

A. General: All alarm devices shall be U.L. listed and F.M. approved as sprinkler system attachments. Types utilized shall match piping and equipment connections.

B. Electric-Operated Alarms: Provide 10" outside waterproof vibrating type bell and 6" inside bell, in locations shown on drawings or required by the local Fire Dept.

C. Water-Flow Indicators: UL 346; electrical-supervision, vane-type water-flow detector; with 250-psig pressure rating; and designed for horizontal or vertical installation. Include two single-pole, double-throw, circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

D. Pressure Switches: UL 753; electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.

E. Valve Supervisory Switches: UL 753; electrical; single-pole, double throw; with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

F. Low air Supervisory Switch: UL listed, electrical-supervisory-type, pressure activated, single pole, double throw, normally closed contacts, field adjustable and designed to operate on a decrease in air pressure.

G. Low Temperature Supervisory Switch: UL listed, electrical-supervisory-type, temperature activated, normally open contact, operated at set temperature of 40°F.

2.11 PRESSURE GAGES

A. Pressure Gages: UL 393, 3-1/2- to 4-1/2-inch diameter dial with dial range of 0 to 250 psig.

2.12 PREACTION SUPPRESSION SYSTEM

A. The system shall be a complete and operating, supervised, single interlocked, controlled electric release with riser-mounted air compressor system.

B. The equipment shall be a total Viking System that shall include all system components, devices, valves, fittings, control panel, compressor, etc., for a field installation.

C. The installation shall be in strict conformance with the manufacturer's written instructions and schematic diagrams.

D. Electrical power wiring shall be provided to the control panel and to the compressor by the Electrical Subcontractor. All wiring beyond that point shall be considered control wiring, and shall be the responsibility of the Fire Protection Contractor. This includes detector wiring between the heat detectors and the control panel.

E. Heat detectors for the system are not included in the Viking package. The detectors shall be furnished by the fire alarm Subcontractor.

PART 3 – EXECUTION

3.1 PREPARATION OF WORKING PLANS

A. The contractor shall be responsible for reviewing the Architectural and Structural Design Drawings and verifying with the General Contractor, that substitutions of noncombustible building materials with combustible building materials have not been made that alter the requirements of the sprinkler system shown on the Fire Protection Design Drawings. Report such substitutions to the Architect and Engineer for review, prior to the design of sprinkler systems. Combustible framing or construction is not allowed above ceilings, below floors or in concealed spaces, unless specifically protected by sprinklers.

B. The final arrangement, positions and connections of pipes, drains, valves, sprinklers etc., shall be established by the fire protection contractor's design, and shall be configured to drain fully, avoiding trapped piping sections and excessive auxiliary drains. Sprinkler systems shall be installed concealed above architectural suspended ceilings where ceilings are provided, unless indicated otherwise.

C. Design the specified fire protection systems from the fire service entry riser, in accordance with the mandatory requirements and all advisory provisions of NFPA#13 and NFPA#14, the requirements of the authority having jurisdiction and the Owner's insurance agent, utilizing hydraulic calculations, with uniform water distribution over each most remote design area and/or specified demand.

D. Establish each sprinkler position, giving full consideration to the vertical and horizontal obstructions to sprinkler spray pattern development that may be presented by building construction, ductwork, mechanical and electrical equipment, piping, soffits and ceilings constructed with different adjacent elevations, suspended and surface mounted lighting fixtures etc.; coordinate the position and location of sprinklers, piping and system components, referencing the detailed working drawings of all other trades, to avoid installation conflicts.

E. Contractor shall be responsible for planning and providing the required penetrations of fire rated walls, floors and smoke partitions, in such a manner that U.L. listed details that restore their fire rating integrity and that have prior approval of the Delaware State Fire Marshal's Office where they are utilized.

F. Where practical, uniformly space sprinklers on branchlines; sprinklers shall be spaced in architectural patterns consistent with symmetrical positions of lights, air diffusers, speakers, and other ceiling elements, where sprinklers are shown on architectural reflected ceiling grid plans.

   1. Pendent sprinklers in architectural ceilings shall be centered in square ceiling tiles in both directions, and centered in the short dimension of rectangular tiles, with sprinkler positions acceptable at quarter points of the long dimension, +/- 12".

   2. Provide sprinkler spacing and locations per NFPA#13 requirements, in areas without suspended ceilings.

G. Where sprinkler piping within concealed spaces provides protection for occupancies below, sprinklers for protection of concealed spaces may be attached to the same piping system. Hydraulically calculate each set of sprinklers separately and provide pipe sizes for the hydraulically more demanding group.

H. Sprinklers for the protection of attic spaces may be conventional upright or pendent types, or a combination of these types of sprinklers. The position of sprinklers in attics framed of combustible construction, shall establish sprinkler protection into the eaves overhanging the outside of the building.

I. Provide sprinkler protection in combustible framed, horizontal and vertical soffits and wall cavities, with outside finished dimensions greater than 14." Where combustible concealed construction and spaces are permitted to be unsprinklered, meeting one or more of the exceptions of NFPA#13, Section 8.15.1.1, the design area of application shall be increased to a minimum of 3,000 sq.ft., without revising the hydraulic density, per NFPA#13, Section 11.2.3.1.5 and 11.2.3.2.

J. Where used, antifreeze systems shall use pharmaceutically pure glycerin or propylene glycol only and shall be premixed in accordance with NFPA 13. Provide a reduced pressure zone backflow preventer assembly and an expansion chamber where noted on the drawings, at the point of connection to the wet sprinkler system supply. Pipe discharge port of backflow preventer to a drain point capable of accepting full flow discharge. Antifreeze systems over 40 gallons total capacity shall be hydraulically calculated using the Darcy-Weisback equation, Moody Diagram, E-factors for age of pipe, and adjusted K-factors for fluid properties.

3.2 PIPING APPLICATIONS

A. Flanges, unions, transitions and special fittings shall have pressure ratings the same as or higher than system's static pressure rating for use in aboveground applications, unless otherwise indicated.

B. Piping between Fire Department Connections and Check Valves: Use galvanized, standard-weight steel pipe with grooved ends; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.

C. Underground Service-Entrance Piping: Use ductile-iron, push-on-joint pipe and fittings and restrained joints.

Fire Suppression Bulk Mains and Risers: See Fire Protection Drawing FP-2.

D. Wet-Pipe Sprinkler Branch and Standpipe Piping: See Fire Protection Drawing FP-2.

1. NPS 2-1/2" and Larger: Standard weight (Schedule 10) steel pipe with roll-grooved ends; steel, grooved-end fittings; and grooved couplings.
2. NPS 2" and Smaller: Standard-weight steel pipe with threaded ends, cast- or malleable-iron threaded fittings, and threaded joints.

E. Drypipe Sprinkler Branch Piping: See Fire Protection Drawing FP-2.

1. NPS 2-1/2" and larger: Standard weight, hot dipped galvanized steel pipe with grooved ends, steel grooved-end fittings and grooved couplings.
2. NPS 2" and smaller: Standard weight, hot dipped galvanized, steel pipe with threaded ends, cast or malleable iron, threaded fittings and threaded joints.

3.3 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Fire-Protection-Service Valves: UL listed and approved for applications where required by NFPA#13.

   Shutoff Duty: Use gate and/or butterfly valves.

2. General-Duty Valves: For applications where UL-listed and approved valves are not required by NFPA #13.

Shutoff Duty: Use gate, ball, or butterfly valves.

3.4 JOINT CONSTRUCTION

A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for basic piping joint construction. Apply joint compound or tape to male threads only.

B. Steel-Piping, Grooved Joints: Use Schedule 40 steel pipe with cut or roll-grooved ends and Schedule 30 or thinner steel pipe with only roll-grooved ends; steel, grooved-end fittings; and steel, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions. Use gaskets listed for dry-pipe service for dry piping.

C. Locking-Lug-Fitting, Twist-Locked Joints: Follow fitting manufacturer's written instructions.

D. Dissimilar-Piping-Material Joints: Construct joints using adapters or couplings compatible with both piping materials. Use dielectric fittings if both piping materials are metal. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for dielectric fittings.

3.5 WATER-SUPPLY CONNECTION

A. Connect sprinkler piping to the 12” stubbed-up flanged outlet connection provided by the Plumbing Contractor.

B. Install shutoff valve, backflow preventer, riser check valve assembly, pressure gage, drain, and other accessories indicated at connection. The backflow preventer shall be UL listed for fire protection service. Backflow preventer for this project shall be AMES 3000 “Silver Bullet.”

3.6 PIPING INSTALLATION

A. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for basic piping installation.

B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping installation require written approval from authorities having jurisdiction. File copy of written approval with Architect before deviating from approved working plans.

C. Use only approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes. Bushings shall not be used.

D. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections. Not required on grooved connections.

E. Install "Inspector's Test Connections" for each sprinkler system, sized and located according to NFPA #13 requirements. Install main drain test connection at location that will permit full flow discharge for a time sufficient to allow for proper testing of water supplies, without flooding or water damage.

F. Install sprinkler piping to avoid excessive auxiliary drains. Provide auxiliary drains as required for complete drainage of trapped piping sections.

G. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to sprinkler risers when sprinkler branch piping is connected to sprinkler risers.

H. Install ball drip valves to drain piping between fire department connections and check valves. Drain ball drips to floor drain or outside building.

I. Install alarm devices in piping systems.

J. Hangers and Supports: Comply with NFPA #13 for hanger materials and installation. Hangers, hanger rods and attachments must be capable of supporting five (5) times the weight of the water-

filled pipe, plus 250 pounds minimum, at each point of hanging. Piping shall be supported from building structure only, and shall not be hung from ductwork, conduit runs or other piping. Install piping straight and true, parallel with building walls, without dips or sags. Piping shall bear evenly on all pipe hangers. Provide complete details of earthquake bracing and flexible couplings consistent with the requirements of the seismic zone of the project location.

K. Install piping with grooved joints according to manufacturer's written instructions. Construct rigid piping joints, unless otherwise indicated.

L. Install pressure gages on system risers and at each sprinkler test connection. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

3.7 SPECIALTY SPRINKLER FITTING INSTALLATION

A. Install specialty sprinkler fittings according to manufacturer's written instructions.

3.8 VALVE INSTALLATION

A. Refer to Division 22 Section "Valves" for installing general-duty valves. Install fire-protection specialty valves, trim, fittings, controls, and specialties according to NFPA #13, manufacturer's written instructions, and authorities having jurisdiction.

B. Gate/Butterfly/Valves: Install fire-protection-service valves supervised-open, unless noted otherwise, located to sectionalize system and control sources of water supply, except from fire department connections. All sectional control valves shall be installed in accessible locations.

1. Provide drains at all sectional control valves. Pipe drains to an acceptable location, capable of accepting full flow discharge without flooding or damage. Provide permanent identification signs indicating portion of system controlled by each valve, according to NFPA#13 requirements.

C. Install check valve in each water-supply connection. Install UL listed fire protection backflow preventers instead of check valves in potable-water supply sources.

D. Riser Check Valves: Install valves in vertical position unless noted otherwise, for proper direction of flow.

3.9 SPRINKLER APPLICATIONS

A. General: Only new sprinklers shall be installed, according to their listing requirements. Ornamental finishes shall be factory applied only. Position sprinkler deflectors at the same elevation, parallel with ceiling plane.

B. Use sprinklers according to the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Dry Pendent, sprinklers.
3. Wall Mounting: Sidewall sprinklers.
3. Special Applications: Use quick-response sprinklers where indicated.
4. Sprinkler Finishes: Use sprinklers with the following finishes:
   a. Upright, Pendent, and Sidewall Sprinklers: White-plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

3.10 SPRINKLER INSTALLATION

A. Install sprinklers in patterns indicated. Install sprinklers in suspended ceilings in center of acoustical panels and tiles.

1. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical panels, and quarter points of the long dimension.

B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space,

C. Install approved sprinkler guards at all sprinklers installed below 7’-6”, or where mechanical damage is possible.

D. Install sprinklers in accordance with manufacturer’s requirements.

3.11 CONNECTIONS

A. Install ball drip valves at each check valve for fire department connection. Route drain pipe to floor drain or outside building.

B. Connect piping to specialty valves, specialties, fire department connections, and accessories.

C. Connect alarm devices to sprinkler systems.

3.12 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA #13, Division 22 Section "Basic Mechanical Materials and Methods", and the Delaware State Fire Prevention Regulations.

3.13 FIELD QUALITY CONTROL

A. Provide a flanged spool section of pipe and a temporary conical type strainer on the incoming fire protection water service, before the building fire protection and sprinkler system equipment (backflow preventer, fire pump, etc.), for the fire protection system during installation. Prior to the final commissioning, remove the strainer and reinstall flanged spool section.

B. Flush, test, and inspect sprinkler piping according to NFPA #13, "System Acceptance" Chapter.

C. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.

D. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.14 CLEANING

A. Clean dirt and debris from sprinklers, remove protective covers used during painting.

B. Remove and replace sprinklers having paint other than factory finish.

3.15 PROTECTION

A. Protect sprinklers from damage until Substantial Completion.

3.16 COMMISSIONING

A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.

B. Verify that specified tests of piping are complete.

C. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.

D. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.

E. Verify that fire department connections have threads compatible with local fire department equipment.

F. Adjust operating controls and pressure settings.

G. Coordinate with fire alarm tests. Operate alarm devices with water, as required to demonstrate proper function.

H. Provide an 8-1/2" x 11" drawing in "pdf" format for the Owner, Local Fire Department and the Fire Marshal's Office. Data required on drawing shall indicate the following:

1. Name, address and location of the building.
2. The location of all fire suppression system control valves.
3. The location of all fire department connections for all fire suppression systems.
4. The location of the fire alarm control pane and annunciation panel.
5. The location of all site fire hydrants.
6. Main entrance and exits.
7. Name, and telephone numbers of responsible personnel for responding during emergencies.

3.17 SYSTEMS ACCEPTANCE AND TESTING

A. Notify the Authority Having Jurisdiction, the Owner's representative, and Architect and Engineer of time and date of scheduled testing. Provide minimum of 5 day prior notice of testing to allow for witnessing.

B. Perform all required system testing and acceptance requirements on the new (and modified) system installations in accordance with NFPA 13 & 25, the Delaware State Fire Prevention Regulations, the Authorities Having Jurisdiction (AHJ) requirements and all other local codes and ordinances. At a minimum provide the following:

1. Perform all acceptance requirements per the codes; pipe flushing, inspections, etc.
2. Perform all operational and functional tests of systems and equipment required by the codes and equipment manufacturers.
3. Perform hydronstatic pressure test on new (and modified) above ground systems piping in accordance with NFPA 13. New system shall be tested to 50 psi over normal system working pressure (minimum 200 psi) for 2 hours without leaks.

C. Provide all required reports, records and documentation, to the owner, engineer and authority having jurisdiction prior to or at the completion of the project. At a minimum provide the following:

1. Completed and signed "Contractor's Material and Test Certificate for Aboveground Piping' for each system.
2. Completed and signed "Contractor's Material and Test Certificate for Underground Piping."

D. Prior to placing systems in final service, provide a final inspection of new and/or modified systems to ensure item such as protective caps & strapes have been removed or put in place, escutcheons have been install, penetrations seals have been provided, ceiling tiles have been replaced, etc.

3.18 DEMONSTRATION

A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.

B. Schedule demonstration with Owner with at least seven days' advance notice.

END OF SECTION 21 0170

SECTION 22 0000

GENERAL PROVISIONS - PLUMBING/FIRE PROTECTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and all other applicable Divisions, apply to work of this Section.

B. This specification or drawing and the design features or resulting construction disclosed, are the property of Furlow Associates, Inc., and shall not be reproduced without written permission.

C. All fire protection suppression systems shall be part of and included in all of the following 220000 thru 220191 Sections.

D. Refer to Section 07841 for Through-Penetration Firestop Systems.

E. Refer to Section 08311 for Access Doors and Frames

1.2 WORK INCLUDED

A. Provide labor, materials, equipment and supervision necessary to install complete operating Plumbing and Fire Protection Systems as indicated the drawings and specified herein, including all work at the site and within the proposed construction areas to accomplish the required work.

1.3 REGULATIONS, CODES AND STANDARDS

A. Work shall be performed in accordance with latest adopted codes, regulations and ordinances by authorities having jurisdiction. Observe all safety regulations.

B. Latest editions of any referenced standards shall govern.

C. Obtain all municipal and/or the Authorities Having Jurisdiction permits and inspection certificates and pay all charges.

D. Make or arrange for any/or all inspection agency reviews or visits and pay all charges. This includes communication with each respective agency and/or utility to verify the project system work, coordination responsibilities, fees, back charges, etc., required.

E. All fees and back charges shall be verified during the bidding phase of the work. Any discrepancy of this item between any utility, inspection agency and the Contractor shall be brought to the attention of the A/E prior to bid opening.

F. Submission of a bid will be deemed evidence of having complied with these requirements.

1.4 RELATED WORK

A. Refer to equipment shown or specified in all other applicable Divisions that require Plumbing and Fire Protection services.

B. Refer to work related to Plumbing and Fire Protection as shown on the following contract drawings:

Architectural & Structural

HVAC

Electrical

1.5 COORDINATION

A. The Mechanical, Plumbing and Electrical Contractors are responsible to coordinate all manufacturer's recommended circuit breakers, starters, disconnects and fuse sizes for all equipment. Submission of a shop drawing will certify that this has been completed. Any necessary changes required will be included as part of this contract.

B. Plumbing and Sprinkler Contractors shall coordinate scheduling, submittals and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of independent work elements, with provisions to accommodate items that may be installed at a later time.

C. Plumbing and Sprinkler Contractors shall verify utility requirements and all characteristics of operating equipment are compatible with the building utilities. Coordinate the work of all sections related and required for installing, connection and placing in service of all equipment.

D. Plumbing and Sprinkler Contractors shall coordinate all space requirements, supports and installation of all mechanical, electrical, plumbing and fire protection work, which are indicated diagrammatically on the Drawings. Verify routing of all pipes, ducts, conduits and equipment connections. Maximize accessibility for other work, and service requirements for maintenance and repairs. Develop overall coordination drawing (all trades) and submit for review prior to fabrication/installation.

E. Obtain written confirmation from all related trade Contractors and the Owner or his representative that requirements, conflicts and coordination issues have been discussed and resolved.

1.6 SUBMITTALS

A. Shop Drawings & Product Data:

1. Shop drawings and product data shall be submitted in accordance with Division 22 specifications except where herein modified.

   NOTE: Submittals will only be reviewed once and resubmittals will be reviewed once. Any other submittals will be billed to the Contractor at the Engineer's standard rates.

2. Listed are the required shop drawings and reports required for this project. The Engineer/Owner shall reserve the right to require additional submissions not listed below:

   - All fixtures, equipment and associated devices so listed on the Fixture Schedule on the Drawings.
   - Insulation
   - All specified piping systems.
   - All specified valves.
   - Gauges and thermometers
   - Recirculating pump.
   - Hanger and supports including Sumner system.
   - Piping labels and identification.
   - Sprinkler System and all related data, devices, switches and trimmings.
   - Testing reports.
   - Sterilization report.
   - Operating/Maintenance manuals.
   - As-Built Drawings.

3. Submittals comprising complete catalog cuts, shop drawings and performance test data for Plumbing materials and equipment as required by other sections of Division 22, shall be submitted for review checking. The Contractor shall review these for conformance to contract documents prior to submission and affix contractor's signature to each submittal certifying that this review has been done. By approving and submitting shop drawings, product data, samples and similar materials, the Contractor represents that the Contractor has determined and verified materials, field measurements and field construction data that relates to the work, and has checked and

coordinated this information with all of the requirements contained in the contract documents for the work of all trades.

4. All submittals shall have the following identification data, as applicable, contained therein or permanently adhered thereto.
   a. Project name.
   b. Project number.
   c. Sub-contractor's, vendor's and/or manufacturer's name and address.
   d. Product identification.
   e. Identification of deviation from contract documents.
   f. Applicable contract drawings and specification section number.
   g. Shop drawing title, drawing number, revision number, and date of drawing and revision.
   h. Resubmit revised or additional submittals as requested.
   i. Wherever shop drawings or vendor's standard data sheets indicate work to be done "by others", it shall be the responsibility of the contractor making the submission to identify by name, the contractor who is to do this work. If the contractor named is other than the contractor making the submission, the shop drawing submission must be reviewed by the named contractor and bear his mark of approval, prior to submission to the Architect/Engineer.
   j. Where equipment proposed differs from that shown on the drawings or specified, he shall submit for approval drawings showing the manner in which the layout is affected by the substitution.
   k. The Contractor shall keep one copy of approved shop drawings at the job site,, filed in a suitable metal container. The shop drawings shall be cataloged and kept in good repair, and shall be available for use by the Owner, Architect and Engineer.
   l. No equipment shall be ordered, fabricated, etc., before approval of shop drawings.

B. Contractor is responsible for the shop drawing coordination and interface with the work of other contracts and adjacent work. The relationship of Contractor’s work shall be verified as it relates to adjacent and critical features of the work of this and all contracts and materials.

1.7 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in all other applicable Divisions. In addition, refer to specifications for special guarantees.

B. Wherever in the specification sections of this division, reference is made to a specific warranty period, this warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the contract documents.

1.8 SITE INSPECTION

A. The Contractor shall visit the site, inspect, and become aware of all conditions which may affect the work during the estimation phase of his work and prior to bid openings. Investigate utilities, protection requirements for adjacent facilities, storage locations, and access to the construction area.

B. Submission of a bid will be deemed evidence of having complied with this requirement.

1.9 SUBSTITUTIONS

A. Whenever a material, article, piece of equipment or system is identified in the following specification or indicated on the drawings by reference to manufacturers' or vendors' names, trade names, catalog

numbers or the like, it is so identified for the purpose of establishing the basis of the Bid.

B. Substitution approval must be obtained and included as an addendum item prior to the submission of the bid. An approved substitution shall not be considered as an approval for the Contractor or an equipment vender to deviate from the written portion of the specifications unless so stated in the addendum.

C. The drawings illustrate the space allocated for equipment and the Contractor shall install the equipment accordingly. If changes are required in the building or arrangement due to substitution of equipment, the Contractor making the substitution must pay for the necessary modifications.

D. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements as indicated on all contract documents and as described within the specifications. This shall include, but shall not be limited to space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, then they shall be responsible for any and all additional costs associated with the changes required by other trades.

1.10 LUBRICATION

A. Furnish, install and maintain all required lubrication of any equipment operated prior to acceptance by the Owner. Lubrication shall be as recommended by the equipment manufacturer.

B. Provide one year's supply of lubricants to Owner at date of acceptance.

C. Verify that required lubrication has taken place prior to any equipment start-up.

1.11 EQUIPMENT START-UP

A. Verify proper installation by manufacturer or his representative.

B. Advise General Contractor 2 days prior to actual start-up.

C. Verify proper operation. Obtain signed statement by manufacturer or his representative that equipment is operating within warranty requirements. Submit statement to General Contractor.

1.12 OPERATION & MAINTENANCE INSTRUCTIONS

A. Properly and fully instruct Owner's personnel in the operation and maintenance of all systems and equipment.

B. Insure that the Owner's personnel are familiar with all operations to carry on required activities.

C. Such instruction shall be for each item of equipment and each system as a whole.

D. Provide report that instruction has taken place. Include in the report the equipment and/or systems instructed, date, contractor, Owner's personnel, vendor, and that a complete operating and maintenance manual has been reviewed.

E. Manual shall include all instructions on operation, maintenance, repair parts list, lubrication requirements, brochures, catalogue cuts, wiring diagrams, piping diagrams, control sequences, service requirements, names and addresses of vendors, suppliers and emergency contacts. Three manuals shall be provided.

F. Submit manuals for review prior to operating instruction period. Manuals shall be 8-1/2 x 11" with hard cover, suitably bound.

G. Provide to the Owner any special tools necessary for operation and routine maintenance of any of the equipment.

1.13 TOOLS

A. All equipment furnished by the Contractor which requires special tools or devices other than those

normally available to the maintenance or operating staff shall be furnished in duplicate to the Owner, sufficiently marked, packed or boxed for staff usage. The tools provided shall be listed by the Contractor identified as to their use or the equipment applicable in a written transmittal to the Owner.

1.14 CLEANING AND FINISHING

A. After equipment start-up and all operating tests have been made and the system pronounced satisfactory, each respective Contractor shall go over the entire project, clean all equipment, etc., installed by him and leave in a clean and working condition. Any surfaces found marred after this final cleaning shall be refinished or replaced by each Contractor at no cost to the Owner.

B. Provide for the safety and good condition of all materials and equipment until final acceptance by the Owner. Protect all materials and equipment from damage. Provide adequate and proper storage facilities during the progress of the work. Special care shall be taken to provide protection for bearings, open connections, pipe coils, pumps, compressors and similar equipment.

C. All NEW fixtures, piping, finished surfaces and equipment installed shall have all grease, adhesive labels and foreign materials removed.

D. All new piping installed shall be drained and flushed to remove grease and foreign matter. Pressure regulating assemblies, traps, flush valves and similar items shall be thoroughly cleaned. Remove and thoroughly clean and reinstall all liquid strainer screens after the system has been in operation ten (10) days.

E. Gas piping shall be blown out with clean compressed air or inert gas.

F. When connections are made to existing systems, the Contractor shall do all cleaning and purging of the existing systems required to restore them to the condition existing prior to the start of work.

G. Clean-up: Remove from the premises, all unused material and debris resulting from the performance of work under this section.

PART 2 – PRODUCTS

2.1 GENERAL

A. All material and equipment shall be new and of present day manufacture, and shall conform to accepted standards of the trade where such a standard has been established for the particular type of equipment or material.

B. Whenever equipment or material is referred to in the singular, such as "the plumbing fixture", it shall be deemed to apply to as many such items as necessary to complete the work.

2.2 PRODUCT DELIVERY, STORAGE AND HANDLING

A. During loading, transporting and unloading exercise care to prevent damage to material.

B. Store all materials in dry enclosures or under protective coverings out of way of work progress.

C. Material shall not be allowed to be stored directly on ground.

D. Deliver in manufacturer's original cartons or on skids.

E. Handle and protect so as to prevent damage to product or any surrounding material.

2.3 CONCRETE

A. Concrete if used on this project, shall be in accordance with Section 033000.

B. The 28-day minimum compressive strength shall be 3000 psi.

PART 3 – EXECUTION

3.1 PROTECTION

A. Plug or cap open ends of piping systems.

B. Stored materials shall be covered to prevent damage by inclement weather, sun, dust or moisture.

C. Protect all installed work until accepted in place by the Owner.

D. Plates, polished metal escutcheons and other finished devices shall not be installed until masonry, tile, and painting operations are complete unless otherwise protected.

E. Protect all work from operations which may cause damage such as hauling, welding, soldering, painting, insulating and covering.

F. Do not remove protective material until equipment is placed in service.

3.2 WORKMANSHIP

A. Install all work neat, trim and plumb with building lines.

B. Install work in spaces allocated.

C. Cutting and patching shall be performed by skilled tradesmen normally employed for the work involved.

3.3 EXCAVATION

A. The excavation shall be of the open-trench method and to the depths and widths as may be necessary. The Contractor shall do all excavation required in connection with his work. Bottoms of trenches shall be excavated to a uniform grade. All materials excavated shall be deposited on the side of the trenches and beyond the reach of the slides. Excavated material shall not be piled where it will interfere with traffic. If rock is encountered, it shall be removed by the General Contractor. See provisions in Division 2.

B. No piping shall be bedded directly on rock. They shall be cushioned by a 6-inch layer of crushed stone or gravel of selected grade, of size to pass through 3/4" mesh sieve. Not less than 30% shall be fine which will pass through a 3/8" mesh sieve.

3.4 SHORING AND PUMPING

A. The Contractor shall provide all shoring, bracing or sheet piling necessary to maintain the banks of his excavation and shall take out same as the work progresses and filling in has been accomplished. Shoring shall be in accordance with OSHA Standards.

B. The arrangement of shoring must be such as to prevent any movement of the trench banks and consequent strains on the conduits. Shoring shall be provided to prevent damage to work installed by other trades.

C. The Contractor shall do all pumping required to keep his excavations free of water. The water shall be conveyed in piping or watertight troughs a sufficient distance that it will flow from the site and not affect other work being performed.

3.5 BACKFILLING

A. After work in trenches has been completed, they shall be filled with select fill in 8" layers and shall be pneumatically tamped before the next layer of material has been filled in. The backfill shall be free of excavated rock, cinders, stones, brickbats or other debris.

B. Wherever rock is removed, the Contractor shall secure and fill select clean earth to a minimum depth of 3'-0" above the top of the pipe. Unless otherwise indicated, no rock shall be deposited in the trench fill. This clean earth fill shall be procured other than from the site unless permission for earth borrow from the site is granted by the Architect. If site borrow is permitted, the topsoil removal, relocation and finished grading will be accomplished as directed by the Architect.

C. Under no circumstances shall excavated material be left where it will interfere with the Owner's or other Contractor's operations.

D. All earth and other materials taken from the trenches and not required for backfilling shall be deposited where directed, or removed from the premises as directed by the Architect.

E. Any rock removed from the excavation shall be removed from the project site by the Contractor.

F. Trenches which pass under wall footings or within 18" of column footings shall be backfilled with lean concrete. To secure adequate foundation support, the method and depositing of the concrete fill shall be as directed by the Architect. To prevent the concrete from adhering to the pipes, necessary pipe protection shall be applied.

3.6 EQUIPMENT SETTING

A. Furnish and install as a minimum, a 4 inch concrete pad beneath all floor-mounted equipment. Install anchor bolts in pour.

B. Furnish and install as a minimum, spring vibration isolation under any equipment 10 HP and over and rubber in shear vibration isolation on any equipment up to 10 HP.

C. Concrete shall be 3,000 psi, 28 day compressive strength in accordance with ACI-613. Reinforce with No. 4 rod 12" on centers both ways or as otherwise detailed.

3.7 FASTENERS, HANGERS AND SUPPORTS

A. Furnish and install all hangers and supports required to suspend, mount, or hang the work.

B. Furnish and install all miscellaneous steel angles, channels, beams, clips, brackets and anchors necessary to hang or support the work. Provide submissions for review.

C. Install concrete inserts before concrete is poured.

D. Drilled inserts shall not be loaded more than 1/4 rated capacity or 200 pounds.

E. Power-driven fasteners shall not be allowed for piping larger than 2 inch, or equipment. When used they shall not be loaded more than 1/8 rated capacity or 200 pounds.

F. All hangers, miscellaneous steel, braces and supports shall be galvanized, cadmium plated, or primed steel. Copper tubing shall be supported with copper hangers. No direct contact of dissimilar metals between the piping system and its hanger support shall be permitted.

G. Piping shall be supported from adjustable clevis type hangers with insulation pipe saddles. Where hangers are 18” or longer, provide lateral bracing at every fourth hanger. See IPC Pipe Support Table below:

PIPE SUPPORT SPACING

Material	Horizontal Max. Feet	Vertical Max. Feet
ABS Pipe	4	10
Aluminum	10	15
Brass	10	10
Brass Tube up to 1-1/4”	6	10
Brass Tube over 1-1/2”	10	10
Cast Iron	5	15
Copper up to 1-1/4”	6	10
Copper over 1-1/4”	10	10
CPVC Up to 1”	3	10
CPVC Over 1”	4	10

Material	Horizontal Max. Feet	Vertical Max. Feet
Lead Pipe	Continuous	4
PB Pipe/Tubing	2.6 ft. (32”)	10
PVC Pipe	4	10
PEX	2.6 ft. (32”)	10
Steel Tubing	8	10
Steel Pipe	12	15

H. Support vertical piping at floor levels using approved riser clamps. Clamp material shall be compatible with pipe material. Maximum vertical spacing shall be10’-0”.

3.8 SLEEVES

A. Provide each pipe passing through a masonry or concrete wall, floor or partition with a sleeve made from standard weight steel pipe for pipe with smooth edges, securely and neatly cemented in place. Provide each pipe passing through a frame or metal partition with a sleeve made from No. 22 gauge galvanized sheet metal, securely fastened in place.

B. Pipe passing through foundation wall or under foundation shall be provided with relieving arch or steel pipe per IPC Section 305.5.

C. Be responsible for the proper location and alignment of all sleeves.

D. Provide hydrostatic seals for sleeves passing through outside walls, below grade, or through hydrostatically sealed slabs or floors on grade. Provide fire-rated seals for all other sleeves.

E. Install both piping and sleeve seals so as to maintain integrity of seals with expansion and contraction of piping.

F. Set floor sleeves flush with floor surface in finished areas, 1" above the finished floor in kitchens, cafeterias, and similar service areas unless such areas are slab-on-grade; 1" above the floor in mechanical rooms, pipe chases, pipe spaces and other unfinished areas, unless otherwise indicated, and flush with the underside of slabs. Extend wall and partition sleeves through and cut flush with each surface unless otherwise indicated or specified.

G. Select sleeves two pipe sizes larger than any pipe that is to remain uncovered, unless otherwise required by the sealing method specified. Where pipes are to be covered, provide sleeves large enough to allow the covering to pass through the sleeves with sufficient clearance for sealing as specified hereinafter. Size sleeves for branch piping from vertical risers large enough to permit vertical expansion at the riser.

H. Place sleeves imbedded in concrete floors or walls in the forms before concrete is poured; sleeves shall have integral waterstop flanges, where they are to receive either watertight or hydrostatic seals.

I. Install sleeves passing through above-grade floors of mechanical rooms, toilet rooms, kitchens or similar service areas where liquid leaks or spillover may occur in a watertight manner. Sleeves shall be such that waterproofing membrane can be flashed around and into the sleeve where necessary.

J. Seal sleeves for pipes passing through ceiling air plenum walls or the floor above air tight in a manner similar to that specified for fire-rated sleeves.

K. Hydrostatic Sealing Method: Provide compressible synthetic rubber seals, equivalent to LINK SEAL, manufactured by the Thunderline Corporation, or THRUWALL manufactured by O.Z. Gedney. Install seals in accordance with the manufacturer's recommendations to provide air tightness aboveground and hydrostatic sealing belowgrade. Caulking or other type mastic is not acceptable.

L. Fire-Rated Sealing Method:

1. Fire stopping of all thru-penetrations of fire and/or smoke rated assemblies (partitions, floors, ceilings, etc.) shall be the responsibility of each installer or building trade (Mechanical, Plumbing, Electrical, Communications, Data, etc.) making the thru-penetrations, unless otherwise indicated on the Architectural series drawings (A-series). It is the responsibility of the Contractor making the thru-penetrations to verify and coordinate fire stopping with fire rating, assembly type and field conditions.
2. Sleeves, openings and sealants shall comply with applicable codes, recommended practices and standards, and manufacturer's instructions. Fire sealants shall have ability to prevent spread of flame, smoke or water throughout the penetration and shall pass 3 hour test, UL test ASTM E814 and UL 1479.
3. Products: Refer to Division 7 of the specifications for Fire Stopping Requirements.

3.9 PLATES

A. Furnish and install chrome plated plates wherever piping passes into finished area.

B. Plates shall be securely fastened to piping or building construction.

C. Floor plates shall cover 1 inch sleeve extension.

3.10 OFFSETS, TRANSITIONS, MODIFICATIONS

A. Furnish and install all offsets necessary to install the work and to provide clearance for other trades.

B. Maintain adequate headroom and clearance.

C. Incidental modifications necessary to the installation of the systems shall be made as necessary and as approved by the Architect.

3.11 RECESSES

A. Furnish information to the General Contractor as to sizes and locations of recesses required to install panels, boxes, and other equipment or devices which are to be recessed in walls.

B. Make offsets or modifications as required to suit final locations.

3.12 LABELING

A. All Plumbing equipment such as pumps, and devices requiring identification for operating procedures shall be provided with permanent black laminated micarta white core labels with 3/8 inch letters.

B. This shall also apply to all controllers, remote start/stop pushbuttons and equipment cabinets.

3.13 FLASHING AND COUNTERFLASHING

A. Roof drains, vents, roof curbs, etc., shall have counterflashing fittings. General Contractor shall provide flashing.

B. Piping and conduit thru the roof shall be flashed by the General Contractor. Furnish and install counterflashing.

3.14 ACCESS

A. Locate all equipment, valves, devices and controllers which may need service in accessible places.

B. Where access is not available, access panels shall be provided. Furnish access doors to the General Contractor for installation.

C. Access doors shall be Elmdor, Karp Co., MIFAB or Controlled Air Manufacturing Limited, with 16 gauge frames and 14 gauge steel door, prime painted.

D. Maintain required access clearances.

3.15 WIRING

A. Packaged plumbing system equipment shall be furnished with disconnect switches, and magnetic starters, factory furnished and wired by the unit manufacturer.

B. All control wiring shall be furnished and installed under this Division of the work.

C. All wiring shall be in accordance with the National Electrical Code and as recommended by the equipment manufacturer.

3.16 UTILITIES

A. Do not interrupt any utility or service to the Owner without adequate previous notice and schedule.

B. Arrange and pay for the relocation, disconnection or removal of, or relocate, disconnect or remove existing utilities and services where such work is shown or where such utilities or services interfere with new construction, whether or not shown. Provide all excavation, backfilling and paving required by such work.

C. Perform alteration of utilities and services in accordance with the rules, regulations and requirements of the involved utility companies, regulatory agencies having jurisdiction.

3.17 CUTTING AND PATCHING EXTERIOR SURFACES

A. This Contractor shall be responsible for returning disturbed paved and/or grass areas to original condition where excavation for utilities has been required.

B. Cut and patch paved areas to match original surface.

C. Properly tamp backfill before finishing or repairing disturbed area surfaces.

3.18 OPENINGS - CUTTING, REPAIRING

A. This contractor shall cooperate with the work to be done under other sections in providing information as to openings required in walls, slabs and footings for all piping and equipment, including sleeves where required.

B. Any drilling or cutting required for the performance of work under this Section, shall be the responsibility of this Contractor and the cost thereof shall be borne by him.

C. Holes in Concrete: Sleeves shall be furnished, accurately located and installed in forms before pouring of concrete. This contractor shall pay all additional costs for cutting of holes as the result of the incorrect location of sleeves. All holes through existing concrete shall be either core drill or saw cut. All holes required shall have the approval of the Structural Engineer prior to cutting or drilling.

D. It shall be the responsibility of this Contractor to ascertain that all chases and openings are properly located.

3.19 GUARANTEE

A. All materials and equipment provided and/or installed under this section of the specifications shall be guaranteed for a period of two-year from the date of acceptance of the work by the Owner unless otherwise specified in other applicable Divisions. Should any trouble develop during this period due to defective materials or faulty workmanship, the Contractor shall furnish all necessary labor and materials to correct the trouble without any cost to the Owner. Any defective materials or inferior workmanship noticed at time of installation and/or during the guarantee period shall be corrected immediately to the entire satisfaction of the Owner.

In the event of occupancy by the Owner prior to final acceptance of the project, the guarantee date for equipment placed in operation shall be mutually agreed to by the Contractor and the Owner's representative.

3.20 DRAWINGS

A. The Plumbing and Fire Protection Systems are indicated on the Contract Drawings. Certain pertinent information and details required by the Plumbing and Fire Protection Work appear on the Architectural, Structural and Electrical Drawings; become familiar with all Drawings; and incorporate all pertinent requirements.

B. Drawings are diagrammatic and indicate the general arrangement of systems and requirements of the Work. Do not scale Drawings. Exact locations of fixtures and equipment, not specifically shown shall be obtained before starting work.

C. When indicated on the drawings, plumbing riser diagrams are completely diagrammatic and indicate the intent of the work for both the Contractor, L&I review agencies and/or Authorities Having Jurisdiction. Where valves, shock absorbers, incidental equipment, devices, etc., including execution notes are indicated on the riser diagrams, they shall be so required and installed as part of the system work.

3.21 RECORD DRAWINGS

A. As-Built record drawings, showing dimensions, locations and depth of all buried and concealed piping, plugged outlets and equipment shall be kept up to date. Master copy shall be kept on the job. No backfilling of trenches shall be permitted until as-built drawings are approved as up-to-date by the Owner/Representative. No plumbing progress payments shall be approved unless as-built drawings are up- to-date. Depth of sewers shall be from a permanent bench mark as shown on the contract drawings. Refer to project record drawings under General Conditions.

END OF SECTION 22 0000

SECTION 22 0010

BASIC MATERIALS AND METHODS – PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this Section.

1.2 REFERENCE

A. Install all piping, fixtures, equipment, etc., to meet the requirements of the following:

New Castle County Department of License and Inspection

New Castle County Department of Sewers

Delaware State Plumbing Code

Delaware State Fire Marshal's Office

International Plumbing Code (All applicable sections)

International Mechanical Code (All applicable sections)

International Fuel Gas Code (All applicable sections)

Gas Utility Company

Water Company

NFPA

OSHA

All requirements of the above governing agencies shall be in compliance with the latest issues, rules or regulations in effect.

B. Appliances and materials governed by UL requirements shall meet such requirements and bear the label.

1.3 QUALITY ASSURANCE

A. Provide adequate supervision of labor force to assure all aspects of specifications are being fulfilled.

B. Insure that all work and equipment is installed in accordance with manufacturer's warranty requirements.

C. Replace all pipes and fittings shown to be defective as a result of testing.

1.4 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 220000.

B. Submit the following:

1. Manufacturer's Product Data on all pipe and fittings to be used in project.
2. Manufacturer's Product Data on all valves to be used in project.

1.5 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

PART 2 – PRODUCTS

2.1 STEEL PIPE & FITTINGS

A. Pipe: ASTM A-53, seamless, Schedule 40.

B. Fittings:

1. Cast iron, threaded, 175 psi, ANSI B-16.4.
2. Malleable iron, threaded, ASA B 16.3.
3. Steel, socket weld, ASTM A-53.
4. Wrought iron, socket weld, ASTM A-72.

C. Thread tape shall be teflon tape, 3 mils minimum thickness. Teflon tape shall not be permitted for use on gas piping systems.

D. See Section 220130 for Gas Piping Systems.

2.2 CAST IRON PIPE AND FITTINGS

(Note: Any cast iron piping made or marked “CHINA” will NOT be acceptable on this project)

A. Aboveground:

1. Pipe & Fittings: Hubless cast iron, CISPI 301, ASTM A-74 and ASTM A-888 shall be marked with the collective trademark of the Cast Iron Institute (soil pipe).
2. Joints: Neoprene sleeve and stainless-steel shield and clamp assembly, CISPI 310, ASTM-1277.

B. Below grade and/or slab: (Contractor's Option)

1. Bell and Spigot: Service weight bell and spigot pattern ASTM-74 with compression type neoprene gaskets ASTM C-564.
2. Hubless: Hubless cast iron pipe CISPI 301, with heavy duty 3.04.016 stainless steel bands for below-grade installation. Elastomeric seal component ASTM C-564 and CSA B-602.
3. Hubless Joints: Cast iron CISPI 310 and as TM C-1277.
4. PVC DWV pipe and fittings, Schedule 40, ASTM D-2665, D2949, F891 and CSA B181.2.
5. Corrosion protection shall be in accordance with IPC 305.1. Provide appropriate wrapping or sheathing when pipe is exposed to lime and acid of concrete, cinder or other corrosive materials.
6. Protection of all below-grade storm and sanitary shall be in accordance with IPC Section 305.
7. All Kitchen and Boiler Room below slab piping shall be extra heavy schedule cast iron only. PVC not allowed.

C. Corrosion protection shall be in accordance with IPC 305.1. Provide appropriate wrapping or sheathing when piping is exposed to lime and acid of concrete, cinder or other corrosive materials.

2.3 COPPER TUBING

A. Domestic hot, cold and recirculated water:

1. Aboveground:
   a. Tubing: Hard-drawn, seamless ASTM B-88, Type "L".
   b. Fittings: Solder joint wrought copper ANSI B-16.22.
   c. Joints: Lead-free solder 410°, ASTM B-32 alloy designation “TC”, ASTM B-828.
   d. Flux: Non-toxic and non-corrosive, ASTM B-813.
2. Underground:
   a. Tubing: Soft-drawn, seamless ASTM B-88, Type "K".

b. Fittings: Solder joint wrought copper ANSI B-16.22.

c. Joints: Lead-free solder 410°, ASTM B-32, ASTM B-828.

d. Flux: Non-toxic and non-corrosive, ASTM B-813.

B. Drainage and vent piping:

1. Aboveground:

a. Tubing: Hard-drawn seamless ASTM B-88, ASTM B-75, Type "M" and DWV as pipe size permits.

b. Fittings: Solder joint cast copper drainage type ANSI B-16.29.

c. Joints: Soldered, 95/5 tin-antimony ASTM B-828, ASTM B-32.

d. Flux: Non-toxic and non-corrosive, ASTM B-813.

C. Solder/Flux: See Paragraph 3.4 of this section for Soldering/Brazing.

2.4 DUCTILE IRON PIPE

A. Pipe: Ductile iron, ANSI A-21.51, ANSI/AWWA C151.

B. Joints: Rubber gasket, ANSI A-21.11, ANSI/AWWA C111.

C. Fittings: Mechanical joint, ANSI/AWWA C110, C153 bolt tolerances – AWWA C-111, ASTM A-563.

D. Lining: Cement mortar, ANSI A-21.4, ANSI/AWWA C104.

2.5 PVC GRAVITY SEWER PIPE

A. Pipe: Unplasticized polyvinyl chloride (PVC) with integral wall bell and spigot joints.

B. Material: ASTM D-3034 for SDR 35, colored green for inground identification as sewer pipe.

C. Joints: Two sections of pipe shall be assembled in accordance with manufacturer's recommendations and tested as per ASTM D 3212 for use with flexible elastomeric seals.

D. Sizes: For site drainage systems 4" to 15".

E. Additional compliances:

1. Drop Impact Test - ASTM D-2444

2. Pipe Stiffness - ASTM D-2412

3. Temperature for Testing - Designed to pass all tests at 73 degrees F (+/- 3 degrees F).

2.6 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. Aboveground – Drainage & Vent (Sanitary) IPC Table 202.1

1. ASTM D 2665

2. ASTM D 2949

3. CSA CAN/CSA B 181.2

4. ASTM F 1488

5. ASTM F-81

B. Underground – Drainage & Vent (Sanitary) IPC Table 702.2

1. ASTM D 2665

2. ASTM D 2949

3. ASTM F 891

4. CSA CAN/CSA-B 181.2

C. Building Sewer Pipe (Near Water Service) IPC Table 702.3 (DWV)
   1. ASTM D 2665
   2. ASTM D 2949
   3. ASTM D 3034
   4. ASTM F 891
   5. CSA B182.2
   6. CSA B 182.4 (Ribbed Sewer Pipe & Fittings)

D. Fittings:
   1. ASTM D 3311
   2. ASTM D-2665
   3. ASTM F-1866

E. Solvent Cement: (All Purpose on ABS, PVC and CPVC)
   Potable Water, Sewer, Drain Waste and Vent
   1. ASTM D-2564, D-2235 and F-493
   2. CSA B137.3
   3. CSA B181.2 or B182.1 (Sanitary Pipe only)
   4. ASTM D2855
   5. CSA B181.1

F. Primers: (PVC and CPVC)
   1. ASTM F 656, purple color, SCAQMD Rule 1168 and OTC Regulations for VOC emission levels. NSF Standard 61 PW, DWV, Sewer.

G. Uniformity: To insure installation uniformity, all piping components shall be of one manufacturer.

2.7 POROUS CONCRETE PIPE

A. Pipe & Fittings: Porous concrete drain pipe, A.A.H.O. designation M176.

B. Joints: Interlocking tongue and groove.

2.8 REINFORCED CONCRETE PIPE AND FITTINGS

A. Pipe & Fittings: Reinforced concrete, ANSI/ASTM C-75, Class 2.

B. Joints: Modified tongue and groove, with compression gasket, ANSI/ASTM C-443.

2.9 POLYPROPYLENE PIPE & FITTINGS

A. Pipe & Fittings: Polypropylene flame retardant ASTM D-2146 Schedule (40) (80).

B. Joints: (Aboveground)
   1. Mechanical
   2. Fusion welded socket ends.

C. Joints: (Below ground) Fusion welded - socket ends

2.10 CORRUGATED METAL PIPE

A. Pipe:
   1. 24" diameter and smaller shall be 16 U.S. gauge steel.
   2. 30" diameter and larger shall be 14 U.S. gauge steel.

3. All piping shall be completely bituminous coated on the interior and exterior and shall have a paved invert for 25% of its periphery.

B. Joints: Standard coupling bands and bolts as furnished by the pipe manufacturer.

2.11 VALVES (Copper Systems) – Solder ends of Threaded

A. Valves listed below shall be for domestic water systems and comply with the latest requirements of NSF 61-8. Refer to individual sections for gas valves.

B. Ball Valves: NIBCO two piece, full port, 600 psi WOG rated, cold non-shock valve with reinforced TFE seals, 316 stainless steel ball, Eco-brass body, ASTM 584, Alloy C87850, solder ends, or threaded non-blowout stem design. Acceptable NIBCO figure numbers: T/S 685-80-66-LF; T/S 595-Y-66-LF (3 piece).

C. Check Valves: NIBCO Class 125, Eco-brass body, ASTM 584, Alloy C87850, swing type, Y Pattern, threaded cap access. Acceptable NIBCO figure number: T/S 413-LF.

D. Gate Valves: NIBCO Class 125, Eco-Brass body, ASTM 584, Alloy C87850, Rising Stem. Acceptable NIBCO figure number: T/S 113-LF.

E. Balance Valves: All balance valves shall be provided with a memory stop feature with calibrated name plate to assure specific valve setting. Bronze body/brass ball, carbon filled TFE seat rings. NIBCO, Bell & Gosset, Accu-Flow, Taco or Flow Design "Accusetter". Acceptable NIBCO figure numbers: T/S 1710, F/G 737.

F. Strainers:

1. Class 125 Bronze Y-Strainer, body to be ASTM B584 or B62 bronze with threaded, solder or female press end connections and .033 inch perforated type 304 stainless steel screen or 20 mesh type 304 stainless steel screen accessible without removing the strainer from the line. Acceptable Figure numbers: NIBCO Fig. S/T-221, S/T-222, PF-221/222-A,B.

2. Class 125 Flanged Cast Iron Y-Strainer, body to be ASTM A-126 Class B cast iron. End connections to be Class 125 flanged, tapped bolted bonnet with plug. Screen shall be .033 inch perforated type 304 stainless steel screen or 20 mesh type 304 stainless steel screen accessible without removing the strainer from the line. Acceptable Figure numbers: NIBCO Fig. F 721-A.

3. Class 250 Threaded Cast Iron Y-Strainer: Strainer body to be ASTM A-126 Class B cast iron. End connections to be Class 250 threaded, tapped screw-in bonnet with plug. Screen shall be .033 inch perforated type 304 stainless steel screen or 20 mesh type 304 stainless steel screen accessible without removing the strainer from the line. Acceptable Figure numbers: NIBCO Fig. T-751-A

G. VALVES (Copper Systems) – Press Fit

1. Valves listed below shall be for domestic water systems and comply with the latest requirements of NSF-61-8.

a. 2 Inch and Smaller Ball Valves (On/Off):

Ball Valves with male or female press to connect shall be rated at 200 PSI CWP to +225°F maximum. Valves shall be manufactured in accordance with MSS SP-110 and constructed of dezincification resistant cast bronze bodies. Brass with more than 15% zinc shall not be approved. Valve shall have reinforced PTFE Seats, Blow-out Proof Stem, Full Port Ball, Chrome/Nickel Plated or Stainless Steel Ball for aggressive water.

b. 2 Inch and Smaller Check Valves (Swing Type):

Check valves shall be swing type Y pattern with male or female press to connect ends and shall be rated 200 PSI CWP to + 250°F maximum. Valves shall be manufactured in accordance with MSS SP-80. Body & cap shall be manufactured of dezincification resistant

cast bronze ASTM B62 or ASTM B584 Alloy C8440. Valves shall have PTFE seat disc.

c. 2 Inch and Smaller Check Valves (Lift or Spring Type):

Incline resilient disc, spring actuated, 250psi rating, non-shock cold working pressure, 2500F maximum working temperature, bronze ASTM B584 alloy C84400. Stainless steel stem and disc holder and spring, EDPM O-ring.

H. Insofar as possible, all valves of the same type shall be of the same manufacturer.

I. Valve Manufacturers: Subject to compliance with requirements, provide valves of one of the following:

Apollo/Conbraco

Stockham

Nibco

Milwaukee

Watts

Hammond

Webstone

J. System Application:

1. Domestic Water:

a. Check Valves - 2" & Smaller - threaded or soldered.

b. Ball Valves - 3" & Smaller - threaded or soldered.

c. Balance Valves - All sizes - threaded.

d. Butterfly Valves - 4" and larger - flanged.

e. Butterfly Valves – 3” and smaller – wafer type.

2.12 THERMOMETERS

A. Separable socket, inserted into fluid flow, adjustable, hermetically sealed, red mercury, die-cast, baked enamel finish, double strength glass lens, white scale and black graduations.

B. Scale: Select range of thermometer to indicate normal operating temperature at mid-point of scale for domestic water systems.

C. Manufacturer: U.S. Gauge, H.O. Trerice, Moeller, Duro.

2.13 GAUGES

A. Phosphor bronze bourdon tube, polypropylene case, gasketed glass crystal, aluminum dial, black graduations 4-1/2 inch diameter.

B. Range: 0 to 150 psi, 5 pound intervals, 1/2 pound graduations.

C. Manufacturers: Danton, U.S. Gauge, H.O. Trerice, Moeller.

D. Install with bronze gauge cock.

2.14 ISOLATING FITTINGS

A. Furnish isolating fittings between all sections of dissimilar piping materials or piping, general supports, equipment and supports, including piping hanger and rack supports where one material is ferrous and the other is non-ferrous.

B. Install copper or brass piping or tubing in such a way as not to touch or come in contact with ferrous metals.

C. Where ferrous piping or equipment is connected to copper or brass piping, make connection with insulating or dielectric unions to prevent electrolytic action between the ferrous and non-ferrous metals.

D. Where copper or brass piping, tubing or fittings are anchored to, supported by or may come in contact with ferrous metal construction, provide an insulating nonconductor spacer of rubber, fiber or equivalent material to assure prevention of electrolysis.

E. Manufacturer: Epco Sales, Inc., or insulated unions by Central Plastic Co.

2.15 ANCHORS AND GUIDES

A. Anchors and guides shall be provided to support and maintain pipes in position and properly distribute expansion. The anchors and guides must be securely fastened to the building structure, and must be completely installed before the system is tested.

B. Guides shall be as manufactured by J.J. McNally, Inc., Flexonics, Inc., Tube-Turns, American District Steam Co.

2.16 UNIONS

A. Up to and including 2-inch pipe size: Screwed pattern, bronze-to- bronze seat.

B. Above 2-inch pipe size: 125 Class Flanged pattern, A.S.A. sweat copper fitting, with gaskets, bolts and nuts.

C. Copper tubing unions shall have sweated type ends. Flanged unions on copper tubing may be soldered connections.

D. Materials and pressure ratings shall be the same as specified for the respective pipe and fitting system unless otherwise specified.

PART 3 – EXECUTION

3.1 PIPING SYSTEM INSTALLATION REQUIREMENTS

A. Drawings are generally diagrammatic and due to small scale, it is impossible to indicate all fittings, valves, gauges and specialties required. Provide complete operating systems and all necessary fittings, valves gauges and specialties whether or not indicated.

B. Install all piping in accordance with the best practices of the trade and latest code requirements. Use uniform system materials throughout the building. All branch take-offs shall be off the top of the pipe.

C. Pipe and fittings shall be clean from cutting burrs, foreign materials and defects in structure and threading. Make all cuts square. Ream after cutting. Clean off scale and dirt inside and outside, before assembly. Remove welding slag or other foreign material.

D. Keep all piping as high as possible, consistent with proper pitch, to maintain maximum headroom. Cut piping accurately to measurements established at the building, work into place without springing, forcing or cutting of the building structure, and install as directly as possible between connecting points parallel with or at right angles to building construction, except as required to obtain pitch.

E. Unless otherwise shown, run piping within the building, concealed in the walls, furred spaces, pipe spaces or above suspended ceilings. Unless otherwise noted, do not build in or bury horizontal piping in partitions. Install all exposed piping as closely as possible to walls, ceilings and columns, consistent with access and applicable insulation requirements.

F. This project includes a return air plenum ceiling. Regardless of materials specified, all system piping and/or materials shall be non-combustible and shall be in full compliance with the requirements set forth in the IPC.

G. All piping to drain to low points. Low points will be provided with drain valves with hose thread. All piping shall have high points vented with ball valve, nipple and threaded cap.

H. Do not install trapped lines where water cannot be drained or air can accumulate without being vented.

I. Piping shall run square with building lines.

J. Piping shall not be insulated or covered until tested and until building is closed in.

K. Necessary drains, off-sets, vents and drips shall be provided for coordination of the work as part of the contract.

L. Piping shall not be installed over electrical transformers, panels, switchgear, substations, and control panels as per the National Electric Code. No piping shall be installed in elevator machine rooms unless it is directly related to the room's system equipment.

M. Allow clearance for expansion and contraction.

N. Install isolating fittings between sections of ferrous and non- ferrous pipe or connected equipment.

O. Valves shall be installed with stems above horizontal.

P. Valves shall be installed on all sides of equipment and control valves to allow isolation for repair.

Q. Do not support piping from other piping, conduits or equipment. Provide additional bracing to prevent movement of trapeze piping, or any singular run of pipe to fixtures. Provide additional bracing on all piping through walls to flush valves to prevent movement during normal operation or performing maintenance on valves.

R. Thermometers and gauges shall be installed where indicated on the drawings, required by equipment specifications and where indicated elsewhere in the specifications. Gauges shall be located at an elevation that can be readable.

S. Unions shall be provided adjacent to all valves, at equipment connections, and where necessary to facilitate dismantling of the piping system.

T. Ball valves to be installed with the proper clearance for operating the valve handle. A minimum clearance of 10" from center of valve to wall must be maintained for ease of operation.

U. Thermometers are to be located so they can easily be seen from the floor in front of unit. Make final adjustment by tilting thermometer. Locate bulb in waterway with an oversized tee or elbow fitting.

V. Install pressure gauges on incoming services both domestic water and fire services. Locate pressure gauge after main shut-off valve and ahead of water meter if one is provided within building.

W. All pipe unions installed shall be accessible. Unions shall not be concealed or located in places where they cannot be maintained.

X. Support and bracing of 4" and above pipe shall be in accordance with the CISPI Standards and IPC Chapter 3.

3.2 TAGS, CHARTS, AND IDENTIFICATION

A. All piping shall be labeled in accordance with IPC 303.1 and 303.4.

B. Identify each valve in all systems with black, numbered and stamped 1-1/2" brass or aluminum tags fastened to valve by brass chain and S-hook.

C. Piping Identification: Provide identification and safety products, semi-rigid plastic, wraparound pipe markers with flow arrows and conforming to ANSI A13.1. Locate marker at each valve, changes in direction, where pipes pass thru barriers and every 25' of horizontal runs. Lettering on background shall be in accordance with the following colors:

Legend	Background	Lettering
1. Gas	- Yellow	- Black
2. Fire Protection	- Red	- White

3. Domestic Cold Water	- Green	- White
4. Domestic Hot Water (110° ^ 140°)	- Yellow	- Black
5. Domestic Hot Water Return (110° ^ 140°)	- Yellow	- Black
6. Sanitary Drainage	- Green	- White
7. Condensate Drainage	- Yellow	- Black
8. Vent	- Yellow	- Black
9. Storm Drainage	- Green	- White
10. Medical Gas	Conform to NFPA-99 Regulations	
11. Plant Compressed Air	- Yellow	- Black

D. Provide 1/8" scale diagrams showing location, number and service or function of each tagged item.
   1. Frame diagrams in approved metal frames with clear acrylic front, hinges, and locks.
   2. Secure to wall in Mechanical Room.
   3. Provide two additional separate copies permanently covered and bound.

E. Available Manufacturers: Subject to compliance with requirements, manufacturer's offering identification markers which may be incorporated in the work are limited to the following:

   Seton

   Brimar

   B-Line

   Marking Services, Inc.

3.3 WELDING

A. All concealed and inaccessible black steel piping shall be welded.

B. All black steel piping larger than 2 inch shall be fusion welded.

C. All elbows, tees and branch connections shall be made with welding fittings ANSI B16.9.

D. Welding shall be in accordance with the ASME Boiler and Pressure Vessel Code Section IX.

E. Furnish welder test certificate for review. Certificates of successful qualification by the following organizations shall be acceptable.
   1. ASME Boiler and Pressure Vessel Code
   2. ANSI Code for Pressure Piping
   3. National Certified Pipe Welding Bureau
   4. Military Specification MIL-STD-248

3.4 SOLDERING/BRAZING

A. Connections between copper tubing and copper sweat fittings shall be made by soldering using Taramet Sterling or approved substitute. Flux shall be non-corrosive type "Nokorode" or approved substitute or as recommended by the manufacturer of the solder.

B. All solder shall be "lead nickel and antimony free" in accordance with the Federal Safe Drinking Water Act Amendments of 1986 and 1996 as is ASTM B-32 Grade TC.

   Composition:

   Tin 95%

Copper	4.0 – 5.0%
Selenium	.04 - .2%
Tensile Strength	7,130 psi
Shear Strength	5,970 psi
Melting temperature	410°F

C. Tubing shall be cut square and then reamed and deburred. End of tubing and inside of fitting cup shall be cleaned with steel wool and the flux shall be applied to the clean surface before soldering. After soldering, the excess solder shall be wiped off while still plastic.

D. Brazed Joints:

1. All brazed joints shall be cleaned. An approved flux shall be applied; joint filler metal shall conform to AWS A5.8.
2. Flux shall meet AWS Standard A5.31, Type F83-A or F83-C.

E. 410 solder shall be used for all joints in:

1. Domestic cold water
2. Domestic hot water
3. Domestic hot water return
4. Copper drainage piping
5. Plant compressed air

F. Lead-Tin (50-50) solder or any solder containing lead shall NOT be used or permitted for joint connections on this project.

G. Where the silver brazing is performed in a confined non-ventilated space, a non-toxic, cadmium-free brazing alloy such as Stay-Brite shall be used instead of Easy-Flo. Bring joint to solder temperature or brazing temperature in as short a time as possible.

H. Form continuous solder bead or brazing filler bead around entire circumference of joint.

I. Wipe excess solder from joint area while solder is still plastic.

J. Solder joints shall be in accordance with IPC Section 605.2, 605.14.3 and ASTM B838. Flux shall conform to ASTM B-813.

3.5 PRESS-FIT SYSTEM

A. All new domestic water piping installed on this project shall be a solderless, press-fit, domestic water system. The system shall be Viega/Rigid or Nibco copper press fitting system. Fittings shall be rated 0□ to 250□ at 200 psi and tested to 600 psi.

B. Fittings shall meet ANSI/NSF 61, – ASME B-16.22 and ASTM B88. Elastomeric seals shall meet ASTM D-2000.

C. Mechanical joining shall be recognized by:

IPC International Plumbing Code

SBCCI Standard Plumbing Code

IAPMO Uniform Plumbing Code

PHCC National Standard Plumbing Code

D. Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting

manufacturer. Press end shall have SC (Smart Connect) feature design (leakage path). Smart Connect™ (SC Feature). In ProPress ½" to 4" dimensions, the Smart Connect Feature assures leakage of liquids and/or gases from inside the system past the sealing element of an unpressed connection. This feature shall provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

E. Press Connections: Copper press fitting joints shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer.

F. Installer shall be a qualified installer, licensed within the jurisdiction, and familiar with the installation of ProPress copper press joint systems. ProPress copper press fittings shall be installed using the proper tool, actuator, jaws and rings as instructed by the press fitting manufacturer. The installation of copper tubing for hot and cold-water distribution systems shall conform to the requirements of the ICC International Plumbing Code or IAPMO Uniform Plumbing Code.

G. Note: Viega Pro-Press or Nibco Press-fit installation shall only be permitted on this project. Push-on shark-teeth, or any type connection fittings that are not Press-Fit, shall NOT be approved.

H. T-drill mechanically formed tee fittings shall be used in conjunction with the ProPress Copper System in accordance with the IPC Chapter 6 Section 605.5.1, 605.5.1.2 and 605.14.1. Use caution around combustible material and follow all safety guidelines for open flame during silver brazing.

END OF SECTION 22 0010

SECTION 22 0030

INSULATION & COVERING – PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

1.2 DESCRIPTION OF WORK

A. This section includes insulation and covering furnished and installed on the following piping systems and equipment:

1. Domestic cold water.
2. Domestic hot water supply and return
3. "Primary" Horizontal rainwater conductors including underside of roof drains. "Secondary" rainwater systems insulation is not required.
4. Condensate waste piping from air conditioning units.
5. Branch waste lines from all chilled water fountains.

1.3 REFERENCE STANDARDS

A. Refer to Section 220000 for a general description of requirements applying to this section.

B. Materials shall conform to the requirements of the NFPA Code.

1.4 QUALITY ASSURANCE

A. Refer to Section 220010 for a general description of requirements applying to this section.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 220000.

B. Submit the following:

1. Product data on all insulation and covering.

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

PART 2 – PRODUCTS

2.1 PIPE INSULATION MATERIAL

A. Fiberglass:

1. Material: Preformed fiberglass bonded with resins to form circular pipe sleeves with factory applied, white all-service jacket bonded to reinforced foil vapor barrier jacketing. The jacket shall have factory-applied double pressure-sensitive adhesive closure and vapor sealing of longitudinal joints. Thermal Conductivity: .25 per inch at 100 degrees F. Flame spread of 25 and developed smoke of 50 or less.
2. All Valves and Fittings:
   a. Class fiber insert and premolded PVC cover, Manville "Zeston" and "Hi-Lo Temp Inserts" for valves and fittings.
   b. Factory molded fibrous glass fitting covering for fittings.

c. Mitered sections of pipe covering for valves.

3. Manufacturers: Johns-Manville, Certain-Teed, Owens-Corning.

B. Closed Cell:

1. Material: Flexible elastomeric foamed plastic closed cell structure insulation 25/50 rated with a flame spread rating of 25 or less and a smoke developed rating of 50 or less.
2. Flexible pipe insulation shall be a foamed plastic closed cell structure material, with a thermal conductivity of not more than 0.27 Btu/Hr./Sq. Ft./Inch at a mean temperature of 75 degrees F. The insulation shall have an average density of at least 2 pounds per cubic foot, shall be self-extinguishing, and shall have a water vapor transmission rating of not more than 0.1 perms. Between temperature limits of -40 degrees F and plus 220 degrees F, the insulation shall not indicate any deviation from its original state.
3. Manufacturers: Armacel, Insul-Tube, Nomaco Insulation.
4. Specification Compliance: (Latest accepted Standards and Codes)

IECC 804.5:	Insulation thickness for domestic hot and recirculation mains.
ASTM-E-84	Flame spread and smoke developed.
NFPA 255:	Standard method of test of surface burning of building materials.
ASTM C177:	Thermal conductivity.
NFPA 90A, 90B:	Flame & smoke rating
ASTM-C-534 Type 1 Tubular Grade, Self-Sealing	
UL 181	Factory made air ducts and air connectors. (Armacell UL181 has to do with mold growth)
UL723	Test for surface burning characteristics of building materials.
ASTM G21/C1338:	Fungi resistance
ASTM G2:	Bacterial Resistance
ASTM D1056, 2B1: Standard spec for flexible cellular materials.	
MIL-P-15280J, FORMT	
MIL-C-3133B (MIL STD 670B) Grade SBE-3	
MEA 96-85M	

C. Covering of Pipe Insulation Outdoors:

1. Wrapping: Wrap insulation with embossed .016" aluminum jacket.
2. Fastenings: Cover shall be held in place with soft aluminum bands on 12" centers.
3. Valves and Fittings: Weatherproof all valves and fittings.
4. Manufacturers: Johns-Manville, Certain-Teed, Owens-Corning, Knauf.

D. Protective cover for foam insulation in wet areas indoors:

1. PVC heavy duty fitting covers and jacketing for kitchen wet areas.
2. Fitting covers shall be glossy white, high impact, UV resistant PVC.
3. Operating Temperature Limit: Up to 150ºF.
4. Flame Spread: 25 or less.
5. Smoke Developed: 50 or less.
6. Grade: Weatherable.

7. Color: White
8. Finish: Gloss
9. Fitting covers and jacketing shall be “Zeston” 300 Series PVC, heavy duty covers and “Zeston” PVC jacketing.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Do not install until systems have been tested and meet requirements.

B. Do not install until building is closed in.

C. Heavy work which may damage insulation shall have been completed in the vicinity of the insulation work.

D. All installations shall be made by skilled craftsmen regularly engaged in this type of work.

E. Insulation shall be continuous thru-wall, ceiling and floors.

F. Pipe and equipment to be clean and dry prior to insulating.

G. Install all insulation in strict conformance with manufacturer's instructions.

H. All electrical heat tracing installations shall be coordinated with the electrical contractor. No insulation shall be installed until the heat trace wiring is completely installed, tested and approved. All insulation materials and installation work shall be the responsibility of the Insulation Contractor.

I. Install pipe insulation by slitting tubular sections and applying onto piping or tubing. Alternately, whenever possible, slide unslit sections over the open ends of piping or tubing. All seams and butt joints shall be adhered and sealed using Armaflex 520 or 520 BLV Adhesive. If when using AP Armaflex SS, only the butt joints shall be adhered using Armaflex 520 or 520 BLV Adhesive, Armaflex HT 625 Adhesive shall be used with HT Armaflex.

J. Insulation shall be pushed onto the pipe, never pulled. Stretching of insulation may result in open seams and joints.

K. Tape the ends of the copper tubing before slipping the Armaflex insulation over the new pipes to prevent dust from entering the pipe.

L. All edges shall be clean cut. Rough or jagged edges of the insulation shall not be permitted. Proper tools such as sharp, non-serrated knives must be used.

M. On cold piping, insulation shall be adhered directly to the piping at the high end of the run using a two-inch strip of Armaflex 520 or 520 BLV Adhesive on the ID of the insulation and on the pipe. All exposed end cuts of the insulation shall be coated with Armaflex 520 or 520 BLV Adhesive. All penetrations through the insulation and termination points must be adhered to the substrate to prevent condensation migration.

N. Sheet insulation shall be used on all pipes larger than 6” IPS. Insulation shall not be stretched around the pipe. On pipes larger than 12” IPS, adhere insulation directly to the pipe on the lower 1/3 of the pipe.

O. Seams shall be staggered when applying multiple layers of insulation.

3.2 VALVES, FLANGES AND FITTINGS:

A. All fittings shall be insulated with the same insulation thickness as the adjacent piping. All seams and mitered joints shall be adhered with Armaflex 520 or 520 BLV Adhesive. Screwed fittings shall be sleeved and adhered with a minimum 1” overlap onto the adjacent insulation. Armaflex HT 625 Adhesive shall be used with HT Armaflex.

B. Valves, flanges, strainers and Victaulic couplings shall be insulated using Armaflex donuts that shall then be covered with sheet or oversized tubular insulation.

3.3 HANGERS

A. Support piping system using high density inserts with sufficient compressive strength. The pipe support insulation shall be elastomeric foam with the same or greater thickness than the pipe insulation. All joints shall be sealed with Armaflex 520 or 520 BLV adhesive.

B. Standard and split hangers: Piping supported by ring hangers shall have hangers insulated with the same insulation thickness as the adjacent pipe. All seams and butt joints shall be sealed with Armaflex 520 or 520 BLV Adhesive. Armaflex HT 625 Adhesive shall be used with HT Armaflex. Ring hangers may be sleeved using oversized tubular insulation. On cold piping, insulation shall extend up the hanger rod a distance equal to four times the insulation thickness. Insulation tape may be used to a thickness equal to the adjacent insulation thickness.

C. Clevis Hangers or other pipe support systems: Saddles shall be installed under all insulated lines at unistrut clamps, clevis hangers or locations where the insulation may be compressed due to the weight of the pipe. All piping shall have wooden dowels or blocks of a thickness equal to the insulation inserted and adhered to the insulation between the pipe and the saddle.

It is highly recommended for continuous insulation protection to use hanger sizes equal to the outer diameter of the pipe plus insulation thickness

D. Armafix IPH o Armafix NPH can be used to prevent compression of insulation at standard split, clevis hangers or other pipe support systems. To minimize the movement of Armafix, it is recommended that a pair of non-skid pads be adhered to the clamps. In addition, to prevent loosening of the clamps, use of an antivibratory fastener, such as a nylon-locking nut, is also recommended.

3.4 OUTDOORS EXPOSED PIPING

A. All outdoor exposed piping shall be painted with two coats of WB Armaflex Finish. Prior to applying the Finish, the insulation shall be wiped clean with denatured alcohol. The Finish shall not be tinted.

B. All outdoor exposed piping shall have the seams located on the lower half of the pipe.

3.5 EXTERIOR PIPE COVERING

A. Wrapping: Wrap insulation with embossed .016" aluminum jacket.

B. Fastenings: Cover shall be held in place with soft aluminum bands on 12" centers.

C. Valves and Fittings: Weatherproof all valves and fittings.

D. Finish: Apply two coats of vapor resistant mastic reinforced with glass fabric over wrapping.

3.6 PIPE COVERING (FOAMED PLASTIC TYPE)

A. All joints and seams shall be sealed with a compatible adhesive. Approved adhesives are as follows:

Armacel No. 520 (Low VOC use 520 BLV

Benjamin Foster Company No. 85-75 up to 200 degrees F.

Contractor may use self-sealing insulation in lieu of above.

B. Fitting covers shall be fabricated from the foamed plastic pipe insulation or from sheet insulation of the identical material. The fabrication shall be in accordance with manufacturer's instructions, and all seams mitered joints shall be joined using the adhesives described.

3.7 PIPE INSULATION – TYPES & THICKNESSES

A. Flexible Closed Cell:

Piping System	Up to 3"	Over 3" to 6"	Over 6"

Cold Water	½”	½”	¾”
Hot Water (120º)	1”	1”	1-1/2”
Hot Water Return (120º)	1”	1”	1-1/2”
Hot Water (140º)	1”	1”	1-1/2”
Hot Water Return (140º)	1”	1”	1-1/2”
Condensate Waste	½”	½”	-
Horizontal Storm (Primary)	½”	½”	¾”
Horizontal Storm (Secondary)	-----Not Required-----		
Underside of Roof Drains	½”	½”	¾”
Branch Waste From EWC’s	½”	---	---
Soil/Waste Piping Above Ceiling (where noted)	½”	½”	¾”

B. Fiberglass:

Piping System	Up to 3”	Over 3” to 6”	Over 6”
Cold Water	½”	½”	¾”
Hot Water	1”	1”	1-1/2”
Hot Water Return	1”	1”	1-1/2”
Hot Water	1”	1”	1-1/2”
Hot Water Return	1”	1”	1-1/2”
Condensate Waste	½”	½”	---
Horizontal Storm (Primary)	½”	½”	¾”
Horizontal Storm (Secondary)	-----Not Required-----		
Underside of Roof Drains	½”	½”	---
Soil/Waste Piping Above Ceiling (when noted)	½”	½”	¾”

END OF SECTION 22 0030

SECTION 22 0110

DRAINAGE SYSTEMS – PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this Section.

1.2 DESCRIPTION OF WORK

A. This section includes:

1. Soil and waste piping system work as indicated on drawings and schedules, and by requirements of this section.
2. Applications for soil and waste piping systems include the following:
   a. Above ground soil, waste and vent piping within buildings including soil stacks, vent stacks, horizontal branches, traps and connections to fixtures and drains.
   b. Underground building drain piping including mains, branches, traps, connections to fixtures and drains, and connections to stacks, extension from the building, terminating at connection to site sewer.
3. Insulation for soil and waste and storm water drainage as specified in Section 220030 is included as work of this section.
4. Trenching and backfilling required in conjunction with underground building drainage and site drainage piping as specified in Section 220000 is included as work of this section. Refer to Division I.
5. Installation of detectable metallic underground tape for <u>all</u> exterior buried PVC drainage piping.

1.3 REFERENCE STANDARDS

A. Refer to Section 220000 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 220010 for a general description of requirements applying to this section, and a listing of all applicable codes.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 220000.

B. Submit the following:

1. Product data on all systems equipment.

C. See requirements for submission of cross referencing information.

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

PART 2 – PRODUCTS

2.1 PIPING UNDERGROUND

A. Interior:

1. Sanitary and condensate waste drainage piping within the building and extending beyond the building wall, unless otherwise noted on the plans shall be an option selection of a, b, or c below:

a. Service weight hub and spigot pattern cast iron soil pipe and fittings with neoprene gaskets.

b. Hubless cast iron soil pipe and fittings with cast iron coupling clamps and gaskets or heavy duty 3.04-.016" thick stainless steel bands..

c. PVC Schedule 40 pipe and fittings with solvent cement joints.

2.2 PIPING ABOVE GROUND

A. All above ground condensate, soil, waste and vent piping shall be:

1. Hubless cast iron soil pipe with cast iron drainage fittings, couplings and stainless-steel clamp bands for piping 2" and larger.

2. Copper tubing, type DWV with wrought copper solder type drainage fitting for piping smaller than 2" in size.

2.3 CONDENSATE WASTE PIPING SYSTEM

A. All aboveground condensate waste piping including connection to equipment shall be:

1. Copper tubing, type DWV with wrought copper solder type drainage fittings.

2.4 FLASHING

A. All vents extending through the roof shall be flashed by the General Contractor. However, the Plumbing Contractor shall furnish and install the necessary counterflashing consisting of a Jay R. Smith Figure 1748 counterflashing fitting, or approved substitute as manufactured by Josam or Zurn. Vents shall terminate 18" above the roof.

2.5 SPECIAL EXPANSION COMPENSATION

A. Special expansion compensation products required for condensate, soil and waste piping systems include the following types:

B. Cast Iron Drainage System Expansion Joints: Cast-iron body, adjustable bronze sleeve, bronze bolts with wing nuts; for vertical installation only.

C. PVC Drainage System Expansion Joints: Factory prelubricated "O" ring expansion joint fitting. Installation must be in strict conformance with manufacturer's recommendations.

D. Available Manufacturers: Subject to compliance with requirements. Manufacturers offering expansion joints which may be incorporated in the work include:

1. Cast Iron Piping Systems - J.R. Smith or approved substitute.

2. PVC Piping Systems – George Fisher or approved substitute.

2.6 SYSTEMS EQUIPMENT

A. Refer to Plumbing Fixture and Equipment Schedule for type, number, size and manufacturer of all drainage equipment and accessories.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering drainage equipment which may be incorporated in the work are limited to the following:

<u>Floor Drains (all types)</u>

Zurn

Josam

Wade

Watts

Smith

MIFAB

Cleanouts

Zurn

Josam

Wade

Watts

Smith

MIFAB

Downspout Boots

Froet

Zurn

Josam

Wade

Watts

Smith

MIFAB

C. Cross Reference Identification:

1. If the Contractor selects a manufacturer of drainage equipment products other than as identified on the Schedule but is selected from the available manufacturers listed above, a cover sheet shall be included with the submission of shop drawings indicating the cross-referenced manufacturer and model number.
2. Shop drawings shall not be reviewed or accepted if not in compliance with this requirement.

PART 3 – EXECUTION

3.1 INSTALLATION OF SOIL AND WASTE PIPING

A. The Plumbing Contractor shall install a complete system of sanitary drainage piping as shown on the drawings. All drainage lines shall be properly run, trapped and vented in accordance with the local Plumbing Code and all dry vents, back vents, loop vents, revents or special vents required by the Code shall be furnished and installed by the Plumbing Contractor.

B. Drainage lines of the sizes shown on the drawings shall be extended within the building with branches connecting to the base of all soil, waste and vent stack, etc., leaving outlets for connection to all fixtures, floor drains, as required.

C. All changes in direction of drainage piping shall be installed with "Y" branches and 1/8 bends. All stacks shall be supported with concealed pipe clamps or hangers as required and the openings in the roof for the vent pipes will be provided by this Contractor.

D. All drainage piping which will be located above suspended ceilings shall be checked for slope to assure positive drainage, prior to installation of the ceilings. Pressure tests for leaks, as hereinafter specified, shall also be performed prior to ceiling installation.

E. Install soil and vent piping pitched to drain at minimum slope of 1/4" per foot (2%) for piping 3" and smaller, and 1/8" per foot (1%) for piping 4" and larger.

F. Vertical to horizontal change in direction to be made with long radius fittings.

G. Support all soil and waste piping per IPC Section 308.5, 308.6 and 308.7.

3.2 INSTALLATION OF STORM WATER DRAINAGE PIPING

A. Connect piping to roof drains and outlets provided in gutters, install rainwater conductors and extend to underground storm building drains as indicated.

B. Underground storm building drains shall be extended from the building, terminating beyond the building wall.

C. Provide exterior clean-out on both sanitary and storm drain mains. Minimum size shall be 4” installed within 5 ft. of the building. (Also see Paragraph 3.5).

D. Connect to exterior downspouts, install cast iron downspout shoes, and extend piping from the building wall.

E. All changes in direction of drainage piping shall be installed with "Y" branches and 1/8 bends. All stacks shall be supported with concealed pipe clamps or hangers as required, and the openings in the roof for the vent pipes will be provided by this Contractor.

F. All drainage piping which will be located above suspended ceilings shall be checked for slope to assure positive drainage, prior to installation of the ceilings. Pressure tests for leaks, as hereinafter specified, shall also be performed prior to ceiling installation.

G. Install storm water drainage piping pitched to drain at minimum slope of 1/8" per foot (1%) for piping 4" and larger.

H. Vertical to horizontal change in direction to be made with long radius fittings.

3.3 INSTALLATION OF SPECIAL EXPANSION COMPENSATION PRODUCTS

A. Expansion Joints: Install expansion joints on vertical risers as indicated, and/or as required by International Plumbing Code.

B. PVC piping systems in multi-story (four stories or more) shall require "O" ring expansion joints to compensate for length changes in soil, waste and vent stacks. Expansion joints shall be required at every floor level for soil and waste stack and at alternate floors for vent stacks and rainwater conductors.

3.4 INSTALLATION OF CLEANOUTS

A. Cleanouts: Install in sanitary piping and storm conductor and building drain piping as indicated, and/or as required by International Plumbing Code; at each change in direction of piping greater than 45 degrees; at minimum intervals of 100' for all size straight run piping; and at base of each conductor. Install floor and wall cleanout covers for concealed piping, select type to match adjacent building finish.

B. Exterior cleanouts shall be installed with access covers flush to grade. The cleanout shall be installed within a concrete pad, 18”x18”x6” thick.

3.5 INSTALLATION OF FLOOR DRAINS (ALL TYPES)

A. Install floor drains in accordance with manufacturer's written instructions and in locations indicated.

B. Install floor drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor.

C. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

D. Position drains so that they are accessible and easy to maintain.

E. <u>All</u> floor drains shall be provided with trap primer connections. <u>All</u> floor drains shall have a trap primer discharge line connected to the outlet.

F. All exposed drainage piping shall be DWV copper pipe and fittings. All piping shall be rigidly supported off the wall with split ring clamps or uni-strut.

3.6 UNDERGROUND METALLIC TAPE

A. All exterior underground PVC drainage piping (sanitary, storm, condensate waste) shall be provided with detectable metallic underground tape.

B. Tape shall be similar to Lineguard Maintenance Systems as provided by Utility Supply of America 800-548-1234 or approved substitute as manufactured by Seton.

C. Installation shall comply with manufacturer's recommendations and shall be installed in the backfill after refilling the trench opening completely, and allowed to settle to the desired 4" to 6" depth. The Contractor shall install the tape after final lifts in compaction backfilling or unroll it before final restoration or installation of sod, black dirt, seeding, etc.

D. The tape system shall be installed under the supervision of the Owner's Representative. When the tape system is complete, the Contractor shall provide a test using the tape manufacturer's recommended detection device, to prove the integrity of the installation with the Owner's Representative.

3.7 INVERTS AND ELEVATIONS

A. Indicated inverts and elevations of existing utilities are approximate and based on the best information available. Upon award of Contract, Contractor shall verify in the field all such information and report any discrepancies to the Engineer before proceeding with work.

3.8 PIPING INSTALLED IN FILLED GROUND

A. Piping located below floor slab in filled areas shall be supported either from the floor slab, or with masonry piers to undisturbed earth. Drainage piping shall be supported at each joint. Exterior piping located in filled areas shall be supported with piers.

B. Details of supports and method of installation shall meet with the approval of the Engineer.

3.9 INSPECTION

A. The Plumbing Contractor shall, upon completion of the drainage systems, secure from the Inspector and/or the Municipality under which the installation was made and inspected, certificates or letters of approval indicating the system has been installed satisfactorily. The Plumbing Contractor shall certify that all inspection fees, permits and charges have been duly paid.

END OF SECTION 22 0110

SECTION 22 0120

DOMESTIC WATER SYSTEMS – PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this Section.

1.2 DESCRIPTION OF WORK

A. This Section includes:

1. Domestic water piping systems work is indicated on drawings and schedules and by requirements of this section.

B. Applications for water piping systems include the following:

1. Exterior water service piping from main at curb to building domestic water piping.
2. Exterior water service piping from connection 5'-0" beyond building foundation to building domestic water piping.
3. Exterior fire/sprinkler service from connection 5'-0" beyond building foundation to flanged connection 12" above finished floor slab in Mechanical/Boiler Room.
4. Exterior fire/sprinkler service from street main connection to flanged connection 12" above finished floor slab in Mechanical/Boiler Room.
5. Exterior domestic water meter and pit installation.
6. Domestic cold-water piping.
7. Domestic hot-water piping.
8. Domestic recirculating-water piping.

C. Complete flow balancing of the entire domestic hot water return system.

D. Insulation for domestic water piping as specified in Section 220030 is included as work of this section.

E. Trenching and backfill required in conjunction with exterior water piping as specified in Section 220000 is included as work of this section. Refer to Division 1.

1.3 REFERENCE STANDARDS

A. Refer to Section 220000 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 220010 for a general description of requirements applying to this section.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 220000.

B. Submit the following:

1. Product data on all specialties and systems equipment.

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

PART 2 – PRODUCTS

2.1 DOMESTIC WATER PIPING MATERIALS AND PRODUCTS

A. Provide piping materials and factory fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in domestic water piping systems. Where more than 1 type of materials or products are indicated, selection is Installer's option.

2.2 BASIC PIPE, TUBE AND FITTINGS

A. Provide pipe, tube, and fittings complying with Division 22 Basic Materials and Methods section "Pipe, Tube, and Fittings", in accordance with the following listing:

B. Interior Domestic Water Piping:

Tube Size 4" and Smaller:	Copper tube.
Wall Thickness:	Type "L" hard-drawn temper.
Fittings:	Wrought-copper, solder-joints.

C. Exterior Water Service Piping:

Pipe Size 3" and Smaller:	Copper tube.
Wall Thickness:	Type "K" Soft Temper
Fittings:	Wrought copper solder joint.
Pipe Size 4" and Over:	Ductile-iron pipe with cement-mortar lining, and gasketed joints.
Pipe Weight:	Schedule 150.
Fittings:	Ductile-iron, with cement-mortar lining, mechanical joint.

2.3 BASIC PIPING SPECIALTIES

A. Provide piping specialties complying with Section 220010 Basic Materials and Methods in accordance with the following listing:

Pipe escutcheons

Dielectric unions

Drip pans

Pipe sleeves

Sleeve seals

2.4 SPECIAL PIPING SPECIALTIES

A. Water Hammer Arresters: Provide bellows or piston type water hammer arresters, pressure rated for 250 psi, tested and certified in accordance with PDI Standard WH-201.

2.5 BASIC VALVES

A. Provide valves complying with applicable Division 22 sections "Valves", in accordance with the following listing:

B. <u>Sectional Valves:</u>

2-1/2" and Smaller:	Ball Valves.
	Gate Valves.

3” and Larger:	Ball Valves.
	Butterfly Valves.

C. Shutoff Valves:

2-1/2" and Smaller:	Ball Valves.
	Gate Valves
3" and Larger:	Ball Valves.
	Butterfly Valves.

D. Drain Valves:

All	Hose End Threaded Gate or Ball Valves.

E. Balancing Valves:

2" and Smaller:	Ball Valves (Circuit Setter Type).
	(w/ Memory Stop)

F. Check Valves:

All Sizes:	Swing Check Valves. Horizontal Installations
	Spring Check Valves. Vertical Installations

2.6 SPECIAL VALVES

A. Special valves required for domestic water piping systems include the following types:

B. Hose Bibbs: Threaded end, renewable composition disc, tee handle, 3/4" NPT inlet, 3/4" hose outlet with vacuum breaker.

1. Finished Areas: Chrome plated.
2. Unfinished Areas: Bronze finish.

C. Wall and Yard Hydrants: Non-freeze, cast-bronze body, tee handle key, bronze casing, length to suit wall thickness, vacuum breaker, hinged locking cover, 3/4" inlet, hose outlet.

D. Lawn Boxes: Non-freeze, bronze ground hydrant with locking cover, rough bronze box, vacuum breaker, 1 inch connection, and suitable for 4'-0" depth of bury.

2.7 BASIC THERMOMETERS AND GAUGES

A. Provide thermometers and gauges complying with Division 22 Basic Materials and Methods Section "Meters and Gauges", in accordance with the following listing:

Pressure gauges

Glass thermometers

Pressure and temperature connections

2.8 BASIC PUMPS

A. Provide pumps as specified in applicable Section 220150 Equipment - Plumbing. Use inline pumps for hot water recirculating.

2.9 BACKFLOW PREVENTERS

A. Provide, of the type indicated on the drawing schedule, reduced pressure principal type, blackflow preventers shall consist of an assembly including shutoff valves on inlet and outlet, and strainer on inlet. Backflow preventers shall include test cocks, and pressure-differential relief valve located between two positive seating check valves. Construct in accordance with ASSE Standard.

B. On dead-end services (HVAC make-up) provide a spring-loaded check valve ahead of the backflow preventer assembly.

2.10 SYSTEMS EQUIPMENT MANUFACTURERS

A. Refer to Plumbing Fixture and Equipment Schedule for type, number, size and manufacturer of all equipment and accessories.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering equipment which may be incorporated in the work are limited to the following:

<u>Shock Absorbers:</u>

Zurn

Josam

Wade

Watts

Smith

PPP Inc.

MIFAB

<u>Hose Bibbs</u>

Nibco

Tanner

Central Brass

Wolverine

<u>Wall and Yard Hydrants</u>

Zurn

Josam

Wade

Watts

Smith

Woodford

MIFAB

<u>Backflow Preventers</u>

Conbraco

Febco

Cla-Val

Wilkins

ITT Grinnell

Neptune

Watts

PART 3 – EXECUTION

3.1 INSTALLATION OF BASIC IDENTIFICATION

A. Install mechanical identification in accordance with Section 220010 Basic Materials and Methods.

B. Support vertical piping at floor levels using approved riser clamps. Clamp material shall be compatible with pipe material. Maximum vertical spacing shall be 10'-0". Domestic water piping shall be supported in accordance with the International Mechanical Code, Section 305 and Table 305.4 Spacing Intervals, or in accordance with MSS-SP-69. International Plumbing Code's latest edition, Section 308.5, accept as follows:

1. Copper tubing ½" to 1-1/4" nominal size, not to exceed 6 ft. horizontal intervals.
2. Copper tubing 1-1/2" and larger nominal size, not to exceed 10 ft. horizontal intervals.
3. Copper tubing ½" to 1-1/4" nominal size, not to exceed 10 ft. vertical intervals.
4. Copper tubing 1-1/2" and larger nominal size not to exceed 10 ft. vertical intervals.

3.2 INSTALLATION OF DOMESTIC WATER SERVICE SYSTEM - BUILDING

A. Install water distribution system in accordance with Section 220010 Basic Materials and Methods, and the International Mechanical Codes Section 305, and Support Intervals under Tables 305.4 and 308.5 or in accordance with MSS-SP-69.

3.3 INSTALLATION OF DOMESTIC WATER SERVICE SYSTEM - SITE

A. Install site water service system in compliance with local governing regulations.

B. Water Service Piping: Extend water service piping from site connection and from the meter pit to the water service entrance at building. Provide sleeve in foundation wall for water service entry; make entry watertight. Provide gate valve at water service entry inside building; strainer, pressure gauge, test tee with valve.

C. Ductile-Iron Pipe: Install in accordance with ANSI/AWWA C-60.

D. Sterilization: At completion of water service line installation, flush and sterilize in conformance with AWWA C-601, to satisfaction of local Authorities having jurisdiction.

3.4 INSTALLATION OF PIPING SPECIALTIES

A. Install piping specialties in accordance with Section 220010 Basic Materials and Methods.

B. Water Hammer Arresters: Install in upright position, in locations and of sizes in accordance with PDI Standard WH-201, and elsewhere as indicated.

3.5 REACTION BACKING

A. All plugs, tees and elbows in the underground piping shall be provided with reaction backing consisting of concrete placed between solid undisturbed earth and the fitting to be anchored. Concrete shall be of such bearing area as to assure adequate resistance to the thrust to be encountered. In general, backing shall be so placed that the joint will be accessible for inspection and repair.

3.6 INSTALLATION OF VALVES

A. Install valves in accordance with Division 22 Basic Materials and Methods section, "Valves".

B. Sectional Valves: Install on each branch and riser, close to main, where branch or riser serves 2 or more fixtures, equipment connections, and elsewhere as indicated.

C. Shutoff Valves: Install on inlet of each plumbing equipment item, and on inlet of each plumbing fixture, and elsewhere as indicated.

D. Drain Valves: Install on each plumbing equipment item located to completely drain equipment for service or repair. Install at base of each riser, at base of each rise or drop in piping system, and elsewhere where indicated or required to completely drain domestic water piping system.

E. Check Valves: Install on discharge side of each pump, and elsewhere as indicated.

F. Balance Cocks: Install in main recirculating loop and in each branch hot water recirculating loop. Install a ball valve and check valve at each balance valve installation.

G. Hose Bibbs: Install on exposed piping where indicated, with vacuum breaker.

3.7 INSTALLATION OF BACKFLOW PREVENTERS

A. Install backflow preventers where indicated, and where required by International Plumbing Code. Locate in same room or area as equipment being protected.

B. RPZ type backflow preventers to be piped from the relief outlet to nearest floor drain.

C. A check valve is required on the upstream side of all RPZ installations.

3.8 INSTALLATION OF EXPANSION COMPENSATION PRODUCTS

A. This project shall require the installation of expansion compensators.

B. Furnish and install expansion compensation products in accordance with Section 220210 Basic Materials and Methods – HVAC

3.9 INSTALLATION OF THERMOMETERS AND GAUGES

A. Install thermometers and gauges in accordance with Section 220010 Basic Materials and Methods.

3.10 EQUIPMENT CONNECTIONS

A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by International Plumbing Code.

B. Equipment furnished by the Owner or Contractors other than this Contractor: After equipment has been set in place, this Contractor shall furnish all labor and material required to make final connections, between roughing-in and the equipment. Install valves, fittings, trim and appurtenances furnished with the equipment. All exposed piping in the kitchen areas shall be chrome plated. Piping in other areas shall be of the same material as the system to which it connects.

3.11 SPARE PARTS

A. Furnish to Owner, with receipt, one valve key for each key operated hydrant, bibb, or faucet installed.

3.12 INSTALLATION OF EXTERIOR WATER PIPING (5'-0" EXTENSIONS)

A. Install exterior water service piping system in compliance with local governing regulations.

B. Main Connections: Coordinate all work with the Site Contractor. The Plumbing Contractor shall make final connections of the domestic and fire protection water services.

C. Water Service Piping: From the final connection points, extend water service piping of size and in locations indicated to the water service entrance in building. Provide ball valve at the domestic water service and a flanged connection with a ¾” blow-off valve for the fire protection water service (12" A.F.F.).

D. Ductile-Iron Pipe: Install in accordance with ANSI/AWWA C-60.

E. Test:

1. Domestic Water Service: Minimum 125 psi.
2. Fire Protection Water Service: Minimum 200 psi.
3. Combination Domestic & Fire Protection Water Service: Minimum 200 psi.

F. Sterilization: At completion of water service line installation, flush and sterilize in conformance with AWWA C-601, to satisfaction of local Authorities Having Jurisdiction.

3.13 DOMESTIC HOT WATER RETURN

A. This Contractor shall install complete and operating hot water return system. The system shall be balanced and include a report as required in HVAC Specification Section 230950.

B. Balancing Valves are required in the system as hereinbefore specified. The system shall also include the installation of “air bleed” or “burp” valves to remove any trapped air in the system.

C. Where emergency showers are installed with thermostatic mixing valve, they shall require the installation of a hot water return line as detailed on the drawings.

END OF SECTION 22 0120

SECTION 22 0130

GAS PIPING SYSTEMS – PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this Section.

1.2 DESCRIPTION OF WORK

A. This Section includes:

1. Natural gas piping system as indicated on drawings and schedules, and by requirements of this section.
2. Applications for natural gas piping systems include the following:
   a. Gas service from main to building meter by Delmarva Power Gas Division.
   b. Elevated pressure (psi) gas from meter location to rooftop gas-fired equipment and to all other equipment and outlets, requiring gas service.
3. Trenching and backfill required in conjunction with exterior gas distribution as specified in Section 220000 is included as work of this section. Refer to Division 1.

1.3 REFERENCE STANDARDS

A. Refer to Section 220000 for a general description of requirements applying to this Section.

1.4 QUALITY ASSURANCE

A. Refer to Section 220010 for a general description of requirements applying to this section.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 220000.

B. Submit the following:

1. Product data on gas valves.

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

PART 2 – PRODUCTS

2.1 NATURAL GAS PIPING MATERIALS AND PRODUCTS

A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with ANSI B31.2 where applicable, base pressure rating on natural gas piping system maximum design pressures. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match piping materials used in natural gas piping systems. Where more than 1 type of material or product is indicated, selection is Installer's option.

2.2 BASIC IDENTIFICATION

A. Provide identification complying with Division 22 Sections and in accordance with the following listing:

Building Distribution Piping: Plastic pipe markers.

Gas Service: Underground type plastic line markers with detectable wire..

Gas Valves: Plastic valve tags.

2.3 BASIC PIPE, TUBE AND FITTINGS

A. Provide pipe, tube and fittings complying with Section 220010 Basic Materials and Methods - Plumbing and in accordance with the following listing:

1. Interior Piping: Schedule 40 black steel ASTM A-53, A-106

   Fittings: Malleable black iron, threaded (NCC)

2. Exterior Below Grade Piping: Medium-density polyethylene pipe and fittings by reference meet the Department of Transportation Title 49 Part 192.

3. Exterior Exposed or Roof Top Piping: Schedule 40 black steel with weather coating.

   Fittings: Wrought steel, butt welded.

2.4 BASIC PIPING SPECIALTIES

A. Provide piping specialties complying with applicable Division 22 Sections and in accordance with the following listing:

Pipe escutcheons

Pipe sleeves

Sleeve seals

2.5 SPECIAL VALVES

A. Valves required for gas piping systems on this project shall be the following types:

<u>Gas Valves: (Up to 3”)</u>

1. Apollo 80-100 Series bronze gas ball valve. Threaded, 600 PSIG WOG, cold non-shock. 250 PSIG LP-Gas. 150 PSIG saturated steam. Vacuum service to 29 inches Hg. Federal Specification: WW-V-35C, Type: II, Composition: BZ, Style: 3.

2. Features:

   - UL Listed for LP-Gas and natural gas.
   - Large ports to reduce pressure drop
   - Reinforced TFE seats and seals
   - Blow-out-proof stem design
   - Optional tee handle available
   - Quarter turn on-off
   - Adjustable packing gland
   - One piece bronze body
   - Chromium plated ball

3. UL Listings:

   - Guide YRPV: Gas shut-off valve for use with natural and manufactured gases.

4. This valve shall be used for all pipe sizes up to 3” in the system.

<u>Gas Valves (4” and Larger)</u>

1. Apollo 88A-100 Series carbon steel, ANSI Class 150 flanged standard port ball valves.

   Standards of Compliance:

IFGC: Section 409 (Valves)

ASME B16.5 – Pipe Fittings and Flanges

ASME B16.33 – Manual Operated Metal Gas Valves up to 125 psig

ASME B16.38 – Large Metal Valve Gas Distribution

ASME B31.8 – Gas Transmission and Distribution Piping Systems

UL 125

B. Manufacturers: Subject to compliance with requirements, provide gas valves of one of the following:

Apollo/Conbraco

Stockham

Milwaukee

NIBCO, Inc.

Watts

2.6 GAS METER

A. Provided by Delmarva Power Gas Division.

2.7 GAS PRESSURE REGULATORS

A. ANSI Z21.18, single-stage, steel-jacketed, corrosion-resistant pressure regulators. Include atmospheric vent, elevation compensator, with threaded ends conforming to ASME B1.20.1 for 2 inch NPS and smaller and flanged ends for 2-1/2" NPS and larger. Regulator pressure ratings, inlet and outlet pressures, and flow volume in cubic feet per hour of natural gas at specific gravity are as indicated.

1. Service Pressure Regulators: Inlet pressure rating not less than natural gas distribution system service pressure.
2. Line Gas Pressure Regulators: Inlet pressure rating not less than system pressure.
3. Appliance Gas Pressure Regulators: Inlet pressure rating not less than system pressure.
4. Gas Pressure Regulator Vents: Factory or field installed corrosion-resistant screen in opening when not connected to vent piping.
5. Regulators shall be as manufactured by Fisher (no equal substitute permitted).

PART 3 – EXECUTION

3.1 INSTALLATION OF BASIC IDENTIFICATION

A. Install mechanical identification in accordance with applicable Division 22 Sections.

3.2 INSTALLATION OF NATURAL GAS PIPING (INTERIOR)

A. Install natural gas distribution piping in accordance with Section 220010 Basic Materials and Methods - Plumbing and in accordance with applicable codes IFGC latest edition, and local Utility Company requirements.

B. Use sealants on metal gas piping threads which are chemically resistant to natural gas. Use sealants sparingly, and apply to only male threads of metal joints.

C. Remove cutting and threading burrs before assembling piping.

D. Do not install defective piping or fittings. Do not use pipe with threads which are chipped, stripped or damaged.

E. Plug each gas outlet, including valves, with threaded plug or cap immediately after installation and retain until continuing piping or equipment connections are completed.

F. Install drip-legs in gas piping where indicated, and where required by code or regulation.

G. Install "Tee" fitting with bottom outlet plugged or capped at bottom of pipe risers.

H. Use dielectric unions where dissimilar metals are joined together.

I. Install piping with 1" drop in 60' pipe run (0.14%) in direction of flow.

J. Install piping parallel to other piping, but maintain minimum of 12" clearance between gas piping and steam or hot water piping above 200 degrees F (93 degrees C).

K. For piping buried in building substrate, or below floor slabs, install in welded conduit, ventilated to outdoors on both ends, and tested to same requirements as gas piping.

L. Gas valves shall not be installed above ceilings without access and signage.

M. Supports:

1. All pipe, fittings, valves, installation and testing shall be in accordance with the IFGC, Chapter 4.
2. Gas piping shall be supported in accordance with the International Fuel Gas Code's latest accepted 2003 Edition, Section 407, as follows:
3. Support intervals shall be in accordance with the IFGC listed above and in Section 415, Table 415.1 as follows:
   a. Steel pipe ½" nominal size – not to exceed 6 ft.
   b. Steel pipe ¾" to 1" nominal size – not to exceed 8 ft.
   c. Steel pipe 1-1/4" and larger nominal size horizontal – not to exceed 10 ft.
   d. Steel pipe 1-1/4" and larger nominal size, vertical not to exceed every floor.
4. Support and spacing of CSST Systems shall be in accordance with CSST manufacturer's instructions.

3.3 GAS SERVICE

A. Arrange and coordinate with Utility Company to provide gas service and meter at indicated location with shutoff at terminus. Consult with Utility as to extent of its work, costs, fees and permits involved. Pay such costs and fees; obtain permits.

B. Extend service pipe from Utility's terminus to distribution piping, in compliance with Utility's requirements.

3.4 INSTALLATION OF VALVES

A. Gas valves: Provide at connection to gas train for each gas-fired equipment item; and on risers and branches where indicated.

B. Locate gas valves where easily accessible, and where protected from possible damage.

3.5 EQUIPMENT CONNECTIONS

A. Connect gas piping to each gas-fired equipment item, with drip leg, union and shutoff gas valve. Comply with equipment manufacturer's instructions. Drip legs shall not be installed on any exterior gas piping.

B. Equipment furnished by the Owner, or Contractors other than this Contractor: After equipment has been set in place, this Contractor shall furnish all labor and material required to make final connections between roughing-in and the equipment. Install valves, fittings, trim and appurtenances furnished with the equipment. Piping shall be of the same material as the system to which it connects.

C. All rooftop, gas-fired equipment shall be provided with gas pressure regulating valve to reduce gas pressure from 2 psi to 7-14" WC. All regulators shall be provided with relief vent discharge piping of lengths as required for minimum distance of equipment air intake grilles.

3.6 INSTALLATION OF GAS PRESSURE REGULATORS

A. This Contractor shall furnish and install gas pressure regulating valves for all shown on the drawings. Installation shall be in strict accordance with the requirements of the Utility Company and the Canadian Gas Association.

B. All regulators installed shall be tagged with data noting the inlet and outlet pressure for each individual regulator installed.

C. Medium or High Pressure (MP) (HP) Regulators shall comply with the following:

1. The MP regulator shall be approved and shall be suitable for the inlet and outlet gas pressures for the application.
2. The MP regulator shall maintain a reduced outlet pressure under lockup (no flow) conditions.
3. The capacity of the MP regulator, determined by published ratings of its manufacturer, shall be adequate to supply the appliances served.
4. The MP pressure regulator shall be provided with access. Where located indoors, the regulator shall be vented to the outdoors or shall be equipped with a leak-limiting device, in either case complying with Section 410 of the IFGC.
5. A tee fitting with one opening capped or plugged shall be installed between the MP regulator and its upstream shutoff valve. Such tee fitting shall be positioned to allow connection of a pressure-measuring instrument and to serve as a sediment trap.
6. A tee fitting with one opening capped or plugged shall be installed not less than 10 pipe diameters downstream of the MP regulator outlet. Such tee fitting shall be positioned to allow connection of a pressure-measuring instrument.

3.7 EXTERIOR GAS PIPING

A. All rooftop or exterior gas piping shall be weatherproof with and epoxy resin approved by the Gas Company.

B. Uncoated, threaded or socket welded joints shall not be used in piping in contact with soil or where internal or external service corrosion is known to occur.

C. Protective Coatings and Wrapping: Pipe protective coatings and wrappings shall be approved for the application and shall be factory applied.

OR

C. In lieu of coated steel pipe, the Contractor may use high grade material, physical and mechanical properties as classified in accordance to ASTM D 3350 and cell classification of 234373E plastic pipe and fittings for underground use only, and shall conform with ASTM D-2513. Pipe shall be marked “GAS” and “ASTM D-2513”. Only Contractors registered and/or certified for installation of underground or below-grade plastic piping shall be permitted to install this material on this project.

D. Detectable underground warning tape shall read (“CAUTION – BURIED GAS LINE BELOW”). Printed on APWA approved colors, minimum 2” wide, 5 mil tape with aluminum backing for using non-ferrous locator.

OR

A. All exterior gas pipe and fittings installed , including all welded joints, shall be provided with weatherproof coatings. The coatings shall be a two-layer PE “Pritec” coating as manufactured by Liberty Coating. The coatings shall be Butyl rubber adhesive with a polyethylene topcoat.

B. Component Properties:

Adhesive

Polyethylene

ADHESIVE		
Softening Point	ASTM E28	190°F
Water Absorption	ASTM D570	<0.1%
Adhesive		Compounded Butyl Rubber

POLYETHYLENE		
Color		Black
Density	ASTM D1505	>0.950
Elongation	ASTM D638	>600%
Tensile Strength	ASTM D638	>2,800 psi
Outdoor Exposure		>2 years
Hardness, Shore D	ASTM D2240	>60

PRITEC®		
Operating Temperature		-40°F to +180°F
*Peel Strength	ASTM D1000	>20 lbs lineal
Field Bending	Arctic Service Equipment	1.9 deg. per pipe dia.
Water Absorption	ASTM D570	0.06%
Impact Resistance	ASTM G14	33.65 in/lbs (10/40 sys.)
Volume Resistivity	ASTM D257	$10x10^{16}$ Ohm cm
Dielectric Strength	ASTM D149 @73°F	700 Volts/Mil
Cathodic Disbondment	1.5v/3%/70°F/24 Hrs.	6 mm radiius

END OF SECTION 22 0130

SECTION 22 0140
FIXTURES – PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

1.2 DESCRIPTION OF WORK

A. This Section includes:

1. Plumbing fixtures and trim work as indicated by drawings and schedules, and by requirements of this section.
2. Types of plumbing fixtures required for the project include the following:

   Water Closets

   Urinals

   Lavatories

   Countertop Sinks

   Service Sinks

   Mop Receptors

   Showers

   Electric Water Coolers

   Manually Operated Flush Valves and Faucets

   Lavatory Shield Enclosure
3. Refer to Section 220120 for domestic water piping systems used in conjunction with plumbing fixtures; not work of this section.
4. Refer to Section 220110 for soil and waste piping systems used in conjunction with plumbing fixtures; not work of this section.
5. Refer to Division 26 sections for electrical connections to water coolers and other plumbing fixtures; not work of this section.

1.3 REFERENCE STANDARDS

A. Refer to Section 220000 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 220010 for a general description of requirements applying to this section.

B. Manufacturers: Firms regularly engaged in manufacture of plumbing fixtures of the type, style and configuration required, whose products have been in satisfactory use in similar service for not less than 3 years.

C. Plumbing Fixture Standards: Comply with applicable portions of International Plumbing Code pertaining to materials and installation of plumbing fixtures.

D. ANSI Standards: Comply with applicable ANSI standards pertaining to plumbing fixtures and systems.

E. ANSI & ADA Standards: Comply with ANSI A171.1 Standard and the ADA Standard pertaining to plumbing fixtures and provisions for handicapped.

1. Water closets shall measure 17" to 19" from the floor to the top of the seat. Bowls shall be elongated type.
2. Flush valve mechanisms shall be on the wide side of the stall, no higher than 44" above the floor.
3. Urinals shall be elongated (14" rim from the wall) mounted no higher than 17" from the floor.
4. Lavatories shall be mounted no higher than 34" from the floor and provide knee clearance using an offset drain assembly with "P" trap set parallel to the fixture supporting wall. Trap and wall supplies shall be installed for clearance required for the installation of lavatory shield enclosures.
5. Faucets shall be lever operated, push type, touch type, electronically operated. See Fixture Schedule. All faucets shall operate on less than 5 pounds force and shall not require tight grasping, pinching or twisting of the wrist.

F. PDI Compliance: Comply with standards established by Plumbing and Drainage Institute pertaining to plumbing fixture supports.

G. Federal Standards: Comply with applicable FS WW-P-541/- Series sections pertaining to plumbing fixtures.

H. UL Labels: Provide water coolers which have been listed and labeled by Underwriters' Laboratories.

I. ARI Labels: Provide water coolers which are rated and certified in accordance with applicable Air-Conditioning and Refrigeration Institute Standards.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 220000.

B. Submit the following:

1. Product Data: Submit manufacturer's specifications for plumbing fixtures and trim, including catalog cut of each fixture type and trim item furnished, roughing-in dimensioned drawings, templates for cutting substrates, fixture carriers, and installation instructions.
2. Color Selection Data: Submit charts or samples for color selection where applicable.
3. Maintenance Data: Submit maintenance data and parts lists for each fixture type and trim item, including instructions for care of finishes. Include this data in maintenance manual.

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver plumbing fixtures individually wrapped in factory-fabricated containers.

B. Handle plumbing fixtures carefully to prevent breakage, chipping and scoring the fixture finish. Do not install damaged plumbing fixtures; replace and return damaged units to equipment manufacturer.

PART 2 – PRODUCTS

2.1 PLUMBING FIXTURES

A. Provide factory-fabricated fixtures of type, style and material indicated. For each type fixture, provide fixture manufacturer's standard trim, carrier, seats, and valves as indicated by their published product information; either as designed and constructed, or as recommended by the manufacturer and as required for a complete installation. Where more than one type is indicated, selection is Installer's option; but, all fixtures of same type must be furnished by single manufacturer. Where type is not otherwise indicated, provide fixtures complying with governing regulations.

2.2 MATERIALS

A. Unless otherwise specified, comply with applicable Federal Specification WW-P-541/-Series sections

pertaining to plumbing fixtures, fittings, trim, metals and finishes. Comply with the requirements of WW-P-541/-specification relative to quality of ware, glazing, enamel, composition and finish of metals, air gaps, and vacuum breakers, even though some plumbing fixtures specified in this section are not described in WW-P-541/-.

B. Provide materials which have been selected for their surface flatness and smoothness. Exposed surfaces which exhibit pitting, seam marks, roller marks, foundry sand holes, stains, decoloration, or other surface imperfections on finished units are not acceptable.

C. Where fittings, trim and accessories are exposed or semi-exposed, provide bright chrome-plated or polished stainless steel units. Provide copper or brass where not exposed.

D. Stainless Steel Sheets: ANSI/ASTM A-167, Type 302/304, hardest workable temper. Finish: No. 4, bright, directional polish on exposed surfaces.

E. Steel Sheets for Baked Enamel Finish: ANSI/ASTM A-591, coating Class C, galvanized-bonderized.

F. Steel Sheets for Porcelain Enamel Finish: ANSI/ASTM A-424, commercial quality, Type 1.

G. Vitreous China: High quality, free from fire cracks, spots, blisters, pinholes, and specks; glaze exposed surfaces, and test for crazing resistance in accordance with ANSI/ASTM C-554.

H. Fiberglass: ANSI Z124 smooth surfaced, with color selected by Architect/Engineer.

I. Aluminum: ANSI/ASTM B-209/B-221 sheet, plate and extrusions, as indicated; alloy, temper and finish as determined by manufacturer, except 0.40 mil natural anodized finish on exposed work unless another finish is indicated.

J. Synthetic Stone: High quality free from defects, glaze on exposed surfaces, stain resistant.

2.3 PLUMBING FITTINGS, TRIM AND ACCESSORIES

A. Lavatory Protective Shield Covers:

1. Fully molded enclosure “Lav Shields” as manufactured by Zurn or Truebro, Inc., complete with tamper-resistant stainless steel fasteners.
2. Shield enclosure to meet A.D.A. #4.19.4, ANSI A117.1 and BOCA P- 1203.4.

B. Water Outlets: At locations where water is supplied (by manual, automatic or remote control), provide commercial quality faucets, valves, or dispensing devices, of type and size indicated, and as required to operate as indicated. Include manual shutoff valves and connecting system pipes to permit outlet servicing without shut- down of water supply piping systems.

1. Vacuum Breakers: Provide with flush valves where required by governing regulations, including locations where water outlets are equipped for hose attachment.

C. P-traps: Include removable P-traps where drains are indicated for direct connection to drainage system. All traps shall be minimum 17 gauge.

D. Carriers: Provide cast-iron and/or steel supports for fixtures. Carriers shall be provided for all wall-hung fixtures, and/or the carrier shall be selected to support the fixture independently of the wall. Carriers shall be adjustable type, complete with all fittings and foot supports. Carrier shall be single or double, back-to-back, horizontal offset and vertical stack type. Carrier shall be selected and used as best suited within the pipe chases. Where noted or indicated, stud mount type carriers shall be used and installed within stud wall s 8” and less.

E. Fixture Bolt Caps: Provide manufacturer's standard exposed fixture bolt caps finished to match fixture finish.

F. Escutcheons: Where fixture supplies and drains penetrate walls in exposed locations, provide chrome plated sheet steel escutcheons with friction clips.

G. Aerators: Provide aerators of types approved by Health Departments having jurisdiction.

H. Comply with additional fixture requirements contained in fixture schedule attached to this section.

2.4 FIXTURE LIST

A. Refer to the "Plumbing Fixture & Equipment Schedule" as indicated on the drawings.

2.5 SHOWER - HANDICAP

A. The shower modules shall be manufactured by Crane Plumbing/Fiat Products #MSCI-307, RH/LH (36" x 35") and shall be thermoformed from continuous cast acrylic sheet into one piece, seamless units. The units shall be reinforced in the back with fiberglass reinforced polyester resin and have a backside fire rating of "A" and flame spread of 25.

B. Shower modules shall be pre-drilled and equipped with a model 180AA pressure balanced, single dial lever mixing valve with stops, hand held shower head with swivel fitting, 69" flexible stainless steel hose and in-line vacuum breaker, 10 oz. GSA approved shower curtain with curtain hoods, 2" cast brass chrome plated shower drain, and 1" diameter stainless steel curtain rod.

C. All units shall have anti-skid floor treatment to meet performance requirements of ASTM F-462-78. All units are listed under SBCCI Report No. 8556 and BOCA Report No. 86-40.

D. Additional back reinforcements shall be suitably located to provide code complying structural integrity for factory attaching of grab bars, curtain rod, and slide guide for hand held flexible hose shower head.

E. Standard Equipment:

1. Factory Installed:
   a. Grab Bars: see table for individual models.
   b. Curtain rod: 1" diameter, stainless steel.
   c. Shower curtain, 10 oz. with curtain hooks, GSA approved.
   d. 2” shower drain, chrome plated, cast brass.
   e. Retractable, compact shower seat with stainless steel frame and teakwood seat.
2. Optional Equipment:
   a. Model 180AA pressure balanced, single dial lever mixing valve with integral check stops.
   b. Hand held shower H-11with swivel fitting, 69" flexible stainless steel hose, and in-line vacuum breaker.
   c. Slide guide H-12, 24”
   d. Dome light, ATP-1, 60 watt, recessed.

F. Color: Color option is required. Final selection by Architect.

2.6 AVAILABLE MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering fixtures, trim and carriers which may be incorporated in the work include, and are limited to the following:

<u>Water Closets (Wall-Mounted Back Outlet – China)</u>

Zurn

Crane

American Standard

Kohler

Toto

<u>China/Enameled Fixtures</u>

Zurn

Kohler
American Standard
Eljer
Crane
ToTo
Wash Fountains
Acorn with metered faucets (only)
Faucets/Trim (Non-Sensor Operated)
Kohler
American Standard
Delta
Moen
Elkay
Speakman
Chicago
Flush Valves
Sloan "Royal"
Coyne & Delany
Zurn
ToTo
Wall Supplies/Traps
McGuire
Brass-Craft
Kohler
American Standard
Sanitary-Dash
Teledyne
Wolverine
Pro-Flo
Keeny
Fixture Carriers
Zurn
Josam
Wade
Watts
Smith
MIFAB
Fixture Seats

Olsonite
Sperzel
Benke
Bemis
Church
Kohler
American Standard
Centoco
Comfort Seat
Mop Receptors
Fiat
Stern-Williams
Mustee
Florestone
Water Coolers
Elkay
Haws
Halsey-Taylor
Oasis
Acorn
Stainless Steel Sinks
Elkay
Just
Dayton
Advanced-Tabco
Shower Assemblies & Systems
Acorn
Symmons
Leonard
Powers
Bradley
Emergency/Safety Equipment
Bradley
Haws
Western
Speakman
Guardian
Shower Units

Note: All mop receptor installations must include the combination eyewash and service sink faucet arrangement.

Fiat

Fibersheen

Kohler

American Standard

Acryline

Aqua-Glass

Aquarius

Aqua-Bath

Washer Utility Boxes

PPP, Inc.

Symmons

Guy-Gray

Oatey

B. Cross Reference Identification:

1. If the Contractor selects a manufacturer of drainage equipment products other than as identified on the Schedule but is selected from the available manufacturers listed above, a cover sheet shall be included with the submission of shop drawings indicating the cross-referenced manufacturer and model number.
2. Shop drawings shall not be reviewed or accepted if not in compliance with this requirement.

PART 3 – EXECUTION

3.1 FIXTURE CONNECTIONS

A. Connections to plumbing fixtures shall be of the sizes indicated on the "Plumbing Fixture & Equipment Schedule".

B. The sizes indicated on the Schedule are for drainage and water piping serving an individual fixture; the sizes of the mains and branches shall be as indicated on the drawings.

3.2 FIXTURE SETTING HEIGHTS

A. The plumbing fixtures shall be set in accordance with the heights established by the latest edition of codes and ADA requirements.

Note: Height indicated is established as follows:

Water Closets:	From finished floor to top of seat.
Urinals:	From finished floor to rim of fixture.
Lavatories & EWC:	From finished floor to rim of fixture.
Receptor Fitting:	From finished floor to center of fitting.
Shower:	From finished floor to center of shower head.

B. Refer to Architectural drawings and sections for fixture elevations. Fixtures in various areas may be set at lower elevations. Confirm all rough-in elevations prior to any installation.

3.3 LAVATORY PROTECTIVE SHIELD ENCLOSURES

A. Installation shall conform to manufacturer’s written instructions.

B. All items involved with wall-hung lavatory installations shall be roughed-in and installed within the enclosure. This includes the offset “P” trap assembly, thermostatic mixing valve, sensor faucet trim

and accessories, electrical outlet. Coordinate all work required for complete concealment of all devices.

C. Protective shield enclosures are required on the toilet room's countertop lavatories and are furnished by the Architect. Coordinate all trim and accessories to fit within this enclosure.

3.4 INSPECTION AND PREPARATION

A. Examine roughing-in work of domestic water and waste piping systems to verify actual locations of piping connections prior to installing fixtures. Also examine floors and substrates, and conditions under which fixture work is to be accomplished. Correct any incorrect locations of piping, and other unsatisfactory conditions for installation of plumbing fixtures. Do not proceed with work until satisfactory conditions have been corrected.

B. Install plumbing fixtures of types indicated where shown and at indicated heights; in accordance with fixture manufacturer's written instructions, roughing-in drawings, and with recognized industry practices. Ensure that plumbing fixtures comply with requirements and service intended purposes. Comply with applicable requirements of the International Plumbing Code pertaining to installation of plumbing fixtures.

C. Fasten plumbing fixtures securely to indicated supports or building structure; and ensure that fixtures are level and plumb. Secure plumbing supplies behind or within wall construction so as to be rigid, and not subject to pull or push movement.

3.5 CLEAN AND PROTECT

A. Fixture shall be thoroughly cleaned after completion of installation.

B. Protect installed fixtures from damage during the remainder of the construction period.

3.6 FIELD QUALITY CONTROL

A. Upon completion of installation of plumbing fixtures and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

B. Inspect each installed unit for damage to finish. If feasible, restore and match finish to original at site; otherwise, remove fixture and replace with new unit. Feasibility and match to be judged by Architect/Engineer. Remove cracked or dented units and replace with new units.

END OF SECTION 22 0140

SECTION 22 0150

EQUIPMENT – PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

1.2 DESCRIPTION OF WORK

A. This section includes:

1. Plumbing equipment as indicated on drawings and provisions of this section, including schedules and equipment lists associated with either drawings or this section.
2. Types of plumbing equipment required for project include the following:

   Recirculating Pumps-Domestic Water Return (110 degrees & 140 degrees)

   Exterior Grease Interceptor Vault

   Solids Interceptor

   Domestic Water Heater

   Thermostatic Mixing Valve

1.3 REFERENCE STANDARDS

A. Refer to Section 220000 for a general description of requirements applying to this section.

B. UL and NEMA Compliance: Provide electric motors and electrical components required as part of plumbing equipment, which have been listed and labeled by Underwriters' Laboratories and comply with NEMA Standards.

C. NEC Compliance: Comply with National Electrical Code (ANSI/NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of plumbing equipment.

D. ASME Relief Valve Stamps: Provide water heaters with safety relief valves bearing ASME valve markings.

E. AWWA Compliance: Comply with applicable American Water Works Association Standards pertaining to steel water tanks.

F. CSA and NSF Labels: Provide water tanks which have been listed and labeled by CSA International and National Sanitation Foundation.

G. ASME Code Symbol Stamps: For the following equipment, comply with ASME Boiler & Pressure Vessel Code for construction and stamp with ASME Code Symbol:

   Packaged Domestic Water Heater

H. All packaged equipment shall be independently third party, labeled as a system for its intended use by a nationally recognized testing laboratory (NRTL) in accordance with OSHA Federal Regulations 29CFR 1910.303 and .349 as well as NFPA Pamphlet #70 and NEC Article 90.7.

1.4 QUALITY ASSURANCE

A. Refer to Section 220010 for a general description of requirements applying to this section.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 220000.

B. Submit the following:

1. Product data on all equipment including roughing-in data.
2. Connection diagrams for related piping and specialties.

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS

PART 2 – PRODUCTS

2.1 EQUIPMENT

A. Refer to "Plumbing Fixture & Equipment Schedule" for type, numbers, size and manufacturer of all equipment accessories.

2.2 HOT WATER CIRCULATING PUMPS

A. Provide and install where indicated on the drawings, domestic hot water circulating pumps complete with controls and piping as shown on the drawings. Each pump shall have a capacity of 5 gallons per minute against a total discharge head of 17 feet.

B. Pumps shall be close coupled, centrifugal type, all low lead or lead free bronze with flexible connection to a 1/6 HP, 1750 RPM, 60 cycle, 120 volt, single phase motor.

C. Pump shall be controlled by a manual starter, furnished and installed by the Electrical Contractor. Pumps shall run continuously and be wired into night setback operations.

2.3 MASTER MIXING VALVE

A. Mixing valve shall be constructed entirely of lead free bronze and copper and hydrostatically tested to a pressure of 300 lb. Unit shall be provided with the following features.

1. A long mixing chamber with vanes at an angle to the longitudinal axis of the valve which shall cause a thorough mixing of the hot and cold water.
2. The length of the hydraulic thermostatic element shall assure effective contact with the water.
3. The thermostatic element shall be placed in the body of the valve where the hot and cold water mix. Unit shall be sensitive to any change in water temperature and make the proper correction by opening or closing the hot and cold-water inlets in the valve.
4. The sensitive parts of the thermostatic element shall be inside a heavy non-ferrous tube which shall protect them from any corrosive or scaling action caused by the continuous flow of water past them.

B. Unit shall be as sized on the drawings.

C. Temperature adjusting range shall be between 80 and 160 degrees F.

2.4 WATER HEATERS

A. See schedule on drawings.

2.5 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering plumbing equipment shall be limited to the following:

1. Domestic Water Heaters

   A.O. Smith

   Ruud

   Bradford-White

   State

2. Hot Water Circulating Pumps
   Armstrong
   Bell and Gossett
   Taco
   Aurora
   Grundfos
   Amtrol
3. Master Mixing Valve (Domestic Hot Water System)
   Acron
   Holby Valve Co.

PART 3 – EXECUTION

3.1 INSTALLATION OF WATER HEATERS

A. Install water heaters where indicated in accordance with manufacturer's installation instructions and in compliance with applicable codes.

B. Set units where indicated, orient so controls and devices needing service and maintenance have adequate access. Level and plumb units. Each unit shall be set on a concrete housekeeping pad.

C. New Mechanical Room: Connect gas, hot and cold and recirculating piping system and all associated equipment and devices as detailed on the drawing. Flue extension, roof penetration and weatherproof hood shall be by this Contractor.

D. Start-up, test and adjust hot water heaters in accordance with manufacturer's start-up instructions. Check and calibrate controls.

3.2 INSTALLATION OF THERMOSTATIC MIXING VALVE

A. Install mixing valve in accordance with manufacturer's installation instructions and in compliance with applicable codes.

B. At startup of domestic hot water system, mixing valve outlet temperature shall be checked to insure proper setting and operation. Following adjustments, if required, the mixing valve, if not performing. check if factory required differential temperature in/out with a minimum of 20º Delta "T" is maintained.

C. The temperature of the water delivered by the mixing valve shall be changed by turning the adjusting screw to the right or clockwise for lower temperature; and to the left or counter clockwise for higher temperatures. Maintain a uniform temperature regardless of temperature of incoming water. To facilitate adjustment, a thermometer shall be placed in the line beyond the Holby Tempering Valve as shown in the diagram and water shall be flowing through the Holby Tempering Valve while adjustment is being made.

D. Check valves shall be installed on both inlet (hot and cold) to the unit. Include a full size bypass valve arrangement.

E. The hot water return line shall always be piped through the cold water make-up side of the mixing valve.

3.3 INSTALLATION OF HOT WATER CIRCULATING PUMPS

A. Install pumps where indicated, in accordance with manufacturer's published installation instructions, with recommended clearances provided for service and maintenance.

B. Install in-line pumps, supported from piping system, located for access to oil cups, service, and maintenance.

C. Lubricate pumps before start-up. Start-up shall be in accordance with manufacturer's instructions.

D. Install pump unit as detailed on the drawing. Include a check valve and thermometer at the pump unit. The pump shall run on continuous operation. The pump shall be wired into night setback by the ATC system installer.

END OF SECTION 22 0150

SECTION 22 0190

TESTING – PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other conditions, if any) and Division 1 as appropriate, apply to the work specified in this Section.

1.2 DESCRIPTION OF WORK

A. Extent of plumbing systems to be tested is indicated on the drawings and by requirements of this section.

B. Applications of tests include the following:

1. Interior Piping
   a. Domestic cold, hot & hot water return piping
   b. Gas piping
   c. Sanitary and condensate waste drainage piping
2. Exterior Piping
   a. Sanitary drainage piping
   b. Domestic water service
   c. Gas service

D. See Fire Protection Specifications for testing of Fire Protection Systems.

1.3 REFERENCE STANDARDS

A. Refer to Section 220000 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 220010 for a general description of requirements applying to this section.

1.5 SUBMITTALS

A. Submit test reports in accordance with Section 220000.

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

PART 2 – PRODUCTS

2.1 PIPE & FITTING REPLACEMENTS

A. Refer to Section 220010 for replacement of any defective pipe or fittings. Replacement shall include all required uncovering, excavating, recovering and backfilling.

PART 3 – EXECUTION

3.1 GENERAL

A. All exterior or interior piping shall be tested and approved before backfilling or concealing. Failure to secure the approval of the Municipal Inspector, Utility Company's Inspector or the Inspector of the Architect/Engineer makes it mandatory for the Contractor to completely expose the piping for testing. All expense involved in the uncovering of the piping for the test and recovering shall be borne by the respective Contractor with no change in Contract.

B. All equipment, material and labor required for testing a plumbing system or part thereof shall be furnished by the Plumbing Contractor responsible for installing the work.

3.2 INTERIOR PIPING

A. Drainage Piping:

Rough Plumbing: The piping of all plumbing storm, condensate waste, sanitary drainage and venting systems shall be tested upon completion of the rough piping installation by water or air and proved watertight. Where required by the code official, the cleanout plugs shall be removed to ascertain if the pressure has reached all parts of the system. Either of the following methods shall be used:

1. Water Test: The water test shall be applied to the drainage system either in its entirety or in sections after rough piping has been installed. If applied to the entire system, all openings in the piping shall be closed, except the highest opening, and the system filled with water to the point of overflow. If the system is tested in sections, each opening shall be plugged except the highest opening of the section under test, and each section shall be filled with water, but a section shall not be tested with less than a 10-foot head of water.

   In testing successive sections, at least the upper 10 feet of the next preceding section shall be tested, so that a joint or pipe in the building (except the uppermost 10 feet of the system) shall not have been subjected to a test of less than a 10-foot head of water. The water shall be kept in the system or in the portion under test for a minimum of 15 minutes before inspection starts. The system shall then be tight at all points.

2. Air Test: The air test shall be made by attaching an air compressor testing apparatus to an opening, and, after closing all other inlets and outlets to the system, forcing air into the system until there is a gauge pressure of 5 pounds per square inch (5 psi) or a minimum of 10-inch column of mercury. This pressure shall be held without introduction of additional air for a minimum period of 15 minutes.

   Precautionary Note: The compressibility of air and/or other gases result in tremendous amounts of stored energy, even at lower pressures. Over-pressurizing creates a substantial hazard to personnel and property near the area should a failure occur. Consult with the Plastic Pipe Institute (PPI) for statements and alerts, along with State and local safety offices.

Finished Plumbing: Where required by the code official, after the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas and water-tight by one of the following test methods.

1. The final test for gas and water-tightness of the completed drainage and vent systems shall be made by a smoke test or other approved method. The test shall be made by filling all traps with water, and then introducing into the system smoke produced by one or more smoke machines. When the smoke appears at stack openings on the roof, the stack openings shall be closed and a pressure equivalent to a 1" water column shall be built and maintained for the period of the inspection.

2. After the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proven gas and water-tight by plugging the stack openings on the roof and building drain where the drain leaves the building and with air introduced into the system equal to the pressure of a 1-inch water column. This shall be accomplished by the use of a "U" tube or manometer inserted in the trap of a water closet. Such pressure shall remain constant for the period of inspection without the introduction of additional air.

Building sewer test: The building sewer shall be tested by insertion of a test plug at the point of connection with the public sewer or individual sewage disposal system. The building sewer shall then be filled with water under a head of not less than 10 feet. The water level at the top of the test head of water shall not drop for at least 15 minutes.

B. Domestic Water Piping: All new, altered, extended or replaced interior water piping installed shall be tested at 100 psig maintaining the pressure for four hours with not more than 1% drop in pressure. The system shall be filled with water which shall remain in the system until the water and the piping are the same temperature. If water pipe testing is under the jurisdiction of the local inspector, his requirements shall be used; however, they shall be not less than specified herein. The tests shall be performed in the presence of the representative of the Architect/Engineer and to his satisfaction.

C. Natural Gas Piping:

1. All new, altered, extended or replaced interior natural gas piping installed shall be tested in accordance with the requirements of the National Fire Protection Association, latest edition of the IFGC, Section 107, and the requirements of the local Utility Company as applicable. In the absence of a specific test required by the Authorities, or if such requirements are less stringent than the test hereinafter specified, then the interior gas piping shall be tested as follows in the presence of the representative of the Architect.
2. Before appliances are connected, piping shall be filled with air or nitrogen, to a pressure of 10 psi and proved tight with no drop in pressure for the length of time required to inspect the joints, but in no case less than 30 minutes. The source of pressure shall be isolated before the pressure tests are performed. Pressure shall be measured with a mercury manometer, or slope gauge or equivalent device so calibrated as to be read in increments of not greater than one-tenth pound. All piping which will be concealed shall be tested, prior to being closed in by construction.

3.3 EXTERIOR PIPING

A. Sanitary Drainage Piping:

1. All new exterior sanitary and storm water drainage installed shall be tested in a manner and in a sequence best suited to project. The test shall be performed in the presence of the Inspector of the Municipality under whose jurisdiction the installation is made and shall conform to his requirements.
2. In the absence of a specific code test, the Contractor shall perform the following testing in the presence of the representatives of the Architect.
3. Before any section of sanitary and storm water drainage has been backfilled more than 6 inches above the top of the pipes, exclusive of the joint area, the system shall be tested. Wherever possible, the section of the system shall be tested from manhole to manhole. The lower end of each section to be tested shall be plugged with a suitable device manufactured for this purpose. The section being tested shall be filled with water and the leakage observed and gauged.
4. For the gravity sanitary drainage piping to be acceptable, the water leakage after filling shall not exceed 2 gallons per 24 hours per lineal foot of pipe joints with all joints under a constant pressure of not less than 0.1 pound.
5. For the storm water to be acceptable, the water leakage after filling shall not exceed 3 gallons per 24 hours per lineal foot of pipe joints with all joints under a constant pressure of not less than 0.1 pound.

B. Domestic Water Service: All new exterior water service piping installed shall be tested and proved tight. In the absence of specific requirements or requirements less stringent than those specified herein, this contractor shall test the piping at a minimum pressure of 125 psig maintaining the pressure for two hours without more than 2% drop in pressure. The system shall be filled with water which shall remain in the system until the water and piping are the same temperature.

OR

B. Water Service: All new exterior water service piping installed shall be tested and proved tight. In the absence of specific requirements or requirements less stringent than those specified herein, this

contractor shall test the domestic water service piping at a minimum pressure of 125 psig maintaining the pressure for two hours without more than 2% drop in pressure. The 6" water service from the wet tap to the 6" sprinkler service entry location shall be tested in accordance with the NFPA requirements of at least 200 psi. The systems shall be filled with water which shall remain in the system until the water and piping are the same temperature.

C. Gas Service:

1. All new exterior distribution piping, installed by this Contractor, for natural gas systems shall be tested in accordance with the requirements of the National Fire Protection Association, latest edition of the IFGC, Section 107, and the requirements of the local Utility Company. In the absence of a specific test required by the Authorities, or if such requirements are less stringent than the test hereinafter specified, then the exterior piping shall be tested as follows, before pressure regulating valves are installed, or connection made to interior piping.
2. Piping shall be filled with air or nitrogen, to a pressure of 100 psi, and proved tight with no drop in pressure for the length of time required to inspect the joints, but in no case less than one hour. The source of pressure shall be isolated before the pressure tests are performed. Pressure shall be measured with a gauge so calibrated as to be read in increments of not greater than one pound.

3.4 STERILIZATION

A. After final testing for leaks, all new potable water piping installed including water service piping, shall be flushed to remove foreign material.

B. Before placing domestic water systems in service, a qualified service organization shall be engaged, to sterilize the entire building including the exterior water service piping in accordance with the following procedure:

1. Contractor shall provide a 3/4" hose connection somewhere in the main entering the building, or in the Mechanical Room and/or in the meter pit, pump in sufficient sodium hypochlorite to produce a free available chlorine residual of not less than 100 PPM.
2. Proceed upstream from the point of chlorine application opening all faucets and taps until chlorine is detected. Close faucets and taps when chlorine is evident. Consult with the local code department for additional concentrations and durations.
3. When chlorinated water has been brought to every faucet and tap with a minimum concentration of 200 PPM chlorine, retain this water in the system for at least three hours.
4. At the end of the retention period, no less than 100 PPM of chlorine shall be present at the extreme end of the system.
5. Proceed to open all faucets and taps and thoroughly flush all new lines until the chlorine residual in the water is less than 1.0 PPM.
6. Obtain representative water samples from the system for analysis by a recognized Bacteriological Laboratory.
7. If all samples tested for impurities and organisms are negative, a letter and laboratory reports shall be submitted by the service organization to the contractor, certifying successful completion of the sterilization.
8. If any samples tested indicate the presence of harmful impurities and organisms, the entire sterilization procedure shall be repeated.
9. Plumbing Contractor shall provide plumbing connections and power for pumping chlorine solution into the system.

<u>Warning: PVC and CPVC Pipe:</u> Do not use a dry granular calcium hypochlorite as a disinfecting material for water purification in potable water piping systems. The introduction of granules or pellets

of calcium hypochlorite with solvent cements and primers (including their vapors), may result in violent chemical reactions.

END OF SECTION 22 0190

SECTION 22 0191
BALANCING – PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other conditions, if any) and Division 1 as appropriate, apply to the work specified in this Section.

1.2 DESCRIPTION OF WORK

A. Extent of plumbing systems to be balanced is indicated on the drawings and by requirements of this section.

B. Applications of tests include the following:

1. Interior Piping

a. Domestic hot water and hot water return

1.3 REFERENCE STANDARDS

A. Refer to Section 220000 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 220010 for a general description of requirements applying to this section.

1.5 SUBMITTALS

A. Submit balancing report in accordance with Section 220000.

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

PART 2 – PRODUCTS

2.1 PIPE & FITTING REPLACEMENTS

A. Refer to Section 220010 for replacement of any defective pipe or fittings. Replacement shall include all required draining of system, removal and replacement and uncovering, recovering.

PART 3 – EXECUTION

3.1 GENERAL

A. All new hot water return piping installed or wherever system valves are being replaced, the system shall be tested, balanced and approved before concealing. Failure to secure the approval of the Municipal Inspector, A/E Inspector or the Inspector of the Owner makes it mandatory for the Contractor to completely expose the piping for balancing. All expense involved in the uncovering of the piping for the balancing and recovering shall be borne by the respective Contractor with no change in Contract.

B. All equipment, material and labor required for balancing a plumbing system or part thereof shall be furnished by the Plumbing Contractor responsible for installing the work.

3.2 INTERIOR PIPING

A. Domestic Hot Water Return System: Upon completion of the testing of the domestic hot water supply and recirculation systems, a final procedure is to be performed to obtain uniform circulation within each hot water loop of the domestic hot water system. At the ends of the hot water mains, or wherever a branch return line connects to the main return line, there shall be three (3) valves: ball valve, check valve and balancing valve. These valves are to be installed in an accessible space at/or above the

ceiling or where indicated on the drawings.

B. Based on an Accu-Flo balancing valve, the use of a differential pressure gauge Model No. 779 shall be used to achieve the greatest accuracy.

END OF SECTION 22 0191

SECTION 23 0200

GENERAL PROVISIONS – HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to work of this Section.

B. This specification or drawing and the design features or resulting construction disclosed, are the property of Furlow Associates, Inc., and shall not be reproduced without written permission.

C. All Mechanical Systems shall be part of and included in all of the following: 23 0200 thru 23 0950.

1.2 WORK INCLUDED

A. Provide labor, materials, equipment and supervision necessary to install complete operating HVAC Systems, including all work at the site and within the proposed construction areas to accomplish the required work.

B. Wherever the term "provide" is used, it shall be understood to mean both "furnish" and "install".

1.3 REGULATIONS, CODES AND STANDARDS

A. Work shall be performed in accordance with latest adopted codes, regulations and ordinances by authorities having jurisdiction. Observe all safety regulations.

B. Obtain all permits and inspection certificates and pay all charges.

C. Latest editions of any referenced standards shall govern.

1.4 RELATED WORK

A. Refer to equipment shown or specified in sections of Division 1 thru 14 and 26 that will require Mechanical services and provide such service.

B. Refer to work related to HVAC as shown on the following contract drawings:

Architectural & Structural

Plumbing

Electrical

C. This Contractor shall coordinate with the work of Division 26 and the Fire Alarm System vendor for locations and mounting of all duct smoke detectors. These devices are shown on the Mechanical Drawings for reference only to show the intent of the work. All locations shall be determined based on approved shop drawings from the Fire Alarm System vendor and the Contractor for the work of Division 26, Electrical.

1.5 COORDINATION

A. The Mechanical, Plumbing and Electrical Contractors are responsible to coordinate all manufacturer's recommended circuit breakers, starters, disconnects and fuse sizes for all equipment. Submission of a shop drawing will certify that this has been completed. Any necessary changes required will be included as part of this contract.

B. Mechanical Contractor shall coordinate scheduling, submittals and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of independent work elements, with provisions to accommodate items that may be installed at a later time.

C. Mechanical Contractor shall verify utility requirements and all characteristics of operating equipment are compatible with the building utilities. Coordinate the work of all sections related and required for

installing, connection and placing in service of all equipment.

D. Mechanical Contractor shall coordinate all space requirements, supports and installation of all mechanical, electrical, plumbing and fire protection work, which are indicated diagrammatically on the Drawings. Verify routing of all pipes, ducts, conduits and equipment connections. Maximize accessibility for other work, and service requirements for maintenance and repairs. Develop overall coordination drawing (all trades) and submit for review prior to fabrication/installation.

E. Obtain written confirmation from all related trade Contractors and the Owner or his representative that requirements, conflicts and coordination issues have been discussed and resolved.

F. Submit coordination drawings to verify access and clearances.

1.6 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installation within unheated shelters.

1.7 SUBMITTALS

A. Shop Drawings:

1. Shop drawings shall be submitted in accordance with Division 1 of these specifications except where herein modified.

2. Shop drawings comprising complete catalog cuts, performance test data for HVAC equipment as required by other sections of Division 23, shall be submitted for review checking. The Contractor shall review these shop drawings for conformance to contract documents prior to submission and affix contractor's signature to each submittal certifying that this review has been done. By approving and submitting shop drawings, product data, samples and similar materials, the Contractor represents that the Contractor has determined and verified materials, field measurements and field construction data that relates to the work, and has checked and coordinated this information with all of the requirements contained in the contract documents for the work of all trades.

   a. The Contractor and equipment manufacturer shall clearly indentify in all submittals and shop drawings any and all applications standards which require additional work to accommodate this equipment and provide a complete and operational system as described in the contract documents.

   b. The Contractor shall be completely responsible for any and all additional costs associated with the changes required by this and all other trades.

3. Submit a 1/4" scale layout of all mechanical equipment. All equipment and pads shall be to scale of equipment being furnished. Obtain size information of any and all equipment from other trades and indicate on drawings. The drawings shall be fully coordinated with all trades prior to

submission. Indicate coil pull areas, filter pull areas, maintenance clearances, and access as applicable.

4. All shop drawing submittals shall have the following identification data, as applicable, contained therein or permanently adhered thereto.
   a. Project name.
   b. Project number.
   c. Sub-contractor's, vendor's and/or manufacturer's name and address.
   d. Product identification.
   e. Identification of deviation from contract documents.
   f. Applicable contract drawings and specification section number.
   g. Shop drawing title, drawing number, revision number, and date of drawing and revision.
5. Resubmit revised or additional shop drawings as requested.
6. Wherever shop drawings or vendor's standard data sheets indicate work to be done "by others", it shall be the responsibility of the contractor making the submission to identify by name, the contractor who is to do this work. If the contractor named is other than the contractor making the submission, the shop drawing submission must be reviewed by the named contractor and bear his mark of approval, prior to submission to the Architect/Engineer.
7. Where equipment proposed differs from that shown on the drawings or specified, he shall submit for approval drawings showing the manner in which the layout is affected by the substitution.
8. The Contractor shall keep one copy of approved shop drawings at the job site,, filed in a suitable metal container. The shop drawings shall be cataloged and kept in good repair, and shall be available for use by the Owner, Architect and Engineer.
9. No equipment shall be ordered, fabricated, etc., before approval of shop drawings.

B. Contractor is responsible for the shop drawing coordination and interface with the work of other contracts and adjacent work. The relationship of Contractor’s work shall be verified as it relates to adjacent and critical features of the work of this and all contracts and materials.

C. The Contractor shall submit a complete schedule of all shop drawings required for the scope of work covering all materials and equipment listed in all sections of Division 23, Mechanical, including all documents required for contract closeout, Owner instructions and training, and all turnover items at the completion of the work. This schedule shall be submitted for review and approval within thirty days of contract award and before any subsequent materials are provided for review.

D. The shop drawings provided by the Contractor will be reviewed only once and resubmittals will be reviewed only once. Any other submittals will be billed to the Contractor at the Engineer’s standard rates.

1.8 SITE INSPECTION

A. The Contractor shall visit site, inspect, and become aware of all conditions which may effect the work during the estimation phase of his work prior to bid openings. Investigate utilities, protection requirements for adjacent facilities, storage locations, and access to the construction area.

B. Submission of a bid will be deemed evidence of having complied with this requirement.

1.9 SUBSTITUTIONS

A. Whenever a material, article, piece of equipment or system is identified in the following specification or indicated on the drawings by reference to manufacturers' or vendors' names, trade names, catalog numbers or the like, it is so identified for the purpose of establishing the basis of the Bid.

B. Substitution approval must be obtained and included as an addendum item prior to the submission of the bid. An approved substitution shall not be considered as an approval for the Contractor or an equipment vendor to deviate from the written portion of the specifications unless so stated in the addendum.

C. The drawings illustrate the space allocated for equipment and the Contractor shall install the equipment accordingly. If changes are required in the building or arrangement due to substitution of equipment, the Contractor making the substitution must pay for the necessary modifications.

D. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not be limited to all: space requirements, code clearances, type-horsepower-capacities-number and size of services required from other trades including all auxiliary items provided by this Contractor and all other trades, and all manufacturer's specific equipment applications standards and requirements, for approved equipment including that which is basis of design or a substitution. The bidding related contractor and equipment manufacturers shall clearly identify in all submittals and shop drawings any and all applications standards which require additional work to accommodate this equipment and provide a complete and operational system as described in the contract documents. If the bidding contractor or manufacturer does not comply with these requirements then they shall be completely responsible for any and all additional costs associated with the changes required by this and all other trades.

1.10 LUBRICATION

A. Provide and maintain all required lubrication of any equipment operated prior to acceptance by the Owner. Lubrication shall be as recommended by the equipment manufacturer.

B. Provide one year's supply of lubricants to Owner at date of acceptance.

C. Verify that required lubrication has taken place prior to any equipment start-up.

1.11 EQUIPMENT START-UP

A. Verify proper installation by manufacturer or his representative.

B. Advise Construction Manager 2 days prior to actual start-up.

C. Verify proper operation. Obtain signed statement by manufacturer or his representative that equipment is operating within warranty requirements. Submit statement to Construction Manager.

D. Perform field mechanical balancing in accordance with Section 230950: TESTING AND BALANCING OF MECHANICAL SYSTEMS.

E. The Mechanical Contractor shall own as part of his work, the following:

Provide one (1) additional drive set, if necessary, to obtain final design balancing requirements. The Mechanical Contractor shall coordinate with Balancing Firm and equipment manufacturer for drive selection, including belts and pulleys.

1.12 OPERATION & MAINTENANCE INSTRUCTIONS

A. Properly and fully instruct Owner's personnel in the operation and maintenance of all systems and equipment.

B. Insure that the Owner's personnel are familiar with all operations to carry on required activities.

C. Such instruction shall be for each item of equipment and each system as a whole.

D. Provide report that instruction has taken place. Include in the report the equipment and/or systems instructed, date, contractor, Owner's personnel, vendor, and that a complete operating and maintenance manual has been reviewed.

E. Manual shall include all instructions on operation, maintenance, repair parts list, lubrication requirements, brochures, catalogue cuts, complete schedule of air filters for each unit type in Excel spreadsheet format, wiring diagrams, piping diagrams, control sequences, service requirements, names and addresses of vendors, suppliers and emergency contacts. Three manuals shall be provided.

F. Submit manuals for review prior to operating instruction period. Manuals shall be 8-1/2 x 11" with hard cover, suitably bound.

G. Provide to the Owner any special tools necessary for operation and routine maintenance of any of the equipment.

H. Upon completion of the project, the Mechanical Contractor shall provide a complete set of legible as-built drawings for the Owner.

1.13 TOOLS

A. All equipment furnished by the Mechanical Contractor which requires special tools or devices other than those normally available to the maintenance or operating staff shall be furnished in duplicate to the Owner, sufficiently marked, packed or boxed for staff usage. The tools provided shall be listed by the Mechanical Contractor identified as to their use or the equipment applicable in a written transmittal to the Owner.

1.14 CLEANING AND FINISHING

A. After equipment start-up and all operating tests have been made and the system pronounced satisfactory, each respective Contractor shall go over the entire project, clean all equipment, etc., installed by him and leave in a clean and working condition. Any surfaces found marred after this final cleaning shall be refinished or replaced by each Contractor at no cost to the Owner.

B. Provide for the safety and good condition of all materials and equipment until final acceptance by the Owner. Protect all materials and equipment from damage. Provide adequate and proper storage facilities during the progress of the work. Special care shall be taken to provide protection for bearings, open connections, pipe coils, compressors and similar equipment.

C. All fixtures, piping, finished surfaces and equipment shall have all grease, adhesive labels and foreign materials removed.

D. All piping shall be flushed to remove grease and foreign matter. Pressure regulating assemblies, traps, and similar items shall be thoroughly cleaned.

E. Clean-up: Remove from the premises, all unused material and debris resulting from the performance of work under this section.

PART 2 – PRODUCTS

2.1 GENERAL

A. All material and equipment shall be new and of present day manufacture, and shall conform to accepted standards of the trade where such a standard has been established for the particular type of equipment or material.

B. Whenever equipment or material is referred to in the singular, such as "the fan", it shall be deemed to apply to as many such items as necessary to complete the work.

2.2 PRODUCT DELIVERY, STORAGE AND HANDLING

A. During loading, transporting and unloading exercise care to prevent damage to material.

B. Store all materials in dry enclosures or under protective coverings out of way of work progress.

C. Material shall not be allowed to be stored directly on ground.

D. Deliver in manufacturer's original cartons or on skids.

E. Handle and protect so as to prevent damage to product or any surrounding material.

2.3 CONCRETE

A. Concrete shall be in accordance with Section 03300.

2.4 WARRANTY

A. Wherever in the specification sections of this division, reference is made to a specific warranty period, this warranty shall be in addition to and not a limitation of other rights the Owner may have against the Mechanical Contractor under the contract documents.

PART 3 – EXECUTION

3.1 PROTECTION

A. Plug or cap open ends of piping systems, conduit and ductwork.

B. Stored materials shall be covered to prevent damage by inclement weather, sun, dust or moisture.

C. Protect all installed work until accepted in place by the Owner.

D. Plates, polished metal escutcheons, thermostats and other finished devices shall not be installed until masonry, tile, and painting operations are complete unless otherwise protected.

E. Protect all work from operations which may cause damage such as hauling, welding, soldering, painting, insulating and covering.

3.2 WORKMANSHIP

A. Install all work neat, trim and plumb with building lines.

B. Install work in spaces allocated.

C. Cutting and patching shall be performed by skilled tradesmen normally employed for the work involved.

D. This Contractor shall provide a complete weathertight seal to all new systems in the building including the necessary caulking, weather-stripping and insulation.

3.3 EQUIPMENT SETTING

A. Provide as a minimum, a 4-inch concrete pad beneath all grade-mounted equipment.

B. Provide as a minimum, spring vibration isolation under any equipment 10 HP and over and rubber in shear vibration isolation on any equipment up to 10 HP. For further specifications and additional requirements, refer to other sections.

C. Concrete shall be 3,000 psi, 28-day compressive strength in accordance with ACI-613. Reinforce with No. 4 rod 12" on centers both ways or as otherwise detailed.

3.4 FASTENERS, HANGERS AND SUPPORTS

A. Provide all hangers and supports required to suspend, mount, or hang the work.

B. Provide all miscellaneous steel angles, channels, beams, clips, brackets and anchors necessary to hang or support the work. Provide submissions for review.

C. Install concrete inserts before concrete is poured.

D. Drilled inserts shall not be loaded more than 1/4 rated capacity.

E. Power-driven fasteners shall not be allowed for piping larger than 2 inch, or equipment. When used they shall not be loaded more than 1/8 rated capacity or 200 pounds.

F. All hangers, miscellaneous steel, braces and supports shall be galvanized, cadmium plated, or primed steel. Copper tubing shall be supported with copper hangers.

G. Piping shall be supported from adjustable clevis type hangers with insulation pipe saddles or pipe shields in accordance with piping support spacing table on the drawings. Where hangers are 18" or longer provide lateral bracing at every fourth hanger.

H. Any lintels required for openings for this work if not indicated on Architectural or Structural drawings shall be provided under this Section.

3.5 SLEEVES

A. Provide each pipe, duct or conduit passing through a masonry or concrete wall, floor or partition with a sleeve made from standard weight steel pipe for pipe or conduit and No. 12 gauge galvanized steel for ducts, with smooth edges, securely and neatly cemented in place. Provide each pipe, duct or conduit passing through a frame or metal partition with a sleeve made from No. 22 gauge galvanized sheet metal, securely fastened in place.

B. Be responsible for the proper location and alignment of all sleeves.

C. Provide hydrostatic seals for sleeves passing through outside walls, either above or below grade, or through hydrostatically sealed slabs or floors on grade. Provide fire-rated seals for all sleeves which penetrate fire-rated walls.

D. Install both piping and sleeve seals so as to maintain integrity of seals with expansion and contraction of piping.

E. Set floor sleeves flush with floor surface in finished areas, 1" above the finished floor in kitchens, cafeterias, and similar service areas unless such areas are slab-on-grade; 1" above the floor in mechanical rooms, pipe chases, pipe spaces and other unfinished areas, unless otherwise indicated, and flush with the underside of slabs. Extend wall and partition sleeves through and cut flush with each surface unless otherwise indicated or specified.

F. Select sleeves two pipe sizes larger than any pipe or conduit that is to remain uncovered, unless otherwise required by the sealing method specified. Where pipes are to be covered, provide sleeves large enough to allow the covering to pass through the sleeves with sufficient clearance for sealing as specified hereinafter. Size sleeves for branch piping from vertical risers large enough to permit vertical expansion at the riser.

G. Select duct sleeve sizes to suit requirements of fire and/or smoke dampers and sealing methods as specified.

H. Place sleeves imbedded in concrete floors or walls in the forms before concrete is poured; sleeves shall have integral waterstop flanges, where they are to receive either watertight or hydrostatic seals.

I. Install sleeves passing through above-grade floors of mechanical rooms, toilet rooms, kitchens or similar service areas where liquid leaks or spillover may occur in a watertight manner. Sleeves shall be such that waterproofing membrane can be flashed around and into the sleeve where necessary.

J. Hydrostatic Sealing Method: Provide compressible synthetic rubber seals, equivalent to LINK SEAL, manufactured by the Thunderline Corporation, or THRUWALL manufactured by O.Z. Gedney. Install seals in accordance with the manufacturer's recommendations to provide air tightness aboveground and hydrostatic sealing belowgrade. Caulking or other type mastic is not acceptable.

K. Fire-Rated Sealing Method:

1. Sleeves, openings and sealants shall comply with applicable codes, recommended practices and standards, and manufacturer's instructions. Fire sealants shall have ability to prevent spread of flame, smoke or water throughout the penetration and shall pass 3-hour test, UL test ASTM E814 and UL 1479.

2. Products: Chase Corporation CTC PR-855, O. Z. Gedney CRS/CAFS, 3M Electro-Products Division Putty 303 or Caulk CP25 penetration sealing kits, General Electric Company sealants

type RTV-850, 6428 or 7403, Hilti FS-one, Thunderline Corporation "Link-Seal Pyro-Pak". Installation and type of sealant to be used as recommended by the manufacturer.

3.6 PLATES

A. Provide chrome plated plates wherever piping passes into finished area.

B. Plates shall be securely fastened to piping or building construction.

C. Floor plates shall cover 1 inch sleeve extension.

3.7 OFFSETS, TRANSITIONS, MODIFICATIONS

A. Provide all offsets necessary to install the work and to provide clearance for other trades.

B. Maintain adequate headroom and clearance.

C. Incidental modifications necessary to the installation of the systems shall be made as necessary and as approved by the Architect.

3.8 RECESSES

A. Furnish information to the Construction Manager as to sizes and locations of recesses required to install panels, boxes, and other equipment or devices which are to be recessed in walls.

B. Make offsets or modifications as required to suit final locations.

3.9 LABELING

A. All HVAC equipment such as fans, air handling units, and devices requiring identification for operating procedures shall be provided with permanent black laminated micarta white core labels with 3/8 inch letters.

B. This shall also apply to all controllers, remote start/stop pushbuttons and equipment cabinets.

C. This shall not apply to individual room thermostats.

3.10 FLASHING AND COUNTERFLASHING

A. Roof curbs, etc., shall have counterflashing fittings. General Contractor shall provide flashing.

B. Piping and conduit thru the roof shall be flashed by the General Contractor. Provide counterflashing.

C. Provide curbs with base features required to match roof materials, finishes and configuration; e.g., flat, sloped, raised seam, etc.

3.11 ACCESS

A. Locate all equipment, valves, devices and controllers which may need service in accessible places.

B. Where access is not available, access panels shall be provided. Furnish access panels to the Construction Manager for installation.

C. Access panels shall be Nailor-Hart Industries, Karp Co., or Controlled Air Manufacturing Limited, with 16-gauge frames and 14-gauge steel door, prime painted.

D. Maintain access clearances for tube or fan removal, coil pulls, and filter removal.

3.12 WIRING AND MOTOR CONTROLS

A. Packaged equipment shall be furnished with disconnect switches, starters, overloads, factory furnished and wired by the unit manufacturer.

B. Roof-mounted exhaust fans, except utility sets, rated less than 1/2 HP at 115 volts, single phase, shall be furnished with disconnect switches, factory furnished and wired by unit manufacturer.

C. Rooftop equipment shall be furnished with starters, disconnect switches, overloads, factory furnished and wired by unit manufacturer.

D. This Contractor shall furnish all information and assistance required for the Electrical Contractor to purchase all motor starters that are not specified to be part of the mechanical equipment.

E. Control wiring shall be provided under this Division of the work.

F. All wiring shall be in accordance with the National Electrical Code and as recommended by the equipment manufacturer.

3.13 OPENINGS – CUTTING, REPAIRING

A. This Contractor shall cooperate with the work to be done under other sections in providing information as to openings required in walls, slabs and footings for all piping, ductwork and equipment, including sleeves where required.

B. Any drilling or cutting required for the performance of work under this Section, shall be the responsibility of this Contractor and the cost thereof shall be borne by him.

C. Holes in Concrete: Sleeves shall be furnished, accurately located and installed in forms before pouring of concrete. This Contractor shall pay all additional costs for cutting of holes as the result of the incorrect location of sleeves. All holes through concrete shall be either core drilled or saw cut. All holes required shall have the approval of the Structural Engineer prior to cutting or drilling.

D. It shall be the responsibility of this Contractor to ascertain that all chases and openings are properly located.

3.14 PAINTING

A. Refer to the Construction Manager's Scope of Work.

3.15 GUARANTEE

A. All work shall be guaranteed to be free from defects for a period of two years of operation from date of acceptance by the Owner.

B. Guarantee shall be extended on an equal time basis for all non-operational periods due to failure within the guarantee period.

C. All materials and equipment provided and/or installed under this section of the specifications shall be guaranteed for a period of one year from date of acceptance of the work by the Owner unless otherwise specified in Division 1. Should any trouble develop during this period due to defective materials or faulty workmanship, the Mechanical Contractor shall furnish necessary labor and materials to correct the trouble without any cost to the Owner. Any defective materials or inferior workmanship noticed at time of installation and/or during the guarantee period shall be corrected immediately to the entire satisfaction of the Owner.

D. In the event of occupancy by the Owner prior to final acceptance of the project, the guarantee date for equipment placed in operation shall be mutually agreed to by the Mechanical Contractor and the Owner's representative.

3.16 DRAWINGS

A. The Mechanical Systems are indicated on the Contract Drawings. Certain pertinent information and details required by the Mechanical Work appear on the Architectural, Structural and Electrical Drawings; become familiar with all drawings, and incorporate all pertinent requirements.

B. Drawings are diagrammatic and indicate the general arrangement of systems and requirements of the work. Do not scale drawings. Exact locations of fixtures and equipment, not specifically shown, shall be obtained before starting work.

3.17 TESTING AND BALANCING OF MECHANICAL EQUIPMENT

A. Perform field mechanical balancing in accordance with Section 23 0950: TESTING AND BALANCING OF MECHANICAL SYSTEMS.

B. The Mechanical Contractor shall own as part of his work, the following:

Provide one (1) additional drive set, if necessary, to obtain final design balancing requirements. The Mechanical Contractor shall coordinate with Balancing Firm and equipment manufacturer for drive selection, including belts and pulleys.

END OF SECTION 23 0200

SECTION 23 0210

BASIC MATERIALS AND METHODS – HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions.

C. Refer to other sections in Division 23 for materials and methods not specified herein.

1.2 DESCRIPTION OF WORK

A. Included in this Section are the following:

1. Copper Tubing & Fittings
2. Isolating Fittings
3. Unions
4. Motors

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

B. Install work to meet the requirements of the following:

1. New Castle County Dept. of License and Inspections
2. International Mechanical Code
3. Gas Utility Company
4. NFPA
5. OSHA
6. ASHRAE
7. Manufacturer’s Standardization Society (MSS) of the valve and Fittings Industry, Inc.:

SP-58 Pipe Hangers and Supports Materials, Design and Manufacture.

SP-69 Pipe Hangers and Supports Selection and Application

C. Appliances and materials governed by UL requirements shall meet such requirements and bear the label.

1.4 QUALITY ASSURANCE

A. Provide adequate supervision of labor force to assure that all aspects of the specifications are being fulfilled.

B. Verify that all work and equipment is installed in accordance with manufacturer's warranty requirements.

PART 2 – PRODUCTS

2.1 COPPER TUBING & FITTINGS

A. Refrigeration Piping:

1. Copper tubing: Type ACR, hard drawn temper.
2. Fitting: Wrought-copper, solder joints, ASME B16.22 or ASME B16.26.

3. Joints: Brazed, American Welding Society (AWS) Class BCUP-5 for brazing filler metal.

B. Condensate Drain Piping:

1. Pipe: Copper tubing Type DWV.
2. Fittings: Wrought copper solder type drainage fittings, ASME B16.23 or B16.29.

2.2 ISOLATING FITTINGS

A. Provide isolating fittings between all sections of dissimilar piping materials or piping and equipment where one material is ferrous and the other is non-ferrous.

B. Manufacturer: Epco Sales, Inc., or insulated unions by Central Plastic Co.

2.3 UNIONS

A. Up to and including 2-inch pipe size: Screwed pattern, bronze-to- bronze seat.

B. Above 2-inch pipe size: Flanged pattern, A.S.A. forged steel, with gaskets, bolts and nuts.

C. Copper tubing unions shall have sweated type ends. Flanged unions on copper tubing may be soldered connections.

D. Materials and pressure ratings shall be the same as specified for the respective pipe and fitting system unless otherwise specified.

2.4 MOTORS

A. All single phase and polyphase motors shall be manufactured to incorporate the latest NEMA standards.

B. All single phase and polyphase motors shall have steel frames with ball bearings and copper windings. All motors to have a Class "F" insulation system with a service factor of 1.15.

C. All motors shall be 1725 RPM, 4 pole design, unless otherwise noted on the drawings, or in the equipment specifications.

D. Motors installed indoors and not exposed to moisture shall be open, dripproof, Class B temperature rise based on 40 deg. C maximum ambient temperature.

E. Motors installed outdoors and exposed to moisture shall be totally enclosed, fan cooled, Class B temperature rise based on 40 deg. C maximum ambient temperature.

F. Based on NEMA Standards, motors shall comply with the following minimum nominal efficiencies at full load.

Nominal Efficiencies for "NEMA Premium ™" Induction Motors Rated 600 Volts or Less (Random Wound)						
	Open Drip-Proof			**Totally Enclosed Fan-Cooled**		
HP	**3500 RPM**	**1800 RPM**	**1200 RPM**	**3500 RPM**	**1800 RPM**	**1200 RPM**
1	**82.5**	**85.5**	**77.0**	**82.5**	**85.5**	**77.0**
1.5	**86.5**	**86.5**	**84.0**	**87.5**	**86.5**	**84.0**
2	**87.5**	**86.5**	**85.5**	**88.5**	**86.5**	**85.5**
3	**88.5**	**89.5**	**85.5**	**89.5**	**89.5**	**86.5**
5	**89.5**	**89.5**	**86.5**	**89.5**	**89.5**	**88.5**
7.5	**90.2**	**91.0**	**88.5**	**91.0**	**91.7**	**89.5**
10	**91.7**	**91.7**	**89.5**	**91.0**	**91.7**	**90.2**
15	**91.7**	**93.0**	**90.2**	**91.7**	**92.4**	**91.0**
20	**92.4**	**93.0**	**91.0**	**91.7**	**93.0**	**91.0**

G. Motor Characteristics: Refer to Equipment Schedules for specific data.
   1. Fieldhouse:
      277/480 Volt System: Motors 1/2HP & Larger - 480V, 3 Phase, 3 Wire
      Motors Less than 1/2HP-120/277V, 1 Phase, 2 Wire.
   2. Greenhouse/Headhouse and Maintenance Building:
      120/208Volt System: Motors 1/2HP & Larger - 208V, 3 Phase, 3 Wire
      Motors Less than 1/2HP-120V, 1 Phase, 2 Wire.

H. All motors rated less than 1/2HP shall have thermal protection of the auto-reset type as an integral part of the motor.

I. All motors rated 1/2HP and larger shall have thermal protection provided by an external device.

PART 3 – EXECUTION

3.1 PIPING SYSTEMS

A. All piping to drain to low points

B. Piping shall run square with building lines.

C. Piping shall not be insulated or covered until tested and until building is enclosed.

D. Necessary drains, off-sets, vents and drips shall be provided for coordination of the work as part of the contract.

E. Piping shall not be installed over electrical transformers, panels, switchgear, substations, and control panels.

F. Exposed insulated piping risers in unfinished spaces shall be covered with 22-gauge galvanized steel sleeves from floor to ceiling. Refer to Section: Insulation & Covering – HVAC for additional requirements.

G. Allow clearance for expansion and contraction.

H. Install isolating fittings between sections of ferrous and non-ferrous pipe or connected equipment.

I. Do not support piping from other piping, conduits or equipment.

J. Unions shall be provided adjacent to all valves, at equipment connections, and where necessary to facilitate dismantling of the piping system.

K. Material Requirements for Systems:
   1. AC Condensate Drain (including pumped condensate):
      a. Type DWV copper.
   2. Refrigerant Piping: Type ACR hard copper.

3.2 TAGS, CHARTS AND IDENTIFICATION

A. See Paragraph "Labeling" in GENERAL PROVISIONS for equipment labeling.

B. Identify each valve in all systems with black, numbered and stamped 1- 1/2" brass or aluminum tags fastened to valve by brass chain and S-hook.

C. Provide 1/8" scale diagrams showing location, number and service or function of each tagged item.
   1. Frame diagrams in approved metal frames with clear acrylic front, hinges, and locks.
   2. Secure to wall in the office of each building, as designated by the Owner.
   3. Provide two additional separate copies permanently covered and bound.
      a. Include one (1) copy in the Operation and Maintenance Manuals.

D. Piping Identification: Identify piping with Seton "Setmark" or Brimar, semi-rigid plastic, wraparound pipe markers with flow arrows and conforming to ANSI A13.1. Locate marker at each valve, changes in direction, where pipes pass thru barriers and every 25' of horizontal runs. Lettering on background shall be in accordance with the following colors:

Legend		Background	Lettering
1.	Gas	- Yellow	- Black
2.	Refrigerant Liquid	- Yellow	- Black
3.	Refrigerant Gas	- Yellow	- Black

E. Manufacturers: Seton “Setmark”, Brimar, B-Line MSI.

3.3 SOLDERING/BRAZING

A. Connections between copper tubing and copper fittings shall be made with the appropriate filler metal. Flux shall be non-corrosive type as recommended by the manufacturer of the filler metal, and conforming to AWS A5.8.

B. Tubing shall be cut square and then reamed and deburred. End of tubing and inside of fitting cup shall be cleaned with steel wool and the flux shall be applied to the clean surface before joining. After joining, the excess filler metal shall be wiped off while still plastic.

C. Silver brazing alloy shall be equal to Easy-Flo by Handy and Harmon or Sta-Brite silver solder and shall be used for joints in:

1. Air conditioning condensate drain piping

D. Where the silver brazing is performed in a confined non-ventilated space, a non-toxic, cadmium-free brazing alloy such as braze 560 by Handy & Harman shall be used.

E. Refrigerant piping shall be silver brazed using Harris Sil-Fos 15 or equivalent, with nitrogen purge.

F. Bring joint to solder temperature or brazing temperature in as short a time as possible.

G. Form continuous solder bead or brazing filler bead around entire circumference of joint.

H. Wipe excess solder from joint area while solder is still plastic.

END OF SECTION 23 0210

SECTION 23 0230
INSULATION & COVERING – HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 23 0200 for HVAC General Provisions

C. Refer to Section 23 0210 for HVAC Basic Materials & Methods.

1.2 DESCRIPTION OF WORK

A. This Section includes insulation and covering provided on the following piping and equipment:

1. Condensate Drain Lines
2. Refrigerant Piping.
3. Exterior Piping

B. Insulation shall be installed on the following duct systems:

1. All supply ductwork.
2. All return ductwork.
3. All outside air intake and relief ductwork.

1.3 REFERENCE STANDARDS

A. Refer to Section 23 0200 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 23 0210 for a general description of requirements applying to this section.

B. Install insulation in accordance with manufacturer's recommendations.

C. Provide adequate supervision of labor force to assure that all aspects of the specifications are being fulfilled.

1.5 SUBMITTALS

A. Submit shop drawings, installation instructions, and manufacturer's literature of all materials specified in accordance with Section 23 0200.

B. Submit fabrication instructions for pipe fitting and valve insulation.

C. Submit manufacturer's joining recommendations for butt joints and longitudinal seams.

1.6 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements.

PART 2 – PRODUCTS

2.1 PIPE INSULATION MATERIAL

A. Fiberglass:

1. Material: Preformed fiberglass bonded with resin to form circular pipe sleeves with factory applied, white all service jacket bonded to reinforced foil vapor barrier jacketing. The jacket shall have factory applied double pressure-sensitive, self-sealing, adhesive closure and vapor sealing of longitudinal joints. Thermal conductivity: 0.24 Btu/Hr./SF/inch at 100 degrees F. Flame spread

of 25 and developed smoke of 50 or less.

2. All Valves and Fittings:
   a. Glass fiber insert and pre-molded PVC cover, Proto Corp., Johns Manville Corp. "Zeston" and "Hi-Lo Temp Inserts" for fittings. Glass fiber or prefabricated elastomeric foam fittings must fill the entire space within the cover completely.
   b. Factory molded fibrous glass fitting covering for fittings. Coat ends with Fosters 30-36 lagfast adhesive
   c. Mitered sections of pipe covering for valves.
3. Manufacturers: Johns Manville Corp., Certain-Teed, Owens- Corning, Knauf, Armacell.

B. Closed Cell:
1. Material: Black flexible elastomeric foamed closed cell structure insulation 25/50 rated with a flame spread rating of 25 or less and a smoke developed rating of 50 or less with both a moisture seal and a reinforced elastic foam lap seal closure system.
2. Flexible pipe insulation shall be a foamed elastomeric closed cell structure material, with a thermal conductivity of not more than 0.27 Btu/Hr./Sq. Ft./Inch at a mean temperature of 75 degrees F. The insulation shall have an average density of at least 2 pounds per cubic foot, shall be self-extinguishing, and shall have a water vapor transmission rating of not more than 0.1 perms. Between temperature limits of -40 degrees F and plus 220 degrees F, the insulation shall not indicate any deviation from its original state.
3. Specification Compliance:

   ASTM-E-84

   ASTM-C-534 Type I – Tubular, Type II – Sheet.

   ASTM-D-1056, 2B1 – Tubular, Sheet.

   MIL-C-3133B (MIL STD 670B) Grade SBE-3

   MIL-P-15S280J, Form T, Form S.
4. Manufacturers: Armacell, Nomaco, K-Flex, Aeroflex USA, Inc.

C. Covering of Pipe Insulation Outdoors:
1. Wrapping: Wrap insulation with embossed 0.016" aluminum jacket.
2. Fastenings: Cover shall be held in place with soft aluminum bands on 12" centers.
3. Valves and Fittings: Weatherproof all valves and fittings.

D. Manufacturers: Johns Manville Corp.., Certain-Teed, Owens- Corning, Knauf.

2.2 DUCT INSULATION

A. Concealed Supply, Return, Relief, and Outside Air Ductwork: Fiberglass duct wrap bonded with resins, 3/4 pound density, aluminum foil facing reinforced with fiberglass scrim, laminated to Kraft, 2" thick.
1. Thermal Conductivity: 0.27 Btu/Hr./SF/Inch at 75 degrees F. Min. installed "R" value w/25% compression shall be 5.6.
2. Duct wrap shall be cut to stretch-out dimensions as provided in manufacturer’s instructions. Remove a 2” piece of insulation from the facing at the end of the piece of insulation to form an overlapping staple and tape flap. Install with facing outside so tape flap overlaps insulation and facing at other end. Insulation shall be tightly butted and not compressed excessively at duct corners. Seams shall be stapled 6” on center with outward clinching staples. All seams, tears, punctures and other penetrations of the insulation facing shall be sealed with foil tape or vapor

proof mastic. Where rectangular ducts are 24” in width or greater, duct wrap shall be secured to the bottom of the duct with mechanical fasteners; i.e., stick pins spaced 18” on center.

B. Exposed supply, return, relief, and outside air ductwork shall be insulated in finished conditioned spaces, penthouse, mechanical rooms, mezzanine areas, equipment closets, and non-conditioned spaces with 2" thick rigid fiberglass board. Insulation shall be 6 P.C.F. density with a "K" value of 0.25 Btu/Hr./SF/Inch at 75 degrees F. mean temperature and shall be U.L. listed at 25 maximum for flame spread, and 50 maximum for smoke developed. Insulation shall be applied using Graham Pins or Stik-Clips and all seams, edges and breaks shall be sealed with 4” matching tape and sealed with Vicryl CP-10 to match ASJ jacket. Insulation shall be provided with all-service jacket facing.

C. Manufacturers: Johns Manville Corp., Certain-Teed or Owens- Corning, Knauf.

PART 3 – EXECUTION

3.1 INSTALLATION – GENERAL

A. Do not install until systems have been tested and meet requirements.

B. Do not install until building is enclosed.

C. Heavy work which may damage insulation shall have been completed in the vicinity of the insulation work.

D. Provide non-compressible insulation saddles at all piping hanger locations, and at all piping hanger locations where piping is insulated with flexible closed cell insulation.

Option: Provide insulation coupling system as made by Klo-Shure Co.

E. All installations shall be made by skilled craftsmen regularly engaged in this type of work.

F. Insulation shall be continuous thru-wall, ceiling and floors.

G. Metal shields, 16 gauge galvanized, shall be installed between hangers and pipe insulation.

H. Pipe, ductwork and equipment shall be clean and dry prior to insulating.

I. Install all insulation per manufacturer's instructions.

J. To avoid undue compression of insulation, provide solid core inserts at all supports as recommended by the insulation manufacturer. Provide insulation shields between the insulation jacket and the hanger.

K. Provide insulation on all piping, equipment, and fixtures that are part of a factory assembly package not otherwise insulated by the manufacture of such packaged equipment. Insulation type and thickness shall comply with all of the requirements of this section.

3.2 PIPE INSULATION – TYPES & THICKNESSES

A. Provide fiberglass insulation of thickness specified on:

1. Refrigerant Piping: Interior locations, exposed and concealed for suction lines and hot gas bypass lines, if applicable. (NOTE: Insulate liquid line if metering device is mounted at the condensing unit.) Option: Flexible closed cell insulation

   Suction Line:

   1/2" for piping 1-1/4" and below

   1" for piping 1-1/2" and larger

   Hot Gas Bypass: (Liquid Line)

   1" for piping 1-1/4" and below

   1-1/2" for piping 1-1/2" and larger

B. Provide flexible closed cell insulation of thickness specified on:

1. Refrigerant Piping: Exterior Locations for suction lines and hot gas bypass lines, if applicable. (NOTE: Insulate liquid line if metering device is mounted at the condensing unit.)

   Suction Line:

   1/2" for piping 1-1/4" and below

   1" for piping 1-1/2" and larger

   Hot Gas Bypass: (Liquid Line)

   1" for piping 1-1/4" and below

   1-1/2" for piping 1-1/2" and larger
2. ½" thickness for condensate drain lines.

3.3 PIPE COVERING (FOAMED PLASTIC TYPE)

A. All joints and seams shall be sealed with a compatible adhesive. Approved adhesives are as follows:

Armstrong World Industries	No. 520
Benjamin Foster Company	No. 85-75 up to 200 degrees F.

Contractor may use Armstrong Self-Seal Armaflex 2000 insulation in lieu of the above wherever 1/2" is specified.

B. Fitting covers shall be fabricated from the foamed plastic pipe insulation or from sheet insulation of the identical material. The fabrication shall be in accordance with manufacturer's instructions, and all seams mitered joints shall be joined using the adhesives described hereinbefore.

C. Pipe insulation in concealed spaces shall require no finish coatings.

D. Pipe insulation in all other areas shall receive two coats of finish of color selected by Architect. Approved finishes are as follows:

Armstrong World Industries	WB Armaflex Finish

3.4 EXTERIOR PIPE COVERING

A. Wrapping: Wrap insulation with embossed 0.016" aluminum jacket, orient seam down.

B. Fastenings: Cover shall be held in place with soft aluminum bands on 12" centers.

C. Valves and Fittings:

1. Weatherproof all valves and fittings.
2. Finish: Apply two coats of vapor resistant mastic reinforced with glass fabric over wrapping.

3.5 INTERIOR PIPE COVERING

A. Provide premolded PVC cover on all interior insulated piping exposed in finished spaces. Orient seams up in overhead piping and toward the wall in vertical runs.

B. Provide factory molded fitting covering for fittings and accessories, sealed and held in place by manufacturer's recommended sealing system.

C. Provide mitered sections of covering for valves.

END OF SECTION 23 0230

SECTION 23 0410

HEATING GENERATION AUXILIARY EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions.

C. Refer to Section 230210 for HVAC Basic Materials and Methods.

D. Refer to Section 230720 for Heating Equipment.

1.2 DESCRIPTION OF WORK

A. This Section includes labor, material, and equipment necessary for a complete boiler system as specified and shown on the drawings:

1. Gas Vent Pipe & Pipe Fittings
2. Miscellaneous Breeching Materials

B. Provision for vent and combustion air piping.

C. Refer to other Division 23 sections for related work.

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this section.

B. Quality Assurance:

1. Manufacturers: Firms regularly engaged in manufacture of equipment types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
2. Regulatory Requirements:
   a. NFPA Compliance: Install gas-fired equipment in accordance with National Fire Protection Association (NFPA) Code 54 "National Fuel Gas Code".
   b. NFPA 211 Compliance: Heating equipment burning gas, solid or liquid fuels, Section 60.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 230200.

B. Submit the following:

1. Shop Drawings
2. Product Data
3. Evidence of specified code or other compliance.

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these

requirements, this Contractor shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS

PART 2 – PRODUCTS

2.1 GAS VENT PIPE & FITTINGS

A. The gas vent system shall be so engineered and constructed as to develop a positive flow adequate to exhaust all flue gases to outside atmosphere, without condensation within the vent.

B. All parts of vent system shall be of Underwriters' Laboratories, Inc., listed Metal-Fab Type CORR/Guard Model CG, double wall gas vent piping, and such piping shall be continuous from the appliance outlets into Metal-Fab vent terminal. Venting System shall be rated at 6” W.C. and tested to 15” W.C. per UL Standard 1738.

C. The Metal-Fab gas vent piping shall be installed in full compliance with the terms of its listing, with the manufacturer's installation instructions, and with nationally recognized building codes representing good practice for such installations.

D. Inside diameter, inner wall thickness shall be 0.015”, Type AL29-4C stainless steel.

Outer casing shall be 0.018”, aluminized steel.

E. Inner and outer walls shall be connected by means of spacer clips that maintain concentricity of the annular space and allow differential thermal expansion of the inner and outer walls.

F. All supports, wall penetration, terminal with miter cut and birdscreen, furnace or heater connector and condensate drain fitting shall be included.

G. All joints shall be sealed using manufacturer’s approved sealant. Joints exposed to the weather shall be sealed to prevent rainwater from entering the annular space between inner and outer walls.

H. Provide adequate accessibility, head room and dimensions so that all vent connections can be correctly sized, spaced and supported.

I. Manufacturers: Metal-Fab, Metalbestos, Heat Fab, Inc., American Metal Products, Van-Packer Co.

2.2 MISCELLANEOUS MATERIALS

A. Provide miscellaneous materials and products of types and sizes to comply with requirements including proper connection of equipment.

B. Provide PVC combustion air intake pipe and accessories:

1. Pipe: ASTM D-1785 Schedule 40, Type 1, Grade 1.
2. Fittings: ASTM D-2466, Schedule 40.
3. Solvent Cement: ASTM D-2564, Schedule 40 and DWV.
4. Uniformity: To ensure installation uniformity, all piping components shall be of one manufacturer.
5. Flux shall be non-toxic type and non-corrosive.

PART 3 – EXECUTION

3.1 GAS VENT PIPE

A. Gas Vent Pipe shall be installed in accordance with the latest International Mechanical Code.

3.2 GAS VENT PIPE (PRE-ENGINEERED)

A. The manufacturer shall warrant the complete system against functional failure due to defects in material and workmanship for 10 years from date of delivery. The system manufacturer shall be responsible for checking the sizing, design, and installation of the system. If any component fails to perform its intended function of exhausting combustion by-products from the boiler equipment, for any reason, within 10 years of shipment, the system supplier shall, at no expense to the Owner, provide a replacement part or parts FOB jobsite.

END OF SECTION 230410

SECTION 23 0450

REFRIGERATION EQUIPMENT – HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

1.2 DESCRIPTION OF WORK

A. This Section includes labor, material, equipment and supervision to for the following:

1. Condensing Units (Less than 10 Tons)

B. Provide complete refrigeration system including aboveground piping and all required accessories.

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

B. Comply with applicable provisions of:

1. International Mechanical Code
2. ASME Codes for Pressure Vessels
3. A.R.I. Capacity Ratings
4. NFPA Pamphlets
5. ASHRAE Standard 15
6. ASHRAE Standard 90.1, Section 6, Table 6.8.1A thru J, minimum equipment efficiency.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this Section.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 230200.

B. Submit the following:

1. Shop drawings and product data for all equipment in this section.
2. 1/4" = 1'-0" scale layout of all equipment in each Building.

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, this Contractor shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements. In addition, the following special guarantee

applies:

1. Manufacturer shall guarantee all refrigeration equipment for five (5) years from start-up.

PART 2 – PRODUCTS

2.1 CONDENSING UNIT (Less than 10 Tons)

A. General:

1. Provide air-cooled condensers in accordance with the performance schedule shown on the plans.
2. Install them as shown on the plans in accordance with:
   - The manufacturer's recommendations and
   - All applicable national and local codes.
3. UL (CSA) approved.
4. Leak, pressure and functionally tested at the factory to assure a trouble-free start-up after installation.
5. In current production with published literature available to check performance, limitations, specifications, power requirements, dimensions, operation and appearance.

B. Condenser Coils:

1. Shall be draw-thru, with manufacturer’s standard wire guards.
2. Shall be constructed of copper tubes arranged in staggered rows and mechanically expanded into aluminum fins.

C. Condenser Fan Motors:

1. Shall be directly connected to the condenser fans.
2. Shall have permanently lubricated ball bearings.
3. Shall have inherent overload protection.
4. Motors shall be of the permanent split-capacitor type.
5. Condenser fans shall be arranged for vertical discharge of the condenser air, with manufacturer’s standard wire guards.

D. The wiring for each unit shall include:

1. A 24-volt temperature control circuit.
2. High and low pressure circuits.
3. Condenser fan motor controls to assure stable operation of ambient temperatures down to 0 degrees F.
4. Condenser fan and compressor contactor.

E. The refrigerant piping for each system shall include:

1. A strainer-drier,
2. A moisture indicating sight glass, and
3. Service access valves.
4. Locking type, tamper resistance caps on all refrigerant access ports.

The strainer-drier and sight glass may be shipped separately for field installation.

F. Manufacturer: Carrier, Lennox, Daikin McQuay, Trane, York.

1. Any listed equivalent manufacturer and the Mechanical Contractor shall be completely responsible to comply with all requirements on the contract documents. This shall include, but

not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades.

PART 3 – EXECUTION

3.1 REFRIGERATION EQUIPMENT

A. All equipment to be installed in accordance with manufacturer's recommendations.

3.2 SPLIT SYSTEMS

A. Install split system units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory mounted.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements. Do not proceed with equipment start-up until wiring installation is acceptable.

3.3 FIELD QUALITY CONTROL

A. Start-up all units in accordance with manufacturer's start-up instructions. Replace damaged or malfunctioning controls and equipment.

B. Manufacturer's Field Services

1. Manufacturer shall furnish a factory trained service engineer without additional charge to start the unit(s). Representatives shall provide leak testing, evacuation, dehydration, and charging of the unit(s) as required. Manufacturers shall maintain service capabilities to promptly respond within 24 hours or less to service calls at the site.
2. A start-up log shall be furnished by the manufacturer to document the start-up date and shall be signed by the owner or his authorized representative prior to commissioning.
3. The manufacturer shall furnish complete submittal wiring diagrams.

END OF SECTION 23 0450

SECTION 23 0600

AIR DISTRIBUTION & ACCESSORIES – HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

D. This Contractor shall coordinate with the work of Division 26 and the Fire Alarm System vendor for locations and mounting of all duct smoke detectors. These devices are shown on the Mechanical Drawings for reference only to show the intent of the work. All locations shall be determined based on approved shop drawings from the Fire Alarm System vendor and the Contractor for the work of Division 26, Electrical. Mount smoke detectors in the supply and return air stream at each unit in accordance with NFPA 72.

1.2 DESCRIPTION OF WORK

A. This Section includes labor, material, equipment and supervision to provide a complete air distribution system as specified herein and as shown on drawings.

1. Ductwork – Single Wall, Square and Rectangular
2. Ductwork - Single Wall, Spiral Round
3. Flexible Air Duct
4. Flexible Connections
5. Dampers
6. Air Diffusers, Registers and Grilles
7. Roof-Mounted Relief and Intake Air Hoods
8. Louvers
9. Duct Access Doors (Interior)

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

B. Requirements established within the portions of the Project Manual titled Division 1, General Requirements, are collectively applicable to the work of this section.

C. IMC (International Mechanical Code).

D. SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.)

E. American Society of Heating, Refrigerating and Air Conditioning Engineers' recommendations in ASHRAE Guide shall apply to this work.

F. ARI Standard 885 - Standard for Estimating Occupied Sound Levels in the Applications of Air Terminals and Air Outlets.

G. UL (Underwriter's Laboratories, Inc.)

H. NFPA 90A shall apply to this work.

I. State Fire Prevention Regulations.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this Section.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 230200.

B. Submit the following:

1. Shop drawings of all sheet metal. Indicate all steel, piping, conduit, and Architectural/Structural features to demonstrate complete coordination. Scale shall not be less than ¼”.

   a. Shop drawings shall indicate the sizes and lengths of each section of ductwork as well as all system components such as access doors, dampers, diffusers and register locations. Also indicate the type of joints used.

   b. The location of the duct runs and the air outlets shall be closely coordinated with all other trades by the sheet metal contractor to avoid interference. The shop drawings shall show the contact surfaces adjacent to the ducts or air outlets and the space assigned for concealment. The drawings shall indicate principal items of equipment, adjacent piping and conduit, etc., the location of which shall be secured from the contractors of other trades.

   c. Sheet Metal Contractor to include resubmissions of the shop drawings to the Engineer. The resubmissions are to include all corrections to previous submissions.

2. Manufacturer's literature and performance data of all equipment and devices.

3. Samples: Furnish color samples, etc., at request of the Architect.

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but shall not be limited to space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, they shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements.

PART 2 – PRODUCTS

2.1 DUCTWORK (SINGLE WALL, SQUARE AND RECTANGULAR)

A. All ductwork shall be fabricated in accordance with SMACNA "HVAC Duct Construction Standards - Metal and Flexible" latest Edition except as described below. The minimum thickness of metal ductwork is 26 gauge. Fabrication requirements shall be based on ductwork subjected to positive or negative pressures of 2” W.G. Ductwork systems shall be sealed to SMACNA "Seal Class “A” Standards. Alternatively, "Ductmate" System 45 can be used in accordance with manufacturer's specifications. Drive slip joints are not permitted.

   Exception: For ductwork <u>smaller</u> than 12” x 8”, Contractor may provide slip and drive joints with all joints sealed with Hardcast tape and mastic system.

B. Rectangular ducts for 2” W.G. or less, positive or negative pressure shall be per SMACNA Table 1-5. Longitudinal seams shall be Pittsburgh Lock Type L-l per SMACNA Figure 1-5. Transverse joints shall be standing seam type T -15 per Figure 1-4.

1. In the event that material size is not compatible with duct size and segmenting must be utilized to fabricate duct, use SMACNA Figure 1-5, seam L-4 (Standing Seam).

C. Joints:

1. Per SMACNA Transverse Joint Reinforcement Table 1-12, only joints T -22, T -25a, T -25b and Proprietary slip on flanges will be acceptable.
2. Joints T -25a and T -25b that have stress fractures from bending will not be accepted.
3. All joints will have butyl gasket 3/16" thick by 5/8" wide installed per manufacturers installation instructions.

D. Ductwork systems for this standard shall be galvanized sheet steel, commercial quality of lock - forming grade, conforming to ASTM coating standards A-525 or A-527 with coating of designation G-60. For moist conditions, use coating designation G-90.

1. Where the outer surface of the duct is exposed in finished spaces and is <u>not</u> scheduled for insulation, duct material shall be galvannealed, suitable for field painting by the General Contractor.

E. The size and configuration of each duct shall be indicated on design drawings. Where thicker sheets or different types of materials are required, they shall be specified on the design drawings or in the project specifications.

F. Aluminum Rectangular Ductwork:

1. Aluminum ductwork shall be two B.& S. gauges heavier than specified for the equivalent width steel ductwork. Bracing, supports and joints shall be as specified for steel ductwork.
2. Aluminum ducts shall be used where the ducts are concealed when exhausting saturated air from showers, outside air intakes and similar designated spaces.

2.2 DUCTWORK (SINGLE WALL, SPIRAL ROUND)

A. Design Pressure: 2”

B. Leakage: All ductwork shall meet SMACNA Class "A" leak standards.

C. Fabrication:

1. Gauges, reinforcing angles, seams, joints, fabrication methods, installation methods and practices, duct reinforcement, fabricated dampers and devices installed in duct system, fittings, etc., shall conform to the latest editions of SMACNA standards for construction in accordance with requirements indicated in these specifications.
2. Minimum metal gauges shall be 26 gauge (.019). Follow SMACNA Table 3-2A for Positive pressure and Table 3-2B for Negative pressure.
3. Where the outer surface of the duct is exposed in finished spaces and is <u>not</u> scheduled for insulation, duct material shall be galvannealed, suitable for field painting by the General Contractor.

D. Joints:

1. Duct up to 36" diameter - Male/Female beaded slip joint similar to SMACNA Figure 3-2, joint RT-1 or RT-5, as long as it meets the criteria for the system design pressure. Fittings shall be undersized to fit into spiral duct. All joints shall be secured with a minimum of 4 screws on each duct section (equally spaced). Seal joint with an approved sealant compound, continuously applied prior to assembly of joint and after fastening, making certain that the majority of the sealant resides on the interior of the joint.

2. In lieu of beaded slip connections or angle ring connections (the above-mentioned joints), there are proprietary connections that may be used, as long as they meet the pressure criteria set forth in this specification.

2.3 FLEXIBLE AIR DUCT

A. Core material shall be an acoustical spun bond nylon fabric supported by helically wound galvanized steel. The fabric shall be mechanically fastened to the steel helix without the use of adhesive. The core shall maintain its free area and a center line radius of 1.0 or better.

B. The internal working pressure rating shall be at least as follows with a bursting pressure of at least 2½ times the working pressure.

1. Positive: 6 inches W. G.
2. Negative: 5 inches W. G.

C. The duct shall be rated for a velocity of at least 5,500 feet per minute.

D. Suitable for operating temperatures of at least 250°F.

E. Minimum Acoustic Performance:

1. The insertion loss (dB) of a 9 foot length of duct when tested in accordance with ASTM E 477 at a velocity of 2,500 feet per minute shall be at least:

	125 Hz	250 Hz	500 Hz	1,000 Hz	2,000 Hz	4,000 Hz
1) 8 inch dia.	27	27	32	33	37	33
2) 12 inch dia.	24	23	30	31	37	25

F. Insulation shall be fiberglass flexible blanket with metalized vapor barrier, rated for R6.

G. Manufacturer: Flexmaster USA

2.4 FLEXIBLE CONNECTIONS

A. Required between ductwork and suction and discharge connection of all fans and air handlers.

B. Material: Woven fiberglass with mounting hardware tested in accordance with UL Standard 181, listed and labeled as Class 0 or 1.

C. Manufacturer: Ventfabrics, Inc., Durodyne, Dynair, Ductmate Pro Flex.

2.5 DAMPERS

A. Provide where indicated and required to control flow of air and balance system.

B. Round dampers shall be single blade, molded synthetic bearings at each end, 20 gauge galvanized steel, adjusting quadrant and locking device. Round dampers shall be Ruskin Model MDRS25.

C. Rectangular and square dampers shall be opposed blade within 16 gauge galvanized steel channel frame with corner brace, 16 gauge galvanized steel blades; molded synthetic bearings and hex steel shafts, exposed or concealed linkage, adjustable quadrant and locking device. Dampers shall be Ruskin Model MD35.

D. Approved Manufacturers: Ruskin, Arrow, Nailor-Hart, Pottorff, Lloyd Industries, Inc., Cesco Products, Louvers & Dampers, United Enertech.

2.6 AIR DIFFUSERS, REGISTERS AND GRILLES

A. Air diffusing terminals shall be provided in duct runs on drawings. The diffusers shall properly and uniformly distribute the design air quantity with no objectionable drafts, while maintaining not more than 50 F. P. M. velocity in the occupied portion of the space.

B. Ceiling Diffusers:

1. Square Louvered Diffuser Face:

a. Square housing, welded steel construction core of square concentric louvers, removable at face of diffuser, round duct connection, with borders suitable for lay-in ceiling tile application.

b. Diffuser Patterns: Fixed louver face for 1, 2, 3, or 4 direction air flow, direction indicated on drawings.

c. Finish: Matte white finish.

d. Manufacturers: Price Model SMD

2. Round Cone Diffusers:

a. Adjustable round cone diffuser, welded steel construction with round neck and removable inner assembly of cones.

b. Air pattern shall be field adjustable from horizontal to vertical.

c. Finish: Matte white finish

d. Price Model RCDA

C. Registers & Grilles:

1. Registers and grilles shall be steel construction, fixed single deflection type, with clips and/or flange holes and screws (as required by Architectural finishes) to secure registers to ceiling construction. Face bars shall be inclined 30 degrees. Registers and grilles shall be factory primed and painted with a baked-on white enamel finish.

2. Ceiling Return Register (CR):

a. Ceiling registers shall have a perforated face with 3/16-inch diameter holes on 1/4-inch staggered centers and no less than 51 percent free area. Perforated face shall be aluminum according to the model selected. The back pan shall be one piece stamped heavy gauge steel of the sizes and mounting types shown on the plans and outlet schedule.

b. The finish shall be #26 white. The finish shall be a baked on anodic acrylic paint, with a pencil hardness of HB to H. Inside of back pan shall be painted flat black.

c. Price Model PDDR

3. Exhaust Grilles:

a. Grilles shall be available parallel to the long dimension of the grille. Construction shall be of steel with a 11/4-inch wide border on all sides. Screw holes shall be countersunk for a neat appearance. Corners shall be welded with full penetration resistance welds.

b. Deflection blades shall be firmly held in place by mullions from behind the grille and fixed to the grille by welding in place. Blade deflection angle shall be available at 35°.

c. The finish shall be #26 white. The finish shall be a baked on anodic acrylic paint, with a pencil hardness of HB to H.

d. Price Model 535 FL

4. Ceiling Return Filter Grille (CR):

a. Return filter grilles shall be of size and mounting type as shown on the drawings and schedules.

b. Return grilles shall provide minimum free area of 90%.

c. Borders shall be constructed of heavy extruded aluminum with countersink holes or frame suitable for ceiling finish in each room.

d. The four corners shall be interlocked and mechanically staked to form a rigid frame.

e. Aluminum grid core shall have ½ x ½ x ½ inch openings

f. Return grilles shall be provided with a filter frame that will accommodate a standard 1-inch thick disposable filter to fit the specified duct size. Filter shall be grille module size minus 4 inches. Filter capacity shall be as scheduled on the drawings.

g. Return grille finish shall be white powder coat.

h. Price Model 535FF-TB

D. Manufacturers: Provide diffusers, registers and grilles of one of the following:

Anemostat	Price
Carnes Co.	Titus
Krueger	Tuttle & Bailey
Metalaire	Nailor Industries

2.7 ROOF-MOUNTED RELIEFAND INTAKE AIR HOODS

A. Heavy gauge aluminum construction.

B. Hinged hood.

C. Hood underside insulated with 1" fiberglass

D. Aluminum insect screen

E. Provide 13-inch-high insulated roof curb with blocking to secure equipment, and integral cant to accommodate configuration of roofing material/membrane.

F. Manufacturers: Penn Ventilator Co., Carnes Co., Greenheck, Loren Cook or Acme

2.8 LOUVERS

A. All wall louvers for intake and exhaust shall be stationary stormproof type.

B. Construction shall be of extruded aluminum with 0.081-inch-thick blades and frames and all fastening shall be aluminum or stainless steel.

C. An aluminum expanded metal bird screen with frame shall be secured to the rear face of the louver assembly.

D. Depth of the louver frame shall be 6" unless otherwise indicated.

E. Performance Rating:

1. Free Area: Louvers shall have a minimum of 50% free area based on a 48-inch-high by 48-inch-wide size.

2. Air Performance: Not more than 0.08 inch WG static pressure drop at 700 FPM free area intake velocity.

3. Water Penetration: Maximum of 0.01 ounces per square foot of free area at an air flow of 750 feet per minute free area velocity when tested for 15 minutes.

F. The surface areas shall be factory anodized finish of color selected by Architect.

G. Manufacturers: Airstream Products Co., Air Balance, Inc., Carnes Co., Arrow Co., Empco, Pottorff, Cesco, Lloyd Industries, Inc., Ruskin, Louvers & Dampers, United Enertech, NCA Manufacturing, Inc.

2.9 DUCT ACCESS DOORS (Interior Locations)

A. SMACNA standard duct access doors shall be fabricated with 22-gauge galvanized steel door and frame with double wall construction.

1. Doors shall be fabricated of aluminum when installed in aluminum ductwork and stainless steel to match special duct systems.

B. Continuous piano type hinge, same material as door.

C. Latches shall be sash type locks equal to Ventlock 100 latches.

1. Doors 16" and under shall have one latch.
2. Doors over 16" shall have two latches.

D. Door seals shall be foam gasket material continuously bonded to perimeter of door frame.

E. Door insulation shall be 1" thick fiberglass, minimum 1.5 pcf density.

F. Doors shall be able to withstand 3" W.C. static pressure up to 12" x 12" in size; 2" W.C. above that size.

G. Makes: Cesco Products, Karp Co., Nailor-Hart Industries, Pottorff, Lloyd Industries, Inc., Ductmate Industries, Inc.

PART 3 – EXECUTION

3.1 DUCTWORK

A. Dimensions on drawings are inside dimensions.

B. Ducts shall be concealed unless otherwise indicated.

C. Changes in direction shall be made with radius bends or turning vanes.

D. Supports shall be galvanized steel for steel ductwork and aluminum for aluminum ductwork.

E. Locate ceiling air diffusers, registers, and grilles on "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling modules.

F. Do not install ductwork directly above any electrical equipment.

G. Ductwork shall be supported per SMACNA Standards except as follows:

1. Rivet or screw to side of duct when using flat strap hangers. Rivet or screw to bottom of duct when using trapeze hangers.
2. Extend hangers down the side of the duct at least 9"; pass hangers under ducts less than 9" deep.
3. Space hangers not more than 8' on centers for ducts up to 18" wide and 4' on centers for ducts over 18" wide.
4. Wire hangers are not acceptable.
5. Support ductwork from building structure with expansion bolts, rods, steel angles or channels installed to meet existing or new building conditions.
6. Drilling into the roof deck is not permitted.
7. Driving nails into anchors is not permitted.

H. Air Flow Control:

1. Major take-offs: Install volume control dampers.
2. Branches: Install volume control dampers in all branches and at tap in branch take-off connections.
3. Elbows: Use unvaned elbows with throat radius equal to width of duct and full heel radius; provide turning vanes where full throat and heel radius are not possible.
4. Transitions: Make transitions in ducts as required by structural or architectural interferences.
   a. Proportion airways to compensate for any obstructions within duct.
   b. Avoid dead ends and abrupt angles.
   c. Do not exceed 15 degrees slope on sides of transitions.

3.2 LOUVERS

A. Locate and place louver units level, plumb and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible.

C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers.

D. Repair damaged finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alternations and refinish entire unit or provide new units.

E. Protect galvanized and non-ferrous metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry or dissimilar metals.

3.3 FLEXIBLE AIR DUCT

A. When flexible duct is used for final connection between duct mains on branches and diffusers on registers. The maximum length of flexible ductwork shall be 5'-0" in length.

B. Flexible ductwork shall be properly hung at the tap collar in order to prevent eventual wear and damage to the flexible duct.

C. The ceiling tile system should not be considered a support on which to lay flexible duct. Refer to SMACNA Standards for proper installation.

3.4 DUCT SYSTEM LEAK SEALING

A. Joints in duct systems at duct heaters, air monitors, fire dampers, sound traps, supply air terminals including air handling light fixtures, shall be sealed to prevent air leakage.

B. All duct joints and seams in medium pressure and high pressure duct systems shall be sealed to SMACNA Seal Class" A" Standards to prevent air leakage.

C. In the event there is in excess of 5% air leakage indicated in low pressure duct systems, it shall be the Contractors responsibility to seal the duct system. The amount of sealing necessary shall be that required to obtain the design air quantity at each terminal.

D. Duct sealing shall be by means of high velocity duct sealants such as Hardcast and/or Neoprene gaskets. Type of sealant and method of application shall conform to recommendations in SMACNA high velocity duct construction standards.

3.5 DUCTWORK TESTING

A. The following ductwork shall be pressure leak tested:

1. Supply ductwork
2. Return ductwork
3. Exhaust ductwork
4. Outside air intake ductwork

B. All tests shall be conducted in accordance with AABC National Standards.

C. Ducts to be tested at 100% maximum of static pressure before any duct is insulated externally and concealed in accordance with SMACNA Standards.

D. Calculate the allowable leakage using leakage factor of 5% of Design Air Flow.

E. Select a limited section of duct for which the estimated leakage will not exceed capacity of the test apparatus.

F. Connect the blower and flow meter to the duct section and provide temporary seals at all openings of the ductwork.

G. Start the blower motor with the inlet damper closed. Increase pressure until the required level is reached.

H. Read the flow meter and compare the leakage in cfm. Reading should be 5% or less of design flow for the duct segment being tested.

I. If reading is more than 5% of design flow, depressurize duct, repair all leaks and retest until 5% or less of design flow is obtained.

J. Complete test reports and obtain Owner's witness signature.

K. Remove all temporary blanks and seals.

L. Warning: Do not overpressure duct.

3.6 EQUIPMENT

A. Test apparatus shall consist of an airflow measuring device, flow producing unit, pressure indicating devices and accessories necessary to connect the metering system to the test specimen.

B. The Contractor conducting tests shall arrange for or provide all temporary services, all test apparatus, all temporary seals and all qualified personnel necessary to conduct the specified testing.

C. Test apparatus shall be accurate within plus or minus 7.5% at the indicated flow rate and test pressure and shall have calibration data or a certificate signifying manufacture of the meter in conformance with the ASME Requirements for Fluid Meters. Verification of above, to be supplied to Owner upon request.

D. Pressure differential sensing instruments shall be readable to 0.05" scale division for flow rates below 10 cfm or below 0.5" w.g. differential. For flows greater than 10 cfm scale divisions of 0.1" are appropriate. U-tube manometers should not be used for reading less than 1" of water.

E. Liquid for manometers shall have a specific gravity of 1 (as water) unless the scale is calibrated to read in inches of water contingent on use of a liquid of another specific gravity, in which case the associated gauge fluid must be used.

F. Instruments must be adjusted to zero reading before pressure is applied.

3.7 TEST REPORT

A. Log the project and system identification data.

B. Enter the fan CFM, the test pressure, and the leakage class specified by the designer.

C. Enter an identification for each duct segment to be tested.

D. Calculate the allowable leakage factor. Enter this number on the report for each test segment.

E. Conduct and record the field tests. If the sum of the CFM measured is less than or equal to the sum of the allowable leakage, the test is passed. Record the date(s), presence of witnesses and flow meter characteristics.

F. Maintain a mechanical duct plan of all tested duct segments. Plan to include duct segment identification and dates tested.

G. Test reports shall be submitted as required by the project documents.

END OF SECTION 23 0600

SECTION 23 0605
FANS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

1.2 DESCRIPTION OF WORK

A. This Section includes labor, material, equipment and supervision to provide a complete air distribution system as specified herein and as shown on drawings.

1. Recessed Ceiling Fan
2. Centrifugal Belt Drive Cabinet Fan
3. Roof-Mounted Exhaust Fans
4. Vertical Discharge Exhaust Fan

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

B. Requirements established within the portions of the Project Manual titled Division 1, General Requirements, are collectively applicable to the work of this section.

C. IMC (International Mechanical Code)

D. SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.)

E. American Society of Heating, Refrigerating and Air Conditioning Engineers' recommendations in ASHRAE Guide shall apply to this work.

F. UL (Underwriter's Laboratories, Inc.)

G. NFPA 90A shall apply to this work.

H. State Fire Prevention Regulations.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this Section.

1.5 SUBMITTALS

A. Submit shop drawings and product data in accordance with Section 230200.

B. Submit the following:

1. Shop drawings of all sheet metal. Indicate all steel, piping, conduit, and Architectural/Structural features to demonstrate complete coordination. Scale shall not be less than 1/4" = 1'-0".
2. Manufacturer's literature and performance data of all equipment and devices.

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents and as described within the specifications. This shall include, but shall not be limited to space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades,

including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, they shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements.

PART 2 – PRODUCTS

2.1 RECESSED CEILING FAN

A. Recessed ceiling fan shall consist of a rectangular steel cabinet enclosing a true centrifugal fan directly driven by an electric motor.

B. Cabinet shall be complete with a finished plastic ceiling grille and discharge collar equipped with a backdraft damper, metal or plastic, gravity or spring return.

C. Motor and fan shall be conveniently removable with plug-in power chord.

D. The casing shall be sound attenuated, with minimum ½" thick acoustic lining.

E. Provide electronic speed controller, wall cap, roof terminal, metal grille, isolator package, time delay switch with adjustable relay as scheduled on the drawings.

F. Unit shall be AMCA certified.

G. Manufacturers: Loren-Cook, Penn Ventilator, Acme, Carnes, Greenheck, Breidert, Panasonic.

2.2 CENTRIFUGAL BELT DRIVE CABINET FAN

A. Fan shall be centrifugal belt driven in-line type. Fan housing shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars.

B. Fan shall be provided with removable service doors located perpendicular to the motor mounting panel. The service doors must be of sufficient size to permit easy access to all interior components.

C. Fan wheel shall be of the aluminum backward inclined, centrifugal type. Wheels shall be dynamically and statically balanced and shall overlap the spun inlet venturi for maximum performance.

D. Motor and drives shall be isolated from the air stream. Motors shall be of the heavy duty type with permanently lubricated, sealed ball bearings. Wheel shaft shall be ground and polished shafting mounted in heavy duty permanently sealed pillow block bearings. Drives shall be sized for a minimum of 165% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shaft. Motor pulleys shall be adjustable for final system balancing.

E. Flexible wiring leads shall be provided from the fan motor to an external mounted junction box and disconnect switch permitting access for service without disconnecting the field wiring. All fans shall bear the AMCA Certified Ratings Seal for both air and sound performance.

F. Manufacturers: Penn Ventilator, Greenheck, Carnes, Loren-Cook, American Coolair/ILG, Breidert, Hartzell.

2.3 ROOF-MOUNTED EXHAUST FANS

A. Aluminum casing shall be heavy gauge, mill finish of spun construction, weatherproof, removable, with aluminum birdscreen.

B. Aluminum centrifugal fan, adjustable V-belt drive selected for 150% of motor ampere rating.

C. Fans shall be quiet operating, selected for sound level below that of the space ventilated.

D. Accessories: Disconnect switch, insulated roof curb.

E. Manufacturers: Penn Ventilator Co., Greenheck, Loren Cook, Acme, Carnes, Breidert, Hartzell.

2.4 VERTICAL DISCHARGE EXHAUST FAN

A. The exhaust fan shall be a vertical discharge, roof-mounted, power ventilator with heat, vapor and fume resistant features.

B. The casing shall consist of base curb cap, ventilated motor compartment, and upper and lower exterior wind bands. The casing shall be of mill finish aluminum of spun construction.

C. Fan wheel shall be centrifugal backward curved type constructed of aluminum. Back plate of fan wheel shall be finned to provide forced cooling of the motor compartment.

D. An insulated heat shield shall separate the ventilated motor compartment from the air stream, and a shaft seal shall prevent seepage of heat and fumes from around the shaft into the motor compartment.

E. The fan shaft shall be motor driven through a V-belt drive which shall be adjustable by varying the pitch diameter of the motor pulley. The drive shall be provided with a safety factor equal to 150% of the motor ampere nameplate rating. Provision shall be made for adjusting the V- belt tension.

F. A disconnect safety switch shall be mounted under the removable motor dome. The fan motor shall have copper windings.

G. The fan shall be provided with a bird guard constructed of stainless steel expanded metal.

H. Provision shall be made in the unit design for ready access for cleaning and for serving all components and accessories. Provide hinged curb cap with stay brace to fit onto curb.

I. The exhaust fan unit shall be AMCA certified and shall be as manufactured by Penn Ventilator Company, Loren Cook, Acme, Greenheck, American Coolair/ILG, Breidert, Hartzell.

PART 3 – EXECUTION

3.1 FANS, EQUIPMENT AND ACCESSORIES

A. Install in accordance with manufacturer's details and instructions.

B. Mount fan speed control at the fan to facilitate mechanical balancing. Power wiring shall be part of the work of Division 26.

C. Perform field mechanical balancing in accordance with Section 230950: TESTING AND BALANCING OF MECHANICAL SYSTEMS.

D. Install units in accordance with manufacturer’s installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer’s recommended clearances.

E. Support: Install and secure roof curb structure, in accordance with National Roofing Contractor’s Association (NRCA) installation recommendations and shop drawings. Install and secure units on curbs and coordinate roof penetrations and flashing.

F. The Mechanical Contractor shall own as a part of his work, the following:

Provide one (1) additional drive set, if necessary, to obtain final design balancing requirements. The Mechanical Contractor shall coordinate with Balancing Firm and equipment manufacturer for drive selection, including belts and pulleys.

END OF SECTION 230605

SECTION 23 0720
INDOOR FUEL-FIRED HEATERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

1.2 DESCRIPTION OF WORK

A. This Section includes work necessary and/or required and materials and equipment for construction of a complete system. Such work includes, but is not limited to the following:

1. Gas-Fired Duct Furnace
2. High Efficiency, Gas-Fired Furnace
3. Condensate Pump / Receiver Unit
4. High Efficiency, Gas-fired Unit Heater

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

B. Media type air filters shall comply with U.L. Standard 900.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this Section.

1.5 SUBMITTALS

A. Submit shop drawings in accordance with Section 230200.

B. Submit shop drawings and descriptive data for all equipment specified in this section.

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, this Contractor shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements.

PART 2 – PRODUCTS

2.1 GAS-FIRED DUCT FURNACES

A. Provide a gas-fired duct furnace in accordance with the schedule shown on the drawings.

1. Install each furnace as shown on the plans in accordance with the manufacturer's recommendations and all applicable national and local codes.

2. In current production with published literature available to check unit performance, limitations, specifications, power requirements, dimensions, operation, and appearance.

B. Units shall be completely factory assembled, piped, wired and test fired. All units must be (AGA) Certified and conform with the latest ANSI Standard for safe and efficient performance.

C. Performance Ratings: Units shall have at least a 80% thermal efficiency rating.

D. Heating Capacity: Btu/Hr. rated heating output when heated by natural gas. Gas heating capacity is sea level rating.

E. Refer to Schedule.

F. Jacketing:

1. Casing and trim pieces shall be fabricated from 20-gauge cold-rolled steel and finished on all four sides with baked enamel finish.
2. Duct discharge flanges shall be provided for use with field ductwork.

G. Heat Exchanger shall consist of tube sections not lighter than 20 gauge and connecting plates not lighter than 18 gauge. Heat exchanger shall be 100% welded. Material shall be 409 stainless steel and shall be equipped with a stainless steel burner shade.

H. Burner:

1. Gas burner shall be sealed combustion type.
2. Burners shall be corrosion resistant 409 stainless steel.
3. Service access to the burners, pilot and orifices shall be provided a side access burner drawer which slides out from the side of the unit.
4. Burner shall be welded at each port to maintain flame integrity and then spot welded. V-shaped stainless-steel flame spreader shades ports from dust and rust.
5. Burner shall be individually removable for ease of inspection and servicing.
6. Gas Burner Safety Controls: Thermo-couple sensor prevents opening of solenoid gas valve until pilot flame is proven and stops gas flow on ignition failure.

I. Controls:

1. A factory installed junction box shall be provided for all power connections. A 24-volt transformer high limit and a fan time delay shall be provided.
2. High Limit Control: Fixed stop at maximum permissible setting, deenergizes burner on high bonnet temperature and re-energizes when temperature drops to lower value.
3. Units:
   a. Units shall be provided with a 24-volt combination automatic gas valve, including main operating valve and pilot safety shutoff, pressure regulator, manual main and pilot shutoff valve, and adjustable pilot valve.
   b. Gas valve shall be suitable to a maximum inlet pressure of 0.5 psi (14" W.C.) on natural gas.
4. The unit shall be suitable for natural gas and have two-stage gas control and intermittent pilot ignition with electronic flame supervision.
5. Fan Control: A fan time delay switch shall be provided and shall be controlled by a low voltage thermostat.

J. Operating Controls:

1. Room Thermostat: Low voltage, two-stage to control burner operation, heater stages, to maintain temperature setting.

K. Accessories:
   1. Units shall be provided with aluminized steel drain pans.
   2. Electronic modulating gas control valve.
   3. Safety redundant gas valve.

L. Manufacturers: Reznor, Sterling, Trane, York

2.2 HIGH EFFICIENCY, GAS-FIRED FURNACE

A. Provide high efficiency, gas-fired furnace in accordance with the schedule shown on drawings.
   1. Install each furnace as shown on the plans in accordance with:
      - The manufacturer's recommendations and
      - All applicable national and local codes.
   2. In current production with published literature available to check unit performance, limitations, specifications, power requirements, dimensions, operation and appearance.
   3. Completely assembled for one-piece shipping and rigging.
   4. Insulated with aluminum-faced fiberglass for thermal and acoustical properties.
   5. A.G.A. tested and listed for its intended application and certified to FTC for both capacity and efficiency, in accordance with DOE test procedures. AFUE shall be 95.5.

B. Casing:
   1. External panels of steel with a baked enamel finish, embossed for added strength.
   2. Lift-lock front panels which are easily removable, for maintenance, service and adjustment of all internal controls and components.
   3. A heat exchanger which shall be of continuous seam welded multi- section design with individually removable sections.
   4. Burners constructed of formed steel tube with multiple ports and connected by a lanced port carryover tube.
   5. A blower which shall be dynamically and statically balanced.

C. Motor:
   1. All direct-drive motors must have three or more speed taps and have inherent internal overload protection.
   2. A standard cleanable filter for either bottom or side return application.
   3. Adjustable fan/limit control.
   4. Auxiliary limit control on counterflow and horizontal models.
   5. Provide control transformer as required.
   6. Blower door interlock switch.
   7. Standard air conditioning blower relay.

D. Spark Ignition:
   1. Solid state ignition control for intermittent proven pilot operation.
   2. Matching redundant gas valve.
   3. Igniter and sensing functions provided through the same lead wire.
   4. Automatic spark ignition pilot.

E. Provide programmable seven-day heating/cooling thermostat with automatic changeover.

F. Provide concentric roof termination kit. Terminate in accordance with IFGC and all local code requirements.

G. Manufacturers: Carrier, Lennox, Trane, York/Johnson Controls.

2.3 CONDENSATE PUMP / RECEIVER UNIT

A. Provide high capacity, one-gallon reservoir, suitable for condensing furnace application.

B. Integral pump shall provide 4.5 GPM output at 24’ of lift.

C. Motor shall be rated 1/18 HP, 2.5 MCA at 115 VAC, single phase power.

D. Provide unit with 6’ power cord with 3-prong molded plug, overflow safety switch with normally closed 115 VAC contacts to shut down furnace on high level condition, and inline check valve at pump discharge connection.

E. Manufacturer: Little Giant Model VCL-24ULS, or equal.

2.4 HIGH EFFICIENCY, GAS-FIRED UNIT HEATER

A. Provide high efficiency, gas-fired unit heater in accordance with the schedule shown on drawings.

1. Install each unit as shown on the plans in accordance with:
   - The manufacturer's recommendations and
   - All applicable national and local codes.
2. In current production with published literature available to check unit performance, limitations, specifications, power requirements, dimensions, operation and appearance.
3. Completely assembled for one-piece shipping and rigging.
4. Unit shall bear ETL design certification to ASNI Z83.8, latest revision, standard for “Gas unit Heater and Gas-Fired Duct Furnaces” for safe operation, construction, and performance.

B. Casing:

1. External panels of minimum 20-gauge aluminized steel with a minimum 7-mil polyester powder paint, baked enamel finish.
2. Panels which are easily removable, for maintenance, service and adjustment of all internal controls and components.
3. The unit shall be furnished with horizontal air deflectors which are adjustable to provide directional airflow control up or down.
4. The unit shall be equipped with tapped holes to accept 3/8-16 threaded rod for 4 suspension points.

C. Furnace Section

1. A heat exchanger which shall be of continuous 18-gauge aluminized steel tubes and headers design with individually removable sections.
2. Each heat exchanger tube shall be individually and directly flame-fired. The tube shall be crimped to allow for thermal expansion. The flue collar box shall be made of minimum 20-gauge AL29-4C stainless steel.
3. The thermal efficiency of the unit shall be minimum of 93% for all air flow ranges through the use of a secondary heat exchanger constructed of AL29-4C stainless steel to withstand condensing gas fire equipment.

D. Blower and Motor:

1. All direct-drive motors shall have inherent internal overload protection.
2. A blower which shall be dynamically and statically balanced.

3. Motor shall be factory wired, time delay relay control, totally enclosed single speed.
4. Provide control transformer, factory mounted and wired, 115/24VAC.
5. Standard residual heat blower relay, delay on to start, delay off to remove.

E. Spark Ignition:

1. Solid state ignition control for direct spark igniter on thermostat call for heat operation.
2. Single stage gas control with single stage combination gas control, ignition control, 100% full fe
3. Igniter and sensing functions provided through the same lead wire.
4. Automatic reset high limit switch mounted in the airstream to shut off gas supply in the event of overheating.
5. Automatic reset high limit switch mounted on the power exhauster housing to shut ogg gas supply in the event of overheating flue gas temperatures.
6. Condensate drain line overflow switch to sense clogged line and shut down heater.

F. Provide single-stage room thermostat.

G. Provide concentric wall termination kit. Terminate in accordance with IFGC and all local code requirements.

H. Accessories as schedule on the drawings.

I. Manufacturers: Modine, Reznor, Sterling.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF HEATERS

A. Install heaters and in accordance with manufacturer's installation instructions.

B. Uncrate units and inspect for damage. Verify that nameplate data corresponds with unit designation.

C. Hang units from building substrate. Mount as high as possible to maintain greatest headroom possible, unless otherwise indicated.

D. Support units with rod-type hangers anchored to building substrate.

E. Protect units with protective covers during balance of construction.

F. Perform field mechanical balancing in accordance with Section 23 0950: TESTING AND BALANCING OF MECHANICAL SYSTEMS.

G. The Mechanical Contractor shall own as part of his work, the following:

Provide one (1) additional drive set, if necessary to obtain final design balancing requirements. The Mechanical Contractor shall coordinate with Balancing Firm and equipment manufacturer for drive selection, including belts and pulleys.

END OF SECTION 23 0720

SECTION 23 0725
TERMINAL HEATING UNITS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

1.2 DESCRIPTION OF WORK

A. This Section includes work necessary and/or required and materials and equipment for construction of a complete system. Such work includes, but is not limited to the following:

1. Electric Unit Heaters
2. Electric Wall Heaters
3. Electric Cabinet Heaters

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this Section.

1.5 SUBMITTALS

A. Submit shop drawings in accordance with Section 230200.

B. Submit shop drawings and descriptive date for all equipment specified in this section.

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, this Contractor shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements.

PART 2 – PRODUCTS

2.1 ELECTRIC UNIT HEATERS

A. Horizontal Unit: Construct casing of steel, phosphatized inside and out, and finished with baked enamel. Provide motor-mounted panel, minimum of 18 gauge steel. Fabricate casing to enclose heater, louvers and fan blades. Provide individually adjustable louvers for air diffusion.

B. Construct fans of aluminum and factory balance.

C. Metal sheath fin tube electric heating element.

D. Provide totally enclosed motors, with built-in overload protection, having electrical characteristics as

scheduled.

E. Provide integral residual heat sensor to continue fan operation until element temperature fall below preset point.

F. Manufacturers: American Air Filter, Electromode, Berko, Indeeco, TPI/Markel, Q-Mark.

2.2 ELECTRIC WALL HEATERS

A. Construct casing of steel, phosphatized inside and out, and finished with baked enamel. Provide motor-mounted panel, minimum of 18 gauge steel, fabricate casing to enclose heater, and fan. Front panel shall be tamperproof style with stamped louver grille. Suitable for recessed or surface mounting.

B. Construct fans of aluminum and factory balance.

C. Metal sheath fin tube electric heating element.

D. Provide totally enclosed motors, with built-in overload protection, having electrical characteristics as scheduled.

E. Provide integral residual heat sensor to continue fan operation until element temperature falls below preset point. Provide unit-mounted thermostat and disconnect.

F. Manufacturers: Q-Mark, Berko, TPI/Markel, Indeeco, Electromode.

2.3 ELECTRIC CABINET HEATERS

A. Provide cabinet heaters including chassis, heating elements, fan and motor designed for either recessed mounting within 2’x2’ ceiling grid, or within wall construction.

B. Chassis: Galvanized steel wraparound structural frame with edges flanged.

C. Power disconnect switch, 30 AMPs, 600 volts, 3 phase.

D. Cabinet: Horizontal recessed model, heavy gauge, four sided overlap front panel with stamped steel louver air openings. Clean cabinet parts, phosphatize and coat with baked-on enamel finish. Color: white.

E. Coils: Steel fins, copper brazed, for a permanent bond to low watt density, steel sheathed tubular heating elements.

F. Grilles: Intake and outlet grilles shall be integral, stamped 15 deg. Deflection in ceiling trim ring.

G. Fans: Provide direct drive, five bladed aluminum.

H. Motors: Provide single speed impedance protected, totally enclosed motor with integral overload protection and motor cords to junction box in unit.

I. Provide built-in fan delay control and automatic thermal cutout.

J. Manufacturers: Q-Mark, Berko, TPI/Markel, Indeeco, Electromode.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF ELECTRIC HEATERS

A. Install heaters in accordance with manufacturer's installation instructions.

B. Uncrate units and inspect for damage. Verify that nameplate data corresponds with unit designation.

C. Hang unit from building substrate.

D. Protect units with protective covers during balance of construction.

E. Perform field mechanical balancing in accordance with Section 23 0950: TESTING AND BALANCING OF MECHANICAL SYSTEMS.

END OF SECTION 23 0725

SECTION 23 0732
TERMINAL HEAT PUMPS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

1.2 DESCRIPTION OF WORK

A. This Section includes work necessary and/or required and materials and equipment for construction of a complete system. Such work includes, but is not limited to the following:

1. Packaged Terminal Heat Pump

1.3 REFERENCE STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

B. Media type air filters shall comply with U.L. Standard 900.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this section.

1.5 SUBMITTALS

A. Submit shop drawings in accordance with Section 230200.

B. Submit shop drawings and descriptive date for all equipment specified in this section.

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, this Contractor shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, General Requirements. In addition, the following special guarantee applies:

1. Each compressor unit shall be provided with manufacturer's five (5) year warranty.

PART 2 – PRODUCTS

2.1 PACKAGED TERMINAL HEAT PUMP

A. Cabinet and Finish: Sleeve and unit chassis are heavy, 18-gauge, phosphatized, galvanized steel.

B. The filter shall be accessed by removing the front panel. To clean the coils and service the unit, the front panel of the unit chassis is removable.

C. Discharge:

1. Unit has sloped discharge so that obstructions are not placed on unit.

2. Discharge is directed into the room at an angle and can be adjusted by reversing the discharge grille.

D. Control:

1. Wall-mounted programmable thermostat shall provide the following functions:

   OFF - Turns unit off.

   FAN ONLY - Indoor fan operates

   COOL - Provides cooling with indoor fan.

   HEAT - Provides heating with indoor fan.

   HI - Provides Hi fan speed.

   LOW - Provides low fan speed.

E. Outside Air Damper: Control lever is located on the unit behind the chassis' front panel. Zero cfm outside air (closed) or fully open 60 cfm (open).

F. Refrigeration System: Compressor is fully hermetic, and externally isolated to ensure elimination of compressor sound and vibration. Tubing connections to compressor are looped to further isolate vibration.

G. A capillary tube expansion device:

1. Used to ensure proper refrigerant flow throughout the system's operating range to maintain operating efficiency.
2. Coils use seamless copper tubing mechanically expanded into configured aluminum plate fins. Coils are each tested at 455 psi.

H. Motors: All motors are high efficiency, permanent split capacitor type. Provide separate motor for evaporator and condenser fans.

I. Electrical: Units shall have factory installed cord. Power connection using the cord shall be made to a receptacle in the sub-base.

J. Electric Supplemental Heaters: Slide-in heater module mounted in unit discharge air passage. Elements are constructed of heavy duty nickel chromium internally connected on single phase.

K. Sub-Base: Attaches to wall sleeve to provide concealed cord path to chassis and for cord connection used as service disconnect, provide two leveling screws and receptacles.

L. Exterior Grille: A horizontal louver aluminum grille in mill finish.

M. Manufacturers: Amana, Carrier, Climate Master, Fredrick, Daikin McQuay, York/JCI.

1. Any listed equivalent manufacturer and the Mechanical Contractor shall be completely responsible to comply with all requirements on the contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which equipment is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

B. Install in accordance with manufacturer's recommendations. Unit and all component sections shall be properly supported and vibration isolated.

3.2 INSTALLATION

A. Verify that coils, filters, motors, drives and other components are matched with the proper unit.

B. Assemble unit components following manufacturer's instructions for handling, testing and operating. Repair damaged galvanized areas, and paint in accordance with manufacturer's written recommendations.

C. Vacuum clean interior of units prior to operation.

D. Repair air leaks from or into casing that can be heard or felt during normal operation.

E. Perform field mechanical balancing in accordance with Section 230950: TESTING AND BALANCING OF MECHANICAL SYSTEMS.

END OF SECTION 23 0732

SECTION 23 0861
AIR PURIFICATION SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract, including the conditions of the contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the work specified in this section.

B. Refer to Section 230200 for HVAC General Provisions.

C. Refer to Section 230210 for HVAC Basic Materials & Methods.

1.2 DESCRIPTION OF WORK

A. This Section describes the design, performance and installation of an air purification system intended for use as part of another manufacturer's air handling unit as shown on the plans, details and equipment schedules.

B. This Section includes work necessary and/or required and materials and equipment for construction of a complete system.

1.3 REFERENCED STANDARDS

A. Refer to Section 230200 for a general description of requirements applying to this section.

B. The following codes and standards are referenced through out. The edition to be used is that currently enforced by the authority having jurisdiction (AHJ) or in absence of such direction that referenced by the current enforceable IBC code or as indicated by the contract documents, except where specifically referenced by this section of the specifications.

1. ASHRAE Standards 62 & 52
2. National Electric Code NFPA 70
3. UL 867-2007 including ozone chamber test required as of December 21, 2007
4. UL 2998 Environment – No Ozone Certification
5. The cold plasma equipment and power supply shall be UL listed.
6. The technology shall have been tested to DO-160 by an independent lab and successfully passed all requirements for shock, vibration, EMF and line noise. Manufacturers not tested to DO-160 shall not be acceptable. DO-160 is normally used to test devices in aviation applications, but this standard is applicable to confirm EMF and line noise in HVAC applications.

1.4 QUALITY ASSURANCE

A. Refer to Section 230210 for a general description of requirements applying to this Section.

B. Basis of design is Global Plasma Solutions. The Air Purification System shall be a product of an established manufacturer within the USA. Direct Current (DC) Ion modules manufactured outside the USA and assembled in the USA on mounting plates or formed channels shall not be acceptable.

C. A qualified representative from the manufacturer shall be available to inspect the installation of the air purification system to ensure installation in accordance with manufacturer's recommendation.

D. Technologies that do not address gas disassociation such as UV Lights, Powered Particulate Filters and/or polarized media filters shall not be considered. Uni-polar ion generators shall not

be acceptable. "Plasma" particulate filters shall not be acceptable. Any system containing titanium dioxide (Ti02), which has been listed by the CDC as a known carcinogen, shall not be acceptable.

E. Projects designed using ASHRAE Standard 62, IAQ Procedure shall require the manufacturer to provide Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1-2007 to validate acceptable indoor air quality at the quantity of outside air scheduled with the technology submitted. The manufacturer shall provide independent test data on a previous installation performed within the last two years and in a similar application, that proves compliance to ASHRAE 62 and the accuracy of the calculations. The data shall be based on the manufacturer's use of the same make and model number as the equipment submitted on this project.

F. The Air Purification Technology shall have been tested by UL to prove conformance to UL 867-2007 including the ozone chamber testing and peak ozone test for electronic devices. Manufacturers that achieved UL 867 prior to December 21, 2007 and have not been tested in accordance with the newest UL 867 standard with the ozone amendment shall not be acceptable. All manufacturers requesting prior approval shall submit their independent UL 867 test data with ozone results to the engineer for preliminary review and during the submittal process. All manufacturers shall submit a copy with their quotation. Contractors shall not accept any proposal without the proper ozone testing documentation.

G. The maximum allowable ozone concentration per the UL 867-2007 chamber test shall be 0.001 PPM. The maximum peak ozone concentration per the UL 867-2007 peak test as measured 2 inches away from the electronic air cleaner's output shall be no more than 0.001 PPM. Manufacturers with ozone output exceeding these ozone values shall not be acceptable.

H. All manufacturers shall have their product tested to UL 2998 Environmental Standard for confirmation of no ozone with certificate available. The final report shall indicate the ozone levels and high voltage output the device's electrode(s) were operating during the test. Reports that do not include high voltage output during the UL 2998 testing shall not be acceptable.

1.5 SUBMITTALS

A. Submit shop drawings in accordance with Section 230200.

B. Product Data: Submit manufacturer's technical product data for ion generators including:

1. Schedule of plasma generators indicating unit designation, number of each type required for each unit/application.
2. Data sheet for each type of plasma generator, and accessory furnished; indicating construction, sizes, and mounting details.
3. Performance data for each type of plasma device furnished.
4. Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1-2007 to validate acceptable indoor air quality at the quantity of outside air Scheduled (when projects are designed with outside air reduction).
5. Product drawings detailing all physical, electrical and control requirements.
6. Copy of UL 867 independent ozone test.
7. Copy of UL 2998 conformance certificate.
8. Statement on the manufacturer's letterhead stating that the technology contains no titanium dioxide (Ti02).
9. Job-specific, factory wiring diagrams and instructions for field installation of all components.

1.6 SUBSTITUTIONS

A. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but not limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items provided by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, this Contractor shall be responsible for any and all additional costs associated with the changes required by other trades.

1.7 WARRANTY

A. Equipment shall be warranted by the manufacturer against defects in material and workmanship for a period of eighteen months after shipment or twelve months from owner acceptance, whichever occurs first. Labor to replace equipment under warranty shall be provided by the owner or installing contractor.

PART 2 – PRODUCTS

2.1 AIR PURIFCATION SYSTEM

A. GENERAL: The air purification system(s) shall be of the size, type, arrangement and capacity indicated and required by the unit furnished and shall be of the manufacturer specified.

B. Each air handling unit, so designated on the drawings, details, equipment schedules and/or specifications shall contain a Plasma Generator with Bi-polar Ionization output as described herein.

C. The Bi-polar Ionization system shall be capable of:

1. Effectively killing microorganisms downstream of the bi-polar ionization equipment (mold, bacteria, virus, etc.).
2. Controlling gas phase contaminants generated from human occupants, building structure, furnishings and outside air contaminants.
3. Capable of reducing static space charges.
4. Effectively reducing space particle counts.
5. All manufacturers shall provide documentation by an independent NELEC accredited laboratory that proves the product has minimum kill rates for the following pathogens given the allotted time and in a space condition:
   a. MRSA - >96% in 30 minutes or less
   b. E.coli - > 99% in 15 minutes or less
   c. TB - > 69% in 60 minutes or less
   d. C. diff - >86% in 30 minutes or less
   e. Noro Virus -> 93.5% in 30 minutes or less
   f. Legionella -> 99.7% in 30 minutes or less

   Manufacturers not providing the equivalent space kill rates shall not be acceptable. All manufactures requesting prior approval shall provide to the engineer independent test data from a NELAC accredited independent lab confirming kill rates and time meeting the minimum requirements stated. Products tested only on Petri dishes to prove kill rates shall not be acceptable. Products being sold under different trade names than those tested shall not be acceptable.
6. Capable of modular field assembly in 6-inch sections.

D. The bi-polar ionization system shall operate in a manner such that equal amounts of positive and negative ions are produced. Uni-polar ion devices shall not be acceptable. Ionizers with positive and negative output (DC type) shall not be acceptable. All ionizers provided shall be AC type ionizers with one electrode pulsing between positive and negative.

1. Air exchange rates may vary through the full operating range of a constant volume or VAV system. The quantity of air exchange shall not be increased due to requirements of the air purification system.
2. Velocity Profile: The air purification device shall not have maximum velocity profile.

E. Humidity: Plasma Generators shall not require preheat protection when the relative humidity of the entering air exceeds 85%. Relative humidity from 0 - 100%, condensing, shall not cause damage, deterioration or dangerous conditions within the air purification system. Air purification system shall be capable of wash down duty.

F. Equipment Requirements:

1. Electrode Specifications (Bi-polar Ionization):
   a. Each alternating current (AC) Ionization Bar with Bi-polar Ionization output shall include a minimum of eighteen carbon fiber cluster ion needles per foot of coil face width shall be provided. The entire cooling coil width shall have equal distribution of ionization across the face. Systems without ion needles at least 0.50” apart shall not be acceptable. The plasma electrode shall require no more than 1.0” in the direction of airflow for mounting. All hardware required for mounting shall be provided by the air purification manufacturer except self-tapping screws for the power supply. Bi-polar ionization tubes manufactured of glass and steel mesh shall not be acceptable due to replacement requirements, maintenance, and performance output reduction over time, ozone production and corrosion.
   b. Electrodes shall be provided in 6-inch increments, epoxy filled for an IP55 rating and utilizing brass connection hardware that is recessed into the connection joint once fully engaged and assembled.
   c. Electrodes shall be energized when the main unit disconnect is turned on.
   d. The ionization output shall be a minimum of 60 million ions/cc per inch of cooling coil width as measured 1 inch from the cold plasma needles.
   e. Ionization bars shall be provided with magnet mounting kits to prevent penetration into cooling coils.
   f. Ionization bars shall be constructed of UL 94VO and UL746C composite material.

G. Air Handler Mounted Units: Where so indicated on the plans and/or schedules. Mount the Plasma Generator and wire it to the remote mount power supply using the cables provided by the air purification manufacturer. A 24VAC, 115VAC or 208-230VAC circuit shall be provided to the plasma generator power supply panel. No more than 15 watts shall be required per power supply. Each power supply shall be capable of powering up to 6 ionization bars or a total of 100 linear feet of bar. Each plasma generator shall be designed with powder coated metal casing, liquid tight flexible conduit and a high voltage quick connector.

H. Plasma Requirements: Plasma Generators with Bi-polar ionization output shall be capable of controlling gas phase contaminants and shall be provided.

1. The Bi-polar ionization system shall consist of Bi-Polar Plasma Generator and power supply. The Bi-polar system shall be installed where indicated on the plans or specified to be installed. The device shall be capable of being powered by 24VAC, 115VAC or 208-

230VAC without the use of an external transformer. Ionization systems requiring isolation transformers shall not be acceptable.

2. Ionization Output: The ionization output shall be controlled such that an equal number of positive and negative ions are produced (AC Ionizers only are acceptable). Imbalanced levels shall not be acceptable.
3. Ionization output from each bar shall be a minimum of 60 million ions/cc per inch of bar when tested at 1" from the ionization bar. Bars with needles spaced further apart than 0.5" shall not be acceptable.
4. Each plasma electrode shall be made from an all composite, UL 94V0 and UL 746C rated material for prevention of corrosion and electrical insulation.
5. Ozone Generation: The operation of the electrodes or Bi-polar ionization units shall conform to UL 2998 as tested by UL proving no ozone output.

I. Electrical Requirements:

1. Wiring, conduit and junction boxes shall be installed within housing plenums in accordance with NEC NFPA 70. Plasma Generator shall accept an electrical service of 24VAC or 115 VAC, 1 phase, 60 Hz. Coordinate all electrical requirements with air purification manufacturer's submittals.

J. Control Requirements:

1. All Plasma Generators shall have internal short circuit protection, overload protection, and automatic fault reset. Systems requiring fuses shall not be acceptable.
2. The Plasma Generator power supply shall have internal circuitry to sense the ionization output and provide dry contact alarm status to the BMS as well as a local "Plasma On" indication light.
3. The ionization system shall be provided with a stand-alone, independent ion sensor designed for plenum mounting to the ionization bar to monitor the ion output and report to the BAS system that the ion device is working properly. Ion systems provided without an independent ion sensor, shall not be permitted. The control voltage to power the ion sensor shall be 24VAC to 260VAC and draw no more than 150mA of current. The sensor shall provide at minimum, dry contact status to the BAS and optionally a BacNet or Lonworks interface as specified on the control drawings. Manufacturers not providing a stand-alone ion sensor shall not be acceptable.
4. Mount and wire the Plasma device within the air handling unit specified or as shown or the drawings. The contractor shall follow all manufacturer IOM instructions during installation.
5. A fiberglass NEMA 4X panel with Plasma On/Off Indicator Light (interfaced with stand-alone ionization detector), Ionization Output On/Off Indicator Light and an On/Off Illuminated Switch shall be provided to house the power supply, as noted on the schedule.

K. Manufacturers: Global Plasma Solutions, American Ion, Active Air Solutions.

1. Any listed equivalent manufacturer and the Mechanical Contractor shall be completely responsible to comply with all requirements on the contract documents. This shall include, but not be limited to, space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades.

PART 3 – EXECUTION

3.1 GENERAL

A. The Contractor shall be responsible for maintaining all air systems until the owner accepts the building.

3.2 ASSEMBLY: PLASMA GENERATOR

A. All equipment shall be assembled and installed in a workmanlike manner to the satisfaction of the manufacturer's authorized representative.

B. Any material damaged by handling, water or moisture shall be replaced, at no cost to the owner.

C. All equipment shall be protected from dust and damage on a daily basis throughout construction.

3.3 TESTING

A. Provide the manufacturers recommended electrical tests.

3.4 START-UP & TRAINING

A. A manufacturer's local authorized representative shall provide installation, start-up supervision, and training of owner's personnel in the proper operation and maintenance of all equipment.

END OF SECTION 23 0861

SECTION 23 0950

TESTING & BALANCING OF MECHANICAL SYSTEMS

PART 1 – GENERAL

1.1 JOB CONDITIONS

A. Systems shall be completely installed and in continuous operation as required to accomplish the tests.

B. Heating, ventilating and air conditioning equipment shall be completely installed and in continuous operation as required to accomplish the balance work specified.

C. Adjust and balance shall be performed when outside conditions approximate design conditions indicated for heating and cooling functions.

D. Make at least two inspections of the mechanical systems during construction to verify that balancing procedures may be accomplished. Report findings to the Construction Manager.

E. Balancing firm shall balance Mechanical System two (2) times. The first time shall be considered a rough balance. Any discrepancy in air flow shall be addressed to the Construction Manager. The final balancing will be accomplished after review of rough balance reports.

F. The final balancing reports shall be submitted and approved prior to project's being considered complete; i.e., commencement of warranties.

1.2 ENGINEER QUALIFICATIONS

A. The firm shall be an independent organization having no affiliation with construction contractors, equipment sales or design engineering.

B. The firm shall specialize in balancing heating, ventilating and air conditioning systems.

C. The firm shall show proof of having balanced and tested at least five projects of similar size and scope.

D. All field work shall be under the direct supervision of a registered Professional Engineer who is a full-time employee of the balancing firm.

E. The firm shall be certified by and a member of the AABC (Associated Air Balance Council), or NEBB (National Environmental Balancing Bureau).

1.3 REPORT

A. Data Sheets:

1. Submit data sheets on each item of testing equipment required.
2. Include name of device, manufacturer’s name, model number, latest date of calibration and correction factors.

B. Report Forms:

1. Submit specimen copies of report forms.
2. Forms shall be 8-1/2 x 11-inch paper for loose-leaf binding, with blanks for listing of the required test ratings and for certification of report.
3. Reports shall be on standard forms published by AABC or NEBB.

PART 2 – PRODUCTS

2.1 AIR BALANCE INSTRUMENTS

A. Alnor Velometer with probes and alnor pitot tube.

B. Rotating Vane Anemometer: 4-inch size.

C. ASHRAE Standard Pitot Tubes, stainless steel 5/16 inch outside diameter, lengths 18 inches and 36 inches.

D. Magnehelic Differential Air Pressure Gauges, 0 to 0.5 inches, 0 to 1.0 inch and 0 to 5.0 inches water pressure ranges, each arranged as a portable unit for use with a standard Pitot tube.

E. Combination Inclined-Vertical Portable Manometer, range 0 to 5.0 inches water.

2.2 SYSTEM PERFORMANCE MEASURING INSTRUMENTS

A. Insertion Thermometers, with graduation at 0.5 degrees F for air and 0.1 degrees F for water.

B. Sling Psychrometer.

PART 3 – EXECUTION

3.1 GENERAL REQUIREMENTS

A. Arrange and pay for all tests.

B. Notify Construction Manager at least three working days in advance of test and conduct in presence of Construction Manager.

C. Tests to be performed prior to insulation, covering or concealment.

D. Provide signed report of completion of test with signature of witnesses. Report shall indicate:

1. System Tested
2. Date
3. Specified test requirements and actual testing results

E. The balancing firm shall report to and review the work required with the Architect/Engineer before beginning field balance work. The balancing firm shall make at least two inspections of the air systems during construction and shall report his findings in writing to the Architect/Engineer.

F. The balancing firm shall cooperate with the Construction Manager and the Mechanical Contractor to effect smooth coordination of the balancing work with the job schedule.

G. The balancing firm shall be responsible for getting the various systems into proper operation. They shall enlist the aid of the equipment suppliers and Mechanical Contractor as may be required to effect proper operation consistent with the contract plans and specifications.

H. When the balancing firm cannot balance a belt-driven piece of equipment with the supplied belts and sheaves, inform the Mechanical Contractor that the Mechanical Contractor shall provide additional sheaves as spelled out in other Division 23 Sections.

3.2 DUCTWORK TESTING

A. Witness testing conducted by the Mechanical Contractor per Section 230600, PART 3: EXECUTION.

3.3 BALANCING PROCEDURE

A. Air System Balance:

1. With the fan supply system set to handle normal minimum outdoor air, the balancing firm shall perform the following tests and compile the following information:

   Air Handling Equipment

   a. Design Conditions:
      (1) CFM Supply Air
      (2) Static Pressure
      (3) CFM Fresh Air
      (4) Fan RPM
   b. Installed Equipment:
      (1) Manufacturer

(2) Size/Model Number

(3) Motor HP, Voltage, Phase, Full Load Amperes

c. Field Test:

(1) Fan Speed

(2) No Load Operating Amperes

(3) Fan Motor Operating Amperes

(4) Calculated BHP

d. Test for Total Air:

(1) Size of discharge, return air and outside air ducts.

(2) Number and locations of Velocity Readings taken.

(3) Duct Average Velocity

(4) Total CFM

(5) Outside Air CFM

(6) Return Air CFM

e. Individual Outlets (Diffusers, Registers and/or Grilles):

(1) Identify each outlet or inlet as to location and area and fan system

(2) Outlet, manufacture and type

(3) Outlet size

(4) Outlet free area, core area, or neck area

(5) Required FPM and test velocity found for each outlet.

(6) Required CFM and test results for each outlet

2. After completion of tests, adjustment and balancing under minimum fresh air conditions, set the system for 100% fresh air. Repeat the total CFM tests to check field versus design conditions. The results under 100% fresh air cycle shall agree with conditions found under "minimum fresh air operation" before the system is considered to be in balance. Adjustments of the proper dampers shall be made to achieve balance.

3. Testing and adjusting of individual outlets shall be performed under procedures recommended by the manufacturers of the outlets. All outlets shall be set for air pattern required and all main supply air and return air dampers to be adjusted and set for design CFM indicated. Any required changes in air patterns, settings, etc., necessary for achieving correct air balance, shall be provided by this Contractor. Total CFM of all outlets shall agree with total CFM of all branches and the grand total shall agree with the air volume for the fan(s).

B. In addition to the above work, the Balancing Firm shall check the operation of all automatic temperature control equipment; verify all thermostat, aquastat, etc., set-points and operations; and enlist the aid of the Mechanical Contractor and the Control Subcontractor to make necessary adjustments where required.

END OF SECTION 230950

SECTION 26 0000

GENERAL PROVISIONS – ELECTRICAL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other conditions, if any) and Division 1 as appropriate, apply to the work of this Section.

B. The specification or drawing and the design features or resulting construction disclosed, are the property of Furlow Associates, Inc., and shall not be reproduced without written permission.

C. Refer to Section 078413 for Through-Penetration Firestop Systems.

D. Refer to Section 083113 for Access Doors and Frames

1.2 DESCRIPTION OF WORK

A. Provide all materials, equipment, labor, services and all appurtenances required to completely install and satisfactorily operate the various systems. The items listed below are for general guidance only and do not necessarily include the entire requirements for the project.

1. Coordination with other trades
2. Electrical service
3. Interior feeders
4. Lighting and power panels
5. Lighting branch wiring
6. Power wiring
7. Lighting fixtures and lamps
8. Wiring devices
9. Connections for electrically operated equipment
10. Fire alarm and detection system
11. Telephone/Data systems
12. Lightning protection system
13. Related work as herein described or otherwise defined under the heading "Related Work".

B. Wherever the term "provide" is used, it shall be understood to mean both "furnish" and "install".

1.3 RELATED WORK

A. Equipment specified in sections of Divisions 1 thru 23 that require electric power supply.

B. Work related to this trade as defined on the following contract drawings:

Architectural/Structural

HVAC

Plumbing

1.4 SITE CONDITIONS

A. Attention of all bidders is called to the necessity for a careful inspection of the site, its present condition and encumbrances, the extent of the work, the protection to be afforded to adjacent properties or structure, availability of utilities, the extent and nature of the material required to be excavated and the amount of fill and removal. He shall also determine local or site limitations which

will affect construction.

1.5 PERMITS, INSPECTIONS AND ORDINANCES

A. All work shall be executed and inspected in accordance with local and state ordinances, rules and regulations and the requirements of public utilities having jurisdiction. The contractor shall secure and pay for all permits, inspections and connections required.

B. The Electrical Contractor shall furnish a certificate of inspection to the Owner at the time of completion.

C. Requirements of the following organization shall be considered minimum:

1. National Electrical Code
2. National Electrical Safety Code
3. OSHA
4. Local City and County Codes

D. Reference to technical societies, trade organizations and governmental agencies are in accordance with the following:

1. ANSI - American National Standards Institute
2. ASTM - American Society for Testing Materials
3. IEEE - Institute of Electrical and Electronics Engineers, Inc.
4. NEC - National Electrical Code
5. NEMA - National Electrical Manufacturer's Association
6. NFPA - National Fire Protection Association
7. MSS - Manufacturer's Standardization Society
8. IES - Illuminating Engineers Society
9. ETL - Engineering Testing Laboratories
10. EIA - Electronic Industries Association
11. OSHA - Occupational Safety and Health Administration
12. Federal Specifications
13. UL - Underwriters Laboratories, Inc.

1.6 QUALITY ASSURANCE

A. Provide adequate supervision of labor force to assure that all aspects of the contract documents are fulfilled.

B. Contractor to provide manufacturer’s written certification that the following equipment has been installed and will operate correctly and in accordance with the manufacturer’s warranty requirements.

Fire Alarm and Detection System

C. Testing:

1. After completion of the work, the entire wiring system shall test entirely free from grounds, short circuits, opens, overloads and improper voltage.
2. The grounding system shall be tested for a resistance of 25 ohms or less.
3. Perform testing as follows: Arrange and pay for all tests, provide all equipment, materials and labor to perform test. Notify Engineer and Owner three (3) working days before tests are to be made. Conduct tests in the presence of the Engineer or authorized representative. Repeat tests after defects are corrected.

D. Special Engineering Services: In the instance of complex specialized electrical power and signaling systems, and other similar systems, the installation and final connections of these systems shall be made by and/or under the supervision of a competent installation and service engineer who shall be a representative of the respective equipment manufacturer. Any and all expenses of these installation and service engineers shall be borne by this Contractor.

1.7 COORDINATION

A. As a requirement of this project, the Electrical Contractor shall furnish coordination for his equipment and layouts with other subcontractors furnishing equipment and services for Divisions 1 thru 23. Any and all contractors who install their equipment or furnish services prior to coordination, any contractor who changes their equipment or services after coordination has occurred, without notifying associated subcontractors, shall be held responsible for making all required changes with no additional cost to the Owner. Or delay in construction time. This coordination will include conduit layout to allow access to equipment for maintenance.

B. The Mechanical, Plumbing and Electrical Contractors are responsible to coordinate all manufacturer's recommended circuit breakers, starters, disconnects and fuse sizes for all equipment. Submission of a shop drawing will certify that this has been completed.

C. The drawings and specifications reflect the type, number and size of services required for the equipment the design is based upon. Should the supplying subcontractor elect to furnish an alternate piece of equipment requiring difference services and/or space conditions, he shall inform the subcontractor furnishing those services and be held responsible to pay for all required changes as part of this contract.

1.8 SUBMITTALS

A. Shop Drawings:

1. Shop drawings shall be submitted in accordance with Division 1 of these specifications except where herein modified.

NOTE: Submittals will only be reviewed once and resubmittals will be reviewed once. Any other submittals will be billed to the Contractor at the Engineer's standard rates.

2. Shop drawings comprising complete catalog cuts, performance test data for electrical equipment as required by other sections of Division 26 shall be submitted for review checking. The Contractor shall review these shop drawings for conformance to contract documents prior to submission and affix contractor's signature to each submittal certifying that this review has been done. By approving and submitting shop drawings, product data, wiring diagrams and similar materials, the Electrical Contractor represents that he and/or his subcontractor has determined and verified materials, field measurements and field construction data that relates to the work, and has checked and coordinated this information with all of the Divisions 1 thru 23 subcontractors.

3. All shop drawing submittals shall have the following identification data, as applicable, contained therein or permanently adhered thereto:

   a. Project name

   b. Project number

   c. Sub-Contractor's, Vendor's and/or manufacturer's name and address.

   d. Product identification.

   e. Identification of deviation from the contract documents.

   f. Applicable contract drawings and specification section number.

   g. Shop drawing title, drawing number, revision number, and date of drawing and revision.

h. Resubmit revised or additional shop drawings as requested.

i. Wherever shop drawings or vendor's standard data sheets indicate work to be done "by others", it shall be the responsibility of the Contractor making the submission to identify by name, the Contractor who is to do this work. If the Contractor named is other than the Contractor making the submission, the shop drawing submission must be reviewed by the named Contractor and bear his mark of approval, prior to submission to the Architect/Engineer.

j. Where equipment proposed differs from that shown on the drawings or specified, he shall submit for approval drawings showing the manner in which the layout is affected by the substitution.

k. The Contractor shall keep one copy of approved shop drawings at the job site, filed in a suitable metal container. The shop drawings shall be cataloged and kept in good repair, and shall be available for use by the Owner, Architect and Engineer.

l. No equipment shall be ordered, fabricated, etc., before approval of shop drawings.

1.9 SUBSTITUTIONS

A. Whenever a material, article, piece of equipment or system is identified in the following specification or indicated on the drawings by reference to manufacturers' or vendors' names, trade names, catalog numbers or the like, it is so identified for the purpose of establishing the basis of the Bid.

B. Substitution approval must be obtained and included as an addendum item prior to the submission of the bid. An approved substitution shall not be considered as an approval for the contractor or an equipment vendor to deviate from the written portion of the specifications unless so stated in the addendum.

C. The drawings illustrate the space allocated for equipment and the Contractor shall install the equipment accordingly. If changes are required in the building or arrangement due to substitution of equipment, the Contractor making the substitution must pay for the necessary modifications.

D. The listed equivalent or substituted manufacturers along with the bidding related contractor shall be completely responsible to comply with all requirements on all contract documents. This shall include, but shall not be limited to space requirements, code clearances, the type, horsepower, capacities, number and size of services required from other trades, including all required ancillary items furnished and installed by other trades. If the manufacturer or related bidding contractor does not comply with these requirements, then they shall be responsible for any and all additional costs associated with the changes required by other trades.

1.10 LUBRICATION

A. Furnish, install and maintain all required lubrication of any equipment operated prior to acceptance by the Owner. Lubrication shall be as recommended by the equipment manufacturer.

B. Provide one year's supply of lubricants to Owner at date of acceptance.

C. Verify that required lubrication has taken place prior to any equipment start-up.

1.11 ADJUSTMENT & CLEANING

A. Adjust and clean equipment to be placed in proper operation condition.

1.12 EQUIPMENT START-UP

A. Verify proper installation by manufacturer or his representative.

B. Advise General Contractor 2 days prior to actual start-up.

C. Verify proper operation. Obtain signed statement by manufacturer or his representative that equipment is operating within warranty requirements. Submit statement to General Contractor.

1.13 OPERATION AND MAINTENANCE INSTRUCTIONS

A. Properly and fully instruct Owner's personnel in the operation and maintenance of all systems and equipment.

B. Insure that the Owner's personnel are familiar with all operations to carry on required activities.

C. Such instruction shall be for each item of equipment and each system as a whole.

D. Provide report that instruction has taken place. Include in the report the equipment and/or systems instructed, date, contractor, Owner's personnel, vendor, and that a complete operating and maintenance manual has been reviewed.

E. Manual shall include all instructions on operation, maintenance, repair parts list, lubrication requirements, brochures, catalogue cuts, wiring diagrams, piping diagrams, control sequences, service requirements, names and addresses of vendors, suppliers and emergency contacts. Three manuals shall be provided.

F. Submit manuals for review prior to operating instruction period. Manuals shall be 8-1/2 x 11" with hard cover, suitably bound.

G. Training

1. Electrical Contractor shall be responsible for coordination of Owner training. Factory employed technician(s) shall provide training, including demonstration and education on the system capabilities, operation and maintenance. Training sessions shall be minimum 4 hours (maximum 8 hours), and shall be provided for each shift of workers. Scheduled training shall be coordinated at least two (2) weeks in advance with the Owner and the Commissioning Agent.

2. Video Documentation: Furnish three (3) copies of a professionally taped video and three (3) copies of professionally prepared drawings demonstrating the following:

- Security System
- Fire Alarm System
- Integrated Access Control
- Clock and Speaker System
- VFD’s
- MDF/IDF

1.14 TOOLS

A. All equipment furnished by the Contractor which requires special tools or devices other than those normally available to the maintenance or operating staff shall be furnished in duplicate to the Owner, sufficiently marked, packed or boxed for staff usage. The tools provided shall be listed by the Contractor identified as to their use or the equipment applicable in a written transmittal to the Owner.

1.15 CLEANING AND FINISHING

A. After equipment start-up and all operating tests have been made and the system pronounced satisfactory, each respective Contractor shall go over the entire project, clean all equipment, etc., installed by him and leave in a clean and working condition. Any surfaces found marred after this final cleaning shall be refinished or replaced by each Contractor at no cost to the Owner.

1.16 OPERATING AND MAINTENANCE MANUALS

A. Three complete sets of instructions containing the manufacturer's operating and maintenance instructions for each piece of equipment shall be furnished to the Architect. Each set shall be furnished before the contract is completed. The following identification shall be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS", the name and location

of the building, the name of the Contractor and the name of the Architect and Engineer. Flysheet shall be placed before instructions covering each subject. The instruction sheets shall be approximately 8-1/2 by 11 inches, with large sheets of drawings folded in. The instructions shall include, but shall not be limited to, the following:

Approved wiring and control diagrams, with data to explain the detailed operation and control of each component.

A control sequence describing start-up, operation and shutdown.

Operating and maintenance instructions for each piece of equipment, including lubrication instructions.

Manufacturer's bulletins, cuts and descriptive data.

Parts lists and recommended spare parts.

1.17 SERVICE INTERRUPTION

A. All service interruptions to the electric or related systems, whether during regular working hours or at any other time, must be coordinated with the Owner. All such interruptions shall be so scheduled and planned as to require a minimum of time and shall occur only during a mutually satisfactory period.

1.18 INTERPRETATION OF SYSTEMS

A. The interpretation of the Architect will be final in the event there is a lack of understanding of the full scope or requirements of the systems under this contract.

1.19 LAYOUTS

A. On small scale drawings, i.e., 1/8" - 1'-0", the approximate location of the electrical branch circuit items such as receptacle, telephone, grounding and equipment outlets are shown to indicate their existence. The exact location of these items and their related raceways are governed by structural conditions, coordination with the work of other trades and the Architect's final decision. By accepting a contract, the Contractor agrees to install the work in accordance with the above statement and within the contract price.

PART 2 – PRODUCTS

2.1 MATERIAL

A. All material shall be new and of good quality. Material shall conform to all accepted trade standards, codes, ordinances, regulations, or requirements governing same, and shall be approved before being installed.

B. The Architect reserves the right to require the Contractors to submit samples of any or all articles or materials to be used on the project.

C. Where any device or equipment is herein referred to in the singular number, such as "the panel", this reference shall be deemed to apply to as many such devices or equipment as are required to complete the installation as shown on the drawings or specified.

D. All materials and equipment used in the work shall comply with the standards of recognized authorities such as UL, NEMA, IEEE, ETL, IES and EIA in every instance where such standards have been established for the particular type of materials to be installed.

E. All similar pieces of equipment or materials of the same type or classification used for the same purpose shall be of the same manufacturer.

F. All manufactured equipment shall have factory applied finishes.

2.2 CONCRETE

A. Concrete shall be in accordance with Section 03300.

B. The 28-day minimum compressive strength shall be 3000 psi.

2.3 WARRANTY

A. Wherever in the specification sections of this division, reference is made to a specific warranty period, this warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the contract documents.

PART 3 – EXECUTION

3.1 INSPECTION

A. Prior to performing the work, examine areas and conditions; check and verify all dimensions, under which the work is to be installed and notify the Architect in writing of conditions and dimensions detrimental to the proper and timely completion of the work. Do not proceed until authorization is given by the Architect.

3.2 LAYING OUT WORK

A. The Contractor is responsible for the accuracy of all lines, elevations, and measurements, grading and utilities and must exercise proper precaution to verify figures shown on drawings before laying out work and will be held responsible for any error resulting from his failure to exercise such precaution.

3.3 WORKMANSHIP

A. Install all work neat, trim, parallel and plumb with building lines in accordance with standard trade practice acceptable to the Architect.

3.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protect all equipment and materials from damage during transportation, storage and installation.

3.5 PROTECTION

A. Protect all work, equipment and materials during construction up to the time of acceptance by the Owner.

Arrange and design the protection to prevent damage from infiltration or dust, debris, moisture, chemicals and water. Cap or plug electrical raceways.

B. Protect all surfaces against damage from welding, cutting, burning, or similar construction functions. This protection shall be accomplished by care in operations, covering and shielding. Special care is directed to exposed finished masonry, metal or wood surfaces and painted surfaces. Corrective measures required shall be accomplished by the trade which made the original installation when and as directed by the Architect at the expense of the Contractor.

C. Cover and protect all lighting fixtures as may be necessary until completion of the work. Replace damaged fixtures or damaged fixture parts as directed by the Architect at no cost to the Owner.

D. Do not install devices, polished metal fittings or parts until adjoining tile or masonry work is completed.

E. Maintain and replace protective covering when so directed by the Architect until the work is ready for acceptance.

3.6 CUTTING & PATCHING

A. Furnish information to the General Contractor as to sizes and locations of recesses required to install panel boxes and other equipment or devices. If the information is late or incorrect, this Contractor shall, at his own expense, have the trade which originally installed the work do the required cutting and patching.

B. Perform all cutting of concrete or other material for passage of raceways as required to install the work.

C. Close all such openings around raceways with material as specified under the heading "SEALING".

D. Install concealed work in place for the mason to wall-in as he carries up the walls; otherwise, this Contractor will be responsible as stated in the first paragraph.

3.7 SEALING

A. Where raceways pass through fire-rated walls and floors, seal opening with RTV foam.

B. Seal raceways entering the building to conform to the requirements of the NEC.

3.8 OFFSETS AND MODIFICATIONS

A. Furnish and install all offsets necessary to install the work and to provide clearance for the work of other trades.

B. Maintain adequate clearance as directed by the Architect/Engineer.

C. Incidental modifications necessary to the installation shall be made as necessary and at the direction and/or approval of the Architect.

3.9 SLEEVES

A. Furnish and install sleeves for all raceways passing through floors and walls. Sleeves shall be Schedule 40 galvanized steel pipe and shall extend 1" above finished floor surface. Where sleeves are set in interior walls, they shall finish flush with the wall.

B. Furnish and install watertight sleeves for all raceways extending through foundation walls into crawl spaces, mechanical rooms or basement areas from building exterior or from unexcavated areas to building interior. Sleeve shall consist of extra heavy pipe sleeve with anchor flange. Space between raceway and the sleeve shall be sealed with modular wall and casing seal similar to Thunderline Corporation "Link-Seal", Metraseal or approved substitute. Install seal in strict accordance with the manufacturer's recommendations.

3.10 EXCAVATION

A. The excavation shall be of the open-trench method and to the depths and widths as may be necessary. The Contractor shall do all excavation required in connection with his work. Bottoms of trenches shall be excavated to a uniform grade. All materials excavated shall be deposited on the side of the trenches and beyond the reach of slides. Excavated material shall not be piled where it will interfere with traffic.

B. No conduits shall be bedded directly on rock. They shall be cushioned by a 6-inch layer of crushed stone or gravel of selected grade, of size to pass through a 3/4" mesh sieve. Not less than 30% shall be fine which will pass through a 3/8" mesh sieve.

C. Where excavation is required through tree root areas, roots shall be saw cut, treated with pruning paint and covered with burlap. Burlap shall be wet and shall be protected and maintained in a moist condition during entire period of exposure. Backfill shall be carefully placed and hand-tamped to a minimum of 6" above roots.

D. Bidder shall base his estimate upon the presumption that all excavation required in the performance of this Contract will be earth. If rock is encountered, Contractor will be reimbursed for the additional work required to remove same based upon the unit cost established in the proposal.

E. All detached boulders or loose stone not exceeding 1 cubic yard, all topsoil, sand, gravel, clay, rubbish, walls or other subgrade construction, and all other materials of every name and nature which can be removed without breaking up with pneumatic breakers shall be considered earth excavation.

F. All rocks, attached boulders, boulders exceeding 1 cubic yard, walls or other subgrade construction and materials which cannot be removed without breaking up with pneumatic equipment shall be considered rock excavation.

G. Before commencing any rock excavation for which extra compensation is to be paid, a rock contour drawing shall be prepared by the Contractor and checked by the Architect. The width shall be based on 2'-0". This rock contour drawing and width allowance will be used to compute the quantity of rock for which the Contractor will be reimbursed at the unit price established.

3.11 SHORING AND PUMPING

A. The Contractor shall provide all shoring, bracing or sheet piling necessary to maintain the banks of his excavation and shall take out same as the work progresses and filling in has been accomplished. Shoring shall be in accordance with OSHA Standards.

B. The arrangement of shoring must be such as to prevent any movement of the trench banks and consequent strains on the conduits. Shoring shall be provided to prevent damage to work installed by other trades.

C. The Contractor shall do all pumping required to keep his excavations free of water. The water shall be conveyed in piping or watertight troughs a sufficient distance that it will flow from the site and not affect other work being performed.

3.12 BACKFILLING

A. After work in trenches has been completed, they shall be filled with good, clean, fine earth in 8" layers and shall be pneumatically tamped before the next layer of material has been filled in. The backfill shall be free of excavated rock, cinders, stones, brickbats or other debris.

B. Wherever rock is removed, the Contractor shall secure and fill select clean earth to a minimum depth of 3'-0" above the top of the conduit. Unless otherwise indicated, no rock shall be deposited in the trench fill. This clean earth fill shall be procured other than from the site unless permission for earth borrow from the site is granted by the Architect. If site borrow is permitted, the topsoil removal, relocation and finished grading will be accomplished as directed by the Architect.

C. Under no circumstances shall excavated material be left where it will interfere with the Owner's or other Contractor's operations.

D. All earth and other materials taken from the trenches and not required for backfilling shall be deposited where directed, or removed from the premises as directed by the Architect.

E. Any rock removed from the excavation shall be removed from the project site by the Contractor.

F. Trenches which pass under wall footings or within 18" of column footings shall be backfilled with clean concrete. To secure adequate foundation support, the method and depositing of the concrete fill shall be as directed by the Architect. To prevent the concrete from adhering to the conduits, necessary conduit protection shall be applied.

3.13 FOUNDATIONS FOR EQUIPMENT/HOUSEKEEPING PADS

A. Provide all foundations for equipment installed under this specification Division and/or as indicated on plans.

B. Construct concrete foundations on structural floor slabs or on grade in the manner or as required by the approved shop drawing details of the manufacturer or the utility company.

C. Provide and install concrete.

D. Metal reinforcement shall be deformed steel bars or cold drawn steel wire, or fabricated forms of these materials as required.

E. Furnish anchors of size and number noted, with bottom plates and sleeves.

F. Forms shall conform to the shape, lines, grades, and dimensions of the concrete, required by the approved shop drawing details of the equipment manufacturers, or approved on the Contractor's Equipment room layouts. They shall be sufficiently tight to prevent leakage of mortar and shall be

braced or tied together to maintain position and shape. Forms shall be moved in such manner as to insure the complete safety of the structure.

G. All exposed corners or edges shall be chamfered. All burrs, fins, irregularities of forming or spillage shall be removed and the surface float or trowel finished to a smooth, straight surface.

H. Housekeeping Pads: Provide 4" thick, and size as required by approved shop drawings, concrete pad for all equipment installed on floor. Pad shall be steel reinforced with all edges and surfaces finished as described above. When installing over existing concrete, surface of existing pad shall be prepped using a bushing tool to rough in entire surface. Whether pouring over new or existing concrete, provide U-shaped rebar anchors set in epoxy to secure pad to pad.

3.14 ITEMS RECESSED IN MASONRY CONSTRUCTION

A. Wherever boxes, electric panels, equipment, devices, access panels, and similar items of electrical construction are installed in exposed masonry construction, the Contractor shall utilize and submit for approval items of such size, height, and arrangement to conform to the corresponding masonry unit. The Contractor shall include as part of this contract, the necessary offsets, adjustments and relocations necessary to conform with the instructions of the Architect as to the final location of the equipment item in the exposed masonry.

B. As part of his contract and before the purchase of the items hereinbefore mentioned, the Contractor shall notify the Architect of such modifications in the building arrangement that will be necessary to accommodate the proposed equipment.

3.15 ROOF FLASHINGS

A. All conduit extending through roofs shall be provided with watertight flashing and counterflashing as hereinafter described.

B. Furnish and install standard counterflashing fittings on the conduit or properly designed clamped counterflashing with caulking as directed by the Architect/Engineer.

3.16 PAINTING

A. Refinish all factory applied finishes that have been damaged to match the original finish as directed by the Architect.

B. Prime coat all steel furnished under this Division with material and methods as described in another Section under the heading "PAINTING".

3.17 EQUIPMENT CONNECTIONS

A. Provide required wiring, raceways and final connections for all equipment provided by this Division and Divisions 1 thru 23.

B. Make final connections in accordance with wiring diagrams obtained from equipment manufacturer.

C. Rough-in in accordance with approved shop drawings from the manufacturer or supplier of the equipment. Rough-in prior to shop drawing approval will be subject to change without adjustment to contract cost.

3.18 BALANCING

A. The system of feeder and branch circuits for power and lighting shall be connected to panel busses in such a manner as to electrically balance the connected load as close as is practicable. Should the Owner disclose any unfavorable conditions reacting on the service, this Contractor shall make such changes as may be suggested to balance the load.

3.19 GUARANTEE

A. All work shall be guaranteed to be free from defects for a period of one year of operation from date of acceptance by the Owner unless otherwise specified in Division 1.

B. Guarantee shall be extended on an equal time basis for all non- operational periods due to failure within the guarantee period.

C. Contractor to include an 11 month "walk-thru" of the building system with representatives of the School District, Architect, Engineer and the Construction Manager. The purpose is to establish a list of corrective work that relates to operational issues, material/installation deficiencies.

END OF SECTION 26 0000

SECTION 26 0055
ELECTRICAL IDENTIFICATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. This section is a Division 26 Basic Materials and Methods Section, and is part of each Division 26 Section making reference to electrical identification specified herein.

1.2 DESCRIPTION OF WORK

A. Types of electrical identification specified in this section include the following:

Cable conductor identification.

Operational instructions and warnings.

Danger signs.

Equipment/system identification signs.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products of one of the following (for each type of marker):

W. H. Brady Co.

Ideal Industries, Inc.

Seton Name Plate Co.

3M Electrical Products

2.2 ELECTRICAL IDENTIFICATION MATERIALS

A. Provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

2.3 COLOR-CODED PLASTIC TAPE

A. Provide manufacturer's standard vinyl tape not less than 7 mils thick by 3/4" wide.

B. Colors: Unless otherwise indicated or required by governing regulations, provide tape color as indicated in Paragraph 3.2.B.

C. Tape shall be of Type 3M Scotch 35 for color coding, Scotch Super 33+ for splices and Tem Flex 1700 for general use.

2.4 CABLE/CONDUCTOR IDENTIFICATION BANDS

A. Provide manufacturer's standard vinyl cloth, self-adhesive cable/conductor markers of wrap-around type; either pre-numbered, plastic-coated type, or write-on type with clear plastic, self-adhesive cover flap; numbered to show circuit identification.

2.5 BAKED ENAMEL DANGER SIGNS

A. Provide manufacturer's standard "DANGER" signs of baked enamel finish on 20-gage steel; of standard red, black and white graphics; 14" x 10" size except where 10"x 7"is the largest size which can be applied where needed, and except where larger size is needed for adequate vision; with recognized standard explanation wording (as examples: HIGH VOLTAGE, KEEP AWAY, BURIED CABLE, DO NOT TOUCH SWITCH).

2.6 ENGRAVED PLASTIC-LAMINATE SIGNS

A. Provide engraved stock melamine plastic laminate, in sizes and thicknesses indicated, engraved with engraver's standard letter style of sizes and wording indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/16" for units up to 20 sq. in. or 8" length; 1/8" for larger units.

C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate substrate.

2.7 LETTERING AND GRAPHICS

A. Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of electrical systems and equipment.

PART 3 – EXECUTION

3.1 APPLICATION AND INSTALLATION

A. Coordination: Where identification is to be applied to surfaces which require finish, install identification after completion of painting.

B. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.

3.2 CABLE/CONDUCTOR IDENTIFICATION

A. Apply cable/conductor identification on each cable and conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for project electrical work.

B. Conductor Color Coding:

1. All conductors used in all systems shall have insulation that is inherently colored. All conductors of a system performing the same function shall be colored alike throughout the project.
2. Equipment Grounding Conductors:
   a. Standard and/or general feeders or circuits shall be green.
   b. Isolated feeders or circuits shall be green with yellow stripe.
3. On larger conductors, where colored insulation is not available, colored tape adhesive vinyl bands 3/4" width may be installed 6" maximum from the end of the conductors. Where passing through pull boxes without splice, each conductor shall be banded.
4. Power system conductor colors shall be as follows:
   a. 120/208 Volt System
      Phase A - Black
      Phase B - Red
      Phase C - Blue
      Neutral - White or Gray
   b. 277/480 Volt System
      Phase A - Brown
      Phase B - Orange
      Phase C - Yellow

Neutral - White or Gray

3.3 DANGER SIGNS

A. In addition to installation of danger signs required by governing regulations and authorities, install appropriate danger signs at locations indicated and at locations subsequently identified by Installer of electrical work as constituting similar dangers for persons in or about project.

B. High Voltage: Install danger signs wherever it is possible, under any circumstances, for persons to come into contact with electrical power voltages higher than 110-120 volts.

3.4 EQUIPMENT/SYSTEM IDENTIFICATION

A. Install engraved, plastic laminate sign on each major unit of electrical equipment in building, including central or master unit of each electrical system including communication/signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text, 1/2" high lettering on 1-1/2" high sign (2" high where 2 lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawing. Provide signs for each unit of the following categories of electrical work:

1. Panelboards, electrical cabinets and enclosures.
2. Access panel/doors to electrical facilities.
3. Major electrical switchgear, main and feeder circuit breakers and/or disconnects..
4. Power transfer equipment.
5. Fire Alarm Master Station and Annunciator.
6. Paging and Intercommunication Systems
7. Security Control Panels and Annunciator.

B. Install signs at locations for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with fasteners, except use adhesive where fasteners should not or cannot penetrate the substrate.

3.5 JUNCTION AND PULL BOX IDENTIFICATION

A. Emergency Systems: Each junction and pull box cover shall be painted orange. Use black indelible liquid marker to label "EMERG." in 3/8" letters minimum.

B. Fire Alarm System: Each junction and pull box cover shall be painted red. Use black indelible liquid marker to label "F.A." in 3/8" letters minimum.

C. Feeders Shown on Single Line Diagram: Each junction and pull box shall be marked with black indelible liquid marker with the assigned feeder number "FDR #38" in 3/8" letters minimum.

END OF SECTION 26 0055

SECTION 26 0110
RACEWAYS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

B. Refer to Section 260000 for General Provisions - Electrical.

1.2 DESCRIPTION OF WORK

A. Types of raceways in this section include the following:

Rigid metal conduit

Intermediate metal conduit

Electrical metallic tubing.

Polyvinyl chloride conduit (Exterior Underground Only)

Flexible metal conduit.

Liquid-tight flexible metal conduit.

Multi-Cell Raceway

Wireways.

1.3 REFERENCE STANDARDS

A. Refer to Section 260000 for a general description of requirements applying to this Section.

1.4 QUALITY ASSURANCE

A. Refer to Section 260000 for a general description of requirements applying to this Section.

1.5 WARRANTY/GUARANTEE

A. All work and materials are subject to the general warranty as described in the General Conditions of the Contract and in Division 1, GENERAL REQUIREMENTS.

1.6 COORDINATION

A. The drawings and details there upon are scheme and/or diagrammatic in nature, and indicate the need and intent of the design. These are to be used for general guidance only. It shall be the responsibility of the Electrical Contractor to coordinate, with other Division Subcontractors, the installation of all raceways, raceway supports, junction boxes and required fittings. This coordination will include conduit layout to allow access to equipment for maintenance.

B. This coordination shall be carried out prior to actual installation; this shall be done to eliminate the possibility of conflicts between trades on items such as access, clearances and maintenance issues that may arise after completion of construction.

C. Should the coordination not be carried out prior to installation, and a conflict exists, the installing contractor shall remove and reinstall the equipment as required to clear the conflict at no additional cost to the Owner and no delay in project completion.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. <u>Rigid Metal Conduit</u>:

1. Raceway: Full weight, heavy wall rigid steel with zinc coating conforming to ANSI-C80.1.

2. Fittings: Cast malleable iron fittings with threaded hubs, insulated throat and zinc protective coating.
3. Subject to compliance with requirements, provide products of one of the following:

   Allied Tube and Conduit Corporation

   LTV Steel Tubular Products Co.

   Wheatland Tube

B. Intermediate Metal Conduit:

1. Raceway: Light weight, rigid steel, hot dipped galvanized manufactured in accordance with UL1242.
2. Fittings: Cast malleable iron fittings with threaded hubs, insulated throat and zinc protective coating.
3. Subject to compliance with requirements, provide products of one of the following:

   Allied Tube and Conduit Corporation

   LTV Steel Tubular Products Co.

   Wheatland Tube

C. Electrical Metallic Tubing:

1. Raceway: Light weight, thin wall, rigid steel, hot dipped galvanized manufactured in accordance with ANSI C80.3.
2. Fittings: Raintight, insulated throat, compression type with zinc protective coating.
3. Subject to compliance with requirements, provide products of one of the following:

   Allied Tube and Conduit Corp.

   LTV Steel Tubular Products Co.

   Wheatland Tube Co.

D. Polyvinyl Chloride Conduit:

1. Raceway: Heavy wall, rigid non-metallic, schedule 40 with bell type end, designed for above ground exposed applications, direct earth burial, and concrete encasement.
2. Fittings: Polyvinyl chloride, heavy duty, glue type, designed for Schedule 40 application.
3. Subject to compliance with requirements, provide products of one of the following:

   Allied Tube & Conduit

   Carlon

   Queen City Plastics, Inc.

   Scepter Electric Systems

E. Flexible Metal Conduit:

1. Raceway: Construct of single strip, flexible, continuous, interlocked, and double-wrapped steel, galvanized inside and outside.
2. Fittings: Steel, insulated throat, with zinc protective coating.
3. Subject to compliance with requirements, provide products of one of the following:

   AFC

   Alflex Corp.

   Electri-Flex Company

F. Liquid-Tight Flexible Metal Conduit:

1. Raceway: Construct of single strip, flexible, continuous, interlocked, and double-wrapped, galvanized inside and outside, coat with liquid-tight jacket of flexible polyvinyl chloride.
2. Fittings: Steel, water and oiltight, insulated throat, with zinc protective coating.
3. Subject to compliance with requirements, provide products of one of the following:

   AFC

   Alflex Corp.

   Electri-Flex Company

G. Multi-Cell Raceway

1. Raceways: Shall be a multi-cell raceway system for concrete encasement applications, 20 ft. lay length sections of 4” PVC outer shell type C with four (4) 1-1/4” nominal pre-lubed PVC innerducts pre-installed. The innerducts shall be color coded (white/grey/orange/green). Raceway shall be similar to Carlon Telecom System Part No. MXSS4S-020.
2. Fittings: Raceway shall be provided with a complete line of, but shall not necessarily be limited to, couplings, offsets, 90 deg., 36” radius bends, adapters, hold-down clips, end-caps and other accessories as needed for a complete system.
3. Subject to compliance with requirements, provide products of the following:

   Carlon Electrical Products.

H. Wireways:

1. Furnish electrical wireways of the type, size, and style for each service indicated. Wireway shall be a complete assembly including but not necessarily limited to, couplings, offsets, elbows, adapters, hold-down clips, end-caps and other components and accessories as needed for a complete system.
2. System shall fulfill wiring requirements as indicated in contract documents, and shall comply with applicable portions of Article 362 of the National Electrical Code.
3. Subject to compliance with requirements, provide products of one of the following:

   Circle AW Products Co.

   The EMF Company, Inc.

   Hoffman Engineering Company

   Square "D" Company

J. The above items shall include the statement "Approved Equal" and/or "Approved Substitute". This statement requires that the product or item be in compliance with the written intent of this specification and the submission meets the requirements of Section 260000.

PART 3 – EXECUTION

3.1 INSTALLATION OF ELECTRICAL RACEWAYS

A. Install electrical raceways in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA "Standard of Installation", and complying with recognized industry practices.

B. Coordinate with other work as necessary to interface installation of electrical raceways, wireways and required components.

C. Raceways used for distribution, feeders, or branch circuits shall be a minimum size of 3/4" or equal equivalent cross-sectional area. Raceways used for control and signal shall be a minimum size of 1/2" or equal equivalent cross-sectional area.

D. All raceways shall be concealed within the building construction.

E. All raceways installed in ceiling cavities and exposed within mechanical spaces shall be run parallel with building lines and installed level and square at the proper elevation/height.

F. Complete the installation of electrical raceways before starting the installation of cables/wires within the raceway.

G. Furnish and install one (1) nylon or fiberglass pull cord in each empty raceway. Each empty raceway shall be cleaned, capped, and tagged as to its termination location.

H. Install liquid-tight flexible metal conduit for connections to motors and for other electrical equipment when subject to movement and vibration, and also where subjected to one or more of the following conditions:

1. Exterior locations.
2. Moist or humid atmosphere when condensation can be expected to accumulate.
3. Corrosive atmosphere.
4. Subjected to water spray.
5. Subjected to dripping oil, grease or water.

I. Install Electrical Metallic Tubing for building interior electrical work except:

1. Underground
2. In gravel, cinder, concrete or other sub-base floor construction.
3. Horizontal runs in concrete floor slabs.
4. Where exposed to the elements.
5. In masonry construction below finished grade.
6. Vertically in poured concrete walls.

J. Refer to Section 260000 for excavation, shoring and pumping, concrete and backfilling requirements.

K. Where and whenever possible, install horizontal electrical raceways as tight to building construction as possible and above water, drain and steam piping. A separation of at least six (6) inches shall be maintained between electrical conduits and hot water and steam piping.

L. In accordance with NEC requirements, install Rigid or Intermediate Metal Conduit where Electrical Metallic Tubing is not permitted.

M. In all instances where recessed type panelboards are installed, furnish and install one (1) one inch raceway for each two (2) future circuits for which "space" or "spare" provisions have been made in the panelboard. These raceways shall extend between the panelboard cabinet and a convenient location above an access panel or a removable tile ceiling construction and capped.

3.2 CLEANING

A. Upon completion of installation of raceways, inspect interiors of raceways; remove burrs, dirt and construction debris.

END OF SECTION 26 0110

SECTION 26 0120
WIRES AND CABLES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. This section is a Division 26 Basic Materials and Methods section and is part of each Division 26 Section making reference to wires and cables specified herein.

1.2 DESCRIPTION OF WORK

A. Electrical wire and electrical cable work is indicated by drawings and specifications.

B. Types of wire, cable and connectors in this section include, but not limited to the following:

Copper conductors.

Tap type connectors.

Split-bolt connectors.

C. Refer to other sections of Division 26 for, but not limited to, raceways, connections used in conjunction with wire and cable work.

D. Applications for wire, cable and connectors required for project are as follows unless otherwise indicated:

1. Primary Service Circuitry.
2. Power Distribution Circuitry.
3. Appliance and Equipment Circuitry.
4. Motor Branch Circuitry.
5. Control Circuitry.
6. Signal/Communication Circuitry.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. <u>Wire and Cable</u>

Anaconda Wire and Cable Co.

Advance Wire and Cable, Inc.

American

Cerro Wire and Cable Co.

Electrical Conductors, Inc.

General Cable Corp.

Rome Cable Corp.

Southwire Company

Triangle PWC,, Inc.

The Okonite Co.

General Electric Co.

<u>Connectors</u>

Burndy Corp.

Eagle Electric Mfg. Co., Inc.

Gould, Inc.

Ideal Industries, Inc

Joslyn Mfg. and Supply Co.

O-Z/Gedney Co.

Pyle National Co.

Thomas and Betts Co.

2.2 WIRE, CABLE AND CONNECTIONS

A. Except as otherwise indicated, provide wire, cable and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, and as required for the installation. Minimum wire and cable size is #12 AWG for power and branch circuits and #14 AWG for control and signal/communication circuits unless otherwise indicated.

B. Wire: Provide factory fabricated wire of sizes, ratings, materials and types indicated for each service. Where not indicated, provide proper selection as determined by Installer to comply with project's installation requirements and NEC standards. Select from the following types, materials, conductor configurations, insulation and coverings:

UL Type: THHN

UL Type: TW

UL Type: THW

UL Type: THWN

UL Type: TF

UL Type: XHHW

UL Type: MC (Metal Clad)

Material: Copper

Conductors: Solid (AWG 14 to AWG 10 only).

Conductors: Concentric-lay-stranded (standard flexibility)

Outer Covering: Nylon

Outer Covering: Thermoplastic

C. Connectors: Provide factory fabricated metal connectors of sizes, ratings, materials, types and classes as required for each service. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements and NEC standards. Select from the following types, classes, kinds and styles.

Type: Pressure

Type: Crimp

Type: Threaded

Class: Insulated

Class: Non-insulated

Kind: Copper (for CU to Cu connection).

Style: Butt connection

Style: Elbow connection

Style: Combined "T" and straight connection

Style: "T" connection.

Style: Split-bolt parallel connection

Style: Tap connection

Style: Pigtail connection

D. 25KV Cable: Provide factory fabricated and tested primary service cable; underground residential distribution (URD) type cable, size #1/0 AWG solid aluminum conductor with 25KV cross-linked polyethylene insulation (XLP) with tinned or coated copper wire full size concentric neutral as approved by the Utility Company.

E. 25KV Terminations: Provide 25KV terminations for 25KV #1/0 AWG solid aluminum cable.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install electrical cables, wires and connectors, in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices.

B. Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary for proper interface. Pull conductors together where more than one is being installed in a raceway. Use pulling compound or lubricate, where necessary; compound must not deteriorate conductor or insulation. Use pulling means including fish tape, cable or rope which cannot damage raceway. Rope must be used as pulling means when pulling wires or cables into plastic conduit and duct. Keep conductor splices to a minimum and install in junction boxes only. No splices shall be permitted within conduit. Install splices and tapes which have mechanical strength and insulation rating equivalent or better than conductor. Use splice and tape connectors which are compatible with conductor material.

C. Installation of 25KV primary service cable.

D. 25KV cable terminations.

3.2 FIELD QUALITY CONTROL

A. Prior to energization, test cable and wire for continuity of circuitry and also for short circuits. Correct malfunctions when detected.

B. Subsequent to wire and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements.

C. Test 25KV cable after installation using D.C. high potential (Hi-Pot) testing. All testing shall be performed in accordance with cable manufacturer's recommended specifications. Keep a complete record of all tests and submit to the Engineer upon completion. Testing shall be performed by an independent cable testing company or service.

END OF SECTION 26 0120

SECTION 26 0131
HANDHOLES

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of handholes and handhole installation work is indicated by drawings and specifications.

B. Types of handholes in this section shall include the following:

1. Precast concrete

1.2 SUBMITTALS

A. Submit manufacturer's data on handholes including, but not limited to, roughing-in drawings, construction details and structural support data.

PART 2 – PRODUCTS

2.1 ACCEPTABE MANUFACTURERS

A. Subject to compliance with requirements, provide handholes with frame and cover, and cable accessories of one of the following:

1. Handholes - A.C. Miller Concrete Products, Inc.
   - Gillespie Precast, LLC
2. Frame and Cover - Neenah Foundry Co.
3. Cable Accessories - Midland Ross Corp.

2.2 HANDHOLES

A. Handholes shall be a precast concrete box with interior dimensions of 48" wide x 48" long x 48" deep with 6" walls, floor and top.

B. Floor shall be provided with a ground rod hole, pulling irons and a 12" x 12" X 4-1/2" deep sump.

C. Top shall be a precast 6" slab with a circular opening suitable for a handhole frame opening of 32-1/2".

D. The precast 6" top slab shall be sealed where it joins the handhole. The entire exterior surface of the handhole shall be coated with a bitumastic type waterproof coating prior to installation.

E. Handhole shall be similar in design to A.C. Miller Concrete Products, Inc. size 4'x4'x6'.

2.3 HANDHOLE FRAME AND COVER

A. Frame and cover shall be a round, heavy duty, cast iron frame and solid cover with machined horizontal bearing surfaces. Total weight to be approximately 365 pounds.

B. Frame and cover dimensions shall be as follows:

1. Overall frame size = 38-1/2"
2. Clear opening size = 32-1/2"
3. Overall frame height = 4"

C. Cover shall have the word, "Electric", cast into it.

D. Frame and cover shall be similar in manufacture to Neenah Foundry Company Model No. R-1792-HL.

2.4 CABLE SUPPORT ASSEMBLY

A. Cable support assembly shall consist of a 24" long, 1-1/2" x 1-1/2" x 12 gauge PVC coated channel. On each channel provide three (3) procelain insulator clamps with PVC coated steel straps and bronze slotted hex head screw and nut.

B. In straight pull handholes, two (2) cable support assemblies shall be installed. In angle pull handholes, four (4) support assemblies shall be installed.

C. Cable support assembly shall consist of the following:

1. Channel - Midland Ross (Kindorf) Cat. No. PB-905-10.
2. Porcelain Insulator Clamp - Midland Ross (Kindorf) Cat. No. C-755.
3. PVC Coated Steel Strap - Midland Ross (Kindorf) Cat. No. PBC-105.

2.5 GROUND ROD AND CLAMP

A. Ground rod shall be a rigid steel rod with a heavy duty, uniform, non-porous copper coating. Rod to be 5/8" dia. x 10'-0" long. Clamp to be cast of high copper content bronze alloy.

B. Ground rod assembly to consist of the following:

1. Ground Rod - Blackburn Cat. No. W5810
2. Ground Clamp - Blackburn Cat. No. J-JR.

PART 3 – EXECUTION

3.1 INSTALLATION OF HANDHOLES

A. Install handholes in accordance with manufacturer's written instructions and complying with applicable portions of NEC and NECA's "Standard of Installation."

B. Handholes shall be oriented in accordance with duct bank requirements as indicated on the electrical site plan. The depth of the handhole shall be as required to allow the frame and cover to set level with finished grade.

C. Handholes shall not be set in an area or at an elevation which will allow surface water or runoff to enter handhole through the cover. Should this occur, this Contractor shall be required to raise the frame and cover and regrade the area.

D. Contractor shall properly install cables in the cable support assemblies and tag each cable as to voltage and phase. Where cable splices occur in handholes, all shield wiring shall be connected to ground rod along with circuit ground conductor.

3.2 FIELD QUALITY CONTROL

A. Contractor shall inspect the conduit entrances into the handhole looking for broken ducts and/or rough edges and repairing the findings. Contractor shall also check that conduit entrances are sealed to keep out ground water.

B. All handholes shall be cleaned of dirt and construction debris. All spare conduits shall have a nylon pull cord installed for future use.

END OF SECTION 26 0131

SECTION 26 0135
ELECTRICAL BOXES & FITTINGS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. This section is a Division 26 Basic Materials and Methods section, and is a part of each Division 26 section making reference to electrical wiring boxes and fittings specified herein.

1.2 DESCRIPTION OF WORK

A. Types of electrical boxes and fittings in this section include the following:

Outlet boxes.

Junction boxes.

Pull boxes.

Conduit bodies.

Bushings.

Locknuts.

Knockout closures.

PART 2 – PRODUCTS

2.1 INTERIOR METALLIC OUTLET BOXES

A. Provide galvanized flat rolled sheet steel interior outlet non-gangable wiring boxes, of types, shapes and sizes, including box depths, to suit each respective location and installation; construct with stamped knockouts in back and sides and with threaded screw holes with corrosion-resistant screws for securing box covers and wiring devices.

B. Provide outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used and fulfilling requirements of individual wiring situations. Choice of accessories is Installer's option.

C. Manufacturer: Subject to compliance with requirements, provide interior outlet boxes of one of the following:

Appleton Electric Co.

Bell Electric/Square D Co.

Pass and Seymour, Inc.

RACO, Inc.

Steel City/Midland-Ross Corp.

2.2 WEATHERPROOF OUTLET BOXES

A. Provide corrosion resistant cast-metal weatherproof outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit ends, cast-metal face plates with spring-hinged waterproof caps suitably configured for each application, including face plate gaskets and corrosion-resistant fasteners.

B. Manufacturer: Subject to compliance with requirements, provide weatherproof outlet boxes of one of the following:

Arrow-Hart Div., Crouse-Hinds Co.

Bell Electric/Square D Co.

Harvey Hubbell, Inc.

O-Z/Gedney Co.

Slater Electric Co.

2.3 JUNCTION PULL BOXES

A. Provide galvanized code-gauge sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.

B. Manufacturers: Subject to compliance with requirements, provide junction and pull boxes of one of the following:

Adalet-PLM Div., Scott and Fetzer Co.

Appleton Electric Co.

Arrow-Hart Div., Crouse-Hinds Co.

Bell Electric/Square D Co.

GTE Corporation

Keystone Columbia, Inc.

O-Z/Gedney Co.

Slater Electric Co.

Spring City Elect. Mfg. Co.

2.4 CONDUIT BODIES

A. Provide galvanized cast-metal conduit bodies, of types, shapes, and sizes, to suit respective locations and installation, construct with threaded-conduit-entrance ends, removable covers, and corrosion-resistant screws.

B. Manufacturers: Subject to compliance with requirements, provide conduit bodies of one of the following:

Appleton Electric Co.

Crouse-Hinds Co.

Gould, Inc.

Killark Electric Mfg. Co.

O-Z/Gedney Co.

Spring City Electrical Mfg. Co.

2.5 BUSHINGS, KNOCKOUT CLOSURES AND LOCKNUTS

A. Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts and insulated malleable iron conduit bushings, offset connectors, of types and sizes to suit respective uses and installation.

B. Manufacturers: Subject to compliance with requirements, provide bushings, knockout closures, locknuts and connectors of one of the following:

Appleton Electric Co.

Burndy Corp.

Crouse-Hinds Co.

Gould, Inc.

O-Z/Gedney Co.

RACO, Inc.

Steel City/Midland-Ross Corp.

Thomas and Betts Co., Inc.

PART 3 – EXECUTION

3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

A. Install electrical boxes and fittings, complying with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work.

C. Provide weatherproof outlets for interior and exterior locations exposed to weather or moisture.

D. Provide knockout closures to cap unused knockout holes where blanks have been removed.

E. Install boxes and conduit bodies in those locations to ensure ready accessibility of electrical wiring.

F. Avoid using round boxes where conduit must enter box through side of box, which would result in difficult and insecure connections when fastened with locknut or bushing on rounded surface.

G. Fasten boxes rigidly to substrates or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry.

H. Provide electrical connections for installed boxes.

I. Pull boxes and junction boxes shall be furnished and installed in all conduit runs at intervals not exceeding 100 feet maximum.

J. Identify each circuit in all pull boxes and junction boxes whether the box contains one or more circuits.

END OF SECTION 26 0135

SECTION 26 0140
WIRING DEVICES

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. The extent of wiring device work is indicated by drawings, schedules and specifications. Wiring devices are defined as single discrete units of the electrical distribution system which are intended to carry but not utilize electric energy.

B. Types of electrical wiring devices in this section include the following:

Receptacles.

Switches.

Device plates.

Contactors

Energy Control Devices

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on electrical wiring devices.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of wiring device):

Legrand Co.

Hubbell, Inc.

Leviton Mfg. Co.

Lutron Electronics Co., Inc.

Square D Co.

Eaton Corp.

Siemens

Wattstopper

Sensor Switch

2.2 FABRICATED WIRING DEVICES

A. Provide factory fabricated wiring devices, in types, styles, colors, and electrical ratings for applications indicated and complying with NEMA Standards Pub. No. WD 1. Where types and grades are not indicated, provide proper selection as determined by Installer to fulfill wiring requirements, and complying with NEC and NEMA Standards for wiring devices. Color selection to be verified by Contractor with Architect/Engineer.

2.3 RECEPTACLES

A. All simplex receptacles shall be extra heavy duty, 20 amperes, 125 volts, 2 pole, 3 wire grounding, with green hexagonal equipment ground screw, with metal plaster ears, side wiring, NEMA configuration 5-20R unless otherwise indicated. Hubbell Cat. #HBL5361 or approved substitute.

B. All duplex receptacles shall be extra heavy duty, 20 amperes, 125 volts, 2 pole, 3 wire grounding type with green hexagonal equipment ground screw, with metal plaster ears, side wiring, NEMA configuration 5-20R unless otherwise indicated. Hubbell Cat. #HBL5362 or approved substitute, HBL5362TR where tamperproof is indicated.

C. Special Purpose Receptacles: Provide polarized grounding type special purpose receptacles of the required amperage and voltage ratings, extra heavy duty. Device shall include a green hexagonal equipment ground screw.

D. All ground fault receptacles shall be extra heavy duty duplex, tamper resistant, 20 amperes, 125 volts, 2 pole, 3 wire grounding type with green hexagonal equipment ground screw,integral ground fault circuit interrupter, UL rated Class A, Group 1, with metal plaster ears, side wiring, NEMA Configuration 5-20R, self-testing with red and green LED indicator lights. Device shall include solid state ground-fault sensing and signalling, with a 5 milliampere ground fault trip level, plus or minus 1 milliampere. Hubbell Cat. #GFR5362SG or approved substitute.

1. Whether indicated or not on the floor plans, the Electrical Contractor shall furnish and install GFI protected devices in kitchen areas on countertops near sinks, water coolers, refrigerators, on rooftop equipment, on exterior walls; and as indicated by the N.E.C., it shall be the discretion of the Electrical Contractor to provide GFI receptacles or GFI circuit breaker. Receptacles protected by GFI circuit breakers shall be permanently labeled on the faceplate as GFCI.

2.4 SWITCHES

A. Toggle Switch: Provide extra heavy duty, industrial series flush toggle, 1 pole, 2 pole, 3-way, 4-way AC quiet switch rated 20 amperes @ 120/277 volts with green hexagonal equipment ground screw, metal plaster earls, and side wired screw terminals. Similar to Hubbell Series HBL Series or approved substitute.

B. Toggle Switch with Pilot Light: Provide extra heavy duty industrial series, flush toggle, single pole, AC quiet switch rated 20 amperes @ 120 volts with green hexagonal equipment ground screw, metal plaster ears, side-wired screw terminals and 1/25 watts, 125-volt neon pilot light, designed to mount within a single gang outlet box. Similar to Hubbell HBL or approved substitute.

C. Key Switch: Provide extra heavy duty, industrial, 1 pole, 2 pole, 3-way, 4-way barrel key locking switch rated at 20 AMPs @ 120/277 volts with green grounding screw, metal plaster ears and side wired screw terminals. The tumbler shall be a six-point cylinder type. All project keyed switches to be keyed alike. Similar to Hubbell 122*RKL series.

2.5 DEVICE PLATES

A. Provide switch and receptacle outlet wall plates for wiring devices, of types, sizes, and with ganging and cut outs required by the devices being installed. Construct with metal screws for securing plates to devices; screw heads colored to match finish of plates; plates colored to match wiring devices to which attached. **All emergency receptacles to have red coverplates.** Provide device plates possessing the following additional construction features: **Receptacle outlet plates to be permanently marked with panel designation and circuit number on back side of plate.**

1. Metal Plates to be stainless steel of non-corrosive and non-magnetic 302 alloy, .032" nominal thickness. Plates shall have brushed satin finish.

2. Non-Metallic Plates to be a thermoplastic, virtually indestructible, molded polycarbonate material offering resistance to impact, scratches, discoloration and be self-extinguishing. Plates shall have no-line smooth finish.

B. Weatherproof device plates shall have spring-hinged waterproof cap suitably configured for each application, including face plate gaskets and corrosion-resistant fasteners. Boxes and devices shall be recessed, weatherproof with smoke gray opaque covers.

C. Existing mechanical spaces where concealed work is impractical, such as masonry poured or block walls, Provide 4" square boxes, surface mounted, with ½" deep surface mounted device plates consisting of same material for devices indicated on plans, whether single or double gang. Use of plaster flange and standard cover plate will not be acceptable.

2.6 CONTACTORS

A. Electrically Held Power Lighting Contactor: Shall be rated 30 to 200 AMPs for 2 thru 5-pole versions and 300 to 800 AMPs for 2 and 3 pole versions, as indicated on the Floor Plan. Contactor shall have factory wired control and clearly marked termination points, designed for mixed load ratings with a UL listed short-circuit rating up to 100,000 amperes. Contactor shall be housed in a NEMA Type I, general purpose enclosure and be similar to Square D Company, Type "S", Class 8903 or approved substitute.

B. Mechanically Held Power Lighting Contactor: Shall be rated 30 to 200 AMPs for 2 thru 5 pole versions and 300 to 800 AMPs for 2 and 3 pole versions, as indicated on the Floor Plan. Contactor shall have factory wired control with coil clearing contacts and clearly marked termination points, designed for mixed load ratings with a UL listed short-circuit rating up to 100,000 amperes. Contactor shall be housed in a NEMA Type I, general purpose enclosure and be similar to Square D Company, Type "S", Class 8903 or approved substitute.

C. Multiple Lighting Contactor: Shall be an electrically or Mechanically held device with 2 thru 12 poles rated 30 AMPs ballast and 20 AMPs tungsten, as indicated. Mechanically held contactor shall have factory wired control with coil clearing contacts and clearly marked termination points. Contactor shall be housed in a NEMA Type I, general purpose enclosure and be similar to Square D Company Types "L" and "LX", Class 8903 or approved substitute.

D. General: All contactor control setups shall include all required interface relays needed to function with maintained or momentary contact switches, time clocks and photocell controls. Control circuits and coil voltages shall be 120 volts A.C. single phase. Where system voltage is 277/480 volts, a control power transformer shall be furnished and installed within the contactor enclosure. Transformer shall be sized to handle the contactor's coil load as well as all associated control devices.

2.7 ENERGY CONTROL DEVICES (Occupancy Sensors)

A. Line Voltage:

1. Combination wall switch and sensor shall be Dual Technology Passive Infrared and Ultrasonic, designed for single gang outlet box installation, with a coverage of 180° for a maximum of 400 square feet. Device shall be suitable for 120/277 dual voltage operation, and have vandal resistant, hard sensor lens. Device shall be similar to Sensor Switch Cat. No. WSD-PDT or Wattstopper DW-100 Series, DW-103 Series for multi-way, DW-200 for dual relay, DW-203 for multi-way dual relay, or approved substitute.

2. Ceiling sensor shall be Dual Technology Passive Infrared and Ultrasonic 360° coverage, 1200 square feet maximum. Self Contained Relay Device shall be suitable for 120/277 Dual Voltage operation. Device shall be similar to Sensor Switch Cat. No. CMR-PDT, Wattstopper DT-355 or approved substitute.

B. Low Voltage:

1. Ceiling mounted sensor shall be Dual Technology Passive Infrared and Ultrasonic with 360° coverage up to 2o feet. Device accepts 12 to 24 volt AC or DC. Device shall be similar to Sensor Switch Cat. No. CM-PDT or approved substitute.

2. Sensor power pack shall be a low voltage power supply with an input of either 120 volts or 277 volts AC and an output of 24 volts DC @ 150 mA. Device shall contain a 20 AMP isolated load control relay. When relay is used, power supply output shall be reduced to 24 volts DC @ 114

mA. Device shall be similar to Sensor Switch PP-20 or approved substitute.

C. Photocontrol

1. Provide epoxy conformal coated cadmium sulphide photocell with Lexan impact and vandal resistant enclosure. Dome and base to be ultrasonically welded. Photocell shall respond to the light spectrum near to that of a human eye. Housing shall mount to ½" conduit and have 180° swivel.
2. Photocell shall have on/off time delay, on at 1 to 5 FC, off at 3 to 15 FC. Tool free adjustment. Unit shall fail in the ON position.
3. Unit shall operate from -40°F to 140°F, with a minimum 5-year warranty.
4. Provide Tork 2001 series or approved equivalent.

PART 3 – EXECUTION

3.1 INSTALLATION OF WIRING AND CONTROL DEVICES

A. Install wiring devices as indicated, in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other work, including painting, electrical box and wiring work, as necessary to interface installation of wiring devices with other work.

C. Install wiring devices only in electrical boxes which are clean, free from building materials, dirt and debris.

D. Provide electrical connections for wiring and control devices.

E. Delay installation of all wiring and control devices until wiring work is completed.

F. Isolated Ground Receptacle Devices shall be connected to the system ground by way of an insulated ground conductor color coded green with a yellow stripe.

3.2 PROTECTION OF WALL PLATES AND RECEPTACLES

A. At time of Substantial Completion, replace those items which have been damaged, including those burned and scorched by faulty plugs.

3.3 GROUNDING

A. Provide electrically continuous, tight grounding connections for wiring and control devices.

3.4 TESTING AND COMMISSIONING

A. Prior to energizing circuitry, test wiring devices for electrical continuity and proper polarity connections. After energizing circuitry, test wiring devices to demonstrate compliance with requirements.

B. After energizing circuitry, the Electrical Contractor shall test and adjust all control devices to provide optimum operation and performance.

C. All areas where energy control devices are specified shall be verified for full coverage and accurate operation. If any area is determined by the Owner, Architect, or Engineer to have inadequate coverage or operation, Contractor shall provide additional energy control devices to remedy the coverage or operation issue. For bidding purposed, own 5 extra devices fully installed. After successful commissioning, uninstalled devices shall be handed over to the Owner for spare devices. Device types shall be as required for commissioning, or as selected by Owner for space devices as applicable.

END OF SECTION 26 0140

SECTION 26 0155
MOTOR STARTERS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of motor starter work is indicated by drawings, schedules and specifications.

B. Refer to sections of other divisions of these specifications for driven equipment specified without motor starters. Motor starters for such equipment are the work of this section.

C. Types of motor starters in this section include the following:

Manual.

Magnetic Full Voltage, Non-Reversing.

Combination Disconnect Switch and Magnetic Starter.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on motor starters and accessories.

1.3 COORDINATION

A. The drawings and details there upon are scheme and/or diagrammatic in nature, and indicate the need and intent of the design. These are to be used for general guidance only. It shall be the responsibility of the Electrical Contractor to coordinate with other Division subcontractors, the installation of all motor starters, the need for control devices including the wiring and conduit, to and from the device.

B. This coordination shall be carried out prior to actual installation. This shall be done to eliminate the possibility of conflicts between trades on items such as access, clearances and maintenance issues that may arise after completion of coordination.

C. During the coordination phase of the project, the Electrical Contractor shall consult with Division 1 thru 23 subcontractors with regard to base design equipment characteristics. Any differences from the electrical plans and specifications shall be considered a change. The trade's contractor making the change at no additional cost to the Owner or delay in project completion shall handle these additional costs.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type and rating of motor starter):

Allen-Bradley Co.

Cutler Hammer Products

Furnas Electric Co.

Square D Co.

Siemens

2.2 MOTOR STARTERS

A. Provide motor starters and ancillary components; of types, sizes, ratings and electrical characteristics indicated which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installations.

B. Fractional HP Manual Motor Starters: Provide manual, single phase, fractional HP motor starters for each motor rated less than 1/2 HP, of types, ratings and electrical characteristics indicated. Equip unit with thermal overload relay for protection of 120 volt AC motors. Provide starters with quick-make,

quick-break, trip free toggle mechanisms, selector switches for hand-off-automatic control; mount starter in NEMA Type 1 or Type 4 enclosure as indicated or required by the NEC.

C. Magnetic Motor Starter: Provide magnetic full voltage, non-reversing starters for each motor rated 1/2 HP and more of types, ratings and electrical characteristics indicated; equip with solid state overload relays, control transformers with 120V secondary, with one secondary fuse and one grounded secondary lead, two normally open and two normally closed auxiliary contacts, hand-off- automatic selector switch, red and green pilot lights wired and mounted through front of the enclosure. Mount starter in NEMA Type 1 or Type 4 enclosure as required by the NEC.

D. Combination Disconnect Switch Magnetic Starter: Provide full-voltage, non-reversing, combination non-fused disconnect switch and magnetic starter for each motor rated 1/2 horsepower and more, of types, ratings and electrical characteristics indicated; equip with solid state overload relays, control transformer with 120 volt secondary, one secondary fuse and one grounded secondary lead, two normally open and two normally closed auxiliary contacts, hand-off- automatic switch, red and green pilot lights wired and mounted through the front of the enclosure. Mount starter in NEMA Type 1 or Type 4 enclosure as required by the National Electrical Code (NEC).

E. Three (3) phase, full voltage, non-reversing magnetic motor starters, horsepower rating with minimum NEMA size #0 shall be as follows:

NEMA Size	Continuous Rating	Maximum Horsepower	
		208 Volt	480 Volt
0	18 AMPs	3HP	5HP
1	27 AMPs	7-1/2HP	10HP
2	45 AMPs	10HP	25HP
3	90 AMPs	25HP	50HP
4	135 AMPs	40HP	100HP
5	270 AMPs	75HP	200HP

Motor full-load current shall not exceed continuous ampere rating of starter.

PART 3 – EXECUTION

3.1 INSTALLATION OF MOTOR STARTERS

A. Install motor starters in accordance with manufacture's written instructions, applicable requirements of NEC, NEMA Standards, and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. The Electrical Contractor shall consult and cooperate with the Control Contractor in assisting him in making control connections to the automatic position of the selector switch and to the auxiliary contacts.

C. Motor Data: Before installing wiring for motors and starters, the Electrical Contractor shall consult the respective parties furnishing the equipment and obtain from them all data necessary to properly connect the apparatus, and for selection of thermal overload relays in accordance with motor nameplate. Any variance in loads or electrical characteristics from the contract drawings should be reported to the Engineer before proceeding with the work.

D. When packaged equipment is furnished, all unit starters shall be furnished, mounted and wired by the installing contractor. The Electrical Contractor shall furnish and install a disconnect switch, as specified in Section 260170, and wire between unit's main terminal block and the disconnect switch.

E. When packaged rooftop equipment is furnished, the unit disconnect switch and all starters shall be furnished, mounted and wired by the installing contractor. The Electrical Contractor shall wire between the line side of the disconnect switch and the building system.

F. Should the Electrical Contractor elect to furnish and install an electric alternator with magnetic starters in lieu of the duplex motor controller, he shall provide all control wiring needed to make the alternator and the starters function as a unit.

G. Provide connections for motor starters.

3.2 ADJUST AND CLEAN

A. Inspect operating mechanisms for malfunctioning and where necessary adjust units for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finish.

3.3 FIELD QUALITY CONTROL

A. Subsequent to wire/cable hookup, energize motor starters and demonstrate functioning of equipment in accordance with requirements.

END OF SECTION 26 0155

SECTION 26 0160
PANELBOARDS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of panelboard load-center and enclosure work, including cabinets and cutout boxes, is indicated by drawings and schedules.

B. Types of panelboards and enclosures in this section include the following:

Lighting and Appliance Panelboards.

Distribution Panelboards.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data including specifications, installation instructions and general recommendations, for each type of panelboard required. Include data substantiating that units comply with requirements.

B. Shop Drawings: Submit dimensioned drawings of panelboards and enclosures showing layouts of enclosures and required individual panelboard devices, including by not necessarily limited to, circuit breakers, contactors, and accessories, including wiring diagrams of contactors.

1.3 COORDINATION

A. The drawings are scheme and/or diagrammatic in nature, and indicate the need and intent of the design. These are to be used for general guidance only. It shall be the responsibility of the Electrical Contractor to coordinate, with other Division Subcontractors, the installation of all raceways, raceway supports, junction boxes and required fittings. This coordination will include conduit layout to allow access to equipment for maintenance.

B. This coordination shall be carried out prior to actual installation; this shall be done to eliminate the possibility of conflicts between trades on items such as access, clearances and maintenance issues that may arise after completion of construction.

C. Should the coordination not be carried out prior to installation, and a conflict exists, the installing contractor shall remove and reinstall the equipment as required to clear the conflict at no additional cost to the Owner and no delay in project completion.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of panelboard and enclosure):

Cutler Hammer, Inc. (Eaton)

Square D Company

Siemens

2.2 PANELBOARDS

A. General:

1. Panelboards shall comply with the following industry standards:

a. UL Listing/Approval

b. UL Standards:

Panelboards - UL67

Cabinet & Boxes - UL50

c. National Electric Code

d. NEMA Standard -PBI

2. Interiors:

a. All interiors shall be completely factory assembled. They shall be so designed that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors, so that circuits may be changed without machining, drilling and tapping.

b. Branch circuits shall be arranged using double row construction. A nameplate shall be provided listing panel type and rating.

c. Unless otherwise noted, full size insulated neutral bars shall be included. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection. A ground bus will be included in all panelboards.

3. Boxes: Boxes shall be a minimum 20 inches wide and manufactured from galvanized steel. Provide minimum gutter space in accordance with the National Electric Code.

4. Trim:

a. Switching device handles shall be accessible. Panel access doors shall not uncover any live parts. Doors shall have flush type cylinder lock and catch except doors over 48" in height shall have auxiliary fastenings top and bottom of door in addition to the flush type cylinder lock and catch. Panelboard trim clamps shall be of the indicating type. Upon removal of screws behind door, the panel interiors become service accessible via piano hinged trim front.

b. Panel access door hinges shall be concealed. All locks shall be keyed alike; directory frame shall be welded metal and having a transparent cover shall be furnished with each door.

c. All exterior and interior steel surfaces of the trim shall be properly cleaned, primed with a rust inhibiting phosphatized coating and finish with a gray ANSI 61 paint. Trims for flush panels shall overlap the box for a least 3/4 inch all around. Surface trims shall have the same width and height as the box. Trims shall be mountable by a screwdriver and without the need for special tools.

5. Main Bus and Branch Circuits: All main bus bars shall be full size aluminum, sized in accordance with U.L. standards to limit the temperature rise on any current carrying part to a maximum of 50 degrees C above an ambient of 40 degrees C maximum.

B. Distribution Panelboards:

1. Panels shall be provided with molded case circuit breakers tested and U.L. labeled per U.L. 489.

2. Circuit breakers 100 ampere through 400 ampere frame sizes shall be thermal-magnetic trip with inverse time current characteristics.

3. Where multiple pole circuit breakers are indicated, provide with common trip so overload on one pole will trip all poles simultaneously. Molded case circuit breakers shall have a minimum 22,000 symmetrical RMS interrupting capacity at 240 volts.

C. Lighting and Appliance Panelboards:

1. Provide switching and protective devices in quantities, ratings, types indicated, with anti-turn solderless pressure type lug connectors approved for copper conductors. Circuit breakers shall be the bolt-on, molded case, thermal magnetic type, with toggle handles that indicate when tripped. Where multiple pole circuit breakers are indicated, provide with common trip so overload on one

pole will trip all poles simultaneously.

2. Panelboards for use at 240 volts AC maximum shall incorporate circuit breakers as shown rated at 10,000 A.I.C. symmetrical at 240 volts.
3. Panelboards for use at 480/277 volts AC maximum shall incorporate circuit breakers as shown rated at 14,000 A.I.C. symmetrical at 480 volts.

PART 3 – EXECUTION

3.1 INSTALLATION OF PANELBOARDS

A. Install panelboards and enclosures where indicated in contract documents and, in accordance with the equipment manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Anchor enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secure.

C. Provide all required electrical and grounding connections within the panelboards and enclosures.

D. The Electrical Contractor shall furnish and install on the door within each enclosure, a circuit labeling identification system for all electrical panelboards. The system must satisfy the NEC Article No. 110-22. The directories shall be typed, NOT handwritten. Directories shall indicate room numbers as indicated on contract documents and room numbers as physically labeled in the field.

E. The Electrical Contractor shall provide directories compiled using a software program that is Windows compatible. Program shall handle multiple panels, calculate panel electrical loads from user supplied data, maintain a history of repairs and upgrades by circuit, and be capable of printing panel directories and summaries. Verify compatibility with Owner’s operating system.

F. Provide two discs to owner containing software and project panel directories and summaries.

END OF SECTION 26 0160

SECTION 26 0165
SWITCHBOARDS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of switchgear and switchboards is indicated by drawings and schedules.

B. Types of switchgear and switchboards in this section include the following:

Dead-Front Switchboards.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on switchgear and switchboards.

B. Shop Drawings: Submit dimensioned drawings of switchgear and switchboards showing accurately scaled basic sections including, but not necessarily limited to, auxiliary compartments, section components, and combination sections.

1.3 COORDINATION

A. The drawings are scheme and/or diagrammatic in nature, and indicate the need and intent of the design. These are to be used for general guidance only. It shall be the responsibility of the Electrical Contractor to coordinate, with other Division Subcontractors, the installation of housekeeping equipment pad, switchboard cabinet structures, feeders, branch circuits, switchboard hardware and required fittings. This coordination will include conduit layout to allow access to equipment for maintenance.

B. This coordination shall be carried out prior to actual installation; this shall be done to eliminate the possibility of conflicts between trades on items such as access, clearances and maintenance issues that may arise after completion of construction.

C. Should the coordination not be carried out prior to installation, and a conflict exists, the installing contractor shall remove and reinstall the equipment as required to clear the conflict at no additional cost to the Owner and no delay in project completion.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:

Dead-Front Switchboards

Cutler Hammer, Inc. (Eaton)

Square D Co.

Siemens

2.2 EQUIPMENT AND COMPONENTS

A. Furnish the service entrance switchboard as indicated in contract documents. The switchboard shall meet the latest requirements of Underwriters Laboratories' Standard No. 891, NEMA PB2 and the National Electric Code. The switchboard shall be furnished with an Underwriters Laboratories' label.

B. Enclosure Construction: The switchboard shall be deadfront with front accessibility required. The switchboard frame shall be of formed code gauge steel rigidly welded and bolted together to support all coverplates, bussing and component devices during shipment and installation. Steel base channels shall be bolted to the frame to rigidly support the entire shipping section for moving on rollers and floor mounting. Each switchboard section shall have an open bottom and an individually removable top plate for installation and termination of conduits. The switchboard enclosure shall be painted on all exterior and interior surfaces. The paint finish shall be a meduim light gray, ANSI #49, applied by

the electro-deposition process over an iron phosphate pre-treatment. All front covers shall be screwed on and removable and all doors shall be hinged with removable hinge pins. Top and bottom conduit areas shall be clearly indicated on shop drawings.

C. Bussing: The switchboard bussing shall be of a sufficient cross-sectional area to meet U.L. Standard 891 temperature rise. Through bus shall be extruded aluminum plated by the Alstan 70 process. The through bus shall have an ampacity where indicated on the single line riser diagram and shall be rated to withstand a short circuit current rating of 50,000 RMS symmetrical ampers. The through bus supports, connections and joints are to be bolted with hex-head bolts and belleville washers to minimize maintenance requirements and shall have provisions for the addition of future sections.

D. Short Circuit Current Rating: Each switchboard, as a complete unit, shall be given a single short circuit current rating by the manufacturer in accordance with U.L. specifications, on equipment constructed similarly to the subject switchboard.

E. Main Circuit Breaker: The service disconnect device shall be a molded case circuit breaker totally front accessible and front connectable. The circuit breaker shall be provided with ground fault protection.

F. Branch Circuit Breakers: Group mounted molded case circuit breakers shall be totally front accessible. The circuit breakers shall be mounted in the switchboard to permit installation, maintenance and testing without reaching over any line side bussing. The circuit breakers are to be removable by the disconnection of only the load side cable terminations and all line and load side connections are to be individual to each circuit breaker. No common mounting brackets or electrical bus connectors will be acceptable.

G. Main switchgear shall be furnished with a phase loss relay with a set of contacts to send a trouble alarm to existing security control panel. Unit shall be furnished, installed and wired by equipment manufacturer. All other wiring required for proper interface to security control panel shall be by the Electrical Contractor. Coordinate all work and provide all required wiring as directed by Owner’s local security system representative.

PART 3 – EXECUTION

3.1 INSTALLATION OF SWITCHGEAR AND SWITCHBOARDS

A. Install switchgear and switchboards where shown, in accordance with manufacturer's written instructions, with recognized industry practices to ensure that switchgear and switchboards comply with requirements of NEMA and NEC Standards, and applicable portions of NECA's "Standard of Installation".

B. Tighten electrical bus connections and mechanical fasteners.

C. Provide connections within switchboard.

3.2 ADJUST AND CLEAN

A. Adjust operating mechanisms for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finish.

3.3 FIELD QUALITY CONTROL

A. Prior to energization of switchboards, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.

B. Prior to energization, check switchboards for electrical continuity of circuits, and for short circuits.

C. Subsequent to wire and cable hook-ups, energize switchboards and demonstrate functioning in accordance with requirements.

END OF SECTION 26 0165

SECTION 26 0170
MOTOR AND CIRCUIT DISCONNECTS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of motor and circuit disconnect switch work is indicated by drawings and schedules.

B. Types of motor and circuit disconnect switches in this section include the following:

Equipment disconnects.

Appliance disconnects.

Motor-circuit disconnects.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data including specifications, installation instructions and general recommendations, for each type of motor and circuit disconnect switch required.

1.3 COORDINATION

A. The drawings are scheme and/or diagrammatic in nature, and indicate the need and intent of the design. These are to be used for general guidance only. It shall be the responsibility of the Electrical Contractor to coordinate, with other Division Subcontractors, the installation of all motor and circuit disconnect switches, supporting hardware, including wiring and conduit, to and from the equipment. This coordination will include conduit layout to allow access to equipment for maintenance.

B. This coordination shall be carried out prior to actual installation; this shall be done to eliminate the possibility of conflicts between trades on items such as access, clearances and maintenance issues that may arise after completion of construction.

C. Should the coordination not be carried out prior to installation, and a conflict exists, the installing contractor shall remove and reinstall the equipment as required to clear the conflict at no additional cost to the Owner and no delay in project completion.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following (for each type of switch):

Cutler-Hammer, Inc. (Eaton)

Square D Company

Siemens

2.2 FABRICATED SWITCHES

A. Safety Switches: Safety switches shall be of sizes noted on the drawings, fusible or non-fusible and contained in a general purpose enclosure. All switches shall be type HD and have quick-make, quick-break operation. All switches shall be of proper horsepower rating as applicable and have dual interlocks designed to interlock the switch box door with the switch operating mechanism. Unit shall be provided with a suitable means of interlock release. An arrangement shall be provided for locking the operating handle in the "ON" or "OFF" position. Safety switches shall have the proper type metal enclosure, i.e., standard, weatherproof, etc., to suit their specific location as required by the National Electrical Code.

B. Fuses: Provide fuses for safety switches, as recommended by switch manufacturer, of classes, types and ratings needed to fulfill electrical requirements for service indicated.

C. When packaged rooftop equipment is furnished, the unit disconnect switch shall be furnished, mounted and wired by the installing contractor.

D. When rooftop exhaust fans rated less than 1/2 HP at 120 volts, single phase, are furnished, except utility sets, the unit disconnect switch shall be furnished, mounted and wired by the installing contractor.

PART 3 – EXECUTION

3.1 INSTALLATION OF MOTOR AND CIRCUIT DISCONNECT SWITCHES

A. Install motor and circuit disconnect switches where indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation", and in accordance with recognized industry practices to ensure that products fulfill requirements.

B. Install disconnect switches used with motor-driven appliances, and motors and controllers within sight of controller position unless otherwise indicated.

C. Provide electrical connections for motor and circuit disconnect switches.

END OF SECTION 26 0170

SECTION 26 0180
OVERCURRENT PROTECTIVE DEVICES

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of overcurrent protective device work is indicated by drawing schedules and specifications.

B. Types of overcurrent protective devices in this section include the following:

1. Service entrance rated disconnect.
2. Molded case circuit breaker.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on overcurrent protective devices, including: voltages and current ratings, interrupting ratings, current limitations, internal inductive and non-inductive loads, time-current trip characteristic curves, and mounting requirements.

B. Shop Drawings: Submit layout drawings of overcurrent protective devices, showing spatial relationships of units to associated electrical equipment, and connections to electrical power supplies.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include the following:

1. Circuit-Breakers

   Cutler-Hammer, Inc. (Eaton)

   Square D Co.

   Siemens

2.2 CIRCUIT BREAKERS

A. Except as otherwise indicated, provide circuit breakers and ancillary components, of types, sizes, ratings and electrical characteristics indicated, which comply with manufacturer's standard design, materials, components, and construction in accordance with published product information, as required for a complete installation.

B. Service Entrance Rated Disconnect: The service disconnect device shall be a molded-case circuit breaker totally front accessible and front connectable. The circuit breaker shall be a three pole device suitable for operation on a 480 volt, 60 Hertz system. Circuit breaker shall have 65,000 RMS symmetrical amperes interrupting rating, and shall be UL approved for Service Entrance equipment.

C. Molded-Case Circuit Breakers: Provide factory assembled, molded-cased circuit breakers of frame size indicated; 120/208 volts, and 277/480 volts 60 Hertz, one, two, or three poles with a short circuit symmetrical ampere interrupting rating as indicated by the panel schedule and/or as shown by the single line riser diagram. Provide circuit breakers with permanent thermal instantaneous magnetic trips in each pole with ampere ratings as indicated. Construct with overcenter, trip-free, toggle type operating mechanisms with quick-make, quick- break action and positive handle trip indication. Construct devices for mounting and operating in any physical position and operating in an ambient temperature of 40 degrees C. Provide circuit breakers with mechanical screw type connector lugs, AL/CU rated.

PART 3 – EXECUTION

3.1 INSTALLATION OF OVERCURRENT PROTECTIVE DEVICES

A. Install overcurrent protective devices as indicated in contract documents, in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC Standards for Installation of overcurrent protective devices.

B. Coordinate with other work, including electrical wiring work, as necessary to interface installation of overcurrent protective devices with other work.

C. Fasten circuit breakers without causing mechanical stresses, twisting or misalignment being exerted by clamps, supports, or cabling.

3.2 ADJUST AND CLEAN

A. Inspect circuit-breaker operating mechanisms for malfunctioning and, where necessary, adjust units for free mechanical movement.

3.3 FIELD QUALITY CONTROL

A. Prior to energization of overcurrent protective devices, test devices for continuity of circuitry and for short-circuits. Correct malfunctioning units, and then demonstrate compliance with requirements.

END OF SECTION 26 0180

SECTION 26 0190
SUPPORTING DEVICES

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Types of supports, anchors, sleeves and seals specified in this section include the following:

Hangers.

Riser Clamps.

C-clamps

I-beam clamps.

One-hole conduit straps.

Two-hole conduit straps.

Round steel rods.

Lead expansion anchors.

Toggle bolts.

U-Channel Strut Systems.

PART 2 – PRODUCTS

2.1 MANUFACTURED SUPPORTING DEVICES

A. Provide supporting devices, complying with manufacturer's standard materials, design and construct in accordance with published product information, and as required for a complete installation, and as herein specified.

B. Supports: Provide supporting devices of types, sizes and materials having the following construction features:

Hangers: For supporting EMT conduit, electro-galvanized steel, with 1/4" minimum diameter hole for round steel rod; approximately MSS types 5, 7, 9 or spring steel conduit clips.

Reducing Couplings: Steel rod reducing coupling, 1/4" minimum black steel.

C-Clamps: Black malleable iron, 1/4" minimum rod size.

I-Beam Clamps: Black steel, 1-1/4" x 3/16" stock; 3/8" cross bolt; flange width 2"; approx. 52 pounds per 100 units.

One-Hole Conduit Straps: For supporting EMT conduit, electro- galvanized steel.

Two-Hole Conduit Straps: For supporting EMT conduit, electro-galvanized steel; 3/4" strap width; and 2-1/8" between center of screw holes.

Hexagon Nuts: For 1/4" rod size; galvanized steel.

Round Steel Rod: Black steel; 1/4" min. dia.

Offset Conduit Clamps: For supporting rigid metal conduit; black steel.

C. Anchors: Provide anchors of types, sizes and materials indicated; and having the following construction features:

Lead Expansion Anchors: 1/4" - 20 Minimum.

Toggle Bolts: Springhead; 3/16 x 4".

D. Manufacturer: Subject to compliance with requirements, provide anchors of the following:

Ackerman Johnson Fastening Systems, Inc.

Elcen Metal Products Co.

Ideal Industries, Inc.

Rawlplug Co., Inc.

Star Expansion Co.

U.S. Expansion Bolt Co.

Erico Products, Inc. (Caddy)

Hilti, Inc.

E. U-Channel Strut Systems: Provide U-channel strut system for supporting electrical equipment, 16-gauge hot dip galvanized steel, construct with 9/16" dia. holes, 8" o.c. on top surface, with standard hot dip galvanized finish, and with the following fittings which mate and match with U-channel.

Beam clamps.

Thinwall conduit clamps.

Conduit hangers.

U-bolts.

F. Manufacturers: Subject to compliance with requirements, provide channel systems of one of the following:

B-Line Systems, Inc.

Elcen Metal Products Co.

Power-Strut Div.; Van Huffel Tube Corp.

Unistrut Div.; GTE Products Corp.

Hilti, Inc.

PART 3 – EXECUTION

3.1 INSTALLATION OF SUPPORTING DEVICES

A. Install hangers and anchors in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NECA, NEC and ANSI/NEMA for installation of supporting devices.

B. Install hangers, supports, clamps and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. Install supports with maximum spacings.

END OF SECTION 26 0190

SECTION 26 0195
POWER SYSTEM STUDIES

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Short Circuit Coordination Study:

1. Short circuit studies, protective device evaluation studies and protective device coordination studies shall be performed by the switchboard manufacturer. The studies shall be submitted to the Engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacture.
2. The studies shall include all portions of the electrical distribution system from the utility service equipment to all downstream distribution and branch panelboards, including normal and emergency equipment.

B. Arc Fault Calculations and Labeling:

1. Complete arc fault available current calculations and labeling shall be provided by the Electrical Contractor. Calculations may be performed by a subcontractor such as the switchboard manufacturer. Calculations shall be submitted to the Engineer prior to manufacture of labels, for review and approval.
2. Calculations shall include all portions of the electrical distribution system from the utility service equipment to <u>all</u> downstream distribution and branch panelboards; and from generator to <u>all</u> emergency distribution and transfer switches.
3. Electrical Contractor shall provide permanent labels on all electrical distribution system equipment as listed above. Labels shall indicate maximum available arc fault current per NEC 2011, Article 110. In addition, labels shall indicate level of personal protective equipment appropriate for the hazard, as defined in NFPA 70E.

PART 2 – DATA ACQUISITION

2.1 DATA COLLECTION FOR THE STUDIES

A. The Contractor shall provide the required data for preparation of the studies. The switchboard manufacturer shall furnish the contractor with a listing of the required data immediately after award of the contract.

B. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacture.

C. The Contractor shall be responsible for provision of all feeder lengths required for all calculations.

2.2 SHORT CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

A. The short circuit study shall be performed with the aid of a digital computer program and shall be in accordance with ANSI C37.5-1969 (R1975), IEEE Std. 320-172 and IEEE Std. 141-1976.

B. The study input data shall include the Power Company's short circuit contribution, resistance and reactance components of the branch impedances, the X/R ratios, base quantities selected, and other source impedances. This data shall be obtained by the contractor from the Utility Company.

C. Short circuit close and latch duty values and interrupting duty values shall be calculated on the basis of assumed three-phase bolted short circuits at each switchgear bus, medium voltage controller, switchboard, low voltage motor control center, distribution panelboard, pertinent branch circuit panel and other significant locations through the system. The short circuit tabulations shall include symmetrical fault currents and X/R ratios. For each fault location, the total duty on the bus, as well as

the individual contribution from each connected branch, shall be listed with its respective X/R ratio.

D. A protective device evaluation of circuit breakers, disconnect switches, and fuses by tabulating and comparing the short circuit ratings of these devices with the calculated fault currents. Appropriate multiplying factors based on system X/R ratios and protective device rating standards shall be applied. Any problem areas or inadequacies in the equipment due to short circuit currents shall be promptly brought to the Engineer's attention.

2.3 PROTECTIVE DEVICE COORDINATION STUDY

A. A protective device coordination study shall be performed to provide the necessary calculations and logic decisions required to select the protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low voltage breaker trip characteristics and settings.

B. The coordination study shall include all medium and low voltage classes of equipment from the building service protective devices down to and including the largest rated device in the MCC low voltage motor control center and panelboard. The phase and ground overcurrent protection shall be included as well as settings of all other adjustable protective devices.

C. The time-current characteristics of the specified protective devices shall be drawn on Keuffel and Esser Log - log paper. The plots shall include complete titles, representative one-line diagram and legends, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breaker trip curves and fuses. The coordination plots shall indicate the types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, transformer magnetizing inrush and ANSI transformer withstand parameters, cable thermal overcurrent withstand limits and significant symmetrical and asymmetrical fault currents. All restrictions of the National Electrical Code shall be adhered to and proper coordination intervals and separation of characteristic curves shall be maintained. The coordination plots for phase and ground protection devices shall be provided on a system basis. A sufficient number of separate curves shall be used to clearly indicate the coordination achieved.

D. The selection and settings of the protective devices shall be provided separately in a tabulated form listing circuit identification, IEEE device number, current transformer ratios and connection, manufacturer and type, range of adjustment and recommended settings. Any discrepancies, problem areas, or inadequacies shall be promptly brought to the Engineer's attention.

2.4 STUDY REPORT

A. The results of the Power System Study shall be summarized in a final report. Submit six (6) bound copies of final report.

B. The report shall include the following sections:

1. Description, purpose, basis and scope of the study and a single line diagram of that portion of the power system which is included within the scope of the study.
2. Tabulations of circuit breakers, and other protective device ratings versus calculated short circuit duties, and commentary regarding same.
3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, and commentary regarding same.
4. Fault current calculations including a definition of terms and guide for interpretation of computer printout.

PART 3 – EXECUTION

3.1 PROTECTIVE DEVICE TESTING, CALIBRATION AND ADJUSTMENT

A. The equipment manufacturer shall provide the services of a qualified field Engineer any necessary

tools and equipment to test, calibrate and adjust the protective relays and circuit breaker trip devices as recommended in the Power System Study.

3.2 ARC FAULT LABELING

A. Contractor shall submit sample of arc fault label during shop drawing review for approval.

END OF SECTION 26 0195

SECTION 260452
GROUNDING

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Types of grounding in this section include the following:

Grounding:

Underground metal piping.

Underground metal water piping.

Grounding rods.

Service equipment.

Enclosures.

Systems.

Equipment.

Building Structural Steel (Bonding)

PART 2 – PRODUCTS

2.1 GROUNDING

A. Except as otherwise indicated, provide each electrical grounding system indicated, with assembly of materials including, but not necessarily limited to, cables/wires, connectors, terminals (solderless lugs), and other items and accessories needed for complete installation. Where materials or components are not otherwise indicated, comply with NEC, NEMA, and established industry standards for applications indicated.

B. Provide conduit, tube, duct, cable and fittings complying with Division 26 Basic Materials and Methods section, "Raceways", in accordance with the following listing:

Rigid steel conduit.

Electrical metallic tubing.

Flexible metal conduit.

Liquid-tight flexible metal conduit.

Rigid metal conduit fittings.

EMT fittings.

Flexible metal conduit fittings.

Liquid-tight flexible metal conduit fittings.

Manufactured Cabling Systems

2.2 ELECTRICAL GROUNDING CONDUCTORS

A. Unless otherwise indicated, furnish a green insulated equipment grounding conductor for all feeders and branch circuits, matching power supply wiring materials and sized according to NEC.

2.3 BONDING PLATES, CONNECTIONS, TERMINALS & CLAMPS

A. Provide electrical bonding plates, connectors, terminals and clamps as recommended by bonding plate, connector, terminal and clamp manufacturers for applications.

2.4 GROUND RODS & PLATES

A. Ground Rods: Steel with copper welded exterior, 3/4" dia. x 10'.

PART 3 – EXECUTION

3.1 INSTALLATION OF GROUNDING SYSTEMS

A. Install electrical grounding systems in accordance with manufacturer's written instructions and with recognized industry practices to ensure grounding complies with requirements. Comply with requirements of NEC, NESC, NEMA and UL standards for installation of grounding systems.

B. Coordinate with other electrical work as necessary to interface installation of grounding system with other work.

C. Clamp cable connections to ground rods.

D. Install bonding jumpers with ground clamps on water meter piping to electrically bypass water meter.

E. Install clamp-on connectors only on thoroughly cleaned metal contact surfaces, to ensure electrical conductivity and circuit integrity.

3.2 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical grounding system, test ground resistance with ground resistance tester. Where tests show resistance-to-ground is over 25 ohms, take appropriate action to reduce resistance to 25 ohms or less by driving additional ground rods and/or by chemically treating soil encircling ground rods with sodium chloride, calcium chloride, copper sulphate, or magnesium. Then retest to demonstrate compliance.

END OF SECTION 26 0452

SECTION 26 0460
TRANSFORMERS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of transformer work is indicated by drawings and schedules.

B. Types of transformers in this section include the following:

Dry type transformers (Energy Star NEMA TP-1 compliant)

Pad-mounted, oil-filled transformers

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on power/distribution transformers, including certification of transformer performance efficiency at indicated loads, percentage regulation at 100% and 80% power factor, no-load and full-load losses in watts, % impedance at 75 Degrees C, hot-spot and average temperature rise above 40 degrees C ambient, sound level in decibels and standard published data including dimensions and net and shipping weights.

B. Shop Drawings: Submit dimensioned drawings of transformer installations, showing mountings and supports.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of transformer):

Pad Mounted	Dry
Cooper	General Electric
The ABB Group	Sorgel Electric Division/Square D Company
Approved Substitute	Cutler-Hammer/Eaton Electrical, Inc.
	The ABB Group
	Siemens Energy & Automation, Inc.
	Approved Substitute

2.2 POWER/DISTRIBUTION TRANSFORMERS

A. Except as otherwise indicated, provide manufacturer's standard materials and components as indicated by published product information designed and constructed as recommended by manufacturer, and as required for complete installation.

B. Three Phase Distribution Transformers: Provide open ventilated dry- type three phase distribution transformers, 480-volt delta primary, 120/208-volt secondary with KVA rating as indicated on the drawings. Transformers shall have 220°C Class insulation and temperature rise rating of 150 degrees C. Unit shall be provided with four approximately 2-1/2% taps, two above and two below rated primary voltage. A low voltage neutral terminal shall be provided. Coils shall be enclosed by a sheet steel enclosure comprised of readily removable sections having ventilated openings in front cover. Core and coil assemblies shall be mounted on rubber isolation pads. Limit terminal compartment to 75 degrees C. at full-rated load. Provide wiring connectors suitable for copper wiring. Cushion-mount transformers with external vibration isolation supports. Electrically ground core and coils to transformer enclosure by means of flexible metal grounding strap.

C. Pad-Mounted Transformers:

1. The transformer shall be compartmental type, self-cooled, tamper-proof and weatherproof for mounting on a pad and shall comply with latest applicable standards of the National Electrical Manufacturers Association (NEMA) and the American National Standards Institute (ANSI). There shall be no exposed screws, bolts, or other fastening devices which are externally removable.
2. The transformer shall be of the sealed tank construction of sufficient strength to withstand a pressure of 7 psi without permanent distortion. The cover shall be welded and the fastenings tamperproof. The transformer shall remain effectively sealed for a top oil temperature range of 50 deg. C to 106 deg. C. When required, cooling panels will be provided on the back and sides of the tank. Lifting eyes and jack pads shall be provided.
3. The core and coil assembly shall be wound core type with aluminum windings. A tap changing mechanism shall be provided for deenergized operation only and externally operable with two 2-1/2% full capacity taps above and two 2-1/2% full capacity taps below normal rated primary voltage.
4. Transformer Characteristics:

   "TFH-1"

   a. KVA — 750 kva
   b. Coolant — Oil
   c. Primary voltage & connection — 14,400/24,940 wye
   d. Secondary voltage & connection — 480/277, 3 Phase, 4 Wire Wye
   e. Frequency — 60 Hertz
   f. Temperature rise — 65 deg.
   g. Basic Impulse Level — 125 KV
   h. Impedance — 5.75% Max.

8. The high and low voltage compartment shall be located side-by-side separated by a steel barrier. When facing the transformer, the low voltage compartment shall be on the right. Terminal compartment shall be full height, air filled with individual doors. The high voltage door fastenings shall not be accessible until low voltage door has been opened. The low voltage door shall have a 3-point latching mechanism with vault type handle having provisions for a single padlock. The doors shall be equipped with lift-off type stainless steel hinges and door stops to hold the doors open when working in the compartments. The front sill of the compartment shall be removable to allow the transformer to be rolled or skidded into position over conduit stubs. ANSI tank grounding provisions shall be furnished in each compartment.
9. The high voltage terminations and equipment shall be dead front and conform to ANSI C57.12.26 requirements. The dead front bushings wells shall have feed-thru inserts designed for use with elbow type terminators and elbow type surge arresters, for operation with distribution hot stick.

   a. Elbow type terminators: Furnish a one piece, three-phase, non-skirted, shielded, loadbreak elbow type rubber termination, classified as ANSI/IEEE Standard 386 "200 AMP loadbreak Interface No. 1", 14.4/24.94 KV, with the following characteristics:

      (1) Standard voltage class — 25KV
      (2) Maximum rating phase to phase — 26.3KV
      (3) Maximum rating phase to ground — 15.2KV
      (4) AC 60 Hz. 1 minute withstand — 40KV

(5) DC 15-min. withstand 78KV

(6) Bil and full wave crest 125KV

(7) Min. corona voltage level 19KV

b. Elbow type surge arresters: Shall combine metal oxide varistor technology in a premolded rubber elbow to provide overvoltage system protection in an insulated fully shielded, deadfront device, with the following characteristics:

(1) Standard voltage class 25KV

(2) Max. operating voltage 18.6KV

(3) Equiv. front of wave voltage 67.5KW

(4) Discharge voltage - 1.5KA 60.0KV

5KA 70.0KV

10KA 78.0KV

20KA 86.0KV

(5) MCOV Rating 18.6KV

Surge arrester shall be designed for use with RTE 200 A loadbreak bushings, similar to RTE components.

10. The low voltage bushings shall be molded epoxy and provided with blade type spade terminals with NEMA standard hole spacing arranged for vertical take-off. The low voltage neutral shall be an insulated bushing grounded to the transformer tank by a removable ground strap.

11. Furnish the following accessories:

a. Nameplate in low voltage compartment.

b. One-inch drain valve with sampling device.

c. Dial type thermometer.

d. Liquid level gauge.

e. Pressure-vacuum gauge.

f. Pressure relief device (self-resealing with indicator).

PART 3 – EXECUTION

3.1 INSTALLATION OF TRANSFORMERS

A. Install transformers as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA and IEEE Standards, and in accordance with recognized industry practices to ensure that products fulfill requirements.

B. Install units on vibration mounts; comply with manufacturer's installation method if any.

3.2 GROUNDING

A. Provide tightly fastened equipment grounding and bonding connections for transformers.

3.3 TESTING

A. Upon completion of installation of transformers, energize primary circuit at rated voltage and frequency from normal power source and test transformers, including, but not limited to, audible sound levels, to demonstrate capability and compliance with requirements. Where possible, correct malfunction units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

END OF SECTION 26 0460

SECTION 26 0470
DISTRIBUTION CIRCUITS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Distribution circuit work is indicated by drawings and schedules.

B. The distribution circuits shall include furnishing and installing a complete wire and conduit system between distribution panelboards and branch circuit panelboards.

C. Types of equipment to be furnished and installed in this section include the following:

Rigid Metal Conduit

Intermediate Metal Conduit (IMC)

Electrical Metallic Tubing (EMT)

PVC (Below Slab Only)

Wires and Cables

Junction Boxes

Pull Boxes

Conduit Bodies

Bushings

Locknuts

Supporting Devices

PART 2 – PRODUCTS

2.1 DISTRIBUTION CIRCUITS

A. Furnish and install each distribution circuit indicated, with assembly of materials, including but not necessarily limited to, conduit, wire, pull boxes, junction boxes and other items and accessories needed for a complete installation. Where materials or components are not otherwise indicated, comply with NEC, NEMA and established industry standards for applications indicated.

PART 3 – EXECUTION

3.1 INSTALLATION OF DISTRIBUTION CIRCUITS

A. Install distribution circuits complying with equipment manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation", and in accordance with recognized industry practices.

B. Multiple circuits within a single raceway shall not be permitted under this section.

END OF SECTION 26 0470

SECTION 26 0471
FEEDER CIRCUITS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Feeder circuit work is indicated by drawings and schedules.

B. The feeder circuits shall include furnishing and installing a complete wire and conduit system between distribution panelboards and major 3 phase loads, between power panels and 3 phase motor loads.

C. Types of equipment to be furnished and installed in this section include the following:

Rigid Metal Conduit

Electrical Metallic Tubing (EMT)

Intermediate Metal Conduit (IMC)

Wires and Cables

Junction Boxes

Pull Boxes

Conduit Bodies

Bushings

Locknuts

Supporting Devices

PART 2 – PRODUCTS

2.1 FEEDER CIRCUITS

A. Furnish and install each feeder circuit with assembly of materials, including but not necessarily limited to, conduit, wire, pull boxes, junction boxes and other items and accessories needed for a complete installation. Where materials or components are not otherwise indicated, comply with NEC, NEMA and established industry standards for applications indicated.

PART 3 – EXECUTION

3.1 INSTALLATION OF FEEDER CIRCUITS

A. Install feeder circuits, complying with equipment manufacturer's written instructions, applicable requirements of NEC, NEMA and NECA's "Standard of Installation", and in accordance with recognized industry practices.

B. Multiple circuits within a single raceway shall not be permitted under this section.

END OF SECTION 26 0471

SECTION 26 0472
BRANCH CIRCUITS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Branch circuit work is indicated by drawings.

B. The branch circuits shall include furnishing and installing a complete wire and conduit or cable system between panelboards and lighting fixtures, receptacles, fractional horsepower motors, and small single-phase loads.

C. Types of equipment to be furnished and installed in this section include the following:

Rigid Raceways – See Section 260110

Electrical Metallic Tubing (EMT)

MC (Metal Clad) (Concealed Work only)

Wires and Cables

Junction Boxes

Pull Boxes

Conduit Bodies

Bushings

Locknuts

Supporting Devices

PART 2 – PRODUCTS

2.1 BRANCH CIRCUITS

A. Furnish each branch circuit with an assembly of materials, including but not necessarily limited to, conduit, wire, cable, pull boxes, junction boxes and other items and accessories needed for a complete installation. Where materials or components are not otherwise indicated, comply with NEC, NEMA and established industry standards for applications indicated.

2.2 CONVENIENCE BRANCH CIRCUITS

A. Intent:

1. The intent of this portion of the specifications is to describe the requirements of a convenience circuit as it applies to 120-volt receptacles.
2. All convenience branch circuits may consist of more than one 120-volt receptacle.

B. Convenience Circuit - General: A circuit consisting of a phase and neutral conductor, which may share its neutral with other phase conductors provided that the neutral conductor does not become overloaded due to circuit phase relationship. This type of circuit shall also include an equipment grounding conductor as described under the grounding section of the specifications.

C. Convenience Circuit - Dedicated: A circuit consisting of a phase and neutral conductor which DOES NOT share conductors with any other circuits. This type of circuit shall also include an equipment grounding conductor as described under the grounding section of the specifications.

PART 3 – EXECUTION

3.1 INSTALLATION OF BRANCH CIRCUITS

A. Install branch circuits, complying with equipment manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation", and in accordance with

recognized industry practices.

B. Multiple circuits within a single raceway or cable shall be permitted under this section. It shall be the responsibility of the Electrical Contractor to assure that the neutral conductors do not become overloaded due to circuit phase relationship.

C. The Electrical Contractor may elect to use metal clad cable in lieu of electrical metallic tubing (EMT) in wall cavities, and/or above tile or dry wall ceilings. In all areas of exposed construction, electrical metallic tubing (EMT) shall be installed.

END OF SECTION 26 0472

SECTION 26 0510
BUILDING LIGHTING

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Lighting fixture work is indicated by specifications, drawings and schedules.

B. Types of lighting fixtures in this section include the following:

1. LED

C. Applications of lighting fixtures required for the project include the following:

1. General Lighting.
2. Supplementary Lighting.
3. Emergency Lighting.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on building lighting fixtures.

B. Shop Drawings: Submit dimensioned drawings of lighting fixture installations, including but not necessarily limited to, layout, relation to associated panelboards, and connections to panelboards. Submit fixture shop drawings in booklet form with separate sheet for each fixture, assembled in luminaire "type" alphabetical order, with proposed fixture and accessories clearly indicated on each sheet.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Each lighting fixture type specified represents a specific style and quality of fixture acceptable for this project.

B. The Engineer reserves the right to reject any shop drawing and to request a resubmission should the contractor submit a shop drawing of an equivalent manufacturer which is viewed as being of an incompatible style or inferior quality.

C. No fixture shop drawing shall be submitted, nor will any be accepted, for any manufacturer which is not specifically listed for that fixture type. When a fixture manufacturer is listed for a specific fixture type, this does not provide him with the right to submit for fixtures he is not listed under. A bidding Contractor may elect to bid using non-listed fixtures for the listed Lighting Representatives. The Engineer and the Architect shall make the final decision on whether the submitted fixture meets the project's requirements during shop drawing review.

D. Should the Contractor be unable to obtain approval of the resubmitted manufacturer, then he should submit the basis of design specified manufacturer/fixture.

2.2 LIGHTING FIXTURES

A. Provide lighting fixtures of the size, type and rating indicated complete with, but not necessarily limited to, housings, lamp holders, reflectors, ballast, lamps, mounting frames, pendants and wiring; wired and connected in place, complete, tested and left in satisfactory operating condition.

B. LED Drivers

1. All LED fixtures shall be provided with integral drivers (unless noted otherwise) and must operate at line voltage as indicated on drawings (unless noted otherwise).
2. LED drivers shall have operating temperature of 50°F - 140°F unless noted otherwise.
3. LED drivers shall carry a 5-year warranty.

C. Fixture Lamps: For the type, number and color of the fixture lamps, refer to the Lighting Fixture Schedule on the drawings.

PART 3 – EXECUTION

3.1 INSTALLATION OF LIGHTING FIXTURES

A. Install lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", NEMA Standards and with recognized industry practices to ensure that lighting fixtures fulfill requirements of the project.

B. Install lighting fixtures in removable tile ceilings using 3/8" flexible metal conduit with 3 # 12 awg. conductor. Maximum length of flexible lead shall not exceed 60". Flexible lead shall extend from the fixture to the junction box. The junction box shall be securely fastened to the building structure above the removable tile ceiling and shall not serve more than two (2) lighting fixtures, nor shall the junction box support any of the lighting fixtures.

3.2 LIGHTING FIXTURE MOUNTING

A. 1' x 4', 2' x 2' and 2' x 4' fixtures installed in a removable tile ceiling shall be installed using T-Bar grid safety clips as provided by the fixture manufacturer and as required by the NEC.

B. 2'x 2' and 2' x 4' fixtures installed in a removable tile ceiling shall be installed using support wires at all four corners of the fixture. The support wires shall be carried up to the building structure and securely anchored using screwed or bolted hardware. Pressure type clips will not be acceptable. The Electrical Contractor shall be responsible for installing or having installed these four (4) support wires.

C. 1' x 4' fixtures installed in a removable tile ceiling shall be installed using support wires at two (2) corners of the fixture. The support wires shall be carried up to the building structure and securely anchored using screwed or bolted hardware. Pressure type clips will not be acceptable. The Electrical Contractor shall be responsible for installing or having installed these Two (2) support wires.

D. Downlights installed in a removable tile ceiling shall be installed using 24" spreader bars attached to the T-Bar grid system. Two (2) support wires shall be installed, one (1) on each side of the fixture and centered between the spreader bars, these support wires shall be carried up to building structure and securely anchored using screwed or bolted hardware. Pressure type clips will not be acceptable. The Electrical Contractor shall be responsible for installing or having installed these two (2) support wires.

E. Pendant lighting fixtures, either chain, cable or stem hung below a removable tile ceiling shall be installed in accordance with fixture manufacturer's written instructions and recommendations. The Electrical Contractor shall furnish and install support wire or threaded rod from the fixture mounting hardware up to building structure and securely anchor using screwed or bolted hardware. Pressure type clips will not be acceptable. These support devices shall be independent from the ceiling T-Bar grid system, the system may be used as a guide, but in no way shall the T-Bar grid system carry any of the weight produced by the fixture or it's support devices.

F. Surface mounted fixtures installed on removable tile ceilings or dry wall ceilings shall be installed in accordance with fixture manufacturer's written instructions and recommendations.

1. Fixtures installed on removable tile ceilings shall be anchored to the T-Bar grid system using snap-on clips with threaded studs and wing nuts. The Electrical Contractor shall furnish and install a support wire from each snap-on clip carried up to building construction and securely anchor using screwed or bolted hardware.

2. Fixtures installed on dry wall ceilings shall be mounted using spring-loaded toggle bolts. The number and location of the anchors shall depend on the fixture manufacture's written

instructions and recommendations. It shall be the responsibility of the Electrical Contractor to follow these instructions and recommendations.

3.3 ADJUST and CLEAN

A. Clean lens, reflectors and interiors of all lighting fixtures of dirt and construction debris upon completion of installation.

B. Protect installed lighting fixtures from damage during the remainder of the construction period.

3.4 FIELD QUALITY CONTROL

A. Upon completion of the installation of the lighting fixtures, and after the building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with project requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

B. At the time of Substantial Completion, replace lamps in lighting fixtures which are observed to be noticeably dimmed after Contractor's use and testing, as judged by the Architect/Engineer. Furnish stock or replacement lamps amounting to 15% (but not less than one (1) lamp in each case) of each type and size used in each type of fixture. Deliver the replacement stock as directed to the Owner's storage area.

1. Refer to Division 1 sections for the replacement/restoration of lamps in lighting fixtures, where used for temporary lighting prior to the time of Substantial Completion.

C. Replace defective and burned out lamps for a period of one (1) year following the time of Substantial Completion.

3.5 GROUNDING

A. Provide tight equipment grounding connections for each lighting fixture installation, in accordance with fixture manufacturer's recommendations and the NEC's requirements.

END OF SECTION 26 0510

SECTION 26 0606
AUTOMATIC TRANSFER SWITCHES

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of A.T.S. work is indicated by drawings, schedules and specifications.

B. Types of A.T.S. specified in this section include the following:

Automatic Transfer Switches

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on A.T.S. and components.

B. Shop Drawings: Submit dimensioned drawings of automatic transfer switches, including accessories, but not limited to the following:

1. System schematic diagram showing all required conduit, wiring interconnections, sizes and quantities.
2. Complete conduit, electric power, control schematics and flow diagrams.
3. Ladder type schematic electrical diagrams with legend identifying all devices on diagrams.

PART 2 – PRODUCTS

2.1 EMERGENCY POWER SYSTEM

A. Furnish A.T.S. and components of types, ratings, and electrical characteristics indicated, consisting of, but not limited to, power transfer module, control module and equipment housing with all required interconnections.

2.2 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, provide products of one of the following:

Automatic Switch Company (ASCO)

Florham Park, New Jersey 07932

Russelectric, Inc.

South Short Industrial Park

Hingham, MA. 02043

B. These specifications are designed and written around the characteristics of ASCO Automatic Transfer Switches and represent the minimum requirements for all other listed manufacturers.

2.3 AUTOMATIC TRANSFER SWITCHES

A. The automatic transfer switches shall consist of a power transfer module and a control module, interconnected to provide a complete automatic power transfer operation. The switch shall be mechanically held and electrically operated by a single solenoid mechanism energized from the source to which the load is to be transferred. The switch shall be rated for continuous duty and be inherently double throw. The switch shall be mechanically interlocked to ensure only one of two positions--normal or emergency.

B. The automatic transfer switches shall be suitable for use with an engine-driven generator source.

C. All main contacts shall be of silver composition. The operating transfer time in either direction shall not exceed one-sixth (1/6) of a second.

D. All contacts, coils, springs and control elements shall be conveniently removable from the front of the transfer switch without major disassembly or disconnection of power conductors.

E. The control module shall be supplied with a protective cover and be mounted separately from the transfer switch for ease of maintenance. Sensing and control logic shall be solid-state and mounted on plug-in printed circuit boards. Printed circuit boards shall be keyed to prevent incorrect installation. Interfacing relays shall be industrial control grade plug-in type with dust covers.

2.4 COMPLIANCE WITH CODES AND STANDARDS

A. The automatic transfer switch and the bypass-isolation switch shall conform to the current requirements of:

1. Underwriters Laboratories UL-1008
2. National Electrical Code Articles 517, 700, 701 and 702.
3. National Fire Protection Association 99 and 110.
4. National Electrical Manufacturer's Association Standard ICS-2-447.

B. Automatic transfer switches utilizing components of molded case circuit breakers, contactors or parts thereof which have not been intended for continuous duty or repetitive load transfer switching shall not be acceptable.

C. Transfer switches rated 400 amperes and less shall be suitable for 100 percent tungsten-filament lamp load.

D. The automatic transfer switch shall be rated to withstand the RMS symmetrical short circuit current available at the automatic transfer switch terminals with the type of overcurrent protection and voltage as indicated on the single line riser diagram.

2.5 ACCESSORIES

A. Provide accessory devices as follows:

1. Two (2) N.O. and two (2) N.C. auxiliary contacts.
2. Solid Neutral (ASCO Accessory No. 22).
3. Overlapping neutral transfer contacts (ASCO Accessory No. 28)
4. In-Phase Monitor (ASCO Accessory No. 27)
5. Engine Exerciser (ASCO Accessory No. 11C) Install on one (1) switch only.

2.6 SWITCH TYPE

A. The automatic transfer switches and controls shall be mounted in a NEMA Type 1, General Purpose enclosure. Switch types shall be as follows:

1. Automatic Transfer Switch: ASCO Type 300

PART 3 – EXECUTION

3.1 INSTALLATION OF EMERGENCY POWER SYSTEM

A. Install Emergency Power System as indicated in contract documents, and in accordance with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that the system equipment complies with requirements. Comply with requirements of NEC and applicable portions of NECA's "Standard of Installation" pertaining to general electric installation practices.

B. The Electrical Contractor shall furnish and install all power wiring as indicated and all control wiring as required by the automatic transfer switch and engine generator manufacturers.

3.2 GROUNDING

A. Provide equipment grounding connections, sufficiently tight to assure permanent and effective ground, for Optional Emergency Power System equipment as indicated in contract documents.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation of Emergency Power System equipment, and after building circuitry has been energized with normal power source, test system to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

3.4 OPERATION, MAINTENANCE, INSTRUCTION MANUALS

A. Provide three (3) operation and maintenance instruction manuals, including spare parts list, to the Owner.

END OF SECTION 26 0606

SECTION 26 0612
EMERGENCY GENERATOR SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. Provide a 22-kW standby power system to supply electrical power at 208/120 Volts, 60 Hertz, 3-Phase. The generators shall consist of a liquid cooled spark-ignited engine, a synchronous AC alternator, a paralleling switch, and system controls with all necessary accessories for complete operating system, including but not limited to the items as specified hereinafter.

B. Types of Emergency Generator System equipment required for project include the following:

Natural gas engine-driven generators.

Weatherproof Enclosures

Fuel piping

Battery Charger

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on engine driven electric generator systems and components.

B. Shop Drawings: Submit dimensioned drawings of engine driven generator units and accessories, including but not limited to the following:

1. System schematic diagram showing all piping and wiring interconnections, sizes and quantities.
2. Installation fact sheet giving fuel, coolant, lubricating oil, exhaust, ventilation, and other pertinent requirements.
3. Complete piping, conduit, electric power and control schematics, and flow diagrams.
4. Engine generator and enclosure elevations (1/10th scale or larger) showing the locations, size, and dimensions of all required Owner interfaces to the package.
5. Ladder type schematic electrical diagrams with legend identifying all devices on diagrams.
6. Factory certified horsepower and fuel consumption data.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, furnish Emergency generator systems of one of the following:

Caterpillar, Inc.

MTU Onsite Energy

Generac Industrial Power

Kohler Co.

Cummins Power Generation

2.2 ENGINE GENERATOR UNIT

A. The following specifications are designed and written around the characteristics of a Generac Engine Generator and represent the minimum requirements for all other listed manufacturers.

B. Natural Gas Engine Generators: Furnish an alternating current generators as indicated in contract documents, with a standby rating of 22KW/27KVA @ 208/120 volt, 3 phase, 4 wire, 60 Hertz, 0.8 percent power factor each. Furnish all the following components, accessories and construction

features as required for a complete and satisfactory operating system. 3 phase, 4 wire, 60 Hz, 0.8 percent power factor, 22 KW, natural gas engine. All accessories and the following components and construction features as required for a complete and satisfactory operating system.

2.3 ENGINE

A. The engine shall be four (4) cylinder, 2 or 4 cycle, water cooled, turbo-charged, after-cooled, with not less than 785 cubic inch displacement. Engine speed shall be governed by a gear driven governor to maintain generator frequency within 0.5% Hertz from no load to 100% rated load.

B. A 12-volt D.C., negative ground electric starting system consisting of a minimum of 525 AMPs cranking current at an ambient temperature of 0 deg. F, A 30 AMP battery alternator, battery racks and a complete set of battery cables.

C. Batteries shall be selected and furnished to comply with NFPA 110, Level 1 starting requirements. Each battery shall be 12-volt, maintenance free, lead-calcium hybrid type with sealed cells. The batteries shall be commissioned according to battery manufacturer's instructions.

2.4 ALTERNATOR

A. The alternator shall be four (4) pole, rotating field, self-ventilated, dripproof construction. Class "H" insulation system per NEMA MG1-1.66, with standard 130 deg. C temperature rise at standby power rating.

B. Furnish skewed rotor and 2/3 pitch windings to smooth voltage wave form, minimize field heating and voltage harmonics.

C. Rotor shall be a dynamically balanced assembly, with a single bearing and direct coupled to engine by a flexible drive disc. Furnish full amortisseur (damper) windings to help minimize voltage deviations and heating effects under unbalanced load conditions.

D. The voltage regulator shall be solid state and furnish torque-matched underfrequency compensation to optimize motor starting performance and to assist the engine during transient load conditions. Voltage regulation from no load to full load shall be +/- 2%.

E. The exciter shall be a permanent magnet, field rotating, brushless armature and shall power the main alternator field windings through shaft mounted, three (3) phase, full wave silicon diode rectifiers. Semi-conductor surge suppressors shall protect the diodes from transient overvoltages induced by load surges.

F. The shunt excitation system shall derive its power from the main output of the alternator.

2.5 CONTROL PANEL

A. Furnish a unit-mounted, automatic start, level 1 control panel, with suitable vibration isolators. Panel shall consist of, but not be limited to, the following:

Equipment

1. Errorproof wiring harness for electrical connections.
2. Lamp test switch.
3. Cyclic cranking
4. Overcrank and starter unmesh protection.
5. Two-wire remote start/stop terminals.
6. AC interlock to prevent starter re-engagement with engine running.
7. Overspeed detection.
8. Voltage-adjust Rheostat +/- 5%.
9. Run - OFF/RESET - Auto switch.

10. Emergency stop pushbutton.
11. Low coolant level detection.
12. D.C. circuit protection.
13. Panel lamps (2).
14. Cool-down timer (5 minutes)
15. Alarm horn and silencing switch.

Instruments

1. A.C. Voltmeter, 3-1/2", 2% full scale accuracy
2. A.C. Ammeter, 3-1/2", 2% full scale accuracy.
3. A.C. Frequency meter, 3-1/2", 0.5% full scale accuracy.
4. D.C. Voltmeter.
5. Engine water temperature.
6. Engine oil temperature.
7. Running time meter.
8. Phase selector switch, seven (7) position.

Indicator Lamps

1. Overcrank
2. Low oil pressure
3. High engine temperature
4. Overspeed
5. Emergency stop
6. Not-In-Auto
7. System ready
8. Low battery volts
9. Battery charge fault
10. Low fuel.
11. Prealarm high engine temperature
12. Prealarm low oil pressure.
13. Low water temperature.
14. Auxiliary alarm
15. Auxiliary prealarm
16. Air damper.

B. Furnish and install all required control wiring, fuses, fuse blocks, terminal blocks, nameplates, fault contacts, auxiliary contacts, and metering current transformers.

2.6 COOLING SYSTEM

A. Engine shall have a unit-mounted radiator with engine-driven cooling fan. The radiator shall be sized to adequately cool the engine under full load conditions as outlined, in a 125 degrees F ambient temperature and have adequate capacity for additional heat radiated by engine. A fan and radiator guard shall be included.

B. Anti-freeze shall be a 50% mixture of ethylene glycol and water and shall contain a suitable rust inhibiting agent and be installed in the cooling system. The unit shall be furnished with, as a minimum total replacement, an additional supply of 50% ethylene glycol and water coolant mixture.

2.7 EXHAUST SYSTEM

A. Furnish one (1) critical grade silencer, with a side inlet and end outlet configuration. Inlet and outlet shall be NPT thread.

B. Silencer shall include a condensate drain plug, and be mounted on the enclosure roof and piped to the engine by means of a stainless-steel exhaust flexible piping.

C. Silencer outlet end shall have a 90-deg. exhaust pipe extension terminating vertically, with a counterbalanced rain cap.

2.8 ENGINE HEATERS AND ACCESSORIES

A. Lube oil heater shall be a 150-watt, 120-volts, single phase thermostatically controlled device. The heater shall be furnished, installed and wired at the factory.

B. Battery heaters shall be a thermostatically controlled, low wattage pad type device, suitable for operation on a 120 volt, single phase circuit.

2.9 BATTERY CHARGER

A. Charger shall be a fully automatic, SCR, float/equalize battery charger. The 12-volt, 30 AMP, silicon controlled rectifier shall be a constant voltage, current limiting charger designed to be permanently connected for float/equalize charging of lead acid starting batteries. The charger shall furnish automatic "Fload-to-Equalize" operation with individual potentiometer adjustments, and shall charge a minimum of 12 lead-acid maintenance free battery cells.

B. Charger shall be furnished with an oversized transformer and heatsink to allow for constant current charging at 30 AMPs, up to the equalize voltage settings.

C. The charger shall be furnished in a NEMA 1, general purpose enclosure, with the following equipment, components and features:

1. DC voltmeter
2. DC ammeter
3. ON/OFF power switch
4. Input and output fuse protection and terminal blocks.
5. Operational monitors shall provide visual output as well as individual Form C relay contacts for the following:
   a. Battery Charger Fault: N.O. contacts close on loss of A.C. input or loss of D.C. output.
   b. Low Battery Voltage: N.O. contacts close on low battery voltage.
   c. High Battery Voltage: N.O. contacts close on high battery voltage, contacts not used.

D. The charger shall be a wall-mounted unit suitable for operation on a 120 volt, single phase power source.

2.10 WEATHER RESISTANT OUTDOOR ENCLOSURE

A. The diesel engine generator and its required accessories shall be furnished with a factory installed, base mounted, maintenance free, pre-painted forest green outdoor enclosure.

B. Enclosure shall be made of heavy gauge aluminum, sound attenuated to reduce generator set noise to 85 DBA @ 23', and shall totally enclose the generator set, its accessories and sub-base fuel oil storage tank.

C. Design Criteria:

1. Rigidity wind test equal to 115 MPH.
2. Roof load equal to 50 lbs. per sq. ft.
3. Rain test equal to 4" per hour.
4. Dimensions: Normal 6' long x 3' wide x 3' high.

D. Enclosure shall consist of a roof, underframe, two (2) side walls, and two (2) end walls, of prepainted aluminum construction and floor.

1. Roof: One piece cambered roof sheet of .040" thick aluminum with 1/8" extruded aluminum recessed side and end rails.
2. Roof bows: Extruded aluminum "I" beams spaced with roof reinforced to carry silencer load.
3. Side and End Walls: Panels shall be .040" thick aluminum sheet, mill-prepainted, riveted 3" on center.
4. Floor and Underframe: Enclosure will have two (2) "I" beam longitudinal skids with fabricated steel cross members on 12" centers. The diesel generator set is mounted through vibration isolators to steel tapping plates. A full steel floor shall be provided.
5. Door Frames: Welded aluminum frame consisting of extruded alloy 1/8"x4-1/2"x1-1/2", riveted to side panels.

E. Enclosure Accessories:

1. Four (4) steel lift rings welded to the underframe.
2. Louvers: Motorized intake and gravity discharge louvers shall be all aluminum construction riveted into aluminized steel frame forming a rigid, water-resistant assembly. Louvers shall be properly sized to allow sufficient engine combustion and radiator cooling air flow with a 0.5" H/2/0 maximum restriction. Birdscreen shall be provided on inlet and exhaust openings.
3. Air Plenums: Furnish vertical intake and discharge 90 deg air plenums for intake and cooling air.
4. Insulation: Furnish 3" acoustic insulation on walls and ceiling, line with perforated metal lining.
5. Access Doors: Furnish two (2) access doors, one (1) on each side of the enclosure, each 24" wide x 30" high with padlockable handles, for servicing and operation of generator set and accessories.
6. Exhaust Hardware: The enclosure shall be furnished with silencer supports, brackets, rain collars and rain shields.

2.11 VIBRATION ISOLATORS

A. Provide rubber-in-shear vibration isolators for mounting between engine-generator skid and the enclosure. The isolators shall be 95% efficient and sized in accordance with equipment manufacturer's requirements.

2.12 CERTIFICATION

A. This Contractor shall consult and cooperate with the factory authorized dealer in making arrangements for a load bank of proper size to certify this unit's power rating, stability, voltage and frequency regulation for 25%, 50%, 75% and 100% load over a four (4) hour period, with a one (1) hour period for each load increment.

B. This Contractor shall provide certification, testing and maintenance in accordance with NEC Article 700-4. These records and reports shall be placed in a looseleaf binder and turned over to the Owner for his continued use.

PART 3 – EXECUTION

3.1 INSTALLATION OF ENGINE GENERATOR SYSTEM

A. Install emergency engine generator sets as indicated in contract documents, and in accordance with the equipment manufacturer's written instructions, Division 26 Section 260000 under the listing "SPECIAL ENGINEERING SERVICES', and with recognized industry practices, to ensure that engine generator sets fulfill requirements. Comply with NFPA standards pertaining to installation of emergency engine generator systems and accessories.

B. Coordinate with other work, including fuel supply, piping and accessories as necessary to interface installation of emergency generator system work with other work.

C. Connect fuel piping to emergency generator equipment and comply with manufacturer's instructions where not otherwise indicated.

D. Perform emergency generator lubrication, equipment startup as specified in Division 26, Section 260000 under the listing "LUBRICATION' and "EQUIPMENT START-UP".

E. Instruct owner's personnel in the operation and maintenance of Emergency Generator System as specified in Division 26 Section 260000 under the listing "Operation and Maintenance Instructions".

3.2 GROUNDING

A. Provide equipment grounding connections, sufficiently tight to assure a permanent and effective ground, for system components as indicated in contract documents.

3.3 TESTING

A. Upon completion of installation of engine generator system and after building circuitry has been energized with normal power source, test engine generator to demonstrate emergency capability and compliance with requirements. Where possible, field correct malfunctioning units, then retest to demonstrate compliance.

END OF SECTION 26 0612

SECTION 26 0731
WIRELESS CLOCK SYSTEM

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS & SCOPE

A. The System is specified as described

1. Furnish and install a complete new Wireless Clock System using the Primex OneVue™ platform.
2. Furnish and install all system devices, accessories, and materials in accordance with these specifications and drawings to provide a complete and operating Wireless Clock System.
3. All bids shall be based on the equipment as specified herein. The model designations are that of Primex. The specifying authority must approve any alternate Wireless Clock System.
4. System shall include the System Devices below:

   Bridge with Ethernet/Power over Ethernet (PoE) and Bluetooth® low energy wireless technology

   Analog Clocks with Bluetooth® low energy wireless technology

1.2 RELATED SECTIONS

A. Division 26 “Electrical”

1.3 REFERENCES

A. System devices specified shall meet or exceed the requirements of the following:

1. Federal Communications Division (FCC); Part 15 - Code of Federal Regulations.
2. National Fire Protection Association (NFPA); NFPA 70E-[2012], Standard for Electrical safety in the Workplace.
3. Institute of Electrical and Electronics Engineers (IEEE); IEEE 802.3af-[1998], Standard for Information Technology - Telecommunications and Information Exchange Between Systems.
4. Bluetooth® wireless technology standard 4.1

1.4 DEFINITIONS

A. This section provides commonly used terms within this specification.

1. TSA:Technical Support Agreement
2. AWS: Amazon Web Services
3. TLS: Transport Layer Security
4. HTTPS: Hypertext Transfer Protocol Secure
5. Bluetooth® low energy - a wireless technology protocol which can be used for communication between embedded devices and smart devices.
6. SNTP – Simple Network Time Protocol.
7. PoE - Power over Ethernet

1.5 SYSTEM DESCRIPTION

A. General Specifications

1. System shall provide synchronized time by way of system devices and a cloud-based system software, hosted by the Manufacturer, that allows Owner to manage and monitor system devices.

2. System can be scaled from a single building to a network of buildings, or an enterprise spread across many time zones, providing traceable of accuracy, data and performance.
3. System shall consist of system clock devices enabled with Bluetooth low energy wireless technology.
4. System Bluetooth clocks shall not be required to have a direct connection to the Owner's existing Power over Ethernet (PoE) or 802.11 wireless network.
5. System devices enabled with 802.11, Power over Ethernet (PoE) technology shall be required to have a direct connection to the Owner's existing network.
6. System Bluetooth clocks shall form a system Bluetooth wireless network by way of the proprietary Bluetooth Network Protocol designed and developed by the Manufacturer, that allows system Bluetooth clocks to form a Bluetooth wireless technology network to allow a communication path to send clock data to the system Bridge devices.
7. System Bridge(s) shall receive data from system Bluetooth clocks and send the data to the system software. Bridge shall download settings from the system software and send settings to the system Bluetooth clocks.
8. System shall not require the installation of any on-site system hardware or software, with the exception of the specified system devices.

B. System Software specifications

1. System software shall be accessed from a web browser and does not require the installation of software or other third-party plug-ins or applications.
2. System users shall be able to access the system software from a web browser on a mobile or tablet device or computer with an internet connection.
3. System software shall provide an online device configuration procedure that allows Owner supplied settings to be installed on system 802.11 Wi-Fi or Non-DHCP network devices prior to shipment from the Manufacturer.
4. System software shall log NTP accuracy.
5. System software shall monitor and display the operating status of system devices.
6. System software shall provide an automated reporting method to notify system users of the operating status of system devices that may warrant corrective action.
7. System software shall allow authorized system users to create reports, view archived reports, and set the system to automate report notifications sent to system users.
8. System software shall maintain and store remote, redundant data backups.

C. System Bluetooth wireless network specifications

1. System Bluetooth wireless network shall be able to adjust and synchronize system Bluetooth clocks to specified Time Zone Offset and DST rules; time zone settings are managed within the system software and sent to the system Bluetooth clocks over the system Bluetooth wireless network.
2. System Bluetooth wireless network protocol shall form a tree-type topology; where clock data transfer is up or down in a tree structure topology; a path with highest Bluetooth Wireless Signal level quality is chosen at any time.
3. System Bluetooth wireless network shall have the capability to distinguish the system Bluetooth devices with Bluetooth wireless technology by the system devices' unique Device ID and/or Network ID; allowing only system Bluetooth devices to authenticate to the system Bluetooth wireless network.

4. At a system set daily time interval, the system Bluetooth clocks shall advertise their Bluetooth signal to form a system Bluetooth wireless network.
5. System Bluetooth wireless network shall be self-forming, self-healing, and self-organizing.
   a. Self-healing: in the event of a system Bluetooth clock hardware failure or loss of Bluetooth wireless signal, a connection previously handled by it is rerouted to another clock within the system Bluetooth wireless network.
   b. Self-forming: a system Bluetooth wireless network is automatically formed once daily at a system set time to allow system Bluetooth clocks to advertise their status to form the system Bluetooth wireless network.
   c. Self-organizing: the System Bluetooth wireless network protocol automatically connects system Bluetooth clocks, that are within Bluetooth wireless range, to form a data transmission path within the system Bluetooth wireless network.

D. Bridge specifications
1. Bridge shall be equipped with Bluetooth enabled gateway; which allows the device to send and receive communication to and from system Bluetooth clocks.
2. Bridge devices shall connect to the Owner's existing wired Ethernet, PoE, or 802.11 wireless network to send its device data and system Bluetooth clock data to the system software and download its device settings and clock settings from the system software.
3. Bridge shall send settings to system Bluetooth clocks within the system Bluetooth wireless network. Each system Bluetooth clock is identified by a unique Device ID allowing each clock to receive its unique Device ID settings. Device ID settings shall be managed in the system software. Bluetooth Analog Clock Device ID settings include its Time Zone Offset setting and DST rules. Bluetooth Digital Clock/Timer Device ID settings include its Time Zone Offset setting and DST rules and display settings.
4. Bridge shall listen and receive system Bluetooth clock data advertised in the system Bluetooth wireless network. During its 8-hour deployment mode, a Bridge shall send a new Bluetooth clock Device IDs to the system software within 30 minutes of receiving it. If not in 8-hour deployment mode, new Bluetooth clock data is sent the system software within 24 hours.
5. Bridge shall obtain Coordinated Universal Time (UTC) derived from a Network Time Protocol (NTP) Server (either internal or external); up to three designated NTP Servers may be specified to ensure continuity of time synchronization. The Bridge shall send obtained UTC time received from its NTP Server to the system Bluetooth clocks and the clocks shall synchronize the received UTC time to their Time Zone Offset setting and DST rules.
6. Bridge devices shall be primarily powered by Power over Ethernet. Battery-power shall be used only as a backup power source for a relatively short period of time.
7. Bridge devices that connect to a Wi-Fi or Non-DHCP network can be preconfigured by the Manufacturer with Owner provided settings before shipment to Owner facility or configured locally at the device by the Owner on-site.
8. Bridge devices shall have a LCD screen that displays connection status, and indicate when in an error or alarm state.
9. Bridge devices shall have LED indicators, located on the front of the device, that provide a visual indicator of its current status and operating state.
10. Bridge device shall have the ability to store configuration data for up to 1400 Bluetooth clocks in its local device memory; to avoid loss of data if a network connectivity issue prevents data to be sent to the system software.

11. Check-in interval setting shall be set by the system. Check-in Interval is the frequency the Bridge device is scheduled establish a network connection to Owners network to send data to and download data from the system software.
12. Unresponsive timeout setting shall be set by the system. Unresponsive timeout is defined as the amount of time a device can go without a connection to the system software; when this time is exceeded, the system sets the device to a warning state.

E. System Clocks enabled with Bluetooth® low energy wireless technology specifications (System Bluetooth clocks)

1. Clocks shall not require manual or direct configuration by an end user to establish a connection to a system Bluetooth wireless network, nor does an end user need to know about the intricacies of Bluetooth networking. The entire Bluetooth network infrastructure is transparent to the end user.
2. Clocks shall be equipped with a Bluetooth low energy wireless technology radio component; that allows system Bluetooth clocks to establish wireless Bluetooth connections to form a system Bluetooth wireless network. Each clock shall be a node within the system Bluetooth wireless network.
3. Clocks shall form a wireless connection and communication path by way of the proprietary system Bluetooth Wireless Networking protocol designed and developed by the Manufacturer.
4. Clocks shall wake-up once a day, at a system defined time, to form and build a system Bluetooth wireless network; allowing each system clock to send and/or forward its status data to the Bridge and receive setting updates sent by the Bridge. Each clock connects to another clock based on the strongest Bluetooth signal. The Bridge stores and sends clock status data to the system software once a day. When a bridge is in a 8-hour deployment mode, clock data is sent every 30 minutes to the system software.
5. Upon first-power up at its installation location, a new system Bluetooth clock shall go through a self-discovery initiation process; the clock shall continuously search for a system clock to receive its time and daily connection schedule.
6. Clocks shall not be required to be in plain line of sight or directly connected to a system Bridge device and shall act as independent nodes within the system Bluetooth wireless network.
7. If a clock's Bluetooth wireless signal connection is interrupted or down, the other clocks within the Bluetooth wireless range shall be able to transmit data to the system Bridge device through other Bluetooth clocks within the system Bluetooth wireless network. Clock data moves through the system Bluetooth wireless network communication path until the data reaches a system Bridge device.
8. Clocks shall be available, at predefined time intervals set by the system, to connect to new Bluetooth clocks that are attempting to connect to the system Bluetooth wireless network; allowing new clocks to receive and synchronize their time from an existing system Bluetooth clock.
9. Clock device firmware shall perform diagnostics on battery life, time accuracy, and connection strength. The Bridge devices shall transmit the clock diagnostic data to the system software.
10. Clocks shall operate with a free running accuracy of .45 seconds per day, and will continue to operate in the absence of receiving the broadcasted UTC time from the Bridge.
11. Clocks shall be fully portable, capable of being relocated at any time.

12. Analog clocks shall report gross mechanical failures by way of automatically performing a daily midnight hand verification check; which if this check shall fail for three consecutive days, the clock shall report a hand position failure status, resulting in a clock warning state within the system software.

F. Encryption and Authentication specifications

1. User software access sessions between the web browser and the system software shall be encrypted by the HTTPS protocol.
2. The network communication of system devices enabled with 802.11, Ethernet, or PoE Technology shall be secure and encrypted using the Transport Layer Security (TLS) encryption protocol and Secure Hypertext Transfer Protocol (HTTPS) authentication.

G. System Administration specifications

1. Software interface shall allow the Owner's system admin user(s) to manage the system components, including: system device settings, reports, system-wide user password complexity settings and user session timeout setting to align with Owner information security policies and procedures, manage system users and grant user access to system data and features, activate and deactivate system users, and view user log in history.
2. System software shall allow each system user to manage their own system profile, including their log in email address, password, and contact settings.
3. System software shall allow system device settings to be user-defined to meet Owner requirements.
4. System software shall allow devices that use a 802.11 or Non-DHCP network connection to be assigned to a primary and alternate network for failover purposes. Network settings are managed within the system software, allowing remote management to migrate devices from one network to another.
5. System software shall allow user-defined reporting; system shall store and present system historical data in the form of system reports. User-defined data shall include the system devices included in a report, the frequency a report is system generated, and a specific range of data included in a report. System reports shall be displayed in the system software electronically within the interface allow a system user to print and download reports. System shall allow report data to be restricted based on the role(s) assigned to a system user profile.

H. System devices with 802.11 Wi-Fi or Non-DCHP network communication specifications

1. Network Communication: Wireless Networking Protocols: 802.11b, 11g, single stream 11n*, 2.4 Ghz | Security Protocols: WPA, WPA2 (AES and TKIP) | Encryption Protocols: TLS 1.2 | Network Communication Protocols: Hypertext Transfer Protocol Secure (HTTPS) | IP Addressing: Dynamic Host Configuration Protocol (DHCP), static IP addressing | Data Packet Size: typically less than 5 kilobytes (kB)
2. Network setting data is stored locally in devices shall be encrypted and access to locally stored setting data can be controlled by a system admin user.
3. Manufacturer shall provide stand-alone configuration software to locally configure a device to meet Owner security policies if network setting data cannot be stored in third-party software or to troubleshoot device network connectivity issues.

1.6 REGULATORY REQUIREMENTS

A. Equipment and components furnished shall be of the Manufacturer latest model.

B. System devices shall be installed in compliance with local and state authorities having jurisdiction.

C. Electrical Components, Devices, and Accessories: Listed and labeled per NFPA 70 by qualified testing agency.

D. Regulatory Requirements: System design and installation shall comply with the following: National Electric Code (NEC)

1. Underwriters Laboratory (UL) standards
2. Local codes and regulations

1.7 SUBMITTALS

A. Product Data: Submit complete catalog data for each system device and components, describing physical characteristics and method of installation.

B. Shop Drawings: Showing the following. 1. Diagram of proposed system showing communication pathway and schedule of individual system device installation locations. 2. Indicate integration with the Owner's network. Include a line diagram of network relationships. 3. Show system device power requirements.

C. Samples: Submit one specified system device model(s) for approval. Approved sample(s) shall be tagged and shall be installed at location directed.

D. Manufacturer Instructions: Submit complete installation, set-up and maintenance instructions electronically.

E. Information submittal: Manufacturer Sample Warranty

F. Information submittal: Manufacturer Technical Support Agreement (TSA)

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of wireless and Ethernet connected system with a minimum of ten years record of satisfactory manufacturing and support of systems comparable to basis of specified system design.

1.9 DELIVERY STORAGE AND HANDLING

A. Deliver all components to the site in the Manufacturer original packaging.

B. Packaging shall contain Manufacturer name and address, product identification number, and other related information.

C. Store equipment in finished building and in unopened packaging until ready for installation.

1.10 PROJECT SITE CONDITIONS

A. System design is integrated with Owner's existing network, including 802.11 wireless, wired Ethernet, or PoE network; limited to devices equipped with wireless or Ethernet (PoE) technology.

B. Conductors and Cables: Comply with requirements of Division 27 Sections "Common Work Results for Communications" and "Communications Horizontal Cabling.

C. Signal and Control Circuits: Manufacturer recommended stranded, single conductors, or twisted-pair cables.

D. Data Circuits: Category 5 minimum, twisted-pair cable.

1.11 WARRANTY

A. Manufacturer shall provide a two-year limited warranty for Education Series Analog Clocks equipped with Bluetooth® low energy wireless technology.

B. Manufacturer shall provide a two-year limited warranty for Non-Education Series Clocks equipped with Bluetooth® low energy wireless technology.

C. Manufacturer shall provide a two-year limited warranty for Bridge devices equipped with Bluetooth® low energy wireless technology.

D. Manufacturer shall provide a two-year limited warranty for Clock devices equipped with Power over Ethernet (PoE) technology.

E. Manufacturer shall offer an extended warranty on system devices.

1.12 SOFTWARE MAINTENANCE

A. Manufacturer shall offer an annual Technical Support Agreement (TSA); agreement shall be inclusive to system software access, phone/email technical support, software maintenance and revisions, and firmware revisions.

B. All system updates, enhancements and maintenance are performed per agreed upon TSA.

PART 2 – PRODUCTS

2.1 SECTION INCLUDES

A. The system and equipment is specified as described in this section.

B. All bids shall be based on the equipment as specified herein. The model designations are that of Primex. The specifying authority must approve an alternate system.

2.2 MANUFACTURER

A. System shall be manufactured by:

US: Primex, 965 Wells Street, Lake Geneva, WI 53147 | Phone: (800) 537-0464 | Fax: (262) 248-0061 | Email: info@primexwireless.com | www.primexwireless.com

2.3 SYSTEM SOFTWARE

A. Basis of Design Software Product: Primex OneVue™ Wireless Clock System.

B. System Software Platform: Cloud-based software platform that resides on Amazon Web Services (AWS) and is accessed via the internet.

C. System stores and monitors system devices operating conditions.

D. All system device and system settings are managed within the system software.

2.4 SYSTEM DEVICES & ACCESSORIES

A. Analog Clocks

1. Clocks shall meet the following specifications:

a. Clocks (single sided) shall be wall mounted.

b. Additional colors, finishes, and dial faces are available from Manufacturer.

c. Clock faces can be customized by Manufacturer to display organization name or logo as specified.

d. Clock frames and lenses are of durable thermoplastic.

e. Clocks shall have a tamper proof/theft resistant clock-lock mounting slots.

f. A dual-mount kit is available from the Manufacturer that combines two single clocks to create a dual-sided clock.

g. Clocks shall be capable of automatically adjusting for Daylight Saving Time.

h. Battery-operated analog clocks shall have a 5-year nominal battery life.

i. Installer will furnish clock batteries in accordance with Manufacturer instructions.

j. SUPPLY MODELS - Analog Clocks

(1) Education Series

Technology: Bluetooth® low energy wireless technology

Size: 12.5"

Color: Black

Power: Battery

B. Bridge

1. Bridge shall meet the following specifications.

a. Enclosure: ABS plastic | Dimension: 4.7" H x 3.7" W x 1.3" D (11.93cm x 9.39cm x 3.30cm) | Weight: 0.3 lb (136 gram) with 2 AA batteries

b. Display: Liquid crystal display (LCD), dimension: 0.75 in. H x 1.38 in. W (1.90 cm x 3.50 cm) | LED Status Indicator: green, yellow, red

c. Mounting: Keyhole slot with lock down screw holes in back panel for wall mount; or surface mount with supplied dual-lock adhesive mounting strips.

d. Configuration: configured from system software or locally at device with supplied device configuration software

e. Backup Battery-power: 3.0v Primex Lithium/Iron Disulfide Battery Pack or two stand-alone 1.5v Lithium AA batteries. Use of alkaline batteries is not recommended.

f. Local memory storage capacity: configuration data for up to 1400 Bluetooth clocks.

g. Environment: Operating Temperature: 32 °F to 122 °F (0 °C to 50 °C), indoor use only|Storage Temperature: -4 °F to 140 °F (-20 °C to 60 °C)

h. Certifications: FCC, CE, and IC compliant

i. SUPPLY MODELS - Bridge

(1) Technology: [802.11 Wireless] [Ethernet (PoE) Technology]

(2) Power: Power over Ethernet (PoE)

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 system and the system devices.

B. Do not proceed until unsatisfactory conditions have been corrected.

C. Verify that construction is complete in spaces to receive equipment and that rooms are clean and dry.

3.2 INSTALLATION

A. General: Install system devices in accordance with applicable codes.

B. Install system devices in accordance with Manufacturer written instructions.

C. Provide all system equipment necessary for a complete and operable system.

D. Comply with requirements of Division 26 Sections "Common Work Results for Communications" and "Communications Horizontal Cabling."

E. Cables: Install cables in raceways and cable trays except within consoles, cabinets, and desks [and except in accessible ceiling spaces and framed partitions where exposed wiring is allowed by Owner]. Install plenum cable where required. Conceal cable installation where possible.

F. Provide and install 12.5” in all rooms, except Cafeteria and Gymnasium.

G. Bridges shall be installed in all data closets or as required by Simplex Grinnel for a complete and operational stable system.

3.3 FIELD INSPECTION

A. Inspection: Make observations to verify that system devices and components are properly labeled.

B. Prior to final acceptance, inspect each system device and component, adjust as required, and replace parts which are found defective.

C. At completion of system device installation and prior to final acceptance, turn on the equipment; ensure that all equipment is operating properly, and that the system software and all system devices and components are functioning.

3.4 SERVICES

A. Manufacturer system software user guides and system device installation guides shall be provided electronically.

B. Commissioning General: Provide system commissioning in accordance with Manufacturer written recommendations. Perform operational testing to verify compliance with requirements. Adjust as required.

C. Services shall include specified level of commissioning services.

1. On-site commissioning service: system deployment training, including system set up, validation of device preconfiguration, system functionality, verification of device network connections, and device installation training.

3.5 CLEANING

A. Prior to final acceptance, clean exposed surfaces of devices, using cleaning methods recommended by Manufacturer.

3.6 DEMONSTRATION

A. Initial Demonstration and Training: provide demonstration and training for Owner facility staff that is responsible to perform system software administration.

B. Demonstrate maintenance procedures for system devices.

C. Demonstrate the system software components and features, including monitoring and management of system devices.

3.7 PROTECTION

A. Protect finished installation until final acceptance of the project.

3.8 TESTING

A. All system devices must be tested at their operational installation location under normal operational conditions.

3.9 SPARE EQUIPMENT

A. The Electrical Contractor shall furnish and install 10% of clocks with batteries, as directed by Owner. If this equipment is not installed, turn over to Owner as attic stock.

END OF SECTION 26 0731

SECTION 26 0740
NETWORK CABLING SYSTEMS

PART 1 – GENERAL

1.1 GENERAL PROVISIONS

A. Refer to other sections for General Requirements, etc., which shall apply to the work specified in this section. The following specifications for network cabling are based on the Communications Cabling Construction Standards generated and implemented for all State of Delaware schools and was developed by the State of Delaware, Center for Educational Technology (DCET).

B. The following names shall be the only hardware and cable manufacturers considered for this project at this time:

1. Hardware
   a. Ortronics, Inc.
   b. Hubbell Premise Wiring Channel Solutions
   c. Systimax Solutions
   d. Siemon
   e. Leviton NextLAN
   f. Panduit
2. Wire and Cable

Indoor	Outdoor
a. Berk-Tek	a. Superior Essex
b. Mohawk/CDT	

C. In general, the network sub-contractor will furnish, install and test all cabling and terminations herein specified for distribution of the station/field wiring.

D. It shall be the responsibility of this Contractor to obtain the 3/05 State Standards and Specifications. This document shall be a guideline for installation and basis for estimating.

E. The Electrical Contractor shall utilize one of the licensed State of Delaware installing contractors as indicated on the State list. The contractors are approved for furnishing, installation and testing of the entire network. The contractor must be certified and authorized for the installation of premises cabling system and shall assume responsibility for certifying the installation and providing a warranty for a period of no less than 25 years.

1.2 SCOPE

A. Perform all work necessary and/or required and furnish all materials and equipment for a complete network cabling system as described herein.

B. The data communications system shall be installed, consisting of the following components:

1. Optical fiber network backbone
2. Twisted pair copper work station cabling
3. Work station outlets
4. Cable support system

The MDF shall be connected to each IDF via a single, twelve- strand, composite, optical fiber cable. Each classroom and office data outlet shall be connected to its respective IDF via a four twisted-pair, Cat 6 data cables.

C. The hardware shall include equipment racks, patch panels, station outlets, Cat 6 data cables, optical fiber cables, all required terminations and labeling to provide for a complete data distribution system.

D. In general, one or more data outlets shall be provided for each computer station in classrooms, library and in offices where indicated on floor plans. The teacher's station outlet located in each classroom shall have data/Voip, and audio cable connections.

1.3 SUBMITTALS

A. Furnish shop drawings and descriptive data, complete with project designations for the following:

1. Equipment Racks
2. Patch Panels
3. Station Outlets
4. Cat 6 Data/Voip Cables
5. Optical Fiber Cables – OS2 Single Mode
6. Cable Support System
7. Wire Management Materials
8. Video cables as indicated in schedule on drawing.

1.4 DOCUMENTATION

A. The contractor shall provide a complete system walk-through, by suitably qualified personnel, to personnel designated by the owner, to instruct them on the installed system's location, operation and maintenance.

B. Prior to assembly and installation, the contractor shall submit the following, on reproducible media, to the engineer for review

1. Final schematic drawings of all circuitry, including outlet conductor assignments and all component callouts.
2. Equipment modifications drawings.
3. Front mechanical drawings of each equipment rack.

C. At the completion of the installation, the contractor shall provide one (1) copy of each of the following:

1. Equipment manufacturer's operation and maintenance manuals for each piece of equipment.
2. "As-built" drawings for all equipment installed.
3. "As-built" drawings on contract blueprints of all wire, cable and conduit placement throughout the building.
4. "From-To" listing of in-building wiring and outlets, listing color coding scheme and conductor assignments.

PART 2 – PRODUCTS

2.1 DATA OUTLETS

A. The jacks used for the data outlets shall be of the modular snap-in type. A modular 110 PCB RJ-45 data jack (45* angle) will be used for all Cat 6 data grade cable terminations. All modular jacks will be mounted in a single or double gang faceplate based on the number of services required at that station. All RJ-45 jacks shall have dust covers installed.

The jack color code and lettering scheme is as follows:

1. Data/Voice Jack Cat 6 data grade cable

2.2 IDF EQUIPMENT RACKS

A. The IDF shall contain a minimum of one (1) 24” wide x 4’-0” high equipment rack to mount the data electronics and patch panels onto. The equipment racks shall have 26u of rack mounting space on 19” wide rails.

B. The wall-mounted equipment racks shall be steel and grounded. All racks shall include cable management equipment and a 120-volt power strip.

2.3 HORIZONTAL DISTRIBUTION SYSTEM

A. Horizontal Cable Specifications:

Indoor:

1. Plenum, 4 pair, 24 awg, Category 6 data/voice cable (blue jacket).
2. Outside plant, 12 strand, OS2 – Single Mode
3. Outside Plant, 25 pair Cat – Cat 5E Tie Cast

B. Cable Support Systems:

1. Cable support system shall be a hanger and plastic mesh system designed to support Video cables, telephone cables and high-performance data cables. Caddy Cat. No. CatTrax Series or approved equal.
2. Cable Tray shall be a 12” wide aluminum tray with a 4” load depth and 6” rung spacing. Tray shall be complete with all mounting hardware required. B-Line Systems, Inc. Cat. No. 25A06-12-144 or approved equal.

2.4 CABLE TERMINATIONS

A. All data/voice outlet jacks shall be wired with Cat 6 data cable using the TIA/EIA-568-B standards. In the IDF rooms the data contractor shall furnish and install rack mounted patch panels, the number of patch panels and number of required ports shall be based on the number of classroom data outlets being terminated. On the rear of these patch panels the data contractor shall terminate each Cat 6 cable from the each data outlet. Each port shall be labeled as to room and data outlet served.

B. In the existing MDF/IDF room the data contractor shall furnish and install one (1) rack mount interconnect center, with required adapter plates on the existing MDF rack. The data contractor shall terminate each twelve (12) strand fiber optic cable from each IDF rack and using duplex SC adapters.

PART 3 – EXECUTION

3.1 INSTALLATION PRACTICES

A. Installation shall include delivery, unloading, setting in place, fastening to walls, floors, ceilings, or other structures where required, interconnecting wiring of system components, equipment alignment and adjustment, and all other related work whether or not expressly defined herein. Installation shall be performed in accordance with applicable standards, codes, requirements and recommendations of National, State, and Local authorities having jurisdiction, and the N.E.C. (National Electrical Code).

B. All boxes, equipment, etc., shall be installed plumb and square, and firmly secured in place.

C. Conduit sleeves shall be installed from the station outlet to within 12” of the cable support system. These sleeves shall be the responsibility of the data contractor and are required to accommodate both the data and communication wiring. After completion of the data and communication wiring the data contractor shall fire seal all sleeves with a UL approved fire stop in accordance with the NFPA (National Fire Protection Agency).

D. All sleeves shall be EMT conduit installed with plastic conduit bushings to protect data and communication wiring from damage.

E. In all cases, the Fiber Optic, Cat 6 data/voice cables shall be installed above the ceiling structure in the cable support system. No cable shall be exposed on any ceiling or wall, nor shall any cable lay-on or be in contact with the ceiling structure or it's support system. The data contractor shall furnish and install large conduit sleeves above non-accessible ceilings where the cable support system must pass through, these sleeves shall be sized to handle both data and communication cabling.

3.2 CABLE INSTALLATION

A. All data/voice cables shall be installed in accordance with manufacturer's recommended tension and bending specifications. Any lubricants used must be manufacturer guaranteed to be non-destructive to cable sheaths.

B. All data/voice cables shall be permanently marked with a wrap-around vinyl self-laminating printable marker label (Thomas & Betts E-Z-CODE WSL or approved equivalent) at both ends. There shall be no unmarked cables within the system at any location. Labels shall contain the room number, and the location and drop number within the room. All labeling shall be typed onto the label, not handwritten. Label all cable ends and individual jacks. All jacks shall be labeled to provide visibility when viewed behind cabinets and desks. All cables shall be labeled with jack numbers to permit identification in the event of damage to jacks.

C. All data/voice cables shall not be run in close proximity to, in the same bundle, or parallel with power cables, in order to reduce signal contamination.

D. No cable shall be installed with a bend radius less than that recommended by the cable manufacturer.

3.3 FIBER OPTIC CABLE INSTALLATION

A. The fiber optic cable shall be installed in the cable support system and conduit sleeves from existing MDF to IDF in accordance with cable manufacturer's recommended tension and bending specifications. It will be the responsibility of the data contractor to ensure the quality of the fiber optic cable when received and prior to installation.

B. All fiber optic cable terminations shall be furnished and installed in accordance with termination equipment manufacturer's recommended and required specifications. It will be the responsibility of the data contractor to ensure the quality of the terminations when installation is complete.

3.4 TESTING

A. General Test Procedures: Before an application for final acceptance of the work will be considered, all tests stated within this section shall be satisfactorily completed. The data work shall include miscellaneous tasks, (i.e.. removal of station faceplates) deemed necessary to demonstrate compliance with the requirements of the data specifications, and cable and equipment manufacturer's recommended installation procedures.

B. Upon completion of testing and problem resolution, all connections must be 100% error free: " Error Free" is defined to mean the item meets all the manufacturer's specifications and recommendations as published in their latest manufacturing manuals for proper installation and testing. In addition, the item must conform with all other related industrial practices and standards, Building Trades, and Electrical and Telecommunications Industry Standards and Practices.

C. Copper Cable Test Procedures: Contractor must complete cable system performance verifications on all copper and fiber cable as specified below and provide the test results. Category 6 and fiber optic cables must meet or exceed all manufacturer's and EIA/TIA standards for performance and installation.

1. All copper and fiber optic testing documentation is to be submitted.
2. After the installation is complete, in addition to any other required testing, the data contractor shall at a minimum, conduct and report on the following tests of copper cabling:
   a. MDF-to-IDF tests of all new pairs installed under this contract to determine continuity, shorts, crossed pairs, correct pinning and grounds.
   b. IDF to information outlet tests of all cable pairs installed under this contract to determine continuity, shorts, crossed pairs, correct pinning and grounds.
   c. The Category 6 cabling, serving jacks installed from the IDF closet to the data outlets at the workstations is to be manufacturer verified and warranted for Category 6 compliance. All manufacturer's performance certificates and extended warranties are to be provided upon completion of the testing and manufacturer certification.
   d. All Category 6 cabling is to be tested end to end and documented for Category 6 compliance at all frequencies up to and including 100 MHz. Such testing is to comply with procedures and standards outlined by the cable manufacturer and EIA/TIA TSB-67 concerning testing of Category 6 cable plant. A Microtest Pentascanner Level 11 tester with 2 Way Injector is the instrument to be used for such testing to insure that cable pairs are defect free. "Defect Free" for the copper cable is defined as a copper pair not having any pair reversals, split pairs, shorts or opens. Test results shall be provided to the Engineer within 2 days after testing or 5 days prior to the Owner connecting electronic equipment onto the cable network, whichever is sooner. The data contractor must also provide testing summary reports of all Category 5e cables including run numbers, and pass/fail results with respect to length, impedance, DC resistance, mutual capacitance, attenuation, NEXT loss and active ACR. The data contractor must also provide spread sheet analysis of the linearly dependent parameters of length DC resistance, mutual capacitance and attenuation the field measured values shall be compared to the specifications values on one spread sheet.
   e. In the event that a Category 6 cable fails to perform to the manufacturer's specifications, the data contractor will remove the cable and replace it with a new cable. Replacing the defective cable at no additional expense to the contract.
   f. End-to-end testing is required for every RJ-45 connection. "End-to-End" testing is defined here as testing all cable links to the very last termination point.
   g. The data contractor shall provide copies of all copper cable test results.

D. Fiber Optic Cable Test Procedures: All fiber optic cables and associated equipment, must be thoroughly tested. The fiber optic cable will be accepted only after each strand is tested in accordance with the specifications defined herein. All strands are to be tested and found to be 100% acceptable.
   1. The data contractor shall test all cables, connectors, associated equipment and hardware furnished and installed by the data contractor upon receipt of same as defined herein.
   2. The following must be met for the testing of the fiber optic cable: As a minimum the data contractor shall test, as described below, all optical fiber cable strands installed within the scope of this project:
      a. Fully test complete links only. Piecemeal testing is not acceptable.
      b. Perform end-to-end, bi-directional attenuation (loss) test for each fiber strand at 850nm and 1300nm wavelengths. Conduct tests in accordance with E-526-14, method B and with test instrument manufacturer's published instructions.

(1) Demonstrate that measured link loss does not exceed the value based on the number of noted connector pairs, the connector's published loss per mated pair and the cable's published loss based on distance.

(2) Strands whose measured attenuation falls outside the acceptable range shall be subject to further inspection and testing to determine the nature of the fault.

(3) Horizontal End-to-End testing of individual optical fibers is considered to be from each IDF closet to the data workstation outlet.

c. Faults related to connectorizations shall be corrected and the fiber re-tested as stated above until acceptable attenuation measurements are received.

d. Where defects are to be inherent in the fiber itself, notify the Engineer in writing. Upon obtaining approval by the Engineer, replace any cable having fewer than the manufacturer's guaranteed number of serviceable fibers.

e. Remove all newly installed defective cables from cable support system. Do not abandon cables in place.

f. All test results and corrective procedures are to be documented and submitted to the Engineer.

g. Recommended test equipment:

(1) Optical fiber power meter and Light Source: Siecor CPM-950/1300 meter and OS-100D Light Source, or equivalent.

(2) TDR-Tektrom TFP2 FiberMaster, Laser Precision TD-2000 or equivalent with 850nm and 1300nm emitter modules and bud copy printout, or equal.

(3) Optical fiber inspection scope: Cambridge Instruments 10x fiber scope or equivalent.

h. All fiber optic cabling is to be installed in a manner to comply with and allows DCET to receive the manufacturer's extended warranty. The data contractor is to be certified and authorized to provide the extended warranty.

E. Replacement: Any fiber strand, connector, or module installed by the data contractor which fails to meet the loss budget or tests below the manufacturer's standards, shall be replaced at no additional cost to the project. The replacement cable, connector, or part shall be tested after repairs have been made to verify compliance. Only equipment that meets the installation requirements stated herein shall be accepted.

F. Documentation:

1. Proper labeling and documentation will allow a technician to quickly trace a particular cable link and will significantly reduce the time and cost of moves, adds, changes and troubleshooting. Both labeling and documentation depend on the use of a system-wide coding scheme that will identify and locate each component of the data system and allow all components to be linked in a logical fashion.

2. There are three components of wiring system documentation:

a. Labeling data closet termination areas aids in identifying the source and function of a circuit.

b. A labeling scheme simplifies the documentation process.

c. "As-built" documents provide a permanent record of data infrastructure. These documents are a critical management resource. As a result, it is imperative that "as built" documentation be prepared as part of the data infrastructure project. In addition, these documents must be kept current throughout the system's life cycle.

G. Cable and Data Outlet Identification:

1. The data contractor shall furnish and install cable tags labeled with identifying cable numbers.
2. The data contractor shall clearly and consistently mark the appropriate designation strip labels on all hardware. Data contractor shall submit for approval a sample of all designation labels.
3. The data contractor shall affix outlet identification labels, machine printed or typed, with identifying cable numbers.
4. Subsequent to pulling and terminating cables, the data contractor shall place the appropriate cable tags within six (6) inches of each Category 6 cable and eighteen (18) inches of each optical fiber cable end.
5. If at any time during the project, the cable tape becomes illegible or removed, the data contractor shall immediately replace it with a duplicate preprinted cable tag.
6. The data contractor shall provide a listing keyed to cable types of all cable identification numbers.
7. Data contractor shall label each data outlet with the following label scheme:

   If the IDF closet "A" is the origination point of the cable feeding the data outlet "007"in room 129, the following is the configuration of the label to be installed;

   IDF Closet – Classroom-data outlet

   Example: A-129-007

   Data contractor will submit for approval sample of all data outlet designation labels.

H. As-Built Documentation:

1. Maintaining records and documents is the most important portion of the administration of a data infrastructure. Maintenance and moves, adds and changes can become very tedious if a current set of records and documents are not maintained. In fact, isolation and resolution of problems are often delayed because configuration information is either unavailable or outdated.
2. Subsequent to the installation and prior to acceptance, the data contractor shall prepare and issue As-Built drawings, in an AutoCAD format latest version, that shall reflect the lengths of cables installed, the actual manner and conditions of installation, including all deletions from additions to or departures from the contract documents. The documents are to include the data outlet station numbers and cable routing where it varies from the original plan. A copy of these documents will be stored in the IDF, with a master copy located at the School District's office.

END OF SECTION 26 0740

SECTION 26 0771
INTERCOM/TELECOMMUNICATION

PART 1 – GENERAL

1.1 General

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division l Specifications Sections, apply to work of this section. Electrical Contractor shall provide device boxes, conduit stubs, and pull strings for all wall-mounted speakers.

B. This section is a Division 26 Communications System, and is part of each Division-26 Section making reference to the telecommunications system specified herein.

C. The contractor shall furnish and install all equipment including, but not limited to, outlet boxes, conduit (with pull strings), wiring, cable, speakers, telephones and clocks as shown on the plans, and all other equipment necessary to provide a complete and operating system for the Appoquinimink School District.

1.2 Scope of Work

A. Provide a telephone type communications system for all instructional and administrative areas. Provide for system integration of the following basic school communications systems including the Cafetorium and local classroom sound systems.

1. Telephone System
2. Voice Mail System
3. Intercom/Public Address System

B. Voip Telephone System: System provides for the interconnection to public telephone lines and intercommunications throughout the school. Each classroom or office provided with a telephone can communicate with any other internal telephone by touch-tone access. Integrate with the public telephone lines to provide inward and outward telephone calls on a controlled basis. Features and functions of the telephone system includes:

1. Private two-way telephone handset to handset communications.
2. Direct dial communications.
3. Dial access to intercom system for public address.
4. Administrative control console with display and busy lamp field.
5. Multi-line telephones.
6. Software programmable features, functions, and restrictions.

C. Voice Mail System: Provide system that utilizes recorded voice messages that are accessible from any touch tone telephone. System shall be fully integrated to digital telephone system. System shall provide the following features and functions.

1. Ability to light and extinguish message lights automatically.
2. Automated Attendant
3. Voice Mail

D. Intercom/Public Address System: Provide speaker and amplifier system for paging and public address throughout the school. Provide program channels for cassette tape players and AM/FM radio. System provides the following features and functions.

1. Audio program to classrooms.
2. Emergency paging.

3. All call paging.
4. Zone paging.
5. Hands-free intercom speaker communication.
6. Distribution of master clock class change tones.

1.3 Reference Standards

A. National Fire Protection Association:
1. NFPA 70-90: National Electrical Code.

B. Underwriters Laboratories, Inc.:
1. UL 486A-91: Wire connectors and soldering lugs for use with copper conductors.
2. UL 1449-85: Transient voltage surge suppressors.
3. Comply with UL 1863.

C. Electronics Industries Association:
1. EIA 568-91: Commercial Building Telecommunications Wiring Standard.
2. EIA-160: Sound Systems.
3. EIA-299A: Loudspeakers, Dynamic Magnetic Structures and Impedance.
4. EIA-310A: Racks, Panels and Associated Equipment.
5. SE-101-A: Amplifier for Sound Equipment.
6. SE-103: Speakers for Sound Equipment.

D. Federal Communications Commission:
1. FCC Regulations, Part 15 Title 47.

1.4 Submittals

A. Shop Drawings: Submit in accordance with Section 01300, including the following:
1. Product and cable specification data sheets.
2. Main Distribution Frame (MDF) and equipment assembly details.
   a. Indicate size and space requirements.
   b. Indicate positions of major components.
3. Complete wiring diagrams indicating:
   a. Devices.
   b. Components.
   c. Interconnecting wiring.
   d. Block diagrams
4. Data base programming sheet indicating all features of telephones, speakers, etc.
5. Floor plans indicating device and component locations, conduit, raceway and cable routes.
6. Grounding details and requirements.
7. Power connections, including source and branch circuit data.

B. Operation and Maintenance Manuals: Submit in accordance with Section 01300, including the following:
1. Component Operating Manual including technical data sheets.

a. Control settings.
b. Amplifier loads.

2. Information for reordering replacement parts.
   a. Provide a replacement parts list.
   b. Provide a list of recommended parts, tools, and instruments for testing and maintenance purposes.
3. Wiring diagrams/details:
   a. System functional block diagrams.
   b. System schematic diagrams.
   c. System wiring list.
   d. Identify terminals to facilitate installation, operating and maintenance.
   e. Indicate terminals to facilitate installation, operating and maintenance.
   f. Indicating and distinguish between field and factory wiring.
4. System Operating Instructions: Provide a clear and concise description of operation which gives, in detail, the information required to properly operate the equipment and system.
5. Update to include any information necessitated by construction. Complete "as installed" wiring and schematic diagrams shall be included which show all items of equipment and their interconnecting wiring.
6. Component Service Manual: Include information for testing, repair, troubleshooting, assembly, disassembly, and required/recommended maintenance intervals.

C. Project Record Documents:
   1. Submit in accordance with Section 01300 for the complete system. Record drawings shall include and indicate all components of the installed systems, including the routing of conduit, raceways and cable.
   2. Drawings shall be coordinated and referenced to the O & M manuals and related wiring diagrams. Floor plan drawings shall be 1/16" = 1'-0" or greater to provide for clear a and legible documents.

D. Test Reports: Submit field test reports specified in Part 3.

1.5 Training

A. Provide all training and utilize specified manuals and record documentation. All training shall be provided at the project site and coordinated with the Owner. All training sessions will be video taped by the vendor for Owner's future reference.

B. Training shall include a minimum of two four-hour sessions encompassing all instructions required for system operation. Provide operators manuals and user guides with training. Provide follow up training for 8 hours minimum after initial training.

C. Training shall utilize the equipment provided at the project site. Coordinate use, time and availability of equipment with the Owner.

D. Demonstrate adjustment, operation and maintenance of the system including each component and control.

1.6 Warranty and Maintenance

A. Provide a two (2) year warranty of the installed system against defects in material and workmanship. All labor and materials shall be provided at no expense to the Owner during

normal working hours. The warranty period shall begin on the date of system acceptance.

B. Make available a service contract offering continuing factory authorized service of this system after the initial warranty period.

1.7 Quality Assurance

A. Maintenance Qualifications:

1. Experienced in manufacturing equipment of the types and capacities specified for this project.
2. Equipment has a record of successful in-service performance.

B. Contractor Qualifications:

1. Established communications and electronics contractor for at least five (5) years.
2. Authorized distributor for the equipment supplied with full manufacturer's warranty privileges.
3. Maintains a fully equipped service organization capable of providing full maintenance and service of the installed system within 24 hours.
4. Maintains the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being installed.

C. Manufacturer's Instructions: Comply with all installation instructions and methods recommended or required by the manufacturer.

D. Reference Standards: Comply with all reference standards indicated in this section as applicable. System shall be UL Listed under UL813.

1.8 System Requirements and Operation

<u>Alcatel Lucent Voip System</u>

A. The contractor shall provide a complete and satisfactory digital telephone system. All equipment and installation material requirements shall be furnished and installed including the interfaces to intercom and voice mail systems.

l. Contractor shall provide a microprocessor, stored program control telephone system.
2. The system shall employ state-of-the-art digital technology and be in current production.
3. All talking circuits shall be balanced transmission circuits.
4. System proposed must allow full integration with voice mail.
5. All systems must be adequately surge protected based upon stated manufacturer's requirements.

B. Central Switching Exchange: The installation shall include a comprehensive programmable telephone communications system consisting of a digital central switching exchange. The system shall have expansion capability to support up to 448 ports. The following is a outline of the system minimum requirements.

1. All programmable functions shall be located in battery backed RAM to prevent loss in the event of system failure.
2. The central switch shall utilize standard dual tone multiple frequency (DTMF) decoding in conformance with standard telephone practices.
3. The system shall provide direct dialing, full duplex private telephone communication between all stations equipped with administrative or staff telephones.

4. The system must provide the flexibility of interfacing with all of the following telephone industry standard trunking providing compatibility with existing and future services.
   a. Loop Start 02LS2: The system must be compatible with existing central office lines.
   b. Ground Start O2GS2: The system must be compatible with central office GS Lines.
   c. DID O2RV2: The system must provide Direct Inward Dialing capabilities where direct individual station access over non-dedicated trunks is required.
   d. OPX OL13C: The system must have capabilities of remote extensions not on the local premise to access all system features.
   e. E+M Tie Lines TL31M/TL32M: The system shall be compatible with standard PBX signaling for direct connection to an existing or future remote PBX.
   f. T1 SF/D4 Framing or ESF/D5 Framing: The system shall provide high volume phone traffic capabilities with direct interface without the need for additional interface equipment. Systems requiring additional T1 interfacing equipment such as channel banks are not acceptable.
   g. CENTREX: The system shall have the capability of interfacing with other outside providers such as Centrex, Watts and Data services.
   h. ISDN PRI – The system shall have the capability to interface with outside providers via ISDN primary rate interface.
5. Incoming trunk groups shall provide the capability of directing calls to multiple points such as Operator/Attendant, Administrator, Staff or Emergency Lines. The system shall also offer routing, transferring and conferencing of outside trunks to any of the Administrative or Staff telephones. Outside call that are directly go to an Administrative telephone can be automatically transferred to the attendants station if unanswered within a predetermined amount of time.
6. The system must provide automatic circular hunting for the first available outgoing trunk when placing calls from within the system.
7. The system shall have capabilities for discriminating ringing to enable the receiving party to distinguish between internal and outside calls.
8. The system shall provide Direct Inward System Access (DISA). It shall be possible to access central switch functions (i.e. paging, monitoring, remote activation of time schedules and relays ,etc.) from any offsite touch tone telephone via an incoming telco line. Only authorized individuals may use this feature by dialing the dedicated trunk number and then dialing the system function.
9. The system shall allow for Station Message Detail Recording (SMDR) providing a complete printed record of all calls being placed within the system or when any of the system C.O. lines are accessed.
10. System shall have the capability of connecting in a master/slave configuration with the other building in the complex. System shall house the ISDN PRI cards that will be shared by all systems.
11. Provide the following system features:
    a. Add On Conference: Allows a station user and/or operator console to add a third, fourth, and fifth internal party to an existing two party conversation.
    b. Alpha-Numeric Display For Attendant Position: A visual device on a console switch, by use of digits and/or alphabetical designation, indicates the trunk circuit to which the

attendant is connected, or on internal calls, the station number and alpha/name identification class of service of the station line in voice connection with the attendant.

c. Area/Office Code Restriction: The ability of the switching system to selectively identify 6-digit area and Office Codes, and either allow or deny passage of long distance calls to those specific 6-digit codes. This type of restriction is usually provided on a trunk group basis, and on an "allowed" rather than "denied" basis.

d. Call Forwarding: Allows a station user to program at any time any internal station number (or the attendant), and when activated by the status user, all incoming calls to this station will be automatically rerouted to that preprogrammed number.

e. Call Forwarding - Busy Line: Automatically reroutes incoming Direct Inward Dialing (DID) calls, attendant processed calls, incoming CCS calls, or direct terminating Tie Line Calls, directly to attendant or predetermined secondary station when the called station is busy.

f. Call Forwarding - No Answer: Similar in function to the "busy line" version of Call Forwarding, automatic rerouting of a call, DID, or alternate facility to the attendant or a preprogrammed secondary station occurs when a given station does not answer within a prescribed time interval.

g. Call Transfer: Capability for any mutli-line administrative or single line staff telephone to transfer a "call" to any other multi-line administrative or single line staff telephone.

h. Class Of Service: A numerical index that is assigned to each extension and determines a variety of allowed or denied types of calls on both an incoming and an outgoing basis.

i. Direct Inward Dialing (DID): A basic facility allowing incoming calls from the public telephone network to reach specific lines without attendant intervention or assistance.

j. Direct Outward Dialing: The extension user can make external calls without attendant assistance.

k. Directed Call Pickup: A station user is able to answer calls ringing on any other station by dialing a unique code of that particular station to be answered.

l. Direct Paging Access: Facilities for telephones which have been software programmed with this capability, to instantaneously distribute page announcements simultaneously to all locations equipped with loudspeakers, by dialing a predetermined code number.

m. Direct Station Selector: Ability to one-touch transfer calls to intended party while also providing busy status indication of same extension.

n. Do Not Disturb: A feature allowing incoming calls to an extension to be routed to the call forward destination, other features operate as if the extension is busy.

o. End-To-End Signaling: Attendant and stations are able to continue to send DTMF signaling over an established external communications path.

p. Fixed Night Service: An arrangement used to route incoming calls, normally answered at the attendant position, to pre-selected stations with the system when the attendant is not on duty.

q. Flexible Night Service: Permits the attendant to "set-up" night connections in accordance with day-to-day requirements, with full flexibility in the assignment of incoming trunks to various stations. Such night service arrangements must be established by the attendant on each occasion they are activated.

r. Flexible Numbering Plan: Station dial plan is user definable to meet the requirements of the owner.

s. Hold: The capability to maintain a connection to a busy line, even when the station originating the connection is not off hook to the line or is engaged by another line.

t. Last Number Re-Dial: Memory contained either within the system common equipment or within the station instrument enables the station user to dial a special access digit or button to activate a speed calling treatment of the last number which was dialed from that station instrument.

u. Message Waiting Indication/Activation: A station user may initiate message waiting lamp indication at another station with button or feature code.

v. Programmable Feature Keys: Multiple buttons which can be programmed on a per station basis to access system features with one button access.

w. Remote Maintenance: A remote terminal can access the system for maintenance through a modem part or built-in system modem.

x. Speed Calling Station: Allows station users to assign abbreviated codes to certain frequently called numbers for use system-wide.

y. Speed Call System: Allows attendant to assign abbreviated codes to certain frequently called numbers for use system-wide.

z. Voice Mail Integration: Capability of integration to future voice mail system including direct access to intended party's mailbox without entering any digits, message waiting light indication, and access to immediate operator assistance.

aa. Call Transfer To Voice Mail: Calls may be transferred directly to any voice mail box from any phone.

C. Administrative Attendant Console(s): Provide units with the following features.(Quantity as per plans)

1. Ability to distinguish call type and status via a 32 character liquid crystal display.
2. Ability to transfer calls via a single button to stations.
3. Ability to monitor status of all stations in system via a direct station selection (DSS) console.

D. Multi-Line Digital Telephone(s): Provide units with the following features.(Quantity as per plans)

1. Twenty-Four (24) programmable direct station select “speed dial” keys (buttons) for automatic dialing. These buttons can be initially programmed for C.O. line access, All Call Page, Zone Page, Manual Class Change Signaling and direct station selection of frequently dialed extensions.
2. Feature buttons for a minimum of 8 features.
3. LCD display to show feature use, trunk use, and incoming caller identification.
4. Full handsfree speaker phone.
5. Message waiting indication.

E. Digital Classroom Telephone(s): Provide units with the following features.(Quantity as per plans)

1. Flash key.
2. Message waiting light.
3. Ringer Volume Control
4. Wall or desk mount as indicated on plans.

F. Digital Door Bell (s): (Quantity as per plans).

VOICE MAIL SYSTEM: Provide system that utilizes recorded voice messages that are accessible from any touch tone telephone, 24 hours a day, 7 days a week. System shall be an option card in the Digital Telephone system. Voice Mail shall provide the following features and functions.

A. Digital Integrated with the telephone system including customized call forwarding with personalized greeting or transfer capability. Messages left in a users mailbox will light the users telephone lamp automatically. After accessing messages the system will extinguish the user's lamp automatically.

B. Full or Part Time Automated Attendant.

C. Voice Mail

D. Audio Bulletin Board with Information Mailboxes

E. Outbound Dialing to Phones, cellular services and digital pagers

F. Distribution and School-Wide Announcements

G. Ability to capture and announce Caller ID information within each message

H. A Directory Lookup feature for non users

I. A Windows based System Administrator Editor

J. Number of Ports: The system shall have four (8) ports

INTERCOM/PUBLIC ADDRESS SYSTEM

A. Central Switching Exchange (CSE)

1. The installation shall include a comprehensive programmable microprocessor based communications system consisting of a central switching exchange capable of handling up to 360 remote stations.
2. All programmable functions shall be located in battery backed ram to prevent loss in a power failure condition.
3. The central switch shall utilize standard dual tone multi-frequency type decoding (DTMF) for conformance with standard telephone practices.
4. The central switch shall provide an RS-232 port for connection of on or off site programming and or diagnostics. It shall be possible for the user with a personal computer. (IBM XT or compatible) to access and change all system parameters as necessary and to save complete system architecture on its storage medium. It shall also be possible to run diagnostic software to isolate and correct faults in the system.
5. Provide a one (l) watt amplifier circuit for each remote station to allow absolute flexibility for simultaneous paging, program distribution and time tone schedules. Equipment requiring a single power amp for these functions shall size such an amp as to deliver a minimum of one (l) watt per station. Additional power will be required for hallway speakers, outside horns and common areas.
6. Provide facilities for a printer output to create a log of system activity.
7. The system shall be provided with four (4) multifunction ports for administrative phones and or any loop start trunk port of a key or PBX telephone system. All communication between administrative phones or between administrative phones or between administrative phones and loudspeaker locations shall be non-blocking.
8. Provide capabilities of zoning incoming calls from any staff station location to any of four (4) multifunction ports.

9. Provide four (4) telephonic links between DTMF telephone locations.
10. Provide eight (8) unrestricted talk paths for private communication between administrative phones, administrative phones and staff stations, and program of time tone distribution.
11. Provide one (l) direct dialing, two way voice amplified intercom link with automatic gain control for every twenty-four stations allowing multiple open voice conversations.
12. Tone Generator: The system shall provide nine (9) built in software definable tones for emergency and routine signaling.
13. Program Clock: The system shall provide an integral program clock for time tone distribution and other time related functions. It shall be possible to synchronize the program clock from an external master clock.
14. Clock Schedules: The system shall provide eight (8) separate time-tone schedules with a minimum of 1024 events. Individual events of each schedule shall be capable of sounding one of nine users defined tone types to any of the three hundred and sixty (360) speaker stations. These schedules can be run individually or simultaneously.
15. Programmable Relays: The system shall provide eight (8) internal system relays which can be activated manually from any administrative phone or automatically activated or cycled via an integral Master Time Control Center for controlling facility wide utility functions.

    NOTE: Systems that do not provide manual control of these relays from any administrative telephone will not be accepted.
16. Audio Program Distribution: The system shall provide facilities for the distribution of three (3) simultaneous audio programs. Program distribution shall be defined from an administrative or staff telephone location. Audio routing shall be accomplished via electronic cross-point switching. Systems which can not distribute program from multiple locations via telephones with the proper access level and require manual activation of mechanical switches at the central control rack only will not be accepted.
    a. Administrative phones may distribute program by room, by any of the 24 audio groups or facility wide.
17. Programmable Paging Zones: The system shall provide twenty-four (24) paging zones with two (2) priority levels of all call capability. Paging into any one zone shall not interrupt any program (s) previously distributed. If the areas receiving programs are part of the page zones the program shall be interrupted during the page and returned automatically when the page is completed. These zones are completely separate from the eight (8) zones provided for time signal reception. Any of the three hundred sixty (360) speaker station locations may be programmed to any or all of the systems twenty-four (24) audio zones. Systems providing less than 24 audio zones will not be accepted.
18. Programmable Extension Numbers: The system shall support two (2), three (3) or four (4) digit programmable architectural room numbers for administrative and staff station locations.
19. Pre-Announce Tones: The system shall provide selective pre-announce tones for discriminating between pages and intercom calls. A single chime shall be used for pages and a dual chime for intercom calls.
20. Call-In Confirmation Tone: The system shall provide a call confirmation tone (single beep) at the intercom speaker location when a call is placed. This tone verifies that the call has been placed into the system queue. A second confirmation tone (three beeps) shall be activated if the call is upgraded to an emergency call. Equipment which does not notify the caller that the system has accepted and placed the upgraded call will not be accepted.

21. LCD Display: An operators display shall be provided. This 4 x 20 alpha-numeric LCD display shall continually show time, day, date and current operating time schedule (s) unless it is in the programming mode. In addition, it shall show up to three (3) incoming calls and the priority of each call in queue (the fourth line shows how many additional calls are pending in the queue). Programming menus, time schedules and complete system architecture can also be displayed when in the programming mode. Menu prompts and feedback tones shall be used to help the user program the system. The operators display shall be capable of operating with any administrative phone on the system.

B. Standby Power: The system shall be equipped with an Uninterruptible Power Supply (UPS) system to maintain the system in full operation during power outages. All features and functions shall be maintained while on the UPS including interconnect telephone operation. The UPS system shall operate the system for a minimum of 30 minutes during normal usage of the Voice Communication and Sound System. The UPS system shall be mounted on a shelf one (l) foot off the floor.

C. Diagnostics: The central switching exchange shall provide an RS-232C serial data port for connection to a computer for on-site or via a modem to a remote computer for off-site diagnostic functions by distributor or manufacturer personnel. It shall be possible to determine circuit and software faults via these diagnostic and facilities remote software change. The system shall maintain statistics of operation of the main system functions for use by the individual administering the system.

l. Minimum diagnostic functions shall include:

Check active list of activity within the system.

DTMF test, to check the DTMF registers.

I/O diagnostics enable checking of each line, and each device connected in the circuit.

Capability of checking each link, and ability to remotely block a link from the system if found detective.

D. UL Listing: The system shall be UL8l3 listed meeting the 1990 National Electrical Code (NFPA70).

E. Program Distribution Panel: The system shall provide facilities for the distribution of three (3) simultaneous audio programs. Program distribution shall be defined from an administrative telephone location. Audio routing shall be accomplished via electronic cross-point switching. Systems which cannot distribute program from multiple locations via telephones with the proper access level and require manual activation of mechanical switches at the central control rack only will be considered to be in direct conflict with the intent of this specification.

1. Administrative phones may distribute program by room, by any of the 24 audio groups, or facility wide.
2. Program sources for distribution shall be:

Source #l: Provide a rack mounted, quartz synthesized AM/FM Digital Tuner operating on 120 VAC. The AM section shall be tunable over a range of 530 to 16l0Hz. The FM section shall be tunable over a range of 87.5 to 108MHz. The tuner shall have seek and scan, 20 preset stations, digital readout and shall include a roof mounted antenna.

Source #2: Provide a rack mounted Compact Disc Player operating on 120 VAC. Controls shall include play, stop, pause, search, and skip. The CD player shall have a frequency response of 20-20,000Hz + ldB. Dynamic range shall be 92dB with a total harmonic distortion of 0.007% at lkHz. A digital display indicating number of tracks, total running time of disc, which track is currently running and its elapsed time shall be incorporated in the player. Auto cueing and

random play shall also be standard features.

NOTE: Automobile type combination units are not considered equal in quality.

PART 2 – PRODUCTS

2.1 Acceptable Manufacturers

A. All bids shall be based on the equipment as specified herein.

B. The telecommunication system supplier shall be licensed (Alarm and Communications License furnished by the State Board of Electricity) and be an established professional communications system subcontractor with a minimum of five years of continuous service.

Approved system suppliers for this project are:

1. Simplex Building Systems

2.2 EQUIPMENT

A. Alcatel Lucent Omni PCX Enterprise Communications System

B. Intercom/Public Address System

1. Simplex 5120 Integrated Communication System

2.3 PBX TELEPHONE SYSTEM

A. Office Phones #8038

Classroom Phones #8018

1. Simplex Grinnell to coordinate with District for which rooms are to be equipped with administrative and classroom handsets.

B. Telephone Trunk Ports: Provide ports for the direct connection of 50 central office lines capable of operating with either loop start or ground start trunks for existing and future compatibility with utility services.

C. Digital Telephone Ports: Provide as required to support quantities indicated. Construct system with 20% spare capacity.

D. Single Line Telephone Ports: Provide as required to support quantities indicated. Construct system with 20% spare capacity.

<u>MAIN DISTRIBUTION FRAME (MDF)</u>

A. Voip system server to be mounted in server rack.

<u>WALL PLATES AND JACKS</u>

A. See Specification Section 260741.

<u>POWER SUPPLY AND TRANSIENT/SURGE PROTECTION</u>

A. AC Voltage Supply

1. Separately fused, 110-volt AC circuit fused with a circuit breaker of 20 amps.
2. Protect the AC supply with a Tripp Lite Model ISOBAR (IB) 2.0 AC outlet strip or equivalent.

B. Grounding: The cabinet housing the CSE and associated sound equipment shall be grounded to the building ground via a #6 AWG insulated copper wire.

C. Provide the following standby power equipment:

1. TrippLite Model (BX-750) or (BC-1200) battery backup system. Size as required for 60 minutes of operation.

2.4 INTERCOM/PUBLIC ADDRESS SYSTEM

A. Equipment Rack: Install all sound system components in an equipment rack. Simplex 5100-9810. Unit shall be 61" high with locking rear door. Provide blank panels as necessary to cover excess space. Install the equipment rack (s) on a roller truck with locking wheels to ease servicing and conservation of space.

B. Central Processor: Provide and install a CPU capable of supporting all speakers indicated on plans. System shall be capable of supporting up to 360 individual speaker zones. Simplex Model 5120 System.

C. AM/FM Tuner: Simplex 5100-9177 AM/FM Digital Tuner with antenna mounted above ceiling at exterior wall.

D. Compact Disc Player: Simplex 5120-9184 Compact Disc Player.

PERIPHERAL SYSTEM DEVICES

A. Backboards: Provide 4'x8' plywood backboards for mounting of system cross connect field mount as shown on the plans. Provide modular termination backboards with 110 type terminal blocks as required to terminate all cables. Provide distribution and cross connect backboards equal to AT&T 110 Series for all cross connect wiring.

B. Paging Speakers:

1. Ceiling Tile Installation (Round)
   a. Simplex 5120-9416 8" Speaker, 5 oz. Magnet, 25/70v Transformer
   b. Simplex 5120-9420 Round White Steel Baffle
   c. Simplex 5120-9491 Back Box w/ Tile Bridge
2. Wall Mount Installation (Square)
   a. Simplex 5120-9416 8" Speaker, 5 oz. Magnet, 25/70v Transformer
   b. Simplex 5120-9430 Square White Steel Baffle
   c. Simplex 5120-9492 Square Back Box
3. Surface Ceiling Installation (Square)
   a. Simplex 5120-9416 8" Speaker, 5 oz Magnet, 25/70v Transformer
   b. Simplex 5120-9430 Square White Steel Baffle
   c. Simplex 5120-9493 Square Back Box

C. Horn Loudspeakers:

1. Flush Wall Mount Installation (Square)
   a. Simplex 5120-9411 8" Loudspeakers
   b. Simplex 5120-9494 Flush Enclosure w/Baffle
   c. Provide Weatherproof Where Indicated.

D. Cabling:

1. Two-way intercom speakers: 2 conductor, 22 AWG, solid, plenum.
2. Commons area speakers: 2 conductor, 18 AWG, stranded, plenum.

E. Backboards

PART 3 – EXECUTION

3.1 Conduit and Raceway Installations

A. Provide conduit and raceway systems as specified in Section 260110 f as indicated below.
   1. Accessible suspended ceilings: Provide conduit from each outlet to plenum space above ceiling.
   2. Non-Accessible ceilings: Provide conduit run from each outlet to cable tray.
   3. Exposed structure: Provide conduit run from each outlet to cable tray.

B. Minimum conduit size:
   1. Telephones: 3/4" conduit.
   2. Speakers: 1/2" conduit.

C. Label all conduits at cable tray.

D. Outlet Boxes: 2-1/8 inches deep, 2 gang with single gang device ring as required for wall construction. Use deep masonry boxes at masonry construction.

3.2 WIRING INSTALLATION

A. Methods:
   1. Install wiring in conduit and raceways except as indicated.
   2. Wiring above accessible suspended ceilings may be installed without conduit.
   3. Install wiring in cable tray at all locations where cable tray is provided. Route wiring and cable directly to nearest available cable tray.
   4. Conceal wiring installations where possible.

B. Installation:
   1. Cable Support: Securely fasten to the permanent building structure where not installed in raceway. Support at regular intervals appropriate to the cable and wire size. Cable and wiring shall not lay loose on ceiling tiles or grids. Install parallel to building lines and follow building structure. Use cable support equipment/hardware recommended by the manufacturer.
   2. Cable Pulling: Do not exceed manufacturer's recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between indicated termination, tap, or junction points. Remove and discard cable where damaged during installation and replace it with new cable.
   3. Wiring in Enclosures: Bundle, lace, and trim the conductors to terminal points with no excess. Provide and use lacing bars and distribution spools.
   4. Identify and tag all cables with permanent type markers to denote location served.
   5. Provide cabling and make connection to the telephone company's telephone lines where the service enters the building.
   6. Provide a minimum #6 AWG insulated copper ground wire from the main equipment rack to the building main ground bus. Size and provide grounding as recommended by the manufacturer.

C. Terminations:
   1. Splice, Taps and Terminations: Use numbered terminal strips in junction, pull and outlet boxes, terminal cabinets, and equipment enclosures. Tighten connections to comply with tightening torques specified in UL Standard 486A.
   2. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors.

3. Rack and terminal cabinet wiring shall be neatly routed or bundled in plastic wiring duct and routed along rack sides. All splices and connections shall be by plug, solder or screw terminal strips, etc. Splices shall not hang in racks or terminal cabinets.

3.3 EQUIPMENT INSTALLATIONS

A. Surge Suppressors: Where AC power-operated devices are not protected against voltage transients by integral surge suppressors conforming to UL Standard 1449, install surge suppressors at the device power line terminals.

B. Install and wire equipment in accordance with accepted engineering and installation practices. Only the highest degree of workmanship will be accepted.

C. Label all front panel controls used in the normal operation of the system using plastic laminate engraved labels, or approved equal. Firmly affix to the panel or device. Dymo or Kroy tap adhesive backed lettering is not acceptable. Refer to Section 260055.

D. Label each major system component as to function and area served.

E. Mount system components in cabinets or racks as recommended by manufacturer, except as otherwise indicated.

F. Arrange equipment to facilitate access for maintenance and working space.

G. Identify system components, wiring, cabling, and terminals according to Section 260055 "Electrical Identification".

3.4 FIELD SERVICES AND TESTING

A. Measure the impedance of each amplifier's connected loudspeaker load after all speakers are installed and all transformer "taps" properly set. All room or area volume controls shall be set at "full on" for these measurements. Where more than one zone is connected to the same amplifier, each zone shall be measured individually and then combined. These measurements shall be made with proper test equipment using a 1000 Hz sine wave signal. The results of these measurements shall be recorded for inclusion in the operation manuals.

B. Where the measurement of any amplifier's loudspeaker load is less than 1.25 times the amplifiers nominal output impedance, make required corrections.

C. The gain controls of all electronic equipment shall be set as required and then capped or locked into position. Controls which are used for normal system operation are excluded from this requirement. All control settings shall be recorded for inclusion in operation manuals.

3.5 FINAL CHECKOUT AND ACCEPTANCE

A. System shall be complete and fully operational before requesting final acceptance and scheduling system demonstration/training.

B. Final Acceptance of the system will be given upon completion of all of the specified requirements, including testing, training and demonstration, and submittal of all required documentation.

3.6 EXTRA DEVICES

A. In addition to the equipment shown on the project drawings, include the quantities of the components shown below. These devices may be installed at the discretion of the Owner, Architect or Engineer. If necessary, these devices, along with the required panel additions, wiring, labor, etc., shall be furnished and installed at no additional cost to the Owner. If, at the end of the project, they are not required to be installed, they shall be given to the Owner for their use.

Qty	Description
3	Classroom Telephones
3	Classroom/Office Speakers
1	Administrative Telephone

3.7 EXECUTION

A. All work under this section shall be performed by persons having specific familiarity with telephone, data, and sound system installation. Upon request, the contractor shall submit resumes, references or other corroborating documentation, to the engineer to confirm the contractor's capabilities and experience.

B. GROUNDING: Except where specifically indicated otherwise, all exposed non-current carrying metallic parts of the communications system shall be grounded. This may be accomplished via a driven ground rod, cold water pipe or building power ground. If the building power ground is used, a separate ground conductor shall be used from the equipment to the grounding grid. All grounding shall be done with #6 solid copper wire or larger. The contractor shall use every effort to insure system stability and safety.

END OF SECTION 26 0771

SECTION 263553
SURGE PROTECTION DEVICES

PART 1 GENERAL

1.1 REFERENCES

A. Institute of Electrical and Electronics Engineers:

1. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.

2. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

3. IEEE C62.45 - Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:

1. NEMA LS 1 - Low Voltage Surge Protection Devices.

C. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

2. NFPA 780 - Standard for the Installation of Lightning Protection Systems.

D. Underwriters Laboratories Inc.:

1. UL 1283 - Electromagnetic Interference Filters.

2. UL 1449 – Surge Protection Devices.

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit capacity, dimensions, weights, details, and wiring configuration.

C. Test Reports:

1. Indicate Let-Through voltage test data.

2. Submit spectrum analysis of each unit.

3. Submit test reports from nationally recognized independent testing laboratory verifying suppressors can survive published surge current rating.

D. Manufacturer's Installation Instructions: Submit installation instructions and connection requirements.

E. Manufacturer's Certificate: Certify surge protection device complies with UL 1449 Third Edition Surge Voltage Ratings.

F. The contractor shall submit surge protective device model numbers and product data sheets to the Owner prior to construction.

1.3 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of surge protection devices.

B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, installation instructions, and maintenance and repair data.

1.4 QUALITY ASSURANCE

A. List individual units under UL 1449 and UL 1283.

B. Perform Work in accordance with Appoquinimink County Public Works and National Electrical Code standards and requirements.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept equipment on site in factory packaging. Inspect for damage.

B. Protect equipment from damage by providing temporary covers until construction is complete in adjacent space.

1.7 WARRANTY

A. Furnish a five-year manufacturer's warranty for surge protective devices.

PART 2 PRODUCTS

2.1 SURGE PROTECTIVE DEVICE (SPD)

A. Manufacturers:

1. Cutler-Hammer, Inc.
2. General Electric Company.
3. Square D Company.
4. Siemens Energy & Automation, Inc.

B. Furnish materials in accordance with the Appoquinimink County Public Work's standards.

C. Product Description: Surge protective devices for protection of AC electrical circuits.

D. Types: Lighting panelboards.

E. Unit Operating Voltage: As indicated on Drawings.

F. Maximum Continuous Operating Voltage: Greater than 115 percent of nominal system operating voltage.

G. Construction:

1. Finish: Factory finish of baked enamel.

2. Balanced Suppression Platform: Equally distribute surge current to Metal Oxide Varistor (MOV) components to ensure equal stressing and maximum performance. Furnish surge suppression platform with equal impedance paths to each matched MOV.

3. Internal Connections: Hardwired with connections using low impedance conductors and compression fittings.

4. Safety and Diagnostic Monitoring: Equipped with standard overcurrent protection:

   a. Continuous monitoring of fusing system.

   b. Monitor individual MOV's (including neutral to ground). Capable of identifying open circuit failures not monitored by conventional fusing systems.

   c. Monitor for overheating in each mode due to thermal runaway.

   d. Furnish green and red solid state indicator light on each phase. Absence of green light and presence of red light indicates which phases have been damaged. Fault detection activates flashing trouble light. Units not capable of detecting open circuit damage, thermal conditions, and over current will not be accepted.

5. Labeling: Permanently affix UL 1449 suppression voltage ratings and CSA to unit.

H. Rating:

1. Electrical Noise Filter: Furnish each unit with high performance EMI/RFI noise rejection filter. Electric line noise attenuation no less than 45 dB at 100 kHz using MIL-STD-220A insertion loss test method.

I. Accessories:

1. Digital display transient event counter with manual reset.

2. Local audible alarm.

3. Form C dry contacts one normally open (NO) and one normally closed (NC) for remote status monitoring.

4. Remote monitor panel with indicating lights and audible alarm for mounting in remote location.

5. Push-to-test feature.

J. Surge Current Capacity: Total surge current (based on 8 x 20 microsecond waveform) device is capable of surviving is not less than:

Application	Min Surge Current Per Phase	Min Surge Current Per Mode *
Service Entrance (Switchboards,Switchgear, MCC)	250 kA	125 kA
High Exposure Roof Top Locations	160 kA	80 kA
Distribution and branch locations (Panelboards,MCC, Bus Duct)	120 kA	60 kA
*L-G, L-N and N-G (WYE system); L-L, L-G (Delta system)		

K. Protection Modes: For Wye configured system, furnish device with directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For Delta configured system, furnish device with suppression elements between line to line (L-L) and line to ground (L-G).

L. Do not exceed the following for maximum UL 1449 suppression voltage ratings:

Modes	208Y/120	480Y/277	600Y/347
WYE - L-N; L-G; N-G	400 V	800 V	1200 V
Delta - L-L, L-G	800 V	1500 V	2000 V

M. ANSI/IEEE Catalog C3 Let Through Voltage: Based on ANSI/IEEE C62.41 and C62.45 recommended procedures for Catalog C3 surges (20 kV, 10kA) and not less than:

Modes	208Y/120	480Y/277	600Y/347
L-N	500 V	900 V	1300 V

N. ANSI/IEEE Cat. B3 Let Through Voltage: Based on ANSI/IEEE C62.41 and C62.45 recommended procedures for ANSI/IEEE Catalog B3 Ringwave (6 kV, 500 amps) not less than:

Modes	208Y/120	480Y/277	600Y/347
WYE - L-N; L-G; N-G	400 V	800 V	1200 V
L-N	170 V	300 V	470 V

2.2 SOURCE QUALITY CONTROL AND TESTS

A. Section 01 40 00 - Quality Requirements: Testing, inspection and analysis requirements.

B. Test units to specified surge ratings to ensure devices will achieve required life expectancy and reliability. Testing to full ratings also verifies internal construction quality of suppressors. Provide withstand testing for each mode and each phase basis.

C. Perform actual Let-Through voltage test data in form of oscillograph results for ANSI/IEEE C62.41 Catalog C3 (20 kV, 10 kA), Catalog C1 (6 kV, 3 kA), and Catalog. B3 (6 kv, 500 A at 100 kHz) tested in accordance with ANSI/IEEE C62.45.

D. Perform spectrum analysis of each unit based on MIL-STD-220A test procedures between 50 kHz and 200 kHz verifying device noise attenuation exceeds 45 dB at 100 kHz.

E. Perform test verifying suppressors can survive published surge current rating for each mode and each phase basis. Test wave based on ANSI/IEEE C62.41, 8x20 microsecond current wave.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify mounting area is ready for equipment.

B. Verify circuit rough-ins are at correct location.

3.2 INSTALLATION

A. Install in accordance with IEEE 1100.

B. Install distribution and branch suppressors in panelboards.

C. Install using direct bus bar connection.

D. Install indicator lights, trouble alarms, surge counter within existing electrical cabinet.

E. Install with maximum conductor length of 14 inches. Install SPD with internal fusing.

F. Install Work in accordance Appoquinimink County Public Works and National Electrical Code standards and requirements

END OF SECTION

SECTION 26 56 68
EXTERIOR ATHLETIC LIGHTING

PART 1 – GENERAL

1.1 SUMMARY

A. Work covered by this section of the specifications shall conform to the contract documents, engineering plans as well as state and local codes.

B. The purpose of these specifications is to define the lighting system performance and design standards for Appoquinimink High School using an LED lighting source. The manufacturer / contractor shall supply lighting equipment to meet or exceed the standards set forth in these specifications.

C. The sports lighting will be for the following features:

1. Football/Soccer field
2. Track
3. Home Stands
4. Visitor Stands

D. The primary goals of this sports lighting project are:

1. Guaranteed Light Levels: Selection of appropriate light levels impact the safety of the players and the enjoyment of spectators. Light levels shall be guaranteed to not drop below specified target values for a period of 25 years.
2. Environmental Light Control: The selected fixture shall minimize spill light to adjoining properties and glare to the players, spectators and neighbors.
3. Life-cycle Cost: The selected lighting system shall be energy efficient and cost effective to operate. All maintenance costs shall be eliminated for the duration of the warranty.
4. Control and Monitoring: A remote on/off control system shall be provided for the lighting system. Fields should be proactively monitored to detect luminaire outages over a 25-year life cycle. All communication and monitoring costs for 25-year period shall be included in the bid.

1.2 LIGHTING PERFORMANCE

A. Illumination Levels and Design Factors: Playing surfaces shall be lit to an average target illumination level and uniformity as specified in the chart below. Lighting calculations shall be developed and field measurements taken on the grid spacing with the minimum number of grid points specified below. Appropriate light loss factors shall be applied and submitted for the basis of design. Average illumination level shall be measured in accordance with the IESNA LM-5-04 (IESNA Guide for Photometric Measurements of Area and Sports Lighting Installations). Illumination levels shall not to drop below desired target values in accordance to IES RP-6-15, Page 2, Maintained Average Illuminance and shall be guaranteed for the full warranty period.

Area of Lighting	Average Target Illumination Levels	Maximum to Minimum Uniformity Ratio	Grid Spacing
Football/Soccer field	50 FC	2.0 : 1.0	30’ x 30’
Track	30 FC	4.0 : 1.0	30’ x 30’
Home Stands	4.5 FC	4.25 : 1.0	10’ x 10’
Visitors Stands	5.0 FC	2.5 : 1.0	10’ x 10’

B. Hours of usage: Designs shall be based on the following hours of usage

Area of Lighting	Annual Usage Hours	25-year Usage Hours
Football/Soccer field	300	7,500
Track	300	7,500

C. Color: The lighting system shall have a minimum color temperature of 5700K and a CRI of 75.

D. Power Consumption: The lighting system shall use LED fixtures that do not exceed 1200 watts for field and track lighting. LED fixtures for lighting the stands shall not exceed 400 watts. The overall power consumption of the system shall not exceed 73.7 kilowatts.

E. Mounting Heights: Proper aiming angles shall be used for reducing glare and to provide better playability. Minimum mounting heights shall be as described below. Higher mounting heights may be required based on photometric design evaluation and ability to guarantee the top of the field angle is a minimum of 10 degrees below horizontal.

# of Poles	Pole Designation	Pole Height
2	F1 & F2	80’
2	F3 & F4	90’
2	T1 & T2	50’

1.2 ENVIRONMENTAL LIGHT CONTROL

A. Light Control Luminaires: All luminaires shall utilize spill light and glare control devices including, but not limited to, internal shields, louvers and external shields.

B. Spill Light and Glare Control: The lighting system shall be designed to minimize lighting impacts on adjacent properties. Lighting system shall be designed to adhere to all local codes for lighting trespass and spill control. To minimize impact on adjacent properties, spill light and candela values must not exceed jurisdictional code criteria.

C. Spill Scans: Spill scans must be submitted indicating the amount of horizontal and vertical footcandles along the specified lines. Light levels shall be taken at 30-foot intervals along the boundary line. Readings shall be taken with the meter orientation at both horizontal and aimed towards the most intense bank of lights. Illumination level shall be measured in accordance with the IESNA LM-5-04 after 1 hour warm up.

1.3 LIFE-CYCLE COSTS

A. Manufacturer shall submit a 25-year life cycle cost calculation as outlined in the required submittal information.

B. Preventative and Spot Maintenance: Manufacturer shall provide all preventative and spot maintenance, including parts and labor for 25 years from the date of equipment shipment. Individual outages shall be repaired when the usage of any field is materially impacted. Owner agrees to check fuses in the event of a luminaire outage.

PART 2 – PRODUCTS

2.1 SPORTS LIGHTING SYSTEM CONSTRUCTION

A. Manufacturing Requirements: All components shall be designed and manufactured as a system. All luminaires, wire harnesses, drivers and other enclosures shall be factory assembled, wired and tested.

B. Durability: All exposed components shall be constructed of corrosion resistant material and/or coated to help prevent corrosion. All exposed carbon steel shall be hot dip galvanized per ASTM A123. All exposed aluminum shall be powder coated with high performance polyester or anodized. All exterior reflective inserts shall be anodized, coated, and protected from direct environmental exposure to prevent reflective degradation or corrosion. All exposed hardware and fasteners shall be stainless steel of 18-8 grade or better, passivated and coated with aluminum-based thermosetting epoxy resin for protection against corrosion and stress corrosion cracking. Structural fasteners may be carbon steel and galvanized meeting ASTM A153 and ISO/EN 1461 (for hot dipped galvanizing), or ASTM B695 (for mechanical galvanizing). All wiring shall be enclosed within the cross-arms, pole, or electrical components enclosure.

C. System Description: Lighting system shall consist of the following:

1. Galvanized steel poles and cross-arm assembly.

2. Pre-stressed concrete base embedded in concrete backfill shall be allowed to cure for 12-24 hours before pole stress is applied. Alternate may be an anchor bolt foundation designed such that the steel pole and any exposed steel portion of the foundation is located a minimum of 18 inches above final grade. The concrete for anchor bolt foundations shall be allowed to cure for a minimum of 28 days before the pole stress is applied unless shorter cure time approved by structural engineer of record. Direct bury steel and concrete poles are not allowed.

3. All luminaires shall be constructed with a die-cast aluminum housing or external hail shroud to protect the luminaire reflector system.

4. Manufacturers using remote drivers shall have drivers and supporting electrical equipment in aluminum enclosures mounted approximately 10 feet above grade. The enclosures shall be touch-safe and include driver, capacitor and fusing with indicator lights on fuses to notify when a fuse is to be replaced for each luminaire. Disconnect per circuit for each pole structure will be in the enclosure.

5. Wire harness complete with an abrasion protection sleeve, strain relief and plug-in connections for fast, trouble-free installation.

6. All luminaires, visors, and cross-arm assemblies shall withstand 150 mph winds and maintain luminaire aiming alignment.

7. Control cabinet to provide remote on-off control and monitoring of the lighting system. Cabinet shall be constructed of aluminum and be rated NEMA Type 4. Communication method shall be provided by manufacturer. Cabinet shall contain

custom configured contactor modules for 30, 60, and 100 amps, labeled to match field diagrams and electrical design. Manual off-on-auto selector switches shall be provided.

8. Lightning Protection: Manufacturer shall provide integrated lightning grounding via concrete encased electrode grounding system as defined by NFPA 780 and be UL Listed per UL 96 and UL 96A. If grounding is not integrated into the structure, the manufacturer shall supply grounding electrodes, copper down conductors, and exothermic weld kits. Electrodes and conductors shall be sized as required by NFPA 780. The grounding electrode shall be minimum size of 5/8 inch diameter and 8 feet long, with a minimum of 10 feet embedment. Grounding electrode shall be connected to the structure by a grounding electrode conductor with a minimum size of 2 AWG for poles with 75 feet mounting height or less, and 2/0 AWG for poles with more than 75 feet mounting height.

9. Bleacher/stand lights must be zoned separately with dedicated fixtures to achieve light levels specified in section 1.2.

D. Safety: All system components shall be UL listed for the appropriate application.

2.2 ELECTRICAL

A. Electric Power Requirements for the Sports Lighting Equipment:

1. Electric power: 480 Volt, 3 Phase

2. Maximum total voltage drop: Voltage drop to the disconnect switch located on the poles shall not exceed three (3) percent of the rated voltage.

B. Energy Consumption: The kW consumption for the field lighting system shall not exceed 73.7 kW.

2.3 STRUCTURAL PARAMETERS

A. Wind Loads: Wind loads shall be based on the 2015 International Building Code. Wind loads to be calculated using ASCE 7-10, an ultimate design wind speed of 115 mph and exposure category C.

B. Pole Structural Design: The stress analysis and safety factor of the poles shall conform to 2013 AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (LTS-6).

C. Foundation Design: The foundation design shall be based on soil parameters as outlined in the geotechnical report, Duffield Associates, Report No 3975.GC, July 2010. The contractor shall be responsible for obtaining a signed and sealed foundation design by a Professional Engineer licensed in the State of Delaware.

D. Foundation Drawings: Project specific foundation drawings stamped by a registered engineer in the state where the project is located are required. The foundation drawings must list the moment, shear (horizontal) force, and axial (vertical) force at ground level for each pole

2.4 CONTROL

A. Instant On/Off Capabilities: System shall provide for instant on/off of luminaires.

B. Lighting contactor cabinet(s) constructed of NEMA Type 4 aluminum, designed for easy installation with contactors, labeled to match field diagrams and electrical design. Manual off-on-auto selector switches shall be provided.

C. Remote Lighting Control System: System shall allow owner and users with a security code to schedule on/off system operation via a web site, phone, fax or email up to ten years in advance. Manufacturer shall provide and maintain a two-way TCP/IP communication link.

The owner may assign various security levels to schedulers by function and/or fields. This function must be flexible to allow a range of privileges such as full scheduling capabilities for all fields to only having permission to execute “early off” commands by phone. Scheduling tool shall be capable of setting curfew limits.

Controller shall accept and store 7-day schedules, be protected against memory loss during power outages, and shall reboot once power is regained and execute any commands that would have occurred during outage.

D. Remote Monitoring System: System shall monitor lighting performance and notify manufacturer if individual luminaire outage is detected so that appropriate maintenance can be scheduled. The controller shall determine switch position (manual or auto) and contactor status (open or closed).

E. Management Tools: Manufacturer shall provide a web-based database and dashboard tool of actual field usage and provide reports by facility and user group. Dashboard shall also show current status of luminaire outages, control operation and service. Mobile application will be provided suitable for IOS, Android and Windows devices.

Hours of Usage: Manufacturer shall provide a means of tracking actual hours of usage for the field lighting system that is readily accessible to the owner.

1. Cumulative hours: shall be tracked to show the total hours used by the facility

2. Report hours saved by using early off and push buttons by users.

F. Communication Costs: Manufacturer shall include communication costs for operating the controls and monitoring system for a period of 25 years.

PART 3 – EXECUTION

3.1 SOIL QUALITY CONTROL

A. It shall be the Contractor's responsibility to notify the Owner if soil conditions exist other than those on which the foundation design is based, or if the soil cannot be readily excavated. Contractor may issue a change order request / estimate for the Owner's approval / payment for additional costs associated with:

1. Providing engineered foundation embedment design by a registered engineer in the State of Delaware for soils other than specified soil conditions;

2. Additional materials required to achieve alternate foundation;

3. Excavation and removal of materials other than normal soils, such as rock, caliche, etc.

3.2 DELIVERY TIMING

A. Delivery Timing Equipment On-Site: The equipment must be on-site 6-8 weeks from receipt of approved submittals and receipt of complete order information.

3.3 FIELD QUALITY CONTROL

A. Illumination Measurements: Upon substantial completion of the project and in the presence of the Contractor, Project Engineer, Owner's Representative, and Manufacturer's Representative, illumination measurements shall be taken and verified. The illumination measurements shall be conducted in accordance with IESNA LM-5-04.

B. Field Light Level Accountability

1. Light levels are guaranteed not to fall below the target maintained light levels for the entire warranty period of 25 Years.

2. The contractor/manufacturer shall be responsible for an additional inspection one year from the date of commissioning of the lighting system and will utilize the owner's light meter in the presence of the owner.

3. The contractor/manufacturer will be held responsible for any and all changes needed to bring these fields back to compliance for light levels and uniformities. Contractor/Manufacturer will be held responsible for any damage to the fields during these repairs.

C. Correcting Non-Conformance: If, in the opinion of the Owner or his appointed representative, the actual performance levels including illuminance values and uniformity ratios are not in conformance with the requirements of the performance specifications and submitted information, the Manufacturer shall be required to make adjustments to meet specifications and satisfy Owner.

3.4 WARRANTY AND GUARANTEE

A. 25-Year Warranty: Each manufacturer shall supply a signed warranty covering the entire system for 25 years from the date of shipment. Warranty shall guarantee specified light levels. Manufacturer shall maintain specifically-funded financial reserves to assure fulfillment of the warranty for the full term. Warranty does not cover weather conditions events such as lightning or hail damage, improper installation, vandalism or abuse, unauthorized repairs or alterations, or product made by other manufacturers.

B. Maintenance: Manufacturer shall monitor the performance of the lighting system, including on/off status, hours of usage and luminaire outage for 25 years from the date of equipment shipment. Parts and labor shall be covered such that individual luminaire outages will be repaired when the usage of any field is materially impacted. Owner agrees to check fuses in the event of a luminaire outage.

REQUIRED SUBMITTAL INFORMATION FOR ALL MANUFACTURERS

All items listed below are mandatory, shall comply with the specification and be submitted according to bid submittal requirements. Complete the Yes/No column to indicate compliance (Y) or noncompliance (N) for each item. ***Submit checklist below with submittal.***

Yes / No	Tab	Item	Description
	A	Letter/ Checklist	Listing of all information being submitted must be included on the table of contents. List the name of the manufacturer's local representative and his/her phone number. Signed submittal checklist to be included.
	B	Equipment Layout	Drawing(s) showing field layouts with pole locations. Pole locations shall not deviate from locations shown on the plans unless approved by the Engineer.
	C	On Field Lighting Design	Lighting design drawing(s) showing: a. Field Name, date, file number, prepared by b. Outline of field(s) being lighted, as well as pole locations referenced to the center of the field (x & y), Illuminance levels at grid spacing specified c. Pole height, number of fixtures per pole, horizontal and vertical aiming angles, as well as luminaire information including wattage, lumens and optics d. Height of light test meter above field surface. e. Summary table showing the number and spacing of grid points; average, minimum and maximum illuminance levels in footcandles (fc); uniformity including maximum to minimum ratio, coefficient of variance (CV), coefficient of utilization (CU) uniformity gradient; number of luminaries, total kilowatts, average tilt factor; light loss factor.
	D	Off Field Lighting Design	Lighting design drawing showing initial spill light levels along the boundary line (defined on bid drawings) in footcandles. Light levels shall be taken at 30-foot intervals along the boundary line. Readings shall be taken with the meter orientation at both horizontal and aimed towards the most intense bank of lights.
	E	Environmental Light Control Design	Environmental glare impact scans must be submitted showing the maximum candela from the field edge on a map of the surrounding area until 500 candela or less is achieved.
	F	Photometric Report	Provide a photometric report for all luminaire types being proposed showing candela tabulations as defined by IESNA Publication LM-35-02. Photometric data shall be certified by laboratory with current National Voluntary Laboratory Accreditation Program or an independent testing facility with over 5 years experience.
	G	Performance Guarantee	Provide performance guarantee including a written commitment to undertake all corrections required to meet the performance requirements noted in these specifications at no expense to the owner. Light levels must be guaranteed to not fall below target levels for warranty period.
	H	Structural Calculations	Pole structural calculations and foundation design showing foundation shape, depth backfill requirements, rebar and anchor bolts (if required). Pole base reaction forces shall be shown on the foundation drawing along with soil bearing pressures. Design

			must be stamped by a structural engineer in the state of Delaware.
	I	Control & Monitoring System	Manufacturer of the control and monitoring system shall provide written definition and schematics for automated control system to include monitoring. They will also provide ten (10) references of customers currently using proposed system in the state of Delaware.
	J	Electrical Distribution Plans	Proposed equipment modifying the loading listed in the panelboard schedule shown on the Plans must include a revised electrical distribution plan including any required changes to service entrance, panels and wire sizing, signed by a licensed Electrical Engineer in the state of Delaware.
	K	Warranty	Provide written warranty information including all terms and conditions. Provide ten (10) references of customers currently under specified warranty in the state of Delaware.
	L	Project References	Manufacturer to provide a list of one (1) project where the technology and specific fixture proposed for this project has been installed in the state of Delaware. Reference list will include project name, project city, installation date, and if requested, contact name and contact phone number.
	M	Product Information	Complete bill of material and current brochures/cut sheets for all product being provided.
	N	Delivery	Manufacturer shall supply an expected delivery timeframe from receipt of approved submittals and complete order information.
	O	Non-Compliance	Manufacturer shall list all items that do not comply with the specifications. If in full compliance, tab may be omitted.
	P	Life-cycle Cost Calculation	Document life-cycle cost calculations as defined in the specification. Identify energy costs for operating the luminaires. Maintenance cost for the system must be included in the warranty. All costs should be based on 25 Years.

END OF SECTION

SECTION 28 0721
FIRE ALARM AND DETECTION SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. The work covered by this section is to be coordinated with related work as specified elsewhere in the specifications. Requirements of the following sections apply:

1. Electrical
2. Common Work Results for Electrical
3. Water-Based Fire-Suppression System
4. Clean Agent Fire Extinguishing Systems
5. Heating, Ventilating, and Air-Conditioning (HVAC)
6. Integrated Automation

C. The system and all associated operations shall be in accordance with the following:

1. Requirements of the following Model Building Code: IBC, 2015 Edition
2. Requirements of the following Model Fire Code: NFPA 1, 2015 Edition
3. Requirements of the following Model Mechanical Code: IMC, 2015 Edition
4. NFPA 72, National Fire Alarm Code, 2016 Edition
5. NFPA 70, National Electrical Code, 2014 Edition
6. NFPA 101, Life Safety Code, 2015 Edition
7. NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems, 2015 Edition
8. ANSI/ASME A17.1 / CSA B44, Safety Code for Elevators and Escalators, 2013 Edition
9. ICC/ANSI A117.1 Accessible and Useable Buildings and Facilities, 2015 Edition
10. Local Jurisdictional Adopted Codes and Standards
11. ADA Accessibility Guidelines

1.2 SUMMARY

A. This Section covers fire alarm systems, including initiating devices, notification appliances, controls, and supervisory devices.

B. Work covered by this section includes the furnishing of labor, equipment, and materials for installation of the fire alarm system as indicated on the drawings and specifications.

C. The Fire Alarm System shall consist of all necessary hardware equipment and software programming to perform the following functions:

1. Fire alarm system detection and notification operations.
2. Control and monitoring of elevators, door hold-open devices, fire suppression systems, emergency power systems, and other equipment as indicated in the drawings and specifications.
3. Two-way supervised firefighter's phone operations.
4. One-way supervised automatic voice alarm operations.

D. Network fire alarm control units shall include all features as described in this specification for stand-alone FACUs and shall have network communication capabilities as described herein.

1. All points monitored and controlled by a single node shall be capable of being programmed as "Public". Each point made public to the network may be programmed to be operated by any other node connected to the network.
2. Network communications shall be capable of supporting "point lists" that can be handled as though they were a single point.
3. The network shall provide a means to log into any node on the system via a laptop computer and have complete network access (Set Host) for diagnostics, maintenance reporting, and information gathering of all nodes in the system. Systems not meeting this requirement must provide all diagnostic tools required to support this function from selected points on the network. This Section covers fire alarm systems, including initiating devices, notification appliances, controls, and supervisory devices.

1.3 DEFINITIONS

A. ADA: Americans with Disabilities Act
B. AHJ: Authority Having Jurisdiction
C. ANSI: American National Standards Institute
D. ASME: American Society of Mechanical Engineers
E. FACU: Fire Alarm Control Unit
F. FM: Factory Mutual
G. IBC: International Building Code
H. ICC: International Code Council
I. IDC: Initiating Device Circuit
J. IEEE: Institute of Electrical and Electronic Engineers
K. IFC: International Fire Code
L. IMC: International Mechanical Code
M. IRI: Industrial Risk Insurers
N. LED: Light-emitting diode.
O. NAC: Notification Appliance Circuit
P. NFPA: National Fire Protection Association
Q. NICET: National Institute for Certification in Engineering Technologies.
R. RAC: Releasing Appliance Circuit
S. SLC: Signaling Line Circuit
T. UL: Underwriters Laboratories
U. ULC: Underwriters Laboratories, Canada

1.4 SCOPE OF WORK

A. This section to be completed by Engineer. Detailed description of system goals, operational requirements including unique sequence of operations, working hours, and other PROJECT SPECIFIC items should be included that are not clearly addressed in other sections of this document.

1.5 SYSTEM DESCRIPTION

A. General: Provide a complete, non-coded addressable, microprocessor-based fire alarm system with initiating devices, notification appliances, and monitoring and control devices as indicated on the drawings and as specified herein.

B. Power Requirements

1. The control unit shall receive AC power via a dedicated fused disconnect circuit.
2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period of 24 hours with 15 minutes of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.
3. All circuits requiring system-operating power shall be 24 VDC nominal voltage and shall be individually fused at the control unit.
4. The incoming power to the system shall be supervised so that any power failure will be indicated at the control unit. A green "power on" LED shall be displayed continuously at the user interface while incoming power is present.
5. The system batteries shall be supervised so that a low battery or a depleted battery condition, or disconnection of the battery shall be indicated at the control unit and displayed for the specific fault type.
6. The system shall support NAC Lockout feature to prevent subsequent activation of Notification Appliance Circuits after a Depleted Battery condition occurs in order to make use of battery reserve for front panel annunciation and control.
7. The system shall support 100% of addressable devices in alarm or operated at the same time, under both primary (AC) and secondary (battery) power conditions.
8. Loss of primary power shall sound a trouble signal at the FACU. FACU shall indicate when the system is operating on an alternate power supply.

C. Software: The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary.

1. The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation.
2. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory.
3. Panels shall be capable of full system operation during new site specific configuration download, master exec downloads, and slave exec downloads.
4. Remote panel site-specific software and executive firmware downloads shall be capable of being performed over proprietary fire alarm network communications.
5. Panels shall automatically store all program changes to the panel’s non-volatile memory each time a new program is downloaded. Panels shall be capable of storing the active site-specific configuration program and no less than 9 previous revisions in reserve. A compare utility program shall also be available to authorized users to compare any two of the saved programs. The compare utility shall provide a deviation report highlighting the changes between the two compared programs.
6. Panels shall provide electronic file storage with a means to retrieve a record copy of the site-specific software and up to 9 previous revisions. Sufficient file storage shall be provided for other related system documentation such as record drawings, record of completion, owner’s manuals, testing and maintenance records, etc.

7. The media used to store the record copy of site-specific software and other related system documentation shall be electrically supervised. If the media is removed a trouble shall be reported on the fire alarm control unit.

D. History Logs: The system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. A separate alarm and trouble log shall be provided.

E. Recording of Events: The system shall be capable of recording all alarm, supervisory, and trouble events by means of system printer. The printout shall include the type of signal (alarm, supervisory, or trouble) the device identification, date and time of the occurrence. The printout shall differentiate alarm signals from all other printed indications.

F. Wiring/Signal Transmission:

1. Transmission shall be hard-wired using separate individual circuits for each zone of alarm operation, as required or addressable signal transmission, dedicated to fire alarm service only.
2. System connections for initiating device circuits shall be Class B, Style D, signaling line circuits shall be Class B, Style 4 and notification appliance circuits shall be Class B, Style Y.
3. Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACU. Provide a distinctive indicating audible tone and alphanumeric annunciation.
4. Constant Supervision Audio: When provided, audio notification appliance circuits shall be supervised during standby by monitoring for DC continuity to end-of-line resistors.

G. Supplemental Notification and Remote User Access (Fire Panel Internet Interface)

1. Fire Alarm Control Unit (FACU) shall have the capability to provide supplemental notification and remote user access to the FACU using Ethernet and TCP/IP communications protocol compatible with IEEE Standard 802.3.
2. A standard RJ-45 Ethernet connection shall connect to the owner's Ethernet network. Provisions for that connection must be provided at each fire alarm control unit as part of the contract.
3. The means of providing supplemental email and SMS text messaging notification shall be agency listed for specific interfaces and for the purpose described in this section. The use of non-listed external third party products and interfaces is not acceptable.
4. The fire panel internet interface shall be capable of sending automated notification of discrete system events via email and SMS text messaging to up to 50 individual user accounts and via email to up to 5 distribution lists.
5. Each user account and distribution list shall be capable of being configurable for the specific type of events to be received. Each account shall be configurable to receive notification upon any combination of the following types of events:
   a. Fire Alarm,
   b. Priority 2,
   c. Supervisory,
   d. Trouble,
   e. Custom Action Messages,
   f. Fire Panel Internet Interface Security Violations
6. Each user account and distribution list shall be capable of being configurable for the specific content to be received. Each account shall be configurable to receive any combination of the following message content:

a. Summary,
b. Event Information,
c. Message,
d. Emergency Contacts,
e. Host Fire Alarm Control Unit Information

7. Each user account and distribution list shall be capable of being configurable for the type of Fire Alarm Control Unit Logs and Reports to be received. Each account shall be configurable to receive any combination of the following Logs and Reports via email:
   a. Alarm Log,
   b. Trouble Log,
   c. Analog Sensor Status Report,
   d. Analog Sensor Service Report,
   e. Almost Dirty, Dirty and Excessively Dirty Sensor Report,
   f. CO Analog Sensor Service Report,
   g. Addressable Notification Appliance Candela Report,
   h. Addressable Notification Appliance Status Report
8. Each user account and distribution list shall be capable of receiving email distribution of Fire Alarm Control Unit Logs and Reports On-Demand or automatically on a Pre-Determined schedule. Receipt of Logs and Reports shall be capable of being scheduled as follows:
   a. Weekly, or
   b. Bi-weekly, or
   c. Monthly
9. The Fire Alarm Control Unit Logs and Reports shall be sent in CSV file format which can be imported into common database applications for viewing, sorting, and customization.
   a. Each user account shall be capable of being configured to receive system events via email and/or SMS text messaging.
   b. Each distribution list shall be capable of supporting up to 20 email address recipients.
10. The means to provide email notification shall be compatible with SMTP mail servers, ISP email services, and Internet email services. Communication with the email server shall be verified at selectable intervals of 5 to 30 minutes.
11. Email operation shall be capable of being disabled for service by the system administrator.
12. An email log shall be accessible to authorized users. The email log shall display the 25 most recent email notifications sent.
13. The fire panel internet interface for supplemental notification and remote user access shall support:
    a. Secure HTTPS/SSL encrypted connections,
    b. Up to 50 individual password protected user accounts,
    c. Dynamic and Static IP addressing,
    d. IP Address Blocking,
    e. Restricted number of log-in attempts before lock-out configurable from 1 to 20,
    f. Lock-out duration after unsuccessful log-in attempts configurable from 0 to 24 hours,

g. Email notification to Administrators of unsuccessful log-in attempts,

h. Automatic lock-out reset upon a new event,

i. Automatic inactivity logout configurable from 10 minutes to 24 hours,

j. Firmware updates over Ethernet,

k. Set-up and configuration via Local Service Port or via Remote Services over LAN/WAN connection

14. Authorized users shall be capable of accessing the fire alarm panel using a compatible web browser (Internet Explorer 6.0 or higher) and a secure HTTPS/SSL encrypted connection.

15. The fire panel internet interface shall support concurrent connections for up to 5 users plus 1 administrator.

16. Authorized users with remote access shall be capable of:

    a. Viewing the fire panel internet interface web home page

        (1) The fire panel internet interface home page shall display system status information and provide links to detailed status information and fire alarm panel reports and history logs

        (2) The web browser on the user's computer shall automatically refresh system status information upon a new event

            (a) Systems that require a manual refresh to acquire updated system status information shall not be accepted

    b. Viewing the fire alarm panel detailed card status information

    c. Viewing the fire alarm panel detailed point status information

    d. Viewing the fire alarm panel reports and history logs

    e. Viewing the fire panel internet interface email log

    f. Viewing system summary information

    g. Accessing Custom Hypertext Links

17. The fire panel internet interface home page shall support customization to display the following information:

    a. Customer Name and Address,

    b. Fire Panel Location or Building Name,

    c. Up to 10 Custom Hypertext Links with Text Descriptions

H. Remote Services Access:

1. Fire Alarm Control Unit (FACU) shall have the capability to provide a remote service access feature using Ethernet and TCP/IP communications protocol compatible with IEEE Standard 802.3. The Remote Access feature shall provide automatic notification of system faults and remote diagnostics of system status for responding technicians prior to arrival on site.

2. A standard RJ-45 Ethernet connection shall connect to the owner's Ethernet network. Provisions for that connection must be provided at each fire alarm control unit as part of the contract.

3. The Ethernet access feature shall be agency listed for specific interfaces and for the purpose described in this section. The use of non-listed external third party interfaces is not acceptable.

4. The internet remote access service function shall provide automated real time off-site

reporting of discrete system events to a remote service support center with details of internal FACU fault conditions allowing a pre-site visit analysis of repair requirements.

5. Existing FACU controls shall be capable of retrofitting the Remote Service module as a plug-in upgrade feature.
6. The remote service network shall work on the customers Ethernet infrastructure and be Fire-Wall friendly for two-way communications for off-site reporting. The feature shall be compatible with existing proxy servers and firewalls shall not require any special changes or modifications.
7. The remote service system shall be able to connect to the remote service center without the need for a VPN account or similar tunnel.
8. The remote service system shall be a non Windows based application to protect against conventional virus attacks.
9. The remote service system shall support a secure connection with strong encryption, 128 bit or better, and an optional secondary encryption method if required.
10. The remote service system shall be compatible with virtual LANS (VLAN).
11. The remote service system shall work on an outbound communication premise (panel calls home) in order to eliminate the possibility of any inbound connection into the network (from trusted or non trusted sites).
12. The remote service system shall provide an audit trail of all events and service connections.
13. The Remote Service connection will provide access for panel software downloads and uploads for archiving job specific programs back at the enterprise server.
14. The supplier shall provide a service contract for the Remote Service program that provides the following requirements:
    a. 24/7 recording of FACU service activity.
    b. Off-site diagnostics by a technical specialist to provide repair and parts guidance to the service technician prior to a site visit.

I. Required Functions: The following are required system functions and operating features:

1. Priority of Signals: Fire alarm events have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Priority Two, Supervisory and Trouble events have second-, third-, and fourth-level priority, respectively. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all events regardless of priority or order received.
2. Noninterfering: An event on one zone does not prevent the receipt of signals from any other zone. All zones are manually resettable from the FACU after the initiating device or devices are restored to normal. The activation of an addressable device does not prevent the receipt of signals from subsequent addressable device activations.
3. Transmission to an approved Supervising Station: Automatically route alarm, supervisory, and trouble signals to an approved supervising station service provider, under another contract.
4. Annunciation: Operation of alarm and supervisory initiating devices shall be annunciated at the FACU and the remote annunciator, indicating the type of device, the operational state of the device (i.e. alarm, trouble or supervisory) and shall display the custom label associated with the device.
5. Selective Alarm: A system alarm shall include:

a. Indication of alarm condition at the FACU and the annunciator(s).
b. Identification of the device /zone that is the source of the alarm at the FACU and the annunciator(s).
c. Operation of audible and visible notification appliances until silenced at FACU.
d. Closing doors normally held open by magnetic door holders.
e. Unlocking designated doors.
f. Shutting down supply and return fans serving zone where alarm is initiated.
g. Closing smoke dampers on system serving zone where alarm is initiated.
h. Initiation of smoke control sequence.
i. Transmission of signal to the supervising station.
j. Initiation of elevator Phase I functions (recall, shunt trip, illumination of indicator in cab, etc.) in accordance with ANSI/ASME A17.1 / CSA B44, Safety Code for Elevators and Escalators, when specified detectors or sensors are activated, as appropriate.

6. Supervisory Operations: Upon activation of a supervisory device such as a fire pump power failure, low air pressure switch, and tamper switch, the system shall operate as follows:
   a. Activate the system supervisory service audible signal and illuminate the LED at the control unit and the remote annunciator.
   b. Pressing the Supervisory Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory LED "on" indicating off-normal condition.
   c. Record the event in the FACU historical log.
   d. Transmission of supervisory signal to the supervising station.
   e. Restoring the condition shall cause the Supervisory LED to clear and restore the system to normal.
7. Alarm Silencing: If the "Alarm Silence" button is pressed, all audible alarm signals shall cease operation.
8. Priority Two Operations: Upon activation of a priority two condition gas detection, chemical leak detection, intrusion alert,, the system shall operate as follows:
   a. Activate the system priority two audible signal and illuminate the LED at the control unit and the remote annunciator.
   b. Pressing the Priority 2 Acknowledge Key will silence the audible signal while maintaining the Priority 2 LED "on" indicating off-normal condition.
   c. Record the event in the FACU historical log.
   d. Transmission of priority two signal to the supervising station.
   e. Restoring the condition shall cause the Priority 2 LED to clear and restore the system to normal.
9. System Reset
   a. The "System Reset" button shall be used to return the system to its normal state. Display messages shall provide operator assurance of the sequential steps ("IN PROGRESS", "RESET COMPLETED") as they occur. The system shall verify all circuits or devices are restored prior to resetting the system to avoid the potential for re-alarming the system. The display message shall indicate "ALARM PRESENT, SYSTEM RESET ABORTED."
   b. Should an alarm condition continue, the system will remain in an alarmed state.

10. A manual evacuation (drill) switch shall be provided to operate the notification appliances without causing other control circuits to be activated.
11. WALKTEST: The system shall have the capacity of 8 programmable passcode protected one person testing groups, such that only a portion of the system need be disabled during testing. The actuation of the "enable one person test" program at the control unit shall activate the "One Person Testing" mode of the system as follows:
    a. The city circuit connection and any suppression release circuits shall be bypassed for the testing group.
    b. Control relay functions associated with one of the 8 testing groups shall be bypassed.
    c. The control unit shall indicate a trouble condition.
    d. The alarm activation of any initiating device in the testing group shall cause the audible notification appliances assigned only to that group to sound a code to identify the device or zone.
    e. The unit shall automatically reset itself after signaling is complete.
    f. Any opening of an initiating device or notification appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating the trouble condition.
12. Install Mode: The system shall provide the capability to group all non-commissioned points and devices into a single "Install Mode" trouble condition allowing an operator to clearly identify event activations from commissioned points and devices in occupied areas.
    a. It shall be possible to individually remove points from Install Mode as required for phased system commissioning.
    b. It shall be possible to retrieve an Install Mode report listing that includes a list of all points assigned to the Install Mode. Panels not having an install mode shall be reprogrammed to remove any non-commissioned points and devices.
13. Module Distribution:
    a. The fire alarm control unit shall be capable of allowing remote location of the following modules; interface of such modules shall be through a Style 4 (Class B) supervised serial communications channel (SLC):
        (1) Initiating Device Circuits
        (2) Notification Appliance Circuits
        (3) Auxiliary Control Circuits
        (4) Graphic Annunciator LED/Switch Control Modules
            (a) In systems with two or more Annunciators and/or Command Centers, each Annunciator/Command Center shall be programmable to allow multiple Annunciators/Command Centers to have equal operation priority or to allow hierarchal priority control to be assigned to individual Annunciator/Command Center locations.
        (5) Initiating Device Signaling Line Circuits
        (6) Notification Appliance Signaling Line Circuits
        (7) Power Supplies
        (8) Voice System Amplifiers

J. Integrated Automation
    1. Security Integration

a. The FA System shall provide the means to be integrated directly to a Software House C•Cure 9000 or 800 Security Management System (SMS) via a software interface for the purpose of communicating fire alarm events directly to the security system.

b. Communication between the FA System and SMS shall be accomplished using Computer Port Protocol (CPP).

(1) The FA and the C•Cure SMS shall be connected via a local or network serial port server based RS-232 serial port connection.

c. The CPP shall consist of a bi-directional serial protocol capable of accessing most of the Fire Alarm Control Unit (FACU) diagnostic features.

d. The interface shall provide the means to communicate the following information to the C•Cure SMS:

(1) Device/Point status changes (e.g., Fire, Trouble, Disabled)

(2) Panel event status (e.g. Number of Unacknowledged Fire Alarms, Card Failure Troubles, etc.)

(3) Panel health status (e.g., AC power, battery status)

e. Interface software shall include a data acquisition function that provides the following:

(1) Establishes and maintains a supervised serial link

(2) Extraction of the point database from the FACU

(3) Merges the FACU database into the C•Cure SMS database

f. The software interface shall not allow system control functionality from the C•Cure SMS to the FA System.

g. The installation, programming and maintenance of the FA/C•Cure integration software interface shall be conducted by factory trained certified technicians.

2. Building Automation and Control Network (BACnet) Integration

a. The fire alarm control unit shall be capable of providing a one-way communications interface between the fire alarm control unit and an industry-standard Building Automation and Control Network (BACnet) using ASHRAE® BACnet® IP (internet protocol) compliant with ANSI/ASHRAE Standard 135.

b. The BACnet communications module shall be agency listed to UL Standard 864.

c. The fire alarm control unit shall be capable of communicating up to 1000 status changes to the building automation system.

d. MS/TP Master and MS/TP Slave data link layer options communicating at baud rates up to 76,800 bps shall be supported.

e. The interface shall be capable of supporting ANSI X3.4, ISO 10656 (ICS-4), ISO 10656 (UCS-2), ISO 8859-1, or IBM/Microsoft DBCS character sets.

f. A standard RJ-45 Ethernet connection to the Building Automation System Ethernet network shall be provided at the fire alarm control unit as part of the contract.

3. Refer to section: 25.00 Integrated Automation

K. Fire Suppression Monitoring:

1. Water flow: Activation of a water flow switch shall initiate general alarm operations.

2. Sprinkler valve tamper switch: The activation of any valve tamper switch shall activate system supervisory operations.

3. Water flow switch and sprinkler valve tamper switch shall be capable of existing on the same

initiating zone. Activation of either device shall distinctly report which device is in alarm on the initiating zone.

L. Audible Alarm Notification: By horns in areas as indicated on drawings.

M. Audible Alarm Notification: By voice evacuation and tone signals on loudspeakers in areas as indicated on drawings.

1. Automatic Voice Evacuation Sequence:

a. The audio alarm signal shall consist of an alarm tone for a maximum of five seconds followed by an automatic digital voice message. At the end of the voice message, the alarm tone shall resume. This sequence shall sound continuously until the "Alarm Silence" switch is activated.

b. All audio operations shall be activated by the system software so that any required future changes can be facilitated by authorized personnel without any component rewiring or hardware additions.

N. Speaker: Speaker notification appliances shall be listed to UL 1480.

1. The speaker shall operate on a standard 25VRMS or 70.7VRMS NAC using twisted/shielded wire.

2. The following taps are available: 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker has minimum UL rated sound pressure level of 84dBA at 10 feet.

3. The speaker shall have a frequency response of 400 to 4000 Hz for Fire Alarm and 125 to 12kHz for general signaling.

O. Manual Voice Paging

1. The system shall be configured to allow voice paging. Upon activation of any speaker manual control switch, the alarm tone shall be sounded over all speakers in that group.

2. The control unit operator shall be able to make announcements via the push-to-talk paging microphone over the pre-selected speakers.

3. Total building paging shall be accomplished by the means of an "All Call" switch.

P. Constant Supervision of Non-Alarm Audio Functions

1. When required, the system shall be configured to allow Non-Alarm Audio (NAA) functions such as background music or general/public address paging.

2. During NAA operation, the speaker circuit shall be electrically supervised to provide continuous monitoring of the speaker circuit.

3. During an alarm condition, supervision shall be disabled and alarm signals delivered to speakers.

Q. Firefighter's Phone: Provide a supervised, two-way communication system between the Command Center/main fire alarm control unit and emergency phones.

1. The firefighter's phone system shall be capable of handling single or simultaneous conversations with all phones connected into the system. As many as six phones shall be able to be connected into the active conversation.

2. The phone system circuits shall be designed to prevent static, hum or other interference for clear, intelligible two-way conversation between all phones of the system.

3. The phone system circuits shall be supervised, such that the FACU shall be able to differentiate between whether a handset has been plugged into the emergency phone jack and whether the circuit has a shorted wire.

4. A beeping busy signal shall indicate to the person attempting to use a remote phone that the

signal is being received at the control unit and that the lines are intact.

5. The act of plugging a handset into an emergency phone jack or removal of any phone from its normal hook position shall cause an audible and visual indication at the control unit. Picking up of the master phone and acknowledgment of the phone circuit shall silence the tone and allow for direct two-way communications.
6. The act of unplugging handsets in use and replacement of remote phones to their cradle shall restore normal supervisory functions.
7. Provide emergency phone jacks for installation in each elevator car by the elevator contractor. Required wiring from elevator controls to each elevator car shall be furnished and installed by the elevator contractor.
8. Provide emergency phone jacks as shown on the plans. Each jack shall be mounted on a stainless steel single gang plate with the words "Fire Emergency Phone" screened on each.
9. Provide a minimum of five (5) pluggable emergency phones within a storage cabinet.

R. Network Communication:

1. Network node communication shall be through a token ring, hub, or star topology configuration, or combination thereof.
2. A single open, ground or short on the network communication loop shall not degrade network communications. Token shall be passed in opposite direction to maintain communications throughout all network nodes. At the same time the status of the communication link shall be reported.
3. If a group of nodes becomes isolated from the rest of the network due to multiple fault conditions, that group shall automatically form a sub-network with all common interaction of monitoring and control remaining intact. The network shall be notified with the exact details of the lost communications.
4. Fiber optics communication shall be provided as an option via a fiber optics modem. Modem shall multiplex audio signals and digital communication via full duplex transmission over a single fiber optic cable, either single mode or multi mode.
5. The communication method shall be NFPA 72 style 7.

S. Network Synchronization of Notification Appliances

1. The fire alarm and emergency communications network shall be capable of providing UL Listed synchronization across all the notification appliance circuits for all panels on a network loop in accordance with the requirements of UL 1971.
2. Systems that require all notification appliances to be connected to a single panel for synchronization thus creating a potential single point of failure shall not be acceptable.
3. Up to 99 panels on a network loop shall be capable of UL Listed synchronization of all notification appliance circuits across the network loop in accordance with the requirements of UL 1971.
4. Should network communications be disrupted, re-synchronization shall occur across all nodes that continue to communicate together after network re-initialization is completed and restored to affected nodes.

T. Addressable Notification Appliances (Applies only where addressable notification is provided):

1. Monitoring: The FACU shall monitor individual addressable notification appliances for status, condition, type of appliance, and configured appliance settings. A fault in any individual appliance shall automatically report a trouble condition on the FACU.
2. Individual Appliance Custom Label: Each addressable appliance shall have its own 40

character custom label to identify the location of the appliance and to aid in troubleshooting fault conditions.

3. Individual Appliance Information Display:
   a. The FACU shall be capable of calling up detailed information for each addressable appliance including the appliance location, status, condition, type of appliance, and configured appliance settings.
   b. Notification appliances that are not capable of communicating and reporting their individual location, status, condition, type of appliance, and configured appliance settings to the FACU shall not be accepted.
4. Programmable Appliance Settings:
   a. The selectable operation of each addressable notification appliance shall be capable of being configured by the FACU without having to replace or remove the appliance from the wall or ceiling.
      (1) Programmable appliance settings for applicable addressable notification appliances shall include:
         (a) Operation:
            i. General Evac
            ii. Alert
            iii. User Defined
         (b) Style:
            i. Indoor
            ii. UL Weatherproof
            iii. ULC Weatherproof
         (c) Candela Selections:
            i. Indoor: 15, 30, 75, 110, 135, or 185 cd (per UL1971)
            ii. UL Weatherproof: 15 or 75 cd (per UL1971), and 75 or 185 cd (per UL1638)
            iii. ULC Weatherproof: 20, 30 or 75 cd (per ULCS526)
         (d) Horn Volume:
            i. Hi
            ii. Low
         (e) Horn Cadence:
            i. Temporal 3
            ii. Temporal 4
            iii. March Time 20 bpm
            iv. March Time 60 bpm
            v. March Time 120 bpm
            vi. Steady
         (f) Horn Tone:
            i. 520 HZ
            ii. Bell

iii. Slow Whoop

iv. Siren

v. Hi / Lo

b. Systems that require replacement or removal of the appliances from the wall or ceiling to change their applicable operation or settings shall not be accepted.

5. Programmable Notification Zones:

a. Changing the notification zone assigned to a notification appliance shall be configurable by the FACU and shall not require additional circuits or wiring.

6. Other Emergency and Non Emergency Notification:

a. Where required, notification appliances for purposes not related to fire alarm shall be capable of:

(1) being connected to the same circuit as the fire alarm appliances, and

(2) being individually configured for their intended use without requiring additional circuits or wiring.

7. Addressable Notification Appliance Automated Self-Test:

a. The fire alarm control unit shall be capable of performing an automated functional self-test of all self-test notification appliances and meet the requirements in NFPA 72, 2013 Edition, 14.2.8 Automated Testing and Table 14.4.3.2 testing requirements.

b. Test results for each self-test notification appliance shall be stored in non-volatile memory at the fire alarm control unit.

c. The fire alarm control unit shall be capable of running a functional automated test for all self-test notification appliances in a general alarm group or for all self-test appliances within a specific notification zone.

d. The duration required to complete the automated functional test for all self-test notification appliances shall be accomplished in 2 minutes or less.

e. The automated test results for all self-test notification appliances shall be available from the fire alarm control unit within 4 minutes from the start of the test.

f. If any notification appliance fails its automated functional self-test an audible and visual trouble signal shall be annunciated at the fire alarm control unit.

(1) The self-test trouble signal shall be a latching trouble signal which requires manual restoration to normal.

8. Addressable Notification Appliance Reports:

a. The fire alarm control unit shall maintain configuration and test data for each self-test addressable notification appliance.

b. The fire alarm control unit shall be capable of generating configuration, self-test, and deficiency reports, that can be viewed through the fire alarm control unit user interface or printed via the fire alarm control unit service port.

(1) At minimum, the configuration report shall include the following information applicable for each addressable notification appliance:

(a) Point ID

(b) Custom Label

(c) Device Type

(d) Candela Setting

(2) At minimum, the self-test report shall include the following information applicable for each self-test notification appliance:

(a) Point ID

(b) Custom Label

(c) Time and Date of last test

(d) Pass / Fail results of last visual test

(e) Pass / Fail results of last audible test

c. The fire alarm control unit shall also be capable of providing a deficiency report that includes a list of all self-test notification appliances that have failed self-test.

9. Magnet test: When the control unit is in diagnostic mode, the appliances shall be capable of being tested with a magnet. The magnet diagnostics shall:

a. Pulse the appliance LED to indicate appliance address,and

b. briefly sound the individual horn to confirm the audible appliance operation ,and

c. briefly flash the individual strobe to confirm visible appliance operation

d. briefly sound the individual speaker to confirm the audible appliance operation

1.6 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

1. Product data sheets for system components highlighted to indicate the specific products, features, or functions required to meet this specification. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.

2. Wiring diagrams from manufacturer.

3. Shop drawings showing system details including location of FACU, all devices, circuiting and details of graphic annunciator.

4. System power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate in accordance with the prescribed backup time periods and under all voltage conditions per UL and NFPA standards.

5. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. A list of all input and output points in the system shall be provided with a label indicating location or use of IDC, SLC, NAC, relay, sensor, and auxiliary control circuits.

6. Operating instructions for FACU.

7. Operation and maintenance data for inclusion in Operating and Maintenance Manual. Include data for each type product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations.

8. Product certification signed by a certified representative of the manufacturer of the fire alarm system components certifying that their products comply with indicated requirements.

9. Record of field tests of system.

B. Submission to Authority Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authority having jurisdiction. Include copies of shop drawings as required to depict component locations to facilitate review. Upon receipt of comments from the Authority, make resubmissions, if required, to make clarifications or

revisions to obtain approval.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A factory authorized installer is to perform the work of this section.

B. Each and every item of the Fire Alarm System shall be listed under the appropriate category by a Nationally Recognized Testing Laboratory and shall bear the respective "NRTL" label.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without Architect's written permission.

1.9 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.10 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.11 MAINTENANCE SERVICE

A. Warranty Maintenance Service: Provide maintenance of fire alarm systems and equipment for a period of 12 months, using factory-authorized service representatives

B. Basic Services: Routine maintenance visits on an “as needed” basis at times scheduled with the Owner. Respond to service calls within 24 hours of notification of system trouble either by customer visit or other customer contact as necessary. Adjust and replace defective parts and components with original manufacturer's replacement parts, components, and supplies.

C. Additional Services: Perform services within the above 12-month period not classified as routine maintenance or as warranty work when authorized in writing. Compensation for additional services must be agreed upon in writing prior to performing services.

D. Maintenance Service Contract: No later than 60 days prior to the expiration of the warranty maintenance services, deliver to the Owner a proposal to provide contract maintenance and repair services for an additional one-year term. As an option with this proposal, deliver to the Owner a proposal to provide scheduled inspection and testing services for a one-year term. Owner will be under no obligation to accept maintenance service contract proposal or inspection and testing

proposal.

1.12 EXTRA MATERIALS

A. General: Furnish extra materials, packaged with protective covering for storage, and identified with labels clearly describing contents as follows:

1. Break Rods for Manual Stations: Furnish quantity equal to 15 percent of the number of manual stations installed; minimum of 6 rods.
2. Notification Appliances: Furnish quantity equal to 10 percent of each type and number of units installed, but not less than one of each type.
3. Smoke Detectors or Sensors, Fire Detectors, and Flame Detectors: Furnish quantity equal to 10 percent of each type and number of units installed but not less than one of each type.

B. Detector or Sensor Bases: Furnish quantity equal to 2 percent of each type and number of units installed but not less than one of each type.

C. Printer Ribbons: Furnish 6 spare printer ribbons when a printer is provided.

PART 2 – PRODUCTS

2.1 ACCEPTABLE EQUIPMENT AND SERVICE PROVIDERS

A. Manufacturers: The equipment and service described in this specification are those supplied and supported by Tyco SimplexGrinnell and represent the base bid for the equipment.

1. Subject to compliance with the requirements of this specification, provide products by one of the following:
   a. Simplex, a Tyco Company

B. Being listed as an acceptable Manufacturer in no way relieves obligation to provide all equipment and features in accordance with these specifications.

C. Alternate products must be submitted to the Engineer two weeks prior to bid for approval. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.

D. The equipment and service provider shall be a nationally recognized company specializing in fire alarm and detection systems. This provider shall employ factory trained and NICET Level IV certified technicians, and shall maintain a service organization within 50 miles of this project location. The equipment and service provider shall have a minimum of 10 years experience in the fire protective signaling systems industry.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Flame detectors.
4. Smoke detectors.
5. Duct smoke detectors.
6. Verified automatic alarm operation of smoke detectors.
7. Automatic sprinkler system water flow.
8. Heat detectors in elevator shaft and pit.
9. Fire-extinguishing system operation.

10. Fire standpipe system.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Activate voice/alarm communication system.
7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
8. Activate smoke-control system (smoke management) at firefighter smoke-control system panel.
9. Activate stairwell and elevator-shaft pressurization systems.
10. Close smoke dampers in air ducts of designated air-conditioning duct systems.
11. Recall elevators to primary or alternate recall floors.
12. Activate emergency lighting control.
13. Activate emergency shutoffs for gas and fuel supplies.
14. Record events in the system memory.
15. Record events by the system printer.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Low-air-pressure switch of a dry-pipe sprinkler system.
3. Elevator shunt-trip supervision.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal AC voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.
9. Fire-pump power failure, including a dead-phase or phase-reversal condition.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer where provided.

2.3 FIRE ALARM CONTROL UNIT (FACU)

A. General: Comply with UL 864, "Control Units and Accessories for Fire Alarm Systems".

B. The following FACU hardware shall be provided:

1. Power Limited base panel with platinum cabinet and door, 120 VAC input power.

2. 2,500 point capacity where (1) point equals (1) monitor (input) or (1) control (output).
3. 2000 points of annunciation where one (1) point of annunciation equals:
   a. 1 LED driver output on a graphic driver or 1 switch input on a graphic switch input module.
   b. 1 LED on panel or 1 switch on panel.
4. 9 Amp Power Supply minimum with temperature compensated, dual-rate battery charger capable of charging up to 110 Ah batteries without a separate external battery charger. Battery charger voltage and amperage values shall be accessible on the FACU LCD display.
5. One Auxiliary electronically resettable fused 2A @24VDC Output, with programmable disconnect operation for 4-wire detector reset.
6. One Auxiliary Relay, SPDT 2A @32VDC, programmable as a trouble relay, either as normally energized or de-energized, or as an auxiliary control.
7. Three (3) Class B Addressable Notification Appliance Signaling Line Circuits (SLCs).
   a. Each Addressable Notification Appliance SLC shall be rated at 3A and capable of supporting up to 127 Notification Appliances per channel.
   b. Wiring shall be 18 AWG to 12 AWG unshielded twisted pair wire. Systems that require shielded wire for Notification Appliances shall not be accepted.
   c. A constant voltage under both primary and secondary power conditions shall be maintained at the notification appliance field wiring terminal connections in the FACU to ensure the voltage drop on the circuit is consistent under both primary and secondary power conditions.
   d. For systems that do not provide a constant voltage source at the FACU notification appliance field wiring terminal connections, the fire alarm contractor shall:
      (1) Provide separate point-to-point voltage drop calculations for all notification appliances under worst case secondary power specifications, and
      (2) Perform a complete functional test of all notification appliances under worst case secondary power conditions.
8. Three (3) Class B Notification Appliance Circuits (NAC; rated 3A@24VDC, resistive).
   a. NAC's shall be conventional reverse polarity operation and shall be for synchronized strobes and independent horn/strobe operation over two wires.
   b. NACs shall be selectable as auxiliary power outputs derated to 2 A for continuous duty.
   c. Strobe synchronization and audible cadence synchronization shall be across all panel NAC circuits. Systems that cannot provide listed synchronization across all panel NAC's shall not be acceptable.
9. Where required provide Intelligent Remote Battery Charger for charging up to 50Ah batteries.
10. Expansion Power Supplies with three (3) Class B integral Intelligent Addressable Notification Appliance Signaling Line Circuits (SLCs) for system expansion. Expansion power supplies shall provide complete capability as the primary power supply.
11. Power Supplies with integral conventional reverse polarity Notification Appliance Circuit Class B for system expansion. Expansion power supplies shall provide complete capability as the primary power supply.
12. Four (4) form "C" Auxiliary Relay Circuits (Form C contacts rated 2A @ 24VDC, resistive), operation is programmable for trouble, alarm, supervisory or other fire response functions.

Relays shall be capable of switching up to ½ A @ 120VAC, inductive.

13. The FACU shall support up to (5) RS-232-C ports and one service port. All (5) RS-232 Ports shall be capable of two-way communications.
14. Remote Unit Interface: supervised serial communication channel for control and monitoring of remotely located annunciators and I/O panels.
15. Programmable DACT for per Point Reporting.
16. Fire Panel Internet Interface to provide supplemental notification and remote user access to the FACU using Ethernet and TCP/IP communications protocol compatible with IEEE Standard 802.3.
17. Modular Network Communications Card.

C. Cabinet: Lockable steel enclosure. Arrange unit so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control unit, provide exactly matching modular unit enclosures.

D. Alphanumeric Display and System Controls: Panel shall include an 80 character LCD display to indicate alarm, supervisory, and component status messages and shall include a keypad for use in entering and executing control commands.

1. The system shall have the capability to provide expanded content, multi-line, operator interface displays. The expanded content multi-line displays shall be Quarter-VGA (QVGA) or larger and be capable of supporting a minimum of 854 standard ASCII characters to minimize or eliminate the levels of navigation required for access to information when responding to critical emergencies and abnormal system conditions. The QVGA operator interface shall provide operator prompts and six context sensitive soft-keys for intuitive operation.
   a. Expanded content, multi-line operator interfaces shall be capable of providing the following functions:
      (1) Dual language operation with Instant-Switch language selection during runtime.
      (2) Activity display choices for:
         (a) First 8 Events.
         (b) First 5 Events and Most Recent Event (with first and most recent event time and date stamps).
         (c) First Event and Most Recent Event (with first and most recent event time and date stamps).
         (d) Scrollable List Display
         (e) General Event Status (alarm, priority 2, supervisory, or trouble in system)
         (f) Site Plan
      (3) Equal or hierarchal priority assignment. In systems with two or more operator interfaces, each operator interface shall be programmable to allow multiple operator interfaces to have equal operation priority or to allow hierarchal priority control to be assigned to individual operator interfaces (locations).
      (4) Up to 50 custom point detail messages for providing additional point specific information in detailed point status screens.
      (5) Bitmap file import for operator interface display of site plan and background watermark images.

b. Expanded content, multi-line displays shall have the capability to provide Dual-Language operation.

(1) Language selection shall be via a switch on the operator interface panel. Operator interface panels shall support instant-language-switchover during runtime to allow the operator to toggle between languages each time the language selection switch is operated, without requiring complicated multi-step processes.

(2) Both one-byte and two-byte characters shall be supported.

E. Distributed Module Operation: FACU shall be capable of allowing remote location of the following modules; interface of such modules shall be through a Style 4 (Class B) supervised serial communications channel (SLC):

1. Addressable Signaling Line Circuits
2. Initiating Device Circuits
3. Notification Appliance Circuits
4. Auxiliary Control Circuits
5. Graphic Annunciator LED/Switch Control Modules

a. In systems with two or more Annunciators and/or Command Centers, each Annunciator/Command Center shall be programmable to allow multiple Annunciators/Command Centers to have equal operation priority or to allow hierarchal priority control to be assigned to individual Annunciator/Command Center locations.

6. Amplifiers, voice and telephone control circuits

F. Voice Alarm: Provide an emergency communication system, integral with the FACU, including voice alarm system components, microphones, amplifiers, and tone generators. Features include:

1. Amplifiers comply with UL 1711, "Amplifiers for Fire Protective Signaling Systems." Amplifiers shall provide an onboard local mode temporal coded horn tone as a default backup tone. Test switches on the amplifier shall be provided to test and observe amplifier backup switchover. Each amplifier shall communicate to the host panel amplifier and NAC circuit voltage and current levels for display on the user interface. Each amplifier shall be capable of performing constant supervision for non-alarm audio functions such as background music and general paging.
2. Dual alarm channels permit simultaneous transmission of different announcements to different zones or floors automatically or by use of the central control microphone. All announcements are made over dedicated, supervised communication lines. All risers shall support Class B wiring for each audio channel.
3. Eight channel digitally multiplexed audio for systems that require more than two channels of simultaneous audio. Up to 8 channels of audio shall be multiplexed on either a style 4 or style 7 twisted pair.
4. Emergency voice communication audio controller module shall provide up to 32 minutes of message memory for digitally stored messages. Provide supervised connections for master microphone and up to 5 remote microphones.
5. Status annunciator indicating the status of the various voice alarm speaker zones and the status of fire fighter telephone two-way communication zones.
6. When required, Redundant Voice Command Centers shall be capable of generating voice paging from more than one node in a network audio system.

G. Evacuation System - Non-Alarm Audio

1. The fire alarm control unit shall provide non-alarm audio from an owner supplied paging

and/or music source over the fire alarm evacuation speakers. This feature shall be an integral part of the fire alarm system, and shall use some or all of the audio components from the fire alarm evacuation system.

2. The fire alarm system and the non-alarm audio operation shall comply with NFPA 72 requirements for non-emergency purposes at a fire command center that is not constantly attended by a trained operator.
3. All fire alarm system hardware and software shall be U.L. listed for non-alarm audio use. The fire alarm system shall supervise for system hardware and field wiring faults while playing non-alarm audio over the evacuation speakers. Any hardware failure or speaker circuit fault detected when the system is playing non-alarm audio shall report a trouble on the fire alarm control unit. All audio components used for both the non-alarm audio and the fire alarm evacuation system shall be manufactured by the same supplier.
4. The non-alarm audio shall have two dedicated audio inputs to the fire alarm control unit. Terminal strip connections and an industry standard RCA receptacle shall be provided at the fire alarm control unit for terminating the owner's audio source. The fire alarm input shall be 600-Ohm impedance. The inputs on the fire alarm control unit shall be electrically isolated via an isolation transformer.
5. The fire alarm control unit shall accept industry standard "line level audio input" from the owner's non-alarm audio source. The fire alarm system hardware and software shall distribute the audio over the fire alarm evacuation speakers. The selection of which speaker zones to distribute the non-alarm audio to the building occupants shall be coordinated with the owner's representative.
6. The fire alarm control unit shall be able to make audio input level adjustments from the owner's non-alarm audio source. This adjustment will match the non-alarm audio source to the fire alarm input. After the audio levels are adjusted, the owner shall control the volume level from the non-alarm audio source.
7. The fire alarm system will have the capability to provide operator "keys" that will adjust the volume level of pre-assigned non-alarm audio zones. The volume level of non-alarm audio that is being broadcast to any audio zone will also be individually adjustable by time of day via a pre-specified schedule.
8. The non-alarm audio shall be the lowest priory audio on the fire alarm system. The non-alarm audio shall not interfere with any of the fire alarm emergency signals that may include live voice, pre-recorded emergency voice messages, or any alert tones. Switches shall be located on the fire alarm control unit to turn on or off the non-alarm audio system feature. The fire alarm control unit shall have LED lamps to indicate the ON vs. OFF status of the non-alarm audio feature. Speaker circuits that are actively broadcasting non-alarm audio will also be indicated by LEDs.
9. The non-alarm audio shall be synchronized throughout the fire alarm life safety system amplifiers and speaker circuits. Any remote amplifier panels located on the fire alarm system network shall also be synchronized. The system shall be capable of accepting a system-wide non-alarm audio input at the main fire alarm control or another local non-alarm audio input at a remote amplifier panel to serve only the areas served by that remote panel.
10. Multiple non-alarm audio sources must be accessible by the fire alarm non-alarm audio system. Each separate non-alarm audio source will have the ability to be broadcast into a distinct fire zone, depending on occupant preference. Any system restricted to a limited number of non-audio sources will not be accepted. The system must have the capability of broadcasting an unlimited number of non-alarm sources, except as determined by the number of individual fire zones served by the fire alarm system.

11. Non-alarm audio shall be automatically turned off in the event of primary power failure to the fire alarm control unit or any of the remote amplifier panels controlled by the main fire alarm control unit.

H. Fire fighters' telephone communication system: Arrange system to use dedicated, two-way, supervised voice communication links between the FACU and remote fire fighters' telephone stations throughout the building.

2.4 SMOKE CONTROL SYSTEM

A. Smoke Control System: Provide a smoke control system which is UL 864 (UUKL product category) listed for smoke control system service. The system shall provide automatic operation of smoke exhaust fans, makeup air fans, air handling units, and dampers in accordance with the smoke control sequence indicated on the drawings. The smoke control system shall be located in the fire command center.

B. Provide and install smoke control relays within 3 feet of each smoke exhaust fan controller, makeup air fan controller, air handling units controller, and damper controlled by the smoke control system. The building automation/temperature control system contractor shall terminate the relays to the fan controllers, air handling unit controllers, and dampers.

C. Provide and install addressable modules to monitor status/operation of each smoke exhaust fan, makeup air fan, air handling unit, and damper controlled by the smoke control system. The fire alarm contractor shall terminate the modules to status indicators.

D. Enclosure: Finish to match Fire Alarm Control Units. The locking cover/display assembly is hinged on the left. Key and lock shall be common to all secured fire alarm system enclosures.

2.5 SMOKE CONTROL SYSTEM GRAPHIC ANNUNCIATOR - LED TYPE

A. Annunciator Unit (zoned system): Provide an LED-indicating light located on the graphic annunciator to indicate the status for all smoke control equipment. In addition, in systems with two or more Smoke Control System Graphic Annunciators, each Annunciator shall be programmable to allow multiple Annunciators to have equal operation priority or to allow hierarchal priority control to be assigned to individual Annunciators (locations).

B. Fans, dampers, and other operating equipment in normal status shall be indicated by a GREEN LED. Fans, dampers, and other operating equipment in off or closed status shall be indicated by a RED LED. Fans, dampers, and other operating equipment in fault status shall be indicated by a YELLOW LED. The annunciator shall graphically depict the building arrangement and smoke control system zones. Fans, major ducts, dampers, and airflow direction shall be indicated.

C. Provide HOA switches labeled "ON-AUTO-OFF" on the annunciator to permit fire-fighters manual control of each individual smoke control fan or air handling unit. HOA switches labeled "OPEN-AUTO-CLOSE" shall be provided on the annunciator for each individual smoke control damper.

D. Provide a toggle or push-button switch to test the LEDs mounted on the unit. The test switch does not require key operation.

E. Provide a HOA switch labeled "OPEN-AUTO-LOCK" on the annunciator for each stairway to permit fire-fighters manual control of stairway door locks in accordance with local codes.

F. In the normal switch position, the fans, air handling units, or dampers operate automatically as controlled by the building automation/temperature control system. Automatic controls can be overridden with the HOA switches provided on the graphic annunciator. The operation of the HOA switches shall permit manual control and override of any conflicting signal from the building automation/temperature control system or any other system.

G. Enclosure: finish to match Fire Alarm Control Units. The locking cover/display assembly is

hinged on the left. Key and lock shall be common to all secured fire alarm system enclosures.

2.6 NON-SYSTEM SMOKE DETECTORS

A. Single-Station Smoke Detectors:

1. Comply with UL 217; suitable for NFPA 101, residential occupancies; operating at 120-V ac with 9-V dc battery as the secondary power source. Provide with "low" or "missing" battery chirping-sound device.
2. Auxiliary Relays: One Form C rated at 0.5 A.
3. Audible Notification Appliance: Piezoelectric sounder rated at 90 dBA at 10 feet (3 m) according to UL 464.
4. Visible Notification Appliance: 177-cd strobe as required per floor plans.
5. Heat sensor, 135 deg F (57 deg C) combination rate-of-rise and fixed temperature.
6. Test Switch: Push to test; simulates smoke at rated obscuration.
7. Tandem Connection: Allow tandem connection of number of indicated detectors; alarm on one detector shall actuate notification on all connected detectors.
8. Quick-disconnect wiring harness.
9. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
10. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.

B. Single-Station Duct Smoke Detectors:

1. Comply with UL 268A; operating at 120-V ac.
2. Sensor: LED or infrared light source with matching silicon-cell receiver.
   a. Detector Sensitivity: Smoke obscuration between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) when tested according to UL 268A.
3. Detector shall be twist-lock mounted to a fixed base inside a duct mounted housing with associated electronic components. Provide terminals in the duct housing for connection to building wiring.
   a. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
5. Fan Shutdown Relay: Rated to interrupt fan motor-control circuit.
6. Provide a red alarm LED, a green power-on LED, a piezoelectric tone-alert silence switch, and a key switch for selecting normal operating mode or to initiate a test or reset operation all mounted to a stainless steel 2-gang electrical plate to be provided in a constantly attended location or located as per the AHJ.
7. Provide test port on duct housing for functional smoke testing access with cover in place.

2.7 ADDRESSABLE INITIATING

A. ADDRESSABLE MANUAL PULL STATIONS

1. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

2. Description: Addressable double- action type, red LEXAN. Station shall mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units. Station shall be pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit. Where double-action stations are provided, the mechanism shall require two actions push top activation door to initiate an alarm.
3. Provide with a front showing red LED showing that will flash each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the station LED shall be on steady.
4. Indoor Protective Shield: Where required, or as indicated on the drawings, provide a factory-fabricated, tamperproof, clear LEXAN enclosure shield and red frame that easily fits over manual pull stations which shall be hinged at the top to permit lifting for access to initiate a local alarm. Unit shall be NRTL listed. Lifting the cover shall actuate an integral battery-powered audible horn intended to discourage false-alarm operation. The horn shall be silenced by lowering and realigning the shield. The horn shall provide 85dB at 10 feet and shall be powered by a 9 VDC battery.
5. California Building Code, Title 24: Where required pull station shall be operable with one hand and shall not require tight grasping, pinching or twisting of the wrist. Provides a more easily operated pull station lever compared to standard stations.
6. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

B. ADDRESSABLE CO SENSOR

1. Addressable CO Sensor
   a. The CO Sensor shall be an addressable carbon monoxide (CO) sensing module providing both CO toxic gas detection and enhanced fire detection, and shall be listed to UL 268, Smoke Detectors for Fire Alarm Signaling Systems and UL 2075, Gas and Vapor Detectors and Sensors; allowing systems to be listed to UL 2034, Single and Multiple Station Carbon Monoxide Alarms.
   b. The CO Sensor shall include CO sensor element mounted in the sensor base which can be easily replaced without replacing the complete sensor base assembly.
   c. The CO Sensor base shall provide address selection in the base allowing the address to remain with its location when the sensor is removed for service or type change.
   d. The CO Sensor base shall include an integral red LED to indicate the power-on, trouble, test mode or alarm status.
   e. CO sensor shall provide enhanced fire detection with the addition of two selectable modes of operation: Nuisance Alarm Reduction Mode and Faster Fire Detection.
   f. The CO Sensor shall provide a 10 year life expectancy before replacement is necessary or required.
   g. The CO Sensor base shall report the following CO Sensor troubles: Communication loss, Disabled, Almost Expired 12 Months, Almost Expired 6 Months, Expired (End of Life), and Sensor Missing/Failed.
2. Addressable CO Sensor Sounder Base
   a. The CO Sensing element shall support operation with a Sounder base; the CO Sensor Sounder base shall provide temporal code 3 (TC3) for fire, or temporal code 4 (TC4) for toxic carbon monoxide alarms.
   b. The CO Sensor Sounder base shall be listed to UL464, Audible Signal Appliances.

c. CO sensor shall provide enhanced fire detection with the addition of two selectable modes of operation: Nuisance Alarm Reduction Mode and Faster Fire Detection.

d. The CO Sensor Sounder Base shall include CO sensor element mounted in the sounder base which can be easily replaced without replacing the complete sensor base assembly.

e. The CO Sensor Sounder base shall provide address selection in the base allowing the address to remain with its location when the sensor is removed for service or type change.

f. The CO Sensor Sounder Sensor base shall include an integral red LED to indicate the power-on, trouble, test mode or alarm status.

g. The CO Sensor Sounder base shall report the following CO Sensor troubles: Communication loss, Disabled, Almost Expired 12 Months, Almost Expired 6 Months, Expired (End of Life), and Sensor Missing/Failed.

h. The CO Sensor Sounder Base shall be interchangeable with the CO Sensor 520 Hz Sounder Base.

3. Addressable CO Sensor 520 Hz Sounder Base

a. The CO Sensing element shall support operation with a 520 Hz Sounder base; the 520 Hz CO Sounder base shall provide temporal code 3 (TC3) for fire, or temporal code 4 (TC4) for toxic carbon monoxide alarms.

b. Emitted tone shall be a 520Hz Square Wave signal in compliance with the requirements of the 2010 edition of NFPA 72 for sleeping areas.

c. The CO Sensor 520Hz Sounder base shall be listed to UL 268 and UL464, Audible Signal Appliances.

d. CO sensor shall provide enhanced fire detection with the addition of two selectable modes of operation: Nuisance Alarm Reduction Mode and Faster Fire Detection.

e. The CO Sensor 520 Hz Sounder Base shall include CO sensor element mounted in the sounder base which can be easily replaced without replacing the complete sensor base assembly.

f. The CO Sensor 520 Hz Sounder base shall provide address selection in the base allowing the address to remain with its location when the sensor is removed for service or type change.

g. The CO Sensor 520 Hz Sounder base shall include an integral red LED to indicate the power-on, trouble, test mode or alarm status.

h. The CO Sensor 520 Hz Sounder base shall report the following CO Sensor troubles: Communication loss, Disabled, Almost Expired 12 Months, Almost Expired 6 Months, Expired (End of Life), and Sensor Missing/Failed.

i. The CO Sensor 520 Hz Sounder Base shall be interchangeable with the standard CO Sensor Sounder Base.

C. ADDRESSABLE CIRCUIT INTERFACE MODULES

1. Addressable Circuit Interface Modules: Arrange to monitor or control one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of waterflow, valve tamper, non-addressable devices, and for control of AHU systems.

2. Addressable Circuit Interface Modules will be capable of mounting in a standard electric outlet box. Modules will include cover plates to allow surface or flush mounting. Modules will receive their operating power from the signaling line circuit or a separate two wire pair running from an appropriate power supply, as required.

3. There shall be the following types of modules:
   a. Type 1: Monitor Circuit Interface Module:
      (1) For conventional 2-wire smoke detector and/or contact device monitoring with Class B or Class A wiring supervision. The supervision of the zone wiring will be Class B. This module will communicate status (normal, alarm, trouble) to the FACU.
      (2) For conventional 4-wire smoke detector with Class B wiring supervision. The module will provide detector reset capability and over-current power protection for the 4-wire detector. This module will communicate status (normal, alarm, trouble) to the FACU.
   b. Type 2: Line Powered Monitor Circuit Interface Module
      (1) This type of module is an individually addressable module that has both its power and its communications supplied by the two wire signaling line circuit. It provides location specific addressability to an initiating device by monitoring normally open dry contacts. This module shall have the capability of communicating four zone status conditions (normal, alarm, current limited, trouble) to the FACU.
      (2) This module shall provide location specific addressability for up to five initiating devices by monitoring normally closed or normally open dry contact security devices. The module shall communicate four zone status conditions (open, normal, abnormal, and short). The two-wire signaling line circuit shall supply power and communications to the module.
   c. Type 3: Single Address Multi-Point Interface Modules
      (1) This multipoint module shall provide location specific addressability for four initiating circuits and control two output relays from a single address. Inputs shall provide supervised monitoring of normally open, dry contacts and be capable of communicating four zone status conditions (normal, open, current limited, and short). The input circuits and output relay operation shall be controlled independently and disabled separately.
      (2) This dual point module shall provide a supervised multi-state input and a relay output, using a single address. The input shall provide supervised monitoring of two normally open, dry contacts with a single point and be capable of communicating four zone status conditions (normal, open, current limited, and short). The two-wire signaling line circuit shall supply power and communications to the module.
      (3) This dual point module shall monitor an unsupervised normally open, dry contact with one point and control an output relay with the other point, using a single address. The two-wire signaling line circuit shall supply power and communications to the module.
   d. Type 4: Line Powered Control Circuit Interface Module
      (1) This module shall provide control and status tracking of a Form "C" contact. The two-wire signaling line circuit shall supply power and communications to the module.
   e. Type 5: 4-20 mA Analog Monitor Circuit Interface Module
      (1) This module shall communicate the status of a compatible 4-20 mA sensor to the FACU. The FACU shall annunciate up to three threshold levels, each with custom action message; display and archive actual sensor analog levels; and permit sensor calibration date recording.
4. All Circuit Interface Modules shall be supervised and uniquely identified by the control unit.

Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACU. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

2.8 CONVENTIONAL INITIATING

A. CONVENTIONAL MANUAL PULL STATIONS

1. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
2. Description: Conventional double- action type, red LEXAN. Station shall mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units. Station shall be pull-lever type; with integral terminal strip to accommodate wiring connections to fire-alarm control unit Initiating Device Circuit. Where double-action stations are provided, the mechanism shall require two actions push top activation door to initiate an alarm.
3. Indoor Protective Shield: Where required, or as indicated on the drawings, provide a factory-fabricated, tamperproof, clear LEXAN enclosure shield and red frame that easily fits over manual pull stations which shall be hinged at the top to permit lifting for access to initiate a local alarm. Unit shall be NRTL listed. Lifting the cover shall actuate an integral battery-powered audible horn intended to discourage false-alarm operation. The horn shall be silenced by lowering and realigning the shield. The horn shall provide 85dB at 10 feet and shall be powered by a 9 VDC battery.
4. California Building Code, Title 24: Where required pull station shall be operable with one hand and shall not require tight grasping, pinching or twisting of the wrist. Provides a more easily operated pull station lever compared to standard stations.
5. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.9 ADDRESSABLE NOTIFICATION

2.10 CONVENTIONAL NOTIFICATION

2.11 FIRE FIGHTERS' TELEPHONES

A. Telephone Hand Sets: High-impact plastic handset, heavy-duty coil cord, and hook switch; connected to the FACU by means of dedicated, supervised communication lines. Handsets have a dynamic receiver and a carbon transmitter, operating on 24VDC.

B. A black master telephone handset with a push to talk button and a flexible-coiled self-winding five (5) foot cord shall be provided and recessed within a protective unit-mounted enclosure at the command center.

C. Cabinet: Flush- or surface-mounted as indicated, 18-gage, minimum, painted steel with a latched hinged door with trim labeled "Fire Fighters' Phone." Size to accommodate handset and cord.

2.12 MAGNETIC DOOR HOLDERS

A. Description: Units shall be listed to UL 228. Units are equipped for wall or floor mounting as indicated and are complete with matching door plate. Unit shall operate from a 120VAC, a 24VAC or a 24VDC source, and develop a minimum of 25 lbs. holding force.

B. Material and Finish: Match door hardware.

2.13 REMOTE PC ANNUNCIATOR, PC ANNUNCIATOR CLIENTS AND PRINTERs

A. Fire Alarm Control Unit shall be capable of operating remote PC Annunciators and/or printers; output shall be ASCII from an RS-232-C connection with an adjustable baud rate.

B. Fire Alarm Control Unit shall be capable of operating an Agency Listed PC Annunciator Client/Server which provides status annunciation and limited system control using a convenient and familiar Microsoft Windows 7 Professional operating system based interface. Other compatible Operating Systems shall include Microsoft Vista Business, XP Professional and Windows® 2000 Professional. The PC Annunciator Client/Server shall provide the following functions:

1. Login/logout password protection with time duration selectable automatic logout.
2. Display Alarm, Supervisory, Priority 2, and Trouble conditions with numerical tallies for each.
3. Display first and last alarms.
4. Different event types have separate visible indicators with a common audible indicator.
5. Event logs can be searched and printed.
6. View and/or print TrueAlarm status reports and service reports. (printing requires an available local or network printer).
7. Alarm Silence; System Reset; and Priority 2 Reset.
8. Global and individual point acknowledge.
9. Set system time and date and clear event log.
10. Individual point access for control or parameter revisions.
11. WALKTEST system test is supported for service convenience.
12. Up to (8) Simultaneous Client connections shall be supported by the PC Annunciator Server. Remote Clients shall be capable of connecting to the PC Annunciator Server via Ethernet LAN/WAN connections.

C. Each RS-232-C port shall be capable of supporting and supervising a remote Printer or PC Annunciator; the FACU shall support as many as five (5) remote RS-232 devices in any combination.

2.14 REMOTE LCD ANNUNCIATOR

A. Provide a remote LCD Annunciator, where required, with the same "look and feel" as the FACU operator interface. The Remote LCD Annunciator shall use the same Primary Acknowledge, Silence, and Reset Keys; Status LEDs and LCD Display as the FACU.

B. Annunciator shall have super-twist LCD display with two lines of 40 characters each. Annunciator shall be provided with four (4) programmable control switches and associated LEDs.

C. Under normal conditions the LCD shall display a "SYSTEM IS NORMAL" message and the current time and date.

D. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.

E. The LCD shall display the following information relative to the abnormal condition of a point in the system:

1. 40 character custom location label.
2. Type of device (e.g., smoke, pull station, waterflow).

3. Point status (e.g., alarm, trouble).

F. Operator keys shall be key switch enabled to prevent unauthorized use. The key shall only be removable in the disabled position. Acknowledge, Silence and Reset operation shall be the same as the FACU.

2.15 REMOTE QVGA LCD ANNUNCIATOR

A. Provide a remote QVGA LCD Annunciator, where required, with the same "look and feel" as the FACU operator interface. The Remote QVGA LCD Annunciator shall use the same Primary Acknowledge, Silence, and Reset Keys as the FACU.

B. The QVGA Annunciator shall have an expanded content, multi-line display capable of supporting a minimum of 854 standard ASCII characters to minimize or eliminate the levels of navigation required for access to information when responding to critical emergencies and abnormal system conditions. The QVGA Annunciator shall provide:

1. Operator prompts and six context sensitive soft-keys for intuitive operation.
2. Seven (7) programmable control switches and associated LEDs.
3. Three (3) programmable general purpose LEDs.
4. Capability of supporting Dual Languages with Instant-Switchover between languages in runtime operation.
5. Support for both one-byte and two-byte characters.

C. Under normal conditions the QVGA LCD shall display a "SYSTEM IS NORMAL" message, the current time and date, and the quantity of abnormal status conditions for each event category (i.e., fire alarm, priority 2, supervisory, and trouble).

D. The QVGA Annunciator shall be programmable for the following Activity display choices:

1. First 8 Events.
2. First 5 Events and Most Recent Event with First and Most Recent event time and date stamps.
3. First Event and Most Recent Event with First and Most Recent event time and date stamps.
4. Scrollable List Display displays a scrollable list of active points for the event category (alarm, priority 2, supervisory, or trouble) selected. The position in this list will be the last acknowledged point (not flashing) at the top followed by the next 7 unacknowledged points (flashing).
5. General Event Status (Alarm, Priority 2, Supervisory, or Trouble in system).
6. Site Plan with optional status icons to indicate area status for highest priority active events.

E. Should an abnormal condition be detected the appropriate LED (Alarm, Priority 2, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.

F. The QVGA LCD shall display the following minimum information relative to the abnormal condition of a point in the system:

1. 40 character custom location label.
2. Type of device (e.g., smoke, pull station, waterflow).
3. Point status (e.g., alarm, trouble).

G. QVGA Annunciators shall be protected from unauthorized use via a locked door or equivalent means. In addition, in systems with two or more Annunciators, each Annunciator shall be programmable to allow multiple Annunciators to have equal operation priority or to allow hierarchal priority control to be assigned to individual Annunciators (locations). Acknowledge,

Silence and Reset operation shall be the same as the FACU.

2.16 GRAPHIC ANNUNCIATOR - LED TYPE

A. Annunciator Unit, zoned system: Provide an LED-indicating light located on the floor plan for each zone. Mark zone boundaries on the annunciator floor plan.

B. Annunciator Unit, addressable system: Provide an LED-indicating light located on the floor plan for each device indicating the type of device and floor on which a signal was actuated.

C. Provide individual LED indicators for each alarm and supervisory device or zone and a LED to indicate system trouble. Additional LEDs indicate normal power and emergency power modes for the system. A toggle or push-button switch tests the LEDs mounted on the unit. The test switch does not require key operation.

D. Enclosure: Finish to match Fire Alarm Control Units. The locking cover/display assembly is hinged on the left. Key and lock shall be common to all secured fire alarm system enclosures.

2.17 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address or loss of power.
4. Low battery.
5. Abnormal test signal.
6. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.18 RADIO ALARM TRANSMITTER

A. Transmitter shall comply with NFPA 1221 and shall be listed and labeled by an NRTL.

B. Comply with 47 CFR 90.

C. Description: Manufacturer's standard commercial product; factory assembled, wired, tested, and ready for installation and operation.

1. Packaging: A single, modular, NEMA 250, Type 1 metal enclosure with a tamper-resistant flush tumbler lock.
2. Signal Transmission Mode and Frequency: VHF or UHF 2-W power output, coordinated with operating characteristics of the established remote alarm receiving station designated by Owner.
3. Normal Power Input: 120-V ac.
4. Secondary Power: Integral-sealed, rechargeable, 12-V battery and charger. Comply with NFPA 72 requirements for battery capacity; submit calculations.
5. Antenna: Omnidirectional, coaxial half-wave, dipole type with driving point impedance matched to transmitter and antenna cable output impedance. Wind-load strength of antenna and mounting hardware and supports shall withstand 100 mph (160 km/h) with a gust factor of 1.3 without failure.
6. Antenna Cable: Coaxial cable with impedance matched to the transmitter output impedance.
7. Antenna-Cable Connectors: Weatherproof.
8. Alarm Interface Devices: Circuit boards, modules, and other auxiliary devices, integral to the transmitter, matching fire-alarm and other system outputs to message-generating inputs of the transmitter that produce required message transmissions.

D. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit or from its own internal sensors or controls and shall automatically transmit signal along with a unique code that identifies the transmitting station to the remote alarm receiving station. Transmitted messages shall correspond to standard designations for fire-reporting system to which the signal is being transmitted and shall include separately designated messages in response to the following events or conditions:

1. Transmitter Low-Battery Condition: Sent when battery voltage is below 85 percent of rated value.
2. System Test Message: Initiated manually by a test switch within the transmitter cabinet, or automatically at an optionally preselected time, once every 24 hours, with transmission time controlled by a programmed timing device integral to transmitter controls.
3. Transmitter Trouble Message: Actuated by failure, in excess of one-minute duration, of the transmitter normal power source, derangement of the wiring of the transmitter, or any alarm input interface circuit or device connected to it.
4. Local Fire-Alarm-System Trouble Message: Initiated by events or conditions that cause a trouble signal to be indicated on the building system.
5. Local Fire-Alarm-System Alarm Message: Actuated when the building system goes into an alarm state. Identifies device that initiated the alarm.
6. Local Fire-Alarm-System Supervisory-Alarm Message: Actuated when the building alarm system indicates a supervisory alarm.

2.19 AUTOCALL SYSTEM INTERFACE

A. When a fire alarm system using existing Autocall XA loop devices requires expansion, the FACU shall be capable of interfacing to the XA loop via an interface module. This module shall allow the FACU to be selected to function as either the XA loop master controller (head end) or as a Data Gathering Panel as an intelligent device on the XA loop reporting to a remote master controller. Multiple XA Loop Interface Modules can be installed in the FACU allowing a variety

of system expansion situations to be satisfied.

2.20 NETWORK SYSTEM INTEGRATOR (NSI)

A. The Network System Integrator shall provide Agency Listed integration capable of communicating the status information from multiple brands and/or vintages of control units onto the fire alarm network for reporting at a central command center location and at other network nodes (panels).

1. Protocol communication interfaces for systems integration that require ongoing protocol development necessary to maintain compatibility and agency listings with new versions of software releases shall not be substituted.

B. The Network System Integrator shall receive primary and secondary power from an alternate source

C. The Network System Integrator shall provide 8 isolated voltage monitor inputs for status communication onto the network

1. Inputs shall be rated to monitor voltages from 10 to 33 VDC
2. Inputs shall be compatible with direct switched or reverse polarity circuits

D. The Network System Integrator shall provide 8 dry contact relay outputs for interface to monitored equipment

1. Each output shall be configurable for normally open or normally closed contact operation.
2. Output contacts shall be rated for 1A @ 24VDC / 25VAC or 0.5A @ 70VAC
3. 7 relay outputs shall be programmable
4. 1 relay output shall be normally energized and dedicated for trouble operation

E. The Network System Integrator shall be capable of maintaining Fire Alarm Network communications with other network nodes (panels) when the monitored interface panel is powered down for service (i.e., repeater mode)

2.21 SYSTEM PRINTER

A. General: Provide a dot-matrix type, listed and labeled as an integral part of the fire alarm system.

2.22 EMERGENCY POWER SUPPLY

A. General: Components include battery, charger, and an automatic transfer switch.

B. Battery: Sealed lead-acid or nickel cadmium type. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm notification devices in alarm mode for a period of 15 minutes.

2.23 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by manufacturer of device.
2. Finish: Paint of color to match the protected device.

2.24 SPARE EQUIPMENT

A. The Electrical Contractor shall furnish up to twenty (20) in any combination of fire alarm devices selected by Owner, including but not limited to, smoke, heat, duct, monitor module, control monitor module or audio/visual devices for Owner spare.

PART 3 – EXECUTION

3.1 INSTALLATION, GENERAL

A. Install system components and all associated devices in accordance with applicable NFPA Standards and manufacturer's recommendations.

B. Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection, and testing of fire alarm systems. Examples of qualified personnel shall include, but not be limited to, the following:

1. Factory trained and certified personnel.
2. National Institute of Certification in Engineering Technologies (NICET) fire alarm level II certified personnel.
3. Personnel licensed or certified by state or local authority.

3.2 EQUIPMENT INSTALLATION

A. Furnish and install a complete Fire Alarm System as described herein and as shown on the plans. Include sufficient control unit(s), annunciator(s), manual stations, automatic fire detectors, smoke detectors, audible and visible notification appliances, wiring, terminations, electrical boxes, Ethernet drops, and all other necessary material for a complete operating system.

B. Existing Fire Alarm Equipment shall be maintained fully operational until the new equipment has been tested and accepted.

C. Equipment Removal: After acceptance of the new fire alarm system, disconnect and remove the existing fire alarm equipment and restore damaged surfaces. Package operational fire alarm and detection equipment that has been removed and deliver to the Owner. Remove from the site and legally dispose of the remainder of the existing material.

D. Water-Flow and Valve Supervisory Switches: Connect for each sprinkler valve required to be supervised.

E. Device Location-Indicating Lights: Locate in the public space immediately adjacent to the device they monitor.

F. Install manual station with operating handle 48 inches (1.22 m) above floor. Install wall mounted audible and visual notification appliances not less than 80 inches (2.03 m) above floor to bottom of lens and not greater than 96 inches (2.44 m) above floor to bottom of lens.

G. Mount outlet box for electric door holder to withstand 80 pounds pulling force.

H. Make conduit and wiring connections to door release devices, sprinkler flow switches, sprinkler valve tamper switches, fire suppression system control units, duct smoke detectors .

I. Automatic Detector Installation: Conform to NFPA 72.

J. Ethernet Drop: A standard RJ-45 Ethernet connection to the owner’s Ethernet network shall be provided at each fire alarm control unit as part of the contract.

3.3 PREPARATION

A. Coordinate work of this Section with other affected work and construction schedule.

3.4 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an

addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.
2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
3. Smoke dampers in air ducts of designated air-conditioning duct systems.
4. Alarm-initiating connection to elevator recall system and components.
5. Alarm-initiating connection to activate emergency lighting control.
6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
7. Supervisory connections at valve supervisory switches.
8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
9. Supervisory connections at elevator shunt trip breaker.
10. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
11. Supervisory connections at fire-pump engine control panel.

3.5 WIRING INSTALLATION

A. System Wiring: Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the Authority Having Jurisdiction and shall be installed in accordance with the appropriate articles from the current approved edition of NFPA 70: National Electric Code (NEC).

B. Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.

C. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color-code notification appliance circuits differently from alarm-initiating circuits. Paint fire alarm system junction boxes and covers red.

D. Mount end-of-line device in box with last device or separate box adjacent to last device for Class "B" supervision.

E. Ethernet Circuits:

1. Ethernet circuits shall be provided to the Fire Alarm Control Unit as shown on the plans.
2. Where a dedicated Fire Alarm Ethernet LAN is specified only Agency Listed Fire Alarm Ethernet hardware shall be installed.
3. The fire alarm contractor shall coordinate and ensure proper Ethernet connections occur at the fire alarm control unit and other designated equipment locations prior to system turnover.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.7 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.8 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.

B. Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:

1. Factory trained and certified.
2. National Institute for Certification in Engineering Technologies (NICET) fire alarm certified.
3. International Municipal Signal Association (IMSA) fire alarm certified.
4. Certified by a state or local authority.
5. Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.

C. Pretesting: Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.

D. Inspection:

1. Inspect equipment installation, interconnection with system devices, mounting locations, and mounting methods.
2. Verify that units and controls are properly installed, connected, and labeled and that interconnecting wires and terminals are identified.

E. Acceptance Operational Tests:

1. Perform operational system tests to verify conformance with specifications:
   a. Each alarm initiating device installed shall be operationally tested. Each device shall be tested for alarm and trouble conditions. Contractor shall submit a written certification that the Fire Alarm System installation is complete including all punch-list items. Test battery operated emergency power supply. Test emergency power supply to minimum durations specified. Test Supervising Station Signal Transmitter. Coordinate testing with Supervising Station monitoring firm/entity.
   b. Test each Notification Appliance installed for proper operation. Submit written report indicating sound pressure levels at specified distances.
   c. Test Fire Alarm Control Unit and Remote Annunciator.
2. Provide minimum 10 days notice of acceptance test performance schedule to Owner, and local Authority Having Jurisdiction.

F. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

G. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Use NFPA 72 Forms for documentation.

H. Final Test, Record of Completion, and Certificate of Occupancy:

1. Test the system as required by the Authority Having Jurisdiction in order to obtain a certificate of occupancy. Provide completed NFPA 72 Record of Completion form to Owner and AHJ.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

3.10 CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Clean unit internally using methods and materials recommended by manufacturer.

B. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound pressure levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose.

3.11 TRAINING

A. Provide the services of a factory-authorized service representative to demonstrate the system and train Owner's maintenance personnel as specified below.

1. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 8 hours' training.
2. Schedule training with the Owner at least seven days in advance.

PART 4 – ADDITONAL SERVICES, GUARANTEE AND FINAL TEST

4.1 GENERAL

A. The contractor shall guarantee all equipment and wiring to be free from inherent mechanical and electrical defects for two (2) year (730 days) from the date of final acceptance.

B. In addition to the equipment shown on the project drawings, and as stated above include ten (10) additional peripheral devices of any type (i.e.: smoke detector, duct smoke detector, heat detector, pull station, monitor module, relay module, control module, speaker/strobe, strobe, etc.). These devices may be installed at the discretion of the local Fire Marshal, the project engineer, or the licensed fire alarm company, upon review and/or testing performed by all. Should these devices not be required to be installed, turn over to Owner as attic stock.

If necessary, these devices, along with the required panel additions, wiring, labor, etc., shall be furnished and installed at no additional cost to the owner. If, at the end of the project, they are not required to be installed, they shall be given to the owner for their use.

C. Concurrent with the warranty period, the licensed fire alarm contractor shall provide (2) semi-annual inspections of the completed fire alarm system in accordance with the State of Delaware Fire Prevention Regulations. All costs shall be included in the contract amount. No additional fees will be paid by the owner for this service.

4.2 FINAL TEST

Before the installation shall be considered complete and acceptable by the awarding authority, a test on the system shall be performed as follows:

A. The contractor's job foreman, in the presence of a representative of the owner, and the fire marshal's office shall operate every building fire alarm device to ensure proper operation and correct annunciation at each remote annunciator and control panel.

B. One half (1/2) of all tests shall be performed on battery standby power.

C. Where application of heat would destroy any detector, it may be manually activated.

D. When the testing has been completed to the satisfaction of both the contractor's job foremen and the representatives of the manufacturer and owner, a State of Delaware "Fire Alarm Signaling

System Certificate of Installation" shall be completed and signed by the necessary personnel.

E. The contractor shall leave the fire alarm system in proper working order, and without additional expense to the owner, shall replace any defective materials or equipment provided by him under this contract within two (2) years (730 days) from the date of final acceptance by the awarding authority. Warranty work shall be completed during normal business hours, a maximum of 24 hours after notification of the service request.

F. Provide service response within (1) hour during a "false alarm" condition.

4.3 AS BUILT DRAWINGS, TESTING, and MAINTENANCE INSTRUCTIONS

4.4 As Built Drawings

1. A complete set of reproducible "as-built" drawings showing installed wiring, specific interconnections between all equipment, and internal wiring of the equipment shall be delivered to the owner upon completion of system.

B. Operating and Instruction Manuals

1. Three (3) complete sets of operating and instruction manuals, each placed in a 3-ring binder, shall be delivered to the owner upon completion. Each manual shall contain a copy of the as-built fire alarm system drawings. The instruction period for the owner or it's representatives shall be 4 hours, performed during normal business hours.

C. Testing Frequency Instructions

1. Complete, accurate, step-by-step testing instructions giving recommended and required testing frequency of all equipment, methods for testing each individual piece of equipment, and a complete trouble-shooting manual explaining how to test the primary internal parts of each piece of equipment shall be delivered to the owner upon completion of the system.
2. Maintenance instructions shall be complete, easy to read, understandable, and shall provide the following information:
   - Instruction on replacing any components of the system, including internal parts.
   - Instructions on periodic cleaning and adjustment of equipment with a schedule of these functions.

   A complete list of all equipment and components with information as to the address and phone number of both the manufacturer and local supplier of each item.
3. User operating instructions shall be provided, and prominently displayed on the cabinet front or on a separate sheet located next to the fire alarm control unit, in accordance with UL Standard #864.

END OF SECTION 28 0721

SECTION 28 0725
INTRUSION SYSTEM

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall provide, install, and program a functionally complete, integrated Intrusion System per Manufacturer's guidelines, codes described, within these specifications.

1.2 QUALIFICATIONS

A. The alarm contractor shall provide all equipment and accessories for a complete electrically supervised security alarm system as described herein and shown in the drawings.

B. Model numbers and designations, which appear herein, indicate design, quality, and type of material as well as operating characteristics.

C. The security alarm system products shall be built modular in construction for ease of expansion and service. Functions shall be on replaceable panels or modules to accommodate functional changes when required. All critical wiring and connectors shall be supervised so as to give a trouble signal if removed or disconnected.

1.3 MANUFACTURERS

A. The control/communicator, control stations, and programmers shall be supplied by SimplexGrinnell model Bosch 7412gV2 unless noted otherwise.

1.4 SUBMITTALS

A. Submittals at bid time:

1. For bid evaluation, bid submittals shall include six (10) sets of the items described below:

a. Specification sheets (cut sheets) of all proposed equipment.

b. Equipment list identifying:

Model number of each unit.

Quantities of each type of device.

Unit costs

2. Specification compliance: A letter submitted with the bid, responding to specification sub-sections individually, indicating exceptions, substitutions, and alternates. The Contractor shall submit requests for substitutions (as well as all relevant technical data pertaining to the substituted equipment) to the specifier 10 days prior to the close of bid for evaluation and approval.

B. Submittals after award of contract:

1. Drawings: Shop drawings to provide details of proposed system and the work to be provided. These include point-to-point drawings of systems and wiring diagrams of individual devices.

2. Permits: The Contractor shall be responsible for identifying requirements for permits from the local police department for the installation of the alarm system specified herein and shall assist the owner in obtaining the relevant alarm permits.

1.5 DOCUMENTATION TO BE SUBMITTED BY THE CONTRACTOR UPON COMPLETION OF SYSTEM INSTALLATION

A. "As-builts": Upon completion of installation, the Contractor shall prepare "as-built" drawings of the system. These "As-builts" shall be 30 in. x 42 in. (76 cm x 107 cm) reproducible drawings of each floor plan indicating exact device locations, panel terminations, cable routes and wire numbers as tagged and color-coded on the cable tag.

Additionally, final point-to-point wiring diagrams of each type of device (on 30 in. x 42 in. or 76 cm x 107 cm format) shall be included in the "as-builts."

"As-builts" shall be submitted to the Owner for approval prior to the system acceptance walk-through.

B. Operation and maintenance manuals: Three (3) sets of operating manuals shall be provided explaining the operation and maintenance of the system.

1.6 ON-SITE SECURITY PERSONNEL TRAINING

A. The Contractor upon completion of installation shall furnish training in the complete operation of the systems.

1.7 SYSTEM APPROVALS

A. The system shall be the standard product of one manufacturer, and the manufacturer shall have been in business manufacturing similar products for at least 5 years.

B. After-sales support: The Contractor shall be a factory-authorized and trained dealer of the system and shall be factory-trained and certified to maintain/repair the system after system acceptance.

1.8 QUALITY ASSURANCE

A. All equipment, systems, and materials furnished and installed under this section shall be installed in accordance with the applicable standards of:

National codes: NEC, NFPA, UBC, BOCA, SBCCI

Approvals and listings: UL, FM, (CSFM, NYC-MEA, when applicable)

Local Authorities Having Jurisdiction

1.9 WARRANTY

A. All components, parts, and assemblies supplied by the Manufacturers and installed by the Contractor shall be warranted against defects in material and workmanship for a period of at minimum of two years (parts and labor), commencing upon date of acceptance by Owner. A qualified factory-trained service representative shall provide warranty service.

PART 2 – PRODUCTS

2.1 BASE SYSTEM PANEL (PC4020)

A. The base panel shall have a capacity of 16 hardwired zones and the ability to accommodate up to 128 addressable devices on two addressable loops. The total capacity of the security control panel shall be 128 zones. All zones shall be fully supervised and programmable. Panel shall be complete with integral power supply and supervised battery charger, auxiliary power for powering security detection devices, programmable switched auxiliary power supply for 4-wire smoke detectors, integral supervised digital alarm communicator, supervised bell/siren output, and two general purpose programmable outputs which can be programmed as general purpose outputs or as the system's addressable loops.

1. System Communication Bus: The system shall be complete with a standard, non-shielded, 4-conductor station wire bus for powering and communicating with remote hardwired system expansion modules and devices. For the connection of various system modules, communication bus wire runs (#18 AWG) of up to 3500 ft (1066 m.) shall be standard, and the system shall allow for an additional 3500 ft (1066 m.) of communication bus wire for each communication bus expander added (max. 16).

2. Panel Zone Expansion: The panel shall be expandable to a maximum of 128 zones by adding standard hardwired 8 and/or 16-zone modules to the base panel, by adding up to 128 addressable detection devices to one or both of the addressable loops on the base panel, and by adding 64 wireless zones, and up to 8 wireless receivers to the four-wire communication

bus. The system shall be capable of expansion using hardwired, addressable and wireless simultaneously in any combination that suits the application.

3. User Codes: The system shall provide for 1,500 user codes, select table as either 4 or 6 digits. For access control, user codes shall be assignable to 1 of 64 access levels. User codes shall be assignable to one or multiple partitions.
4. Partitions: The system shall be programmable for up to 8 fully independent partitions, with each partition having its own account code. Keypads shall be assignable as partition keypads or global keypads. Each zone in the system shall be assignable to one or more partitions.
5. Automation: The system shall be complete with an automation control module capable of controlling 32 X-10 or CEBus control devices, by event and by schedule. The system shall include 16 schedules to control automation devices. Automation shall be controllable from any system keypad and through a local or remote tone telephone.
6. Scheduling: The system shall provide for 99 date schedules with 4 intervals per schedule, 4 holiday schedules with 2 years of scheduling capacity, 50 open/close suppression schedules and 16 automation schedules. All schedules shall be programmable from the LCD system keypads and by either local or remote upload/download.
7. Ground Fault Detection: The system shall include an integral ground fault detector, which shall detect a single ground fault on any extended conductor in the system.
8. Supervision: Each zone in the system shall be supervised. The base panel and any remote panel with its own AC input shall be supervised for AC loss. Batteries for the base panel and all remote panels shall be supervised for low power and be short circuit-protected. Each addressable device and each wireless input device shall be supervised for its presence. The communications bus shall be supervised for low voltage and the presence of each enrolled module and keypad. Digital alarm communicators shall be supervised for telephone line trouble and failure to communicate.
9. Central Station Reporting: The system shall provide high speed 10 bps and 20 bps 1400/2300 Hz handshake, Contact ID and SIA reporting formats and shall be capable of being programmed to call up to 3 telephone numbers. The system shall also allow communication to a pager. The telephone numbers shall be programmable for backup dialing should the primary number fail. The system shall be programmable for split reporting so that alarms/restorals, openings/closing and miscellaneous events can be sent to different telephone numbers. The system shall report a separate account code for each partition and for non-partition (system) events. The system shall provide opening/closing scheduled suppression to prevent opens and closes from being reported to the central station. The system shall be capable of reporting all alarms, troubles, and system status information by combinations of all communication methods installed including: digital communication DVACS, and Cellemetry.
10. TCP/IP LAN/WAN Communications: The system shall have the ability to communicate all alarm signals to a central station or dedicated PC (equipped with appropriate software), through a constant connection providing full supervision of the link between the panel and the TCP/IP receiver. Communication shall be via a LAN or WAN, compatible with 10BaseT and 100BaseT Ethernet TCP/IP communications.
11. System Printer: The system shall be capable of output to a serial printer installed anywhere on the communication bus, and capable of printing all system events, alarms and restorals, including the partition, date, and time of these events.
12. 2-Way Serial Port: The system shall support a 2-way data port, offering RS-232 serial communications at data transfer rates of from 300 to 4800 bps. This port shall provide real-time access to all system events and allow system integrators to send control commands to the control panel.

13. False Alarm Prevention: The system shall include the following false alarm prevention features:
    - audible exit delay, audible exit fault
    - arm/disarm bell squawk
    - urgency on entry delay
    - TLM trouble and low battery trouble transmission delay
    - swinger shutdown programmable by zone
    - transmission delay by zone
    - police code (cross zone) transmission
    - opening after alarm transmission
    - recent close code transmission
    - AC fail
    - arming/disarming from outside the protected space using access control or wireless key
14. Power Supply/Relay Output Modules: The system shall be capable of including up to 64 fully programmable output relays with form 'C' contacts rated 2 Amps at 30VDC. Relays shall be added in modules of four and may be located anywhere on the communication bus. Each module shall include a supervised 700mA 12VDC battery charger, and integral power supply to supply up to 2.2 Amps of auxiliary power at 12VDC to power directly connected devices or repower the communication bus.
15. Low Power Outputs: The system shall be capable of including up to 144 low power outputs with each output able to supply 50mA at 12 VDC. Outputs shall be added in increments of 16 and may be added anywhere on the communication bus.
16. System Event Buffer: The system shall have a 3,000-event buffer. All events shall be printable from the system printer. The 2,800 most recent events shall be viewable on the LCD system keypad. All events shall be viewable by upload/download to a PC.
17. System Software: The base panel shall come complete with the software necessary to implement every system feature and to allow for the addition of every expansion or functional module without changes or addition to the basic software.
18. System Programming: The system shall be fully programmable from the LCD keypads and shall also allow event buffer viewing at the keypads. Separate PC-based upload/download software shall allow programming and operation from a directly connected local computer, or from a remote computer via a telephone line or TCP/IP LAN/WAN communications. Remote access shall be controlled by the owner to prevent unauthorized access. All system programming shall be maintained in nonvolatile memory so that programming information is retained even if all AC and battery power is removed.
19. Remote Annunciation: The system shall be capable of remote zone alarm and system status annunciation of up to 144 points, by adding 12, 32 and 64 point annunciators anywhere on the communication bus. Annunciators shall be capable of being flush-mounted. The annunciators shall provide point and/or graphic annunciation capability.
20. System Keypads (LCD4501): The system shall accommodate up to 16 LCD keypads which are powered from the base panel via the four-wire communications bus. LCD keypads shall have a display capacity of at least 32 alphanumeric characters with adjustable brightness and contrast. Keys shall be backlit for low light ease of use. Keypads shall include individual "Armed", "Ready" and "Trouble" indicators, three keypad-activated alarm keys, and five

programmable function keys.

2.2 MATERIALS

A. Addressable Contact Input Module: Provide DSC model # AMP-701 input module for non-addressable devices. Uses 2-wire connection for power and data to the control panel. The AMP-701 has three alarm input terminals to which an external device can be connected. The terminals monitor alarm, tamper and trouble states.

B. Interface to Door Hardware: Provide all necessary interface equipment required. Coordinate with door hardware provider.

C. Passive Infrared Motion Detector: Provide as shown on plans PIR detectors.

1. Wall-Mounted Units: Maximum detection range for individual units exceeds scheduled distance by 25 percent, but not less than 50 feet (15m)
2. Ceiling-Mounted Units: Full 360-degree conical spot-detection pattern. With the device mounted at 8 feet above the floor the pattern at floor level is a minimum diameter of 24 feet. With device mounted at 12 feet above the floor the pattern at floor level is a minimum diameter of 40 feet.

D. Door Switches: Provide as shown on plans magnetic type door switch.

1. Flush-mounted units: unobtrusive, flush with surface of door frame and door.
2. Overhead door units: door mounted magnet and floor mounted switch. Unit shall be listed for outdoor locations.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install all equipment and materials in accordance with the "current" recommendations of the manufacturer. The work shall also be in accordance with:

1. Installation criteria defined in these specifications and in the construction documents.
2. Factory Representative.
3. Approved submittals.
4. Applicable requirements of referenced standards.

3.2 SUPERVISION

A. The contractor shall provide the following services as part of the contract:

1. Supervision of sub-contractors.
2. Coordination of other contractors for system-related work (electrical contractor, finish hardware contractor, architect, and general contractor).
3. Attending site construction/coordination meetings.
4. Keeping updated construction drawings at the construction site.
5. Meeting construction deadlines per the construction schedule.

3.3 PROGRAMMING

A. Programming of the system shall include the following tasks:

1. Programming system configuration parameters (hardware and software, zone/circuit numbers, communication parameters).
2. Programming operational parameters such as opening/closing reports and windows, system response text (custom English) displays of events, activation of relays that drive auxiliary devices, and identifying types of zones/loops.

3. Programming pass codes according to the authorities and functions defined by the owner.
4. Other system programming tasks required by the owner. These additional programming requirements shall be coordinated between the owner and the contractor.

3.4 TESTING

A. Operational Testing: The contractor shall perform thorough operational testing and verify that all system components are fully operational.

B. Hard-copy System Printout: The contractor shall submit a hard-copy system printout of all components tested and certify 100 percent operation indicating all devices/panels/units have passed the test criteria set forth by the manufacturer.

C. Acceptance Test Plan Form: An acceptance test plan form shall be prepared/provided by the contractor prior to the acceptance walk-through.

This form shall include separate sections for each device/panel/unit as well as a column indicating the manufacturer's performance allowance/margin, a column indicating the result of the testing performed by the contractor (pass/fail), and an empty column for recording findings during the walk-through.

3.5 COMMISSIONING

A. The contractor shall certify completion in writing and schedule the commissioning walk-through. The contractor shall provide all the tools and personnel needed to conduct an efficient commissioning process.

END OF SECTION 28 0725

SECTION 28 0727

INTEGRATED ACCESS CONTROL & SECURITY MANAGEMENT SYSTEM

PART I – GENERAL

1.1 GENERAL DESCRIPTION

A. The Security Management System (SMS) shall be a powerful, flexible, multi-function and object-oriented security and event management system that features a variety of customizable interfaces for maintaining the system and for monitoring the desired secure sites. The SMS shall provide an option to display these management and monitoring interfaces in the native languages of the people using the system. The security and event management system shall be flexible in order to meet specific requirements and quickly respond to evolving security challenges. The SMS shall be a scalable platform, simple and economical enough to support a single site, yet upgradeable enough to manage a multi-site network. The SMS shall use an open, distributed architecture, where database servers could reside in geographically separate locations.

B. The SMS shall provide extensive information management capability using Microsoft .NET Framework V4.6. It shall operate in a Client / Server configuration on personal computers with a Windows-based platform. Its distributed client-server architecture shall be capable of supporting up to 256 simultaneous clients, multiple types of controllers, and over 20,000 input devices, including cameras and multiple types of card readers. The SMS shall be constructed to be database independent and shall support at a minimum Microsoft SQL Server 2008R2 (Express, Standard, or Enterprise), for data protection, redundancy and manageability.

C. The SMS shall have true multi-tasking, multiprocessor and remote client support; allowing independent activities and monitoring to occur simultaneously at different locations. The operator workstation (Client) shall be user friendly, employing icon-based menus and providing a mouse-driven interface for system operation and the creation of color graphic maps. The user interface shall be customizable, capable of delivering a unique look and feel without a unique version release. It shall be an intuitive user interface that is similar to Microsoft's Outlook and Explorer with its easy navigation and tree structures. A practical application layout editor shall let users drag and drop any application onto one screen and create a customized hub for all activities via a single "command and control" center.

D. Field devices such as card readers, alarm inputs, control points, etc. shall be connected to fully distributed intelligent field controllers or directly through a Software Development Kit or Web Services, and be capable of operating without host computer intervention. All objects within the SMS, i.e. doors, readers, time intervals, etc. shall be addressed by a unique name as opposed to point numbering or mnemonics. The SMS shall have badge generation tools to create and manage badges using a graphical interface and convenient query features to manage large numbers of badges.

1.2 SUBMITTALS

A. Shop Drawings

1. Prior to assembling or installing the SMS, the Contractor shall provide complete shop drawings which include the following:

   a. Architectural floor plans indicating all system device locations.

   b. Full schematic wiring information for all devices. Wiring information shall include cable type, cable length, conductor routings, quantities, and point-to-point termination schedules.

   c. Complete access control system one-line block diagram.

   d. Statement of the system sequence of operation.

   e. Riser diagrams showing interconnections.

f. Detail drawings showing installation and mounting.

g. Fabrication drawings for console arrangements and equipment layout.

2. All drawings shall be fully dimensioned and prepared in DWG format using any CAD-based software capable of exporting the format (such as AutoCAD).

B. Product Data

1. Prior to assembling or installing the SMS, the Contractor shall provide the following:

a. Complete product data and technical specification data sheets that include manufacturer's data for all material and equipment, including terminal devices, local processors, computer equipment, access cards, and any other equipment provided as part of the SMS.

b. A system description, including analysis and calculations used in sizing equipment required by the SMS. The description shall show how the equipment shall operate as a system to meet the performance requirements of the SMS. The following information shall be supplied as a minimum:

(1) Central processor configuration and memory size.

(2) Description of site equipment and its configuration.

(3) Protocol description.

(4) Rigid disk system size and configuration.

(5) Backup/archive system size and configuration.

(6) Start up operations.

(7) System expansion capability and method of implementation.

(8) System power requirements and UPS sizing.

(9) A description of the operating system and application software.

C. As-Built Drawings

1. At the conclusion of the project, the Contractor shall provide "as built" drawings. The "as built" drawings shall be a continuation of the Contractor's shop drawings as modified, augmented, and reviewed during the installation, check out and acceptance phases of the project. All drawings shall be fully dimensioned and prepared in DWG format using any CAD-based software capable of exporting the format (such as AutoCAD).

D. Manuals

1. At the conclusion of the project, the Contractor shall provide copies of the manuals as described herein. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each security system integrator installing equipment and systems and the nearest service representatives for each item of equipment for each system. The manuals shall have a table of contents and labeled sections. The manuals shall include all modifications made during installation, checkout, and acceptance. The manuals shall contain the following:

a. Hardware Manuals

(1) The hardware manuals shall describe all equipment furnished including:

(2) General description and specifications.

(3) System layout drawings and schematics.

(4) Manufacturers' repair parts list indicating sources of supply.

b. Software Manuals: The software manuals shall describe the functions of all software and shall include all other information necessary to enable proper loading, testing, and operation. The manual shall include:

(1) Definition of terms and functions.

(2) Use of system and applications software.

(3) Initialization, start-up, and shut down.

(4) Alarm reports.

(5) Reports generation.

(6) Database format and data entry requirements.

c. Operator Manual: The operator manual shall fully explain all procedures and instructions for the operation of the system including:

(1) Computers and peripherals.

(2) System start-up and shut down procedures.

(3) Use of system, command, and applications software.

(4) Recovery and restart procedures.

(5) Graphic alarm presentation.

(6) Use of report generator and generation of reports.

(7) Data entry.

(8) Operator commands.

(9) Alarm messages and reprinting formats.

(10) System access requirements.

d. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. The manufacturers of all hardware and software components employed in the SMS shall be established vendors to the access control/security monitoring industry for no less than five (5) years and shall have successfully implemented at least 5 systems of similar size and complexity.

B. Contractor / Integrator Qualifications

1. The security system integrator shall have been regularly engaged in the installation and maintenance of integrated access control systems and have a proven track record with similar systems of the same size, scope, and complexity.

2. The security system integrator shall supply information attesting to the fact that their firm is an authorized product integrator certified with the SMS. A minimum of one technician shall be a Certified SMS installer.

3. The security system integrator shall supply information attesting to the fact that their installation and service technicians are competent factory trained and certified personnel capable of maintaining the system and providing reasonable service time.

4. The security system integrator shall provide a minimum of three (3) references whose systems are of similar complexity and have been installed and maintained by the security system integrator in the last five (5) years.

5. There shall be a local representative and factory authorized local service organization that shall carry a complete stock of parts and provide maintenance for these systems.

C. Testing Agencies

1. The SMS shall be tested and listed by Underwriters Laboratories (UL) for UL/cUL 294 for Access Control System Units.
2. The SMS shall be tested and listed by Underwriters Laboratories (UL) for UL/cUL 1076 for Proprietary Burglar Alarm Units.
3. The SMS shall employ a FIPS 197-listed AES 256-bit encryption between the SMS Servers, Clients, and iSTAR Ultra/eX/Edge Controllers.
4. The SMS shall include full support for FIPS 201 initiative:
   a. Ability to customize a system-wide Card Holder Unique Identification number (CHUID).
   b. Ability to configure custom, extended card formats, including GSA 75-bit Wiegand standard, and to download them to the card access panels.
   c. Ability to use Hashed Message Authentication Codes (HMAC) for medium assurance profile.
   d. Enhanced data fields per the FIPS 201 standard, including Agency Code, System Code, Credential Series and Credential Issue Code.
5. The SMS hardware shall comply with the following regulatory requirements:
   a. FCC Class A.
   b. FCC Class B.
   c. CE.
   d. Canadian Radio Emissions requirements.
   e. Restriction of Hazardous Substances Directive (RoHS) 2002/95/EC.
   f. FIPS 140-2 encryption (certified for the iSTAR Ultra/Edge/eX controllers).
6. The SMS shall support Americans with Disabilities Act (ADA) compliance in door and access operation.

D. Licensing: Licensing shall be required for the SMS software. The licensing shall include:

1. Series (Model).
2. Number of online readers.
3. Number of online inputs.
4. Number of online outputs.
5. Number of card holders.
6. Number of simultaneous clients.
7. Number of simultaneous badging stations.
8. Optional Features.

1.4 WARRANTY

A. The SMS shall be provided with a 2-year product warranty from date of substantial completion. The SMS Hardware shall be provided with a 5-year product warranty from date of manufacture. Software version upgrades shall be available for no charge during this warranty. The software media warranty shall be 90 days per the C•CURE software licensing agreement.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. The SMS shall be the Software House C•CURE 9000 system. The Badging Solution shall be Software House C•CURE ID. The SMS field controllers shall be the Software House iSTAR family of controllers. The hardware manufacturer shall be an ISO 9001:2000 registered company.

2.2 DESCRIPTION

A. The SMS shall be an integrated system that utilizes a single, industry-standard relational database management system for the storage and manipulation of related data. The SMS shall include a server with operating system and applications software, operator and administrator terminals with appropriate software, hard copy printers and fixed magnetic storage media. The security devices shall communicate with the field panels via a dedicated cable network. The field panels shall communicate to the server via a Fast Ethernet 10/100 or 1 Gb, TCP/IP network.

B. The SMS shall allow for growth and scalability from a low-end or entry level system to a high end or enterprise system by increasing CPU power, memory and database. The SMS shall be modular in nature, allowing system capacities to be easily expanded without requiring major changes to system operation. All defined system data as well as historical information shall be maintained. Customizable user interfaces shall allow management of system information and activity for administrators and operators. The SMS shall include an intuitive .NET based badging solution with a WYSIWYG badge layout editor and GUI for badge design.

2.3 SMS Functionality

A. Partitioning

1. The SMS shall allow system administrators to separate the creation and viewing of objects into partitions. SMS operators shall be associated with partitions and this shall determine which objects operators have the ability to create and or view. The SMS shall support an unlimited number of partitions.

   a. The SMS partitions shall include but not be limited to the following objects:

      (1) Personnel
      (2) Clearances
      (3) Doors
      (4) Controllers with all associated hardware (readers, inputs, outputs, etc)
      (5) Video servers with all associated objects (cameras, tours, views, etc)
      (6) Application layouts
      (7) Events
      (8) Dynamic views
      (9) Maps
      (10) Reports, forms, results
      (11) Holidays
      (12) Badge layouts
      (13) Queries
      (14) Images

2. Through the use of privileges, the SMS System Administrator shall be able to determine which objects are associated with a particular partition. These objects shall then be assigned to System Operators with the appropriate privilege.

3. The SMS shall support a super-user assigned the 'System All' privilege who shall have full access to all objects in all partitions.
4. Any operator shall have the ability to be assigned access rights to any partition. Individual Access rights shall be created and have the ability to be assigned to any users of the SMS.
5. The SMS shall allow objects to be created in any partition. The SMS shall have the ability to grant or remove permission from any object in any partition.
6. The SMS shall provide the ability to move objects from one partition to another partition without the requirement of deleting and recreating.
7. The SMS shall provide the ability to import/export any configured object.
8. The SMS shall support the display of all associated objects contained within a partition.

B. Enterprise Architecture

1. The SMS shall provide an Enterprise Architecture, licensable option that allows you to configure multiple Satellite Application Servers (SAS) to communicate with a Master Application Server (MAS). The Master Application Server shall provide a platform for global management of the personnel, video, and access control security objects on two or more Satellite Application Servers (SAS) in an enterprise.
2. The Enterprise Architecture shall work by synchronizing each SAS system's database with the MAS database. The MAS shall contain the global data that is used across every server, such as global personnel records, global clearances, and global schedules. The global data shall be synchronized to each SAS to provide enterprise-wide security. The MAS shall be used to remotely monitor and manage controllers and video servers attached to SAS's in the enterprise, however it shall not support any directly connected controllers or video servers.
3. The MAS shall provide the capability for Central Monitoring of the entire enterprise, using the Monitoring Station application. From a Central Monitoring Station connected to the MAS, the system shall be capable of viewing events, activities, and status of every SAS in the enterprise. Alternatively, you can connect to an individual SAS to monitor that system and its connected hardware. In addition, the MAS shall provide the ability to integrate with external sources via LDAP, XML, CSV or ODBC imports both manually or automatically through scheduled processes.
4. Each SAS shall contain database records for all connected video and access control devices, as well as local personnel, clearances, privileges, and other related data. Each SAS shall synchronize with the MAS so that SAS local data is replicated to the MAS for central management and monitoring. In addition, the MAS shall provide central reporting capability for replicated SAS objects including journal and audit transactional data. [Note, for Connected Program integrations, SAS local data is not replicated to the MAS and central reporting is limited.]
5. All local data shall be synchronized immediately to the MAS or queued if a server is offline. All queued data shall be replicated automatically upon restoral of communication. Global data that is created or changed at the SAS/MAS shall be replicated to all locations. Journal and Audit data shall be synchronized either manually or on a configurable schedule, providing the ability to manage bandwidth usage and load balancing.
6. Operators in the enterprise architecture shall be configured as local or global. Global operators shall be subject to the user privileges as defined on each SAS.
7. The Enterprise Architecture shall support a Standalone to SAS Migration Utility that shall be used to merge a standalone SMS server into an existing SMS Enterprise site.
8. The Enterprise Architecture option shall include:

a. Global Administration of Personnel and Clearances, Images, Card formats, CHUID Formats, Holidays, Personnel groups, and Operators and Privileges
b. Centralized Reporting
c. Central Monitoring of Events and Activities across the Enterprise
d. Central Management of Access Card Enrollment
e. Central Badging and Image processing
f. Global Management of Badge Layouts
g. Single Card Access across the Entire Enterprise
h. Increased Scalability of Security Hardware and Video
i. End-to-End Encryption
j. Automated Synchronization of Enterprise Security Databases
k. Central Management of Video and Hardware Resources
l. Remote Editing of Global and Local Data

9. The SMS Enterprise model shall not restrict the addition and/or configuration of over 40 regional application servers configured to a master application server. Testing and qualification has been completed for up to 40 regional servers. However, the SMS shall have no technical restrictions to regional server capacity limits other than system performance.
10. The SMS shall support the configuration of multiple Global partitions in addition to the default Global partition providing the SMS more organization options for objects within the Enterprise system.
11. The Enterprise Architecture option shall provide Multi-Version support. Multi-Version support shall allow SASs running a prior version of the SMS software to continue to synchronize with the MAS allowing for a phased deployment during an Enterprise-wide upgrade. Client connectivity between MAS and Multi-version SASs for monitoring and administration is supported

C. Graphical User Interface (GUI)

1. The SMS shall employ a standard Windows graphical user interface (GUI). A mouse and keyboard shall be the primary operator interface with the system. Operator screens shall utilize all standard Windows-style functions such as drop-down menus, context menus, radio buttons, and lists, as appropriate. The interface shall utilize a ‘tree structure’ similar to Windows Explorer.

D. Administration Operator Interface

1. The SMS shall employ an Administration Operator Interface to control the following:
   a. Hardware (readers, inputs, outputs, video systems, door controls, CCTV, and other systems).
   b. Configuration of personnel records, operators and operator privileges.
   c. Graphical Maps.
   d. Application Layouts.
   e. Dynamic Views.
   f. Queries.
   g. Import/Export of objects, including images.
   h. System Variables.

i. Reports (either periodic or one-time).

j. System functions (event command and control, actions, schedules).

k. Display of a list of objects in a grid that can have their values modified and respond to real-time status changes.

l. Scheduling of backups.

m. Monitoring of system settings and performance.

n. Designing of and printing of badges.

2. The GUI shall be configurable by the system administrator to control the views and access of each Monitoring Station operator.

E. Monitoring Operator Interface / Activity Monitoring

1. The SMS shall contain a monitoring component that is capable of, among other things, displaying the current state of any object in the system. Additionally, the monitoring station shall be capable of displaying a log of all activity that occurs in the system, from object state changes, to access control information. All text for events (alarms) in the system shall be configurable to be displayed in color based on the user-specified priority of the event.

2. The Monitoring Station shall be capable of showing all changes occurring to an object without requiring the associated activity messages for that object to be routed to that monitoring station. The SMS shall require the operator to have appropriate permissions to view and/or control any object.

3. The monitoring station interface shall be user-customizable. The SMS shall support the ability of the end user to create a customized application layout for the monitoring station. The monitoring station shall support multiple application layouts that can be assigned to the operators. Each application layout can have multiple panes in the same window. The panes can have multiple tabs so that different objects such as cameras and tours can be displayed in the same pane. The panes shall have the ability to include: General activity; Event (Alarm) activity; Dynamic card swipe information; Video cameras and tours; Maps; Dynamic Views; Reports; and links to external applications. Each pane shall have the ability to be moved to a specific screen.

4. The SMS monitoring station shall support a Swipe and Show Viewer. The Swipe and Show Viewer shall monitor a configurable list of Doors, and shall display a portrait or multiple portraits of personnel who present an access credential at a Reader on an included Door or Elevator. The SMS shall allow multiple Swipe and Show Viewers to be added to an Application Layout. The Swipe and Show Viewer shall provide configurable image border colors that shall correspond to access transaction states (Admit, Reject etc.,). The Swipe and Show Viewer shall display the date and time of the transaction, the location, area, Cardholders name and the status of the transaction. The Swipe and Show Viewer shall allow an Operator with the appropriate Privileges to perform the following functions from the Viewer:

a. View/Edit the Cardholder record

b. Perform a momentary unlock of the associated door

c. Grace the Cardholder (allow the cardholder into an APB area)

d. Perform an Area Lockout Grace of the cardholder

e. Perform an APB reset on the cardholder

5. The SMS shall support the ability to configure an Operator's Application Layouts to open in separate instances of the Monitoring Station to enhance the performance of multiple displays. Each Application Layout shall support the assignment of a monitor number. The Operator

opening the Monitoring Application shall automatically open a separate instance of the Monitoring Application on each assigned Monitor. The SMS shall support up to Ten (10) assigned monitors for Application Layouts.

6. The SMS shall provide the Monitoring Operator with following functional capabilities:
   a. Shall provide a scrolling list of lines or tiles showing current activity on the system.
   b. Shall display activity in real-time as data is being transmitted by field hardware.
   c. Shall include icons that indicate the type of activity and textual description of the activity.
   d. The color of the frames of the tiles, icons, and/or text shall indicate the type or importance of the information contained therein.
   e. A series of menus, driven by drop-down or trees, shall allow the Monitoring Station operator to perform manual actions, such as “momentary door unlock” for a given door.
   f. As part of the manual action capability, the system shall provide screens or boxes that query the operator on specifics, such as start and end time, and offer guidance on performing the manual actions.
   g. Ability to view a sortable list of active alarms or events and recently active alarms or activity.
   h. Ability to view video from DVMS systems within the same GUI. The video screen GUI shall be able to display multiple panes of live or recorded video and have on-screen camera controls for each live window, providing PTZ control of individual cameras.
   i. A GUI that minimizes the number of operator mouse clicks or keyboard strokes.
   j. Mouse controls include “right-click” pop-ups and highlighted default selections.
   k. Objects shall be displayed to the operator based on his/her assigned operator privilege. The operator shall only be able to monitor/command those objects for which he or she has been assigned privilege.
   l. When an operator logs out of a workstation and a new operator logs on, the objects displayed on the workstation screen shall by dynamically updated to display only those objects for which the new operator has privilege.
   m. Allow the customization of columns as defined by the operator privilege, including:
      (1) Adjusting width (on the fly or pre-programmed).
      (2) Not displaying Columns (on the fly or pre-programmed).
      (3) Sorting on selected columns (to follow standard Windows conventions).
   n. Allow for a “freeze” function. This includes a configurable “freeze time-out” that permits an activity to be selected and temporarily prevents the display of subsequent activities which push the selected activity off the screen. A break-through event disables the freeze function. The freeze function shall provide a graphic bar where the remaining time available in the freeze timeout shall be displayed. Selecting the freeze timeout icon before the time elapses shall extend the freeze timeout to the maximum.
   o. Provide Acknowledge All, Acknowledge and Clear All and Silence All buttons for events.
   p. Support multiple panes for the display of events, activities, video, personnel images, and maps.
   q. Display the number of active causes of an event.
   r. Support the ability to attach a log message to an event, even after the event has been acknowledged.

s. Provide the ability to attach Predefined Log Messages to an event upon acknowledgement.

t. Shall allow a Monitoring Operator to select on-screen transactions (both events and system activity) and Email the transactions with a single mouse click.

7. Pre-defined Alarm Acknowledgement Messages

a. The SMS shall provide the ability to create Predefined Log Messages. Each log message shall have a Name, Description, Label and Message Text. These messages shall be assigned to any event providing the ability to select the appropriate response that resolved the event. The SMS shall provide the ability to group multiple log messages and then assign the group to an event. Each group shall contain up to one hundred messages and each event shall support up to one hundred messages. The SMS shall allow only users with specified operator privileges to add, modify, or delete messages or message groups. Predefined messages shall be editable by an operator with the proper privilege and may be appended as required by the operator.

b. Messages shall have the following characteristics:

(1) Message Name shall be configured with up to 500 characters

(2) Message Description shall be configured with up to 500 characters

(3) Message Label shall be configured with up to 100 characters

(4) Message Text shall be configured with up to 3000 characters

8. The SMS shall support audible alarm annunciation at operator workstations (operator configurable audio [WAV] files associated with alarms).

9. The activity monitoring screen shall be capable of displaying the following features:

a. System clock.

b. Date/time when the activity actually occurred and the date/time when the activity was received by the server shall be displayed (when they are different).

c. Real time event counters.

d. Count of the active events.

e. Count of the events requiring operator acknowledgment.

f. Name of operator logged on at the workstation.

g. Real-time display of the current activity on the system in chronological order.

h. Acknowledge All and Silence All buttons for events.

i. Manual Action command buttons.

j. Pre-defined and configurable acknowledgement messages.

k. Log message.

l. Clear event.

m. Clear group of events.

n. Event action message (automatically display selected message for event).

o. Dynamic views.

F. Web Client

1. The SMS shall support a Thin Client to provide remote access to the SMS Server via a web browser. The Thin Client shall support Microsoft® Internet Explorer 7.0 and Mozilla Firefox® 3.0 or greater. The Thin Client shall support 128-bit AES encryption to the SMS Server.

2. The Thin Client shall support Single Sign-on utilizing Windows Authentication. The privileges of the SMS operator shall be propagated to the Thin Client User allowing only access to Security Objects for which the SMS Operator is authorized. The Thin Client shall provide support for Partitioning of the system and utilize the Partitions assigned to the Operator.
3. All changes made to the SMS database via the Thin Client shall be recorded in the Audit Trail Database.
4. The Thin Client shall provide Personnel Management including:
    a. Shall allow the operator to create and modify personnel data (includes adding/removing clearances, schedules, and expiration dates).
    b. Operator shall have the ability to enable and disable cards.
    c. Operator shall have the ability to search for, edit, add, and delete Personnel records from the SMS database.
    d. Search function shall allow wildcards and shall include First name, Last name, card number, and user defined text.
    e. Shall support the Auto-increment Card Number feature for Credentials created using the Web Client.
    f. Shall support a Change CHUID Format button on the Credentials tab that allows you to change the CHUID format of a Credential.
    g. Shall support an Auto Generate button that allows you to randomly generate a PIN for PIN-only Credentials.
    h. The SMS thin client shall provide a personnel image tab that includes image display, Image capture from a file or a local USB camera, and the capability to crop the Image and save it to the SMS personnel record.
    i. The SMS thin client shall support the previewing/printing of badges.
5. The Thin Client shall support an Activity Monitor to provide a scrolling display of system activity. Activity shall be restricted based upon the Operator's Privilege and Partition assignments. Display controls shall include page up, page down, and a freeze function.
6. The Thin Client shall support acknowledgement of an Event from the Event Dynamic View.
7. The Thin Client shall support for logging an Event Message from the Event Dynamic View
8. The Thin Client shall support Manual Actions to include the Locking/unlocking of doors, and the Activation/deactivation of events.
9. The Thin Client shall support the display of Dynamic Views as defined by the SMS. Dynamic Views shall provide a real time view of SMS data including Journal and Audit Trail history. Viewing of Multiple Dynamic Views shall be supported.
10. The Thin Client shall support creating, configuring, loading and saving of reports. Reports shall consist of personnel history activity or audit data. The report data shall allow sorting within the thin Client view page by any displayed field in ascending or descending order. The Thin Client shall allow reports to be saved in the following formats: XLS, CSV, XML, TXT or PDF. The operator shall have the option to save the report to a file or send it via email.
11. The Thin Client shall support Manual Action Challenges. The Manual Action Challenge shall require an operator to enter their login credentials (User name and password) when executing a manual action, such as a door unlock, from within the Thin client.
12. The Thin Client shall support the ability to query on a specific cardholder or a group of cardholders for the purpose of assigning clearances to multiple cardholders at once. Once the query is complete, the operator shall have the ability to assign a single access clearance or a

group of clearances to all cardholders.

13. The Thin Client shall support the ability to display a door activity report from the web client cardholder record configuration view. In addition, it shall provide the ability to display the Activation / Expiration Date and Time for each credential assigned to a cardholder. The thin client shall display all user-defined personnel fields and the details of each assigned access clearance in a separate window.
14. The Thin Client shall support Auto-Logoff based upon inactivity. The Thin Client shall monitor user activity and shall automatically log a user out of the workstation after a user defined timeout period.
15. The Thin Client shall support the ability to assign or remove clearances to multiple cardholders simultaneously.

G. SMS Mobile Application

1. The SMS shall support a Mobile Application allowing operators to monitor or administer the SMS system by way of mobile device. The device shall be connected via the phone network and a VPN or via Wi-Fi to the SMS server utilizing Web Service (IIS - Web Service).
2. The SMS Mobile software shall be available for download from the following locations:
   a. Apple App Store
   b. Google Play
3. The Mobile Application shall support mobile phones and tablets running the following operating systems.
   a. Apple iOS 7.1 and higher (iPhone, iPad, iPod Touch)
   b. Android OS 4.0 and higher
4. The Mobile Application shall connect to a standalone SMS server, including an Enterprise Satellite Application Server (SAS) and Site Server (Appliance).
5. The SMS Mobile Application shall support connection to the SMS system through a 3G (minimum), 4G, or Wi-Fi connection.
6. The number of mobile connections allowed by the SMS server shall be based on the SMS licensing model. Each connection made through the SMS Web service shall be considered a simultaneous client connection.
7. Operator login to the SMS Mobile Application shall be consistent with the SMS thick client application, authenticating login credentials via Windows Single Sign-On (SSO).
8. The SMS Web Service shall require Internet Information Services (IIS) be installed on the target system. The SMS Web Service shall be installed on the IIS server during installation.
9. The SMS Mobile Application user interface shall be localized with supported SMS languages: Arabic, Czech, Danish, Dutch, English, French, German, Hungarian, Italian, Japanese, Korean, Polish, Portuguese (Brazilian), Russian, Simplified Chinese, Spanish, Swedish, Traditional Chinese, and Turkish.
10. The SMS Mobile Application shall support SSL-encrypted communications with the remote Mobile Web Service.
11. The SMS Mobile Application shall provide a search and filter option to refine query results.
12. The SMS Mobile Application shall provide a link to a context menu while viewing objects, providing the operator the ability to perform SMS operations consistent with the SMS administration and monitoring applications.
13. The SMS Mobile Application shall provide the following core features:

a. The SMS Mobile Application shall provide operators with the appropriate privilege, access to tools used for inspecting the SMS Journal and Audit Logs.

b. The SMS Mobile Application shall provide a collection of tools to monitor SMS events and other objects. Monitoring shall show active SMS events in real time.

c. The SMS Mobile Application shall provide a collection of tools to manage personnel and shall allow for the following:

(1) Create/Update Personnel Records

(2) Assign/Remove a card/credential to personnel.

(3) Capture an image and associate that image with personnel.

(4) Grace personnel, Antipassback Card Reset, Area Lockout Grace, and remove personnel from an Area

14. The SMS Mobile Application shall provide tools used to explore, edit and control the following objects:

Favorite Filters

Favorite Monitors

Query

Events

Manual Actions

Operators

Controllers

Doors

Elevators

Inputs

iSTAR Clusters

Outputs

Readers

15. The SMS Mobile Application shall provide an editor for local application preferences such as:

a. Login Parameters – Encryption, Inactivity Timer, etc.

b. Data Collection – Page Size

c. Monitoring – Polling Intervals, etc.

H. Graphic Maps

1. The SMS shall support unlimited graphic maps and icons to be displayed on the operator workstation monitor.

2. The system shall support an operator-programmable, color graphic map display that:

a. Shall be capable of showing the floor plan, the location of alarm devices, and alarm instructions for a facility.

b. Shall be centralized in the system configuration and displayed on the operators' workstations.

c. Shall allow various maps to be associated with different areas to create a hierarchy of maps.

d. Shall support graphic maps having a resolution of 1024x768 Pixels or greater.

3. Operators shall be able to use drag-and-drop mouse technique to place dynamic system level

object icons of all objects such as: cameras, video servers, inputs/outputs, events, maps, reports, dynamic views, and door/elevator icons. These dynamic object icons shall allow a system operator to perform tasks and issue commands related to the object by double-clicking on the icon.

4. The SMS shall allow the addition of new layers to the drawing (such that if the drawing must ever be reloaded due to an update of the drawing, the layer(s) created within the SMS will be added back automatically without additional reconfiguration).
5. The SMS shall be able to directly import the following file formats for the map:

   AutoCAD (.DWG)

   DXF

   JPEG (.JPG)

   PNG
6. The Maps feature shall include two operational modes: an administrative mode to allow configuring of the facility floor plans or site plans that show exterior features and a runtime mode to allow monitoring and interacting with the configured facility layouts or site plans.

I. Information Storage, Backup and Transfer

1. All programmed information, as well as transactional history, shall be automatically stored in the database for later retrieval and backup. The SMS shall support configurations where the SMS database(s) may be installed on a hard drive on the SMS server, on an independent database server, or in an existing corporate database server.
2. The SMS shall be capable of backing up and restoring all system data and transactional history. The server shall be capable of transferring all programmed data and transactional history to CD-ROM, DVD, or Hard Drive (including networked drives).
3. The SMS shall allow activity history to be written to a database. The system shall have the capacity to store a minimum of 50 million transactions. There shall be a method of backing up the activity history on external media and then restoring and replaying it.
4. The SMS shall support AES 256-bit encrypted communications between server and user client.
5. The SMS shall support AES 256-bit encrypted communications between server and controller. The encryption shall support both local and third-party digital certificates.

J. Communication Ports

1. The SMS shall be able to support multiple serial devices. In addition to COM1 and COM2, up to [8, 16, 32, to 256] additional ports may be configured through the use of a port expander or its equivalent. These serial ports may be used for connection to CCTV matrix switchers, or apC panels.
2. The SMS shall support the use of Ethernet networks as the communications path between the host computer and field devices such as, iSTAR, apC, apC 8/x, controllers, and CCTV matrix switchers. This communications path shall be the same network used for communications between the host server and the operator workstations. The communications between the host computer and the field devices shall be encapsulated in a TCP/IP network/transport layer. The SMS shall support IPv6. (IPv6 shall be supported only on iStar Ultra controllers.)

K. Printers

1. The SMS shall support report printing. The report printer(s) may be connected directly to the client PC, or shared over a network. The SMS shall support as report printer(s) any printer for which a printer driver exists within the Operating System supported by the current SMS version.

L. Software Configuration

1. The SMS configuration tools shall utilize intelligent configuration controls. The system shall be structured so an operator is unable to perform configuration functions that are invalid based on the configuration used. The system shall support the ability to search within browser lists using filtering operators such as “begins with”, “ends with”, “contains”, etc. The system shall also allow an operator to do searches using filtering operators on any class of object in the system, both in the Administration application and the Monitoring Station application.
2. The SMS shall allow text description of all configured objects. The SMS shall allow the renaming of an existing title description without removing the sub-components of that configuration object. The SMS shall automatically remove from the system all configuration references to an object being deleted. The SMS shall automatically provide default names for all inputs, outputs, readers, and extension boards. The SMS shall clearly display which hardware objects (inputs, outputs, readers) on a controller are configured, and which are not.
3. The SMS shall provide for the configuration of templates. Templates of supported objects shall be operator-configurable to provide default values by pre-populating commonly used data fields.
4. The SMS shall support an unlimited number of groups for any object type. The SMS shall support unlimited object group definitions. In general, a group shall be usable wherever an individual object is referenced in the SMS. For example, a group may be used instead of an object when configuring a schedule/object pair in a clearance, and a group may be used instead of an object when performing a manual action to unlock a door.
5. The SMS shall generally allow any object in the system to be grouped including personnel, doors, inputs, outputs and clearances.
6. The SMS shall restrict the viewing and controlling of objects in the administration and monitoring stations via operator privileges. The SMS shall support the configuration of operator restrictions on an object class basis, and on an object-by-object basis. The SMS shall maintain a distinction between objects that are being monitored and objects that are being controlled, preventing operators from issuing object manual actions to objects for which the operator does not have manual action privileges. There shall be different levels of controls within the system for administration privileges versus monitoring privileges.
7. The SMS shall support unlimited operator accounts with unlimited definable privilege levels.
8. The SMS shall allow configuration of controllers using hierarchical tree-based navigation and context menus.
9. The SMS shall support the ability to download firmware updates to the controllers.
10. The SMS shall support the following methods for Operator authentication and authorization:
    a. Windows Single Sign-On (SSO).
    b. Basic User Authentication with locally defined user names and passwords with strong password rule enforcement.
11. The SMS shall provide an automatic client update process for quick distribution of application updates.
12. The SMS shall have context sensitive online help (at the screen level) available at any point requiring operator input.

M. Personnel Records

1. The SMS shall provide Personnel Templates that shall eliminate repetitive data entry by pre-configuring Personnel Records with data common to all Personnel.

2. The SMS Personnel records shall provide multiple tabbed pages of personnel data containing default system and user-defined fields. The SMS shall support an unlimited number of tabs allowing an unlimited number of user-defined fields. Labels for user-defined field tabs shall be customizable by the System Administrator with the appropriate privileges. Each user-defined field shall allow a name, description and label. A default language shall be selectable by the System Administrator for the user-defined field labels.
3. User-defined fields shall be definable as Mandatory or Unique and shall support the following field types:

   Character

   Integer

   Logical

   Date/Time

   Date

   Time

   Enumerated List

   Multi Line

   Decimal

   Identity
4. User-defined fields shall support masking to provide consistency of data entry across all system operators. Custom masks, as well as the following predefined masks, shall be available:

   Alphabetic

   Alphanumeric

   Numeric

   Phone Number – USA

   Zip Code

   Zip Code +4

   Alpha – All Caps

   Alpha – All Lower case
5. The SMS shall provide a “Personnel Record Document Object” option which allows the operator to assign / attach up to two (2) documents (such as URL, PDF, or TXT files) to the personnel record. The document may be applied to the record as a:
   a. 'Shared' Document - added to the SMS via the Documents Editor.
   b. 'Private' Document - imported from outside the system, such as a birth certificate or a diploma.
6. The SMS shall include a "Documents" tab to user-defined personnel views as well as the default view "Personnel View with Portrait in Header" to support the association of documents. The documents are available for viewing by operators with appropriate privilege.
7. The SMS shall support the generation of a unique random card number for an access credential for all Personnel records. The unique card number shall contain up to the maximum number of digits for the CHUID format chosen for the credential.
8. The SMS shall support the configuration of a trigger for a Personnel record that pulses an Event whenever a 'Card Admitted'/'Card Rejected' message is logged to the Journal for that person at

a defined Door/Elevator.

9. The SMS shall support an email address field for each Personnel Record and shall support the sending of emails to Personnel Groups.

N. Credentials

1. The SMS shall support a minimum of five (5) credentials (cards) per Personnel record and shall only count Active and/or Expired Cards towards the maximum assignable Cards per Person. Cards designated as Lost, Stolen and Disabled shall not count towards the maximum assignable Cards per Person.
2. The SMS shall support the ability to define the default period of time (in Days, Hours or Years) from a Credential's Activation Date until its Expiration. The SMS shall support an override of the default Expiration time period for individual Personnel Types.
3. The SMS shall support Temporary Credentials. Temporary Credentials shall be available for general re-use without being associated to specific Personnel records. Temporary Credentials shall be assignable to visitors and can also serve as temporary replacement cards for Personnel who misplaced or forgot their regular Credentials. The SMS shall support the configuration of a default number of days for Temporary Credentials to remain active after they are created.
4. The SMS shall provide the ability to define background colors for the Active/Expired Credential Status fields in the Personnel Record.
5. The SMS shall support a system-wide setting to automatically disable Personnel Credentials that have not been used for a specified period of time. The Disable by Inactivity process shall support a user configurable daily scan time.

O. Personnel Views

1. The SMS shall support user-defined Personnel Views. Personnel Views shall provide the ability to customize the Personnel record by adding and/or removing certain objects from the operator's view. Personnel Views shall be assignable to SMS operators via the operator's assigned privilege and shall be definable for use in the creation and/or editing of the Personnel record. All Personnel Views enabled for an operator shall be selectable from the current view to allow an operator to switch views in real time. Personnel Views shall support the following:
   a. Adding/Removing Fields (including all user-defined fields)
   b. Custom Field Labels
   c. Adding Boxes to group together common fields
   d. Adding/Removing tabs to organize fields
   e. Custom Tab Labels
   f. Customization of Tab display order
   g. Background/Foreground color control of fields and labels
   h. Personnel Record Document Object – to associate up to two (2) documents to the record

P. Language Localization

1. The SMS shall be configured so the information presented to system operators is displayed in a language native to the system operator provided that the proper translation files exist.
2. It shall be possible to translate the SMS into any left-to-right or right-to-left language supported by Unicode and by the Microsoft Windows operating system.
3. Languages shall include English, Arabic, Brazilian Portuguese, Dutch, French, German, Italian, Polish, Simplified Chinese, Spanish and Japanese.

Q. Inputs

1. The SMS shall monitor both supervised and unsupervised hardware inputs as well as virtual inputs such as predefined system messages. These inputs include door / elevator inputs and monitor points. The SMS shall also monitor controller inputs such as tamper, AC fail, and low battery.
2. The SMS shall have the ability to name and allow for user-defined descriptions for individual inputs, outputs, and readers as well as input and output modules.
3. There shall be three separate and distinct states for inputs, which can be defined on the input configuration screen: Disabled, Enabled / Disarmed and Enabled / Armed.
4. The SMS shall allow configuration to link the state of an input to an output. The system shall allow multiple inputs to activate a single output or group of outputs.

R. Outputs

1. The SMS shall have outputs, also known as Control points, which associate an input or event action with a relay output. These output uses include doors / elevators, alarms and industrial control.
2. There shall be three types of outputs available: dry contact / Form C relays, wet or voltage sourced relays and Open Collectors. Outputs shall be configured such that they can be activated, deactivated or pulsed by system actions.

S. Card and Reader Support

1. The SMS shall be designed to support multiple card formats and card reader types.
2. The SMS shall support the following features for directly connected readers:
   a. OSDP. (Open Supervised Device Protocol), v2.1.6 or higher. OSDP shall only be supported with the iStar Ultra and qualified OSDP capable readers, using OSDP Secure Channel AES128 encryption.
   b. User defined card formats up to 256 bits.
   c. Unlimited number of SMS card formats.
   d. The ability to assign up to 10 card formats per reader.
   e. The ability to show reader status on RM LCD.
   f. Support Wiegand and 3x4 matrix keypads.
   g. The enrollment of biometric templates to smartcards.
   h. Custom CHUID FIPS201-compliant supporting full 256-bit data.
   i. The SMS shall support readers that provide Wiegand signaling and magnetic signaling to include:

      Software House RM readers.

      Software House Multi-technology readers.

      Wiegand swipe/insert readers.

      Proximity readers.

      Biometric readers.

      Smart card readers.

      Wireless readers.

      Magnetic readers.

T. Advanced Door Monitoring

1. The SMS shall support Advanced Door Monitoring allowing additional monitoring inputs and

lock sensing equipment at all doors. Advanced Door Monitoring shall allow integration with third-party lock release inputs, such as fire and crash bar devices, that control emergency egress.

2. Advanced Door Monitoring shall include:
   a. Multiple inputs – Advanced Doors shall support up to 16 inputs.
   b. Single and double-leaf doors with multiple DSM or Request To Exit (RTE) inputs.
   c. Shall support Lock sensing devices – to monitor locking on magnetic bonds, bolts, and cams.
   d. Integrated lock releases – to integrate door unlocking with fire, crash bar, power fail, and key switch inputs.
   e. Special events and actions – to create keypad commands that lock, unlock, and secure doors for a specific time period.
   f. Alarm Suppression and RTE control on a per door basis.
   g. Enhanced Shunt control.
   h. Grace and change timing options – to fine tune the SMS timing to avoid the effects of 'door bounce'.
   i. Journal reports and Monitor Station activities – to manage the system and monitor door activity.
   j. Additional Event Actions related to Advanced Doors

U. Keypad Commands

1. The SMS shall support keypad commands. Keypad commands shall be up to Nine digits in length. Keypad commands shall be entered at a keypad connected to an iSTAR controller and shall be used to activate system events. The event shall be configurable to activate any allowable event action.
2. Keypad Commands shall support Personnel Permission options to accompany the command and validate the issuer's identity. Keypad Commands shall be configurable to require a valid credential or a valid credential plus a PIN. Keypad Commands shall also be available to all Personnel or only selected Personnel as part of a Personnel Group.
3. The SMS shall support the assignment of certain users as Keypad Command Administrators. These users shall be able to issue all Keypad Commands and shall not be required to be part of a Personnel Group assigned to a Keypad Command.
4. Keypad commands shall have the ability to be limited to specific doors as part of a Door Group within an iSTAR Cluster. In addition, specific readers shall be configured to allow or disallow keypad commands.
5. Keypad Commands shall support segmentation of the nine-digit code in the form of Prompt Codes. Prompt Codes shall allow the user to utilize some digits of the Keypad Command to correspond to a command such as a door unlock, and the remaining digits to correspond to an object such as a door. When using Prompt Codes, the first segment shall be entered and the SMS shall prompt the user on the reader LCD module to enter the remaining digits. The SMS shall support two Prompt Codes per keypad command.

V. RM Reader LCD Messages

1. The SMS shall provide custom LCD messages to be displayed on the LCD screen of RM readers. All messages, as well as date and time formats, shall be downloaded to the controller and will be used on all supported readers configured on that panel. The ability for the System Administrator to change the Language for LCD messages shall be provided. (The reader LCD

supports Western character sets only. No double-byte languages are supported.)

W. Wireless Reader Devices

1. The SMS shall provide for a Wireless Lock solution. The SMS shall interface to the wireless lock via panel interface modules. The panel interface modules (PIM) shall support a direct connect Wiegand or RS-485 interface to the Intelligent Controller.
2. The SMS shall support up to 16 wireless readers per controller. The readers shall support communicating to a single panel interface module (PIMs) or up to 16 PIMs depending on reader type and physical location of reader.
3. The SMS shall provide a Wireless Reader configuration tab within the Intelligent Controller UI for the setup of the RS-485 version of panel interface modules.
4. The wireless reader editor shall support the following input configuration:

   Wireless DSM

   Wireless RTE

   Wireless Reader Tamper

   Wireless Reader Communication Fail

   Low Battery

   The wireless reader editor shall support the following output configuration:

   Door Latch Relay
5. The SMS shall also support a Wiegand interface module to communicate to the iSTAR and apC family of controllers as a standard Wiegand reader signal.

X. Door Configurations / Elevator Control

1. The SMS shall allow doors to be configured to operate in any of the following access control modes:
   a. Unlocked
   b. No Access (Secure mode)
   c. Any combination of the following, as defined by schedule, event: card only, PIN only, Card + PIN, Card entry through keypad.
2. The SMS shall allow a door to be configured to operate using the following functions:
   a. Readers shall read cards while the door is in the open position.
   b. Door lock relay shall automatically lock upon the door being opened.
   c. Allow for a user-defined delay relock time period.
   d. Allow for a user-defined door unlock time and door held open time.
   e. A separate (alternate) shunt timer for ADA flagged cardholders
   f. The operator shall be able to specify a shunt expiration output to be triggered for a configurable time (in hh:mm:ss) before the expiration of the door open or alternate shunt. Can be enabled for ADA only, or all the time.
   g. Allow for a user-defined door unlock and door held time, in seconds.
   h. PIN-only access (keypad).
   i. PIN-entry on the reader keypad shall be required during a specified schedule after a card access (unless a manual action or event has disabled PIN).
   j. Card entry through keypad.

3. The SMS shall allow each door to be configured to cause a variety of events such as alarms to occur based on activity at that door.
4. The SMS shall support the activation of an event after a user-defined number of consecutive cards are rejected at a door. A user-configurable timer shall be available to determine the time-frame for the consecutive rejects. The timer shall restart after a valid card read. Separate triggers shall be available for inbound and outbound directions on doors with in and out readers.
5. The SMS shall support configuration of unlimited elevators.
6. The SMS shall support an extended unlock function initiated via two valid card presentations to a single reader or a 'double swipe'. The double swipe feature provides the ability to designate doors at which cardholders with double swipe privileges may perform an extended lock or unlock of the door. The double swipe feature shall support the following:
   a. Toggle mode – the first double swipe shall unlock the door and the second shall relock it. Toggle mode shall support the assignment of a cardholder group that can perform the double swipe.
   b. Cardholders shall be required to have proper clearance to perform double swipe action.
   c. Each SMS door shall be uniquely configurable for double swipe.
   d. Reset of a double swipe unlock (relock) via a scheduled event.
   e. Event activation to reflect double swipe state (Lock, Unlock).
   f. Modified reader beeper pattern to reflect the extended unlock mode.
7. The SMS shall support a two-person mode for unlocking certain doors – two-person mode shall require two cardholders to present valid cards to unlock a door. Two-person mode shall support the assignment of separate cardholder groups for each cardholder that can perform the unlock. (Two person mode shall only be available on doors connected to iStar Ultra Controllers)

Y. Maintenance Mode

1. The SMS shall support a Maintenance Mode to facilitate the installation, testing and maintenance of selected SMS objects. Maintenance Mode shall be used to limit information about an object displayed on the SMS Monitoring Station. An SMS System Operator, with the appropriate Privileges, shall be able to place SMS objects into Maintenance Mode. Placing an object into Maintenance Mode shall not prevent SMS actions associated with that object from occurring. Maintenance Mode shall only affect the Monitoring Application and shall allow the System Operator to:
   a. Only view those objects in Maintenance Mode
   b. Exclude those objects in Maintenance Mode from an Operator's view
   c. View information about all System objects, including those in Maintenance Mode
2. Operator Privilege and Application Layout Filtering assignments shall determine whether or not an object in Maintenance Mode is viewable as being in Maintenance Mode on the Monitoring Station. Only Monitoring Station operators with the correct privilege and Application Layout Filtering shall be able to view objects in Maintenance Mode. Maintenance Mode shall only be reported in Journal messages when an object is placed in Maintenance Mode.
3. The following objects shall be supported in Maintenance Mode (at a minimum):
   a. iSTAR Clusters
   b. Controllers
   c. Doors
   d. Readers
   e. Input/Output Modules
   f. Inputs

g. Outputs
h. Elevators
i. Events
j. Areas
k. Intrusion Zones
l. Keypad Commands

X. Area Control and Antipassback

1. The SMS shall support the ability to define Area configurations. Areas are defined as physical regions bounded by doors. An area shall consist of a room, a specific location(s) within a building, or an entire building
2. All configured areas shall have in/out access doors providing the ability to run reports showing all present cardholders in each area. There shall be no way to leave an area without presenting a credential to a reader/door.
3. The SMS shall support Global Antipassback and shall allow an area to be configured to cross multiple clusters (groups of controllers) to enforce Global Antipassback decisions.
4. The SMS shall provide the ability to run a Roll Call report. The host shall maintain a current area for each personnel record, and the time at which the area was entered (AreaAccessTime).The current area shall represent the last area entered by the cardholder based on a valid admit.
5. The SMS shall support Area control to provide the ability for tracking personnel. With this function, an operator shall obtain the current location of cardholders. Dynamic views and or reports can be generated to show specific cardholders who are present in each defined area.
6. Each cardholder's record shall provide easy access to view and maintain their current area location. This card record property will be updated as a person moves from one area to another using a valid credential.
7. The SMS shall support the configuration of an area as a Mustering area. A Mustering area is an area where Personnel gather in an emergency. A Roll Call report shall be supported for the tracking of Personnel present during an emergency. The SMS shall also support the definition of a De-Mustering area. The De-Mustering area shall be used to place all Personnel in a neutral area to accurately track Personnel as they re-enter a facility.
8. The local controller shall provide the ability to manage and control the Area configuration in the event that it loses communication with the SMS system server.
9. The SMS Area configuration shall have three modes of operations: None, Antipassback, and Timed Antipassback.
10. Antipassback shall control access based on the cardholder's location. The SMS shall deny access to cardholders who are in violation of antipassback rules. In the event that a cardholder leaves an area without presenting their credential to the out access reader/door and then tries to enter back into the area by swiping the In access reader/door, a denial of access will occur. The SMS shall provide the ability to grace individual cardholders who have violated antipassback rules. The Grace option shall also provide the ability to grace all cardholders.
11. Antipassback shall continue to be enforced during communications failure. SMS controllers shall have the ability to be clustered in a group. The master controller in the group and all other controllers within that group shall have full access to the existing antipassback information. The cluster can be configured for 'No Access' Communications Failure mode or for 'Local' Communications Failure mode.
12. Clustered controllers configured in 'Local' mode that are disconnected from the master controller shall grace all cardholders from antipassback violations. The disconnected controller shall then follow antipassback rules specific to the areas defined on that controller. If the

controller does not know if a cardholder is in antipassback violation based on areas that are configured between controllers, access will be granted.

13. Clustered controllers configured in 'No Access' mode that are disconnected from the master controller mode shall not grace all cardholders from antipassback violations. All cardholders will receive a denial of access until communications is restored.
14. The SMS shall support Timed Antipassback. Areas configured for Timed Antipassback shall require a cardholder use an exit reader to exit an area. Cardholders who do not exit properly shall be required to wait for a predetermined period of time before re-entering the area.
15. The SMS shall support Pass-through Areas. Area Pass-through shall serve to restrict the length of time that Personnel can remain in an Area before being required to exit or pass through to another area. The SMS shall support a user-defined time period for the Pass-through area. Personnel Groups shall be configurable with Pass-through Restrictions and each Personnel Group shall support a separate, user-defined time period that may be different than the Area-wide time interval. Personnel Groups shall be configurable to be exempt from Pass-through Restrictions.
16. The SMS shall provide occupancy restrictions for areas. Restrictions shall be applied to individual cardholders (personnel) or user defined groups of cardholders. Areas shall be configurable to provide limits for the maximum and minimum number of personnel who can access an area at one time. It shall be possible to trigger an event based upon a violation of either of these rules. Events shall be configurable based upon the following criteria:

    Maximum occupancy status

    Minimum occupancy status

    Group Maximum occupancy status

    Group Minimum occupancy status

    Personnel Count (user-defined)

    Violation status (Antipassback entry/exit violation etc.)
17. The SMS shall support Soft occupancy restrictions for both maximum and minimum occupancy to allow reporting of violations while still allowing access to the area.
18. The SMS shall support Area Lockout. Area Lockout shall restrict or lockout certain cardholders from an area once they have accessed another area. The cardholder shall be locked out of the designated target Area or Group of Areas for a specified period of time. The maximum time period for lockout shall be five (5) days. The target locked-out Area shall be any of the following:

    Same Area

    Another Area

    Area group
19. The SMS shall allow a System Operator with the appropriate privileges to cancel the lockout time (lockout grace) for all or individual cardholders, thereby canceling the area lockout.

AA. Dynamic Area Manager

1. The SMS shall support the Dynamic Area Manager feature. The Dynamic Area Manager feature shall allow the first qualified person admitted to the Area to act as the Area Manager. This person shall be the first to enter the area and shall be required to be the last to leave the area.
2. An area designated for the Dynamic Area Manager feature shall have an entry reader and an exit reader.

3. The SMS shall deny any exit request from the area manager until all other occupants have left the area.
4. The Dynamic Area Manager feature shall support the use of the Conditional Access feature for the designated area.
5. The Area status display shall show the following Personnel counts:

   Area Manager count

   Managed Personnel Count (All Personnel admitted after the Dynamic Area Manager)

   Conditionally Admitted Personnel Count

BB. Carpool Antipassback

1. The SMS shall provide Carpool Antipassback to facilitate parking lot area controls. Carpool Antipassback shall support the organization of Personnel into Carpool Groups which shall be permitted to park in designated Carpool Areas. The SMS shall move Carpool Groups in and out of Carpool areas based upon the driver's credential. The Carpool Antipassback feature shall allow the monitoring of vehicle counts in the Carpool Area to facilitate parking lot area Occupancy Restrictions. The SMS shall support Timed Antipassback for Carpool Antipassback areas.

CC. Escorted Access

1. The SMS shall provide an Escorted Access feature that gives the ability to control, track, and report on the movements of Personnel designated as Escorted Visitors. An Escorted Visitor shall be a visitor who can only move around a facility in tandem with an employee designated as an Escort.
2. There shall be two Escort Visitor modes: Companion mode and Remote Escort Mode. In Companion mode the system shall allow multiple Escorted Visitors to be accompanied by one escort. In Remote Escort mode the system shall allow Escorted Visitors and the Escort to present their credentials on opposite sides of a door to gain access.
3. The SMS shall have the ability to configure a designated Area to allow an Escorted Visitor to enter/exit the area without an Escort.

DD. Conditional Access

1. The SMS shall support Conditional Access that shall allow an occupant on one side of a door to grant temporary access to a cardholder who does not have clearance and was denied access to that door.
2. The SMS shall support the configuration of an event to be used to notify the occupant that a cardholder is attempting to gain access through the door.
3. The SMS shall support the configuration of a second event to be used to unlock/grant access to the door based upon a response from the occupant or a privileged SMS Operator.
4. The Conditional Access function shall support an Operator configurable timer that shall be used to cancel the Conditional Access request if the occupant is unavailable or chooses to deny access
5. The SMS shall support the use of Conditional Access in conjunction with the Dynamic Area Manager feature.

EE. After Hours Enabling Reader

1. The SMS shall support an After Hours Enabling Reader that shall be used to allow a cardholder access to a group of readers during off hours.

2. The SMS shall support the definition of a group of readers (the After Hours Reader Group) that shall be disabled during a pre-defined after hours period.
3. The SMS shall support the definition of a schedule to be assigned to the after hours reader group defining the time the readers shall be disabled.
4. The SMS shall allow a cardholder access to all readers in the after hours reader group once the cardholder presents a card at the enabling reader.
5. The SMS shall require the cardholder to have proper clearance for any reader before granting access.

FF. Intrusion Zones

1. The SMS shall support the configuration of Intrusion Zones. An Intrusion Zone is a user-defined group of Doors and Inputs on the same local Controller that delineates a physical area. This area shall be monitored and produce an alarm during any violation of the objects associated with the Zone.
2. The local controller shall provide the ability to manage and control the Intrusion Zone in the event that it loses communication with the SMS system server.
3. The Intrusion Zone shall have 2 modes of operations: Armed or Disarmed. When an Intrusion Zone is in an armed mode, the state of the Intrusion Zone shall either be Violated or Not Violated based on the state of the inputs and doors associated with the Zone. If the Zone is violated the SMS shall provide the ability to execute any defined event(s) within the SMS.
4. The SMS shall provide the ability to display the "Ready to Arm State" of any configured Zone. The "Ready to Arm State" shall be able to be displayed from any SMS monitoring application or from a local reader with an LCD display. All off-normal points/doors shall be able to be displayed from both locations. If any point or door associated with a Zone is not in a normal state, the Zone shall show a "Not Ready to Arm State".
5. When a door is placed in a Zone, the operation of the door shall be configured based on the state of the Zone (unlocked, locked, secure). Specific doors assigned to the Intrusion Zone shall be configured as entrance or exit points for the Zone. When the Zone is being armed or disarmed, a user-definable time shall be set for exit or disarm operations. Specific readers/doors shall have the ability to be defined as arm/disarming stations.
6. The Intrusion Zone shall be configured such that when an input configured in a Zone is active, the Zone cannot be armed without executing a force arm. When a Zone is force armed, the input(s) that were in an active state shall not function as part of the Zone until they are placed back in a normal state and the Zone is disarmed and rearmed.
7. Inputs configured in a Zone shall have the ability to be configured as Controlled Inputs or Monitored Inputs. A Controlled Input shall follow the state of the Zone. If the Zone is disarmed, the Controlled Input shall be disarmed as well. A Monitored Input shall have the ability to cause a Zone violation even if the Zone is in a disarmed state.

GG. Schedules

1. The SMS shall support unlimited operator configurable schedules. Each schedule shall allow unlimited individual time intervals.
2. Each system controller shall support a minimum of 128 schedules and a minimum of 18 time intervals per schedule.
3. Each schedule shall consist of operator-defined time segments. Each time segment shall be day(s) of the week and include holidays and starting and ending times. The system shall provide grouping of days.

4. Recurring schedules shall be supported and provide hourly, daily, weekly, bi-weekly, monthly, quarterly, annual and semi-annual intervals. Recurring schedules shall support a start date and shall be configurable to end by a certain date or after a pre-defined number of occurrences.
5. Recurrence patterns shall be supported to allow:
   a. Schedule recurs every X year(s)
   b. Schedule activates on the last day of each month
   c. Schedule activates on the specified day of each month
   d. Schedule activates on the first, second, third etc. weekday of each month

HH. Holidays

1. The SMS shall support unlimited holidays.
2. The SMS shall support holiday type designations as Recurring Day of Month, Recurring Relative Monthly, Non-Recurring or Day of Week. The SMS shall allow assignment of duration to each holiday.
3. Holiday groups can be assigned to a Schedule.

II. Time Zones

1. The SMS shall maintain time zones to be used when configuring certain system objects. A time zone shall adhere to standard international Time Zone behavior, and the system shall support all time zones supported by the Windows OS.
2. The SMS shall allow time zones to be assigned to IP devices, controllers, CCTV matrix switchers, DVRs, and scheduled Manual Actions.

JJ. Clearances

1. The SMS shall support configuration of unlimited Clearances.
2. The iSTAR controllers shall support up to 150 clearances per person except for the iSTAR Ultra controller, which shall support up to 1000 clearances per person.
3. The SMS shall support clearance activation and expiration date and time.
4. The SMS shall support unique activation and expiration dates and times for clearances for each Cardholder. (This functionality requires the iStar Ultra Controller)
5. The SMS shall support the ability to select multiple personnel from a Dynamic View and assign clearance(s) to the selected personnel.
6. The SMS shall support the ability to select multiple personnel from a Dynamic View and remove clearance(s) from the selected personnel.

KK. Custom Clearances

1. The SMS shall support the configuration of up to 20 Custom Clearances per Personnel record and up to 100,000 system-wide. Custom clearance shall give unique individualized access to Doors/Door Groups and Elevators/Elevator Groups during an assigned schedule. The SMS Custom Clearances shall also support the assignment of activation and expiration dates.
2. The SMS shall support a process to remove expired custom clearances from personnel records. The process shall be configured as a system-wide event action with the option to activate by schedule.

LL. Clearance Filters

1. The SMS shall support Clearance Filters. Clearance Filters shall provide the ability to dynamically change the access rights of personnel (cardholders) or groups of personnel. Personnel with a lower Clearance Filter level than that assigned to a card reader shall be denied

access to that card reader (door). Clearance Filter levels shall be assignable to card readers either manually or automatically via event logic or a time schedule.

MM. Events

1. The SMS shall support unlimited operator configurable events, including the scheduling of events, and action-based trigger of events.
2. The system shall provide 8 configurable event priority levels with a total of 200 numbered event priorities. The system shall allow the operator to define custom colors and labels per individual priority level.
3. The system shall allow an event to be configured to:
   a. Be sortable by event name, date/time, priority, state, and any other displayable information.
   b. Be routed to operators by operator privileges, including support for the routing by time of day feature.
   c. Require or not require operator acknowledgment.
   d. Require or not require operator clearing.
   e. Require or not require a log message to be entered by the system operator acknowledging the event.
   f. Require or not require a log message to be entered by the system operator clearing the event.
   g. Display or not display the event activation.
   h. Require the object(s) causing the event activation to reset before the operator may acknowledge the event.
   i. Display an operator-defined text message upon event activation.
   j. Display an operator-defined text message when the event is deactivated.
   k. Be associated with a map so the map opens automatically on the monitoring station when the event activates.
   l. Activate a second event when the first event activates and is unacknowledged for a specified period of time.
   m. Activate a second event when the first event activates, is acknowledged and is not cleared for a specified period of time.
   n. Allow the operator to associate an audio wave file with the event.
   o. Allow for minimum activation time and delayed activation time for events.
   p. Download events to the iSTAR controllers.
   q. Run imports and exports.
   r. Run reports and remove report results.
4. Event Instructions: Each event shall support event instructions to be displayed in the Event Details Screen. Event instructions shall support a maximum of five hundred characters and shall support website addresses, UNC addresses and local file paths.
5. Latch, Unlatch, Toggle, and Pulse for Event: The SMS shall support Event Actions and Manual Action buttons that can be used to Latch, Unlatch, Toggle, and Pulse other Events.
   a. The SMS shall support a “Latch” Event Action which shall cause it to activate and remain activated.
   b. The SMS shall support an “Unlatch” Event Action which shall cause it to deactivate and remain inactive.

c. The SMS shall support a "Toggle" Event Action which shall reverse an Event's Latch-Unlatch state: switching a Latched Event to an Unlatched Event and vice versa.

d. The SMS shall support a "Pulse" Event Action which shall cause an event to activate momentarily.

6. The SMS shall allow an operator to create a copy of an existing event from within the event editor.

7. Event Assessment:

a. The SMS shall provide an Event Assessment Feature which allows an operator to quickly view all objects associated with an event in a user defined Event Assess Application Layout.

b. The SMS shall not require the operator to navigate away from the event assessment window to review objects associated with the event.

c. The SMS shall provide an Event Editor "Assess Configuration" to allow an operator to configure the objects available during the assessment of an event in the Monitoring Station.

d. The Assess Event Application Layout shall have the following capabilities:

(1) View any documents associated with the Event.

(2) View live video associated with the Event.

(3) View recorded video associated with the Event.

(4) View Event details.

(5) View a Map associated with the Event.

(6) View a Journal Replay of the event, based on a query associated with the Event.

(7) Use an Event Details Viewer with additional quick action buttons to process the Event.

e. Each event shall provide the ability to show the entire Event Assessment with a single mouse click via an icon.

f. The event assessment layout shall only be available for viewing by operators with appropriate privilege.

NN. Dual Phase Event Acknowledgement

1. The SMS shall have the capability of configuring user defined events (alarms) to require Dual Phase Acknowledgement. Dual Phase Acknowledgement shall provide a Pending Acknowledgment window and a Pending Clear event monitoring window in addition to the System Activity window. Each event in the SMS shall be configurable individually to use Dual Phase Acknowledgement. Once the event is acknowledged, it shall be removed from the Pending Acknowledgment window and shall appear in the Pending Clear event monitoring window. A monitoring station operator with the appropriate privilege to clear events can select the event from the pending clear event monitor window and click the clear event button to clear the event. Events that require clearing and are waiting to be cleared shall be configurable to require acknowledgement upon re-activation of the event.

2. Events configured for Dual Phase Acknowledgement shall have the following features:

a. The event shall be configurable to require a log message for alarm acknowledgement and or alarm clearing.

b. Predefined log messages shall be assignable to alarm acknowledgement and or alarm clearing.

c. The SMS shall support the configuration of an Operator's monitoring station permissions to determine if the operator can only acknowledge events, only clear events, or can

acknowledge and clear events.

d. Operators with acknowledge and clear privileges shall be able to acknowledge and clear events in a single action.

e. A Dual Phase Acknowledgement event shall be configurable so the acknowledging operator can't clear the event. (In this configuration, clearing the event shall be required by a different operator.)

f. Events that are acknowledged or silenced shall be configurable to remain silent until cleared.

g. A user-defined timer can be configured to activate a second event if acknowledgement of an event, or clearing of an event, does not take place within the specified time frame. The timer shall start when the event is activated.

OO. Sounds

1. The SMS shall include a Sound editor that allows an operator to create Sound objects to associate with 'Play Sound' Actions for Events. A single Sound object may be associated with multiple Events, rather than having to save an individual sound file multiple times—each associated with a single Event.
2. Sounds shall be saved in a Sound table in the SMS database.
3. Sounds shall replicate, on an enterprise system, but they will be Local Only.
4. The SMS shall support the ability to import and export Sounds in .WAV file format. The size of the .WAV files that are imported shall be enforced to be less than 1460000 bytes (1.39 MB).
5. Sounds shall be Privilege based.

PP. Journal Triggers

1. The SMS shall support a Journal Triggers editor that allows an operator to define Triggers to activate an Event when a specified Journal Message occurs. The Journal Trigger shall be a Query-like object that evaluates Journal Messages and pulses an Event when the criteria specified in the configured trigger is logged in the Journal.
2. The SMS shall support an Event Action that sends email notification with a description of the activation cause each time a Journal trigger is activated.
3. The SMS Monitoring Event Status screen shall display the reason a particular Event was pulsed by a Journal trigger.
4. The SMS shall support up to a maximum of 500 Journal Triggers.

QQ. Audit Triggers

1. The SMS shall support an Audit Triggers editor that allows an operator to define Triggers to activate an Event when a specified Audit Log Entry occurs. The Audit Trigger shall be a Query-like object that evaluates Audit Log Entries and pulses an Event when the criteria specified in the configured trigger is logged in the Audit Log.
2. The SMS shall support up to a maximum of 500 Audit Triggers.

RR. Manual Action Challenge

1. The SMS shall support Manual Action Challenges. The Manual Action Challenge shall require a SMS operator to enter their login credentials (User name and password) when executing a manual action from within the SMS.
2. The Manual Action Challenge shall be available from both the Administration and Monitoring Applications.

3. The Manual Action Challenge shall be assigned to a Privilege and the Privilege shall be assigned to the SMS operator.

SS. Document Editor

1. The SMS shall support the ability to import multiple types of document objects to include:

   PDF, TXT, XML, DOC, XLS, JPG, GIF, PNG, TIF

2. The SMS shall have the ability to attach these object types to the following areas:
   a. Personnel records to provide additional information.
   b. Events as part of the Events Assessment Feature.
   c. A Guard Tour

TT. Integrated Email

1. The SMS email system shall have the ability to interface directly to an SMTP-compliant email system supplied and configured by the user.
2. The email configuration shall support user authentication via a password and SSL encrypted communication to the email server.
3. The email system shall support the ability to send emails to Personnel Groups.

UU. Import / Export

1. The SMS shall provide a means for manually importing and exporting selected data in XML format. This mechanism shall support the import and export of any and all classes or types of data in the system. Specific data validation and logging requirements shall be met.
2. The system shall also support importing from CSV files.
3. The SMS shall provide an automated import mechanism (preferably XML-based). This mechanism shall support the import of most classes or types of data into the system. Specific data validation and logging requirements shall be met.
4. The SMS shall have the capability to perform automated imports from an Open Database Connectivity (ODBC) data source allowing the import of personnel data directly into the system database.
5. The system shall have the ability to connect to a directory service source via the Lightweight Directory Application Protocol (LDAP). The connection to the LDAP source shall be user-configurable directly from the SMS and shall not require custom code. The LDAP interface shall also support the automatic assignment of SMS clearances based on data contained in the LDAP record. The LDAP feature shall support the following features:
   a. LDAP server name and user-defined port number.
   b. A base distinguished name for the root of searches.
   c. A user-definable LDAP search filter to refine object search.
   d. User-defined mapping of attributes to SMS personnel fields.
   e. The use of a Distinguished Name (DN) entry for the SMS to authenticate to LDAP.
   f. Option to search all sub-levels of the directory from the base DN.
   g. Preview sample-data based on SMS LDAP import settings.
   h. Automatic roles-based SMS clearance(s) based on two fields of source data.
   i. Automatic import of directory entries from the LDAP source.
   j. Authentication via a user-definable LDAP user account and SSL.
   k. Automatic SMS clearance assignment.

6. The SMS shall provide a Data Mapping feature that provides field mapping information using the XSLT file based on the input data or an external XSLT file.
7. The SMS shall support Import and management of Operators with their respective Privilege Groups using XML and LDAP role-based templates.

VV. Objects

1. Each object within the SMS shall be addressed by a unique operator-defined name. Object names shall be unique within object types.
2. The SMS shall provide the ability to add description text to each object definition.

WW. Reports

1. The SMS shall support a Report Service that runs as a Windows Service. The Report Service shall operate in either 64 or 32 bit mode. The Report Service shall execute Reports that are either run on the Server by an Operator or configured to run automatically as an Event Action.
2. The SMS shall provide configurable data reports for database configuration, historical activity (Journal) and audit tracking. Pre-defined reports shall be available for download and import into the system.
3. The SMS report function shall perform the following:
   a. Create reports about any object.
   b. Create report templates to simplify report design.
   c. Run reports on demand.
   d. Save report results for sharing between different users of the application.
   e. Export reports into formats such as PDF, RTF, TXT, TIFF, Excel (XLS), and MHTML.
   f. Specify a query to select and filter the records on which to report.
   g. Specify the data fields to be included in a report.
   h. Specify a design for the report layout.
   i. Design a report form to be used as a layout for headers / footers for multiple reports.
   j. Access and use system pre-defined report forms.
   k. Select tabular, multi-line, or free form report layouts.
   l. Report on objects linked together with parent / child relations.
   m. Schedule reports to run automatically on a customized schedule.
   n. Send exported report files to the printer or to external recipients via e-mail.
4. The SMS shall support integration to The Business Intelligence Reporting Suite (BIRS). The suite shall offer web-based reporting as well as data warehousing of SMS historical and system data. The suite shall include multiple pre-written reports such as 24 Hour Journal Messages, 24 Hour Trouble Messages, Graphical Usage and Count of Door Group. The open system procedures shall allow the reports to be written and saved for repeat use.
5. The reporting suite shall provide an interactive user experience via any standard web browser, allowing the user to scrutinize the information without needing to print or review hard copies.
6. The reporting suite shall support connecting to one or more SMS systems. This shall provide data and reports across an enterprise solution to allow segregated reports that reflect both satellite application server data as well as master application server data.
7. The reporting suite shall allow an enterprise to share and blend data from other sources such as ERP and Time and Attendance systems to yield critical business information and reporting.

8. The reporting suite shall provide information delivery options such as email, CSV export, PDF export, XML data transfer, or database pool offerings. The suite shall also be a critical resource in system review and audit procedures such as system maintenance and performance.
9. The Reporting Suite shall:
    a. Provide Intuitive user interface and web-based reporting for SMS customers
    b. Share and blend data from other sources to yield critical business information
    c. Leverage Microsoft® Business Intelligence (BI) tools
    d. Include Reporting Service for report delivery and presentation
    e. Perform Reporting and processing from the SMS host
    f. Include Subscription options for automated delivery of reports
    g. Include Dashboard, graphical, and statistical reports, and reports customized by user
    h. Generate Reports on any PC with compatible Web browser without SMS Client software
    i. Offer and secure Data via Active Directory and SQL permissions
    j. Include Optional front end or other application integration including SharePoint

XX. Dynamic Views

1. The system shall support a grid format displayable report that will be usable to display homogeneous lists of objects within the system. This display shall be configurable both at configuration time and also at run time.
2. The Dynamic views shall have the following features:
    a. Real-time updating and display of property values.
    b. The display shall be sortable.
    c. Groupable by any number of columns.
    d. Filterable based on user selectable criteria.
    e. Printable.
    f. Can be saved as a MS Excel file from the current view.
    g. Exportable in either XML or CSV file formats.
    h. The export file shall be viewable in Excel (Excel must be installed separately).
    i. The export file shall be able to be emailed.
    j. The user shall be able to add and remove columns from the grid at runtime to enhance the user experience even if displaying a preconfigured view.
    k. The view shall be capable of pre-configuration so that repeatable displays of objects are possible.
    l. The view shall support in-place editing of properties of the object.
    m. Bulk operations shall be performed via multi-selection. The operations shall consist of (but are not limited to) setting a property to a value and deletion.

YY. Query

1. The SMS shall provide a Query engine to be useful for users without any knowledge of SQL or any other specific query language. It shall allow users to make requests against data sets with preconfigured relations between tables. The relations shall reflect the actual relations between database objects and the user shall be able to put conditions on any available field in the selected object type and its subordinate objects.

2. The users shall be able to construct a proper query expression selecting all available operations, column names, and table names from prompted lists. It shall eliminate the necessity to memorize any particular expression syntax. References to existing configuration objects shall also be prompted through a list of existing objects where applicable, eliminating the necessity of memorizing names. The Query feature also shall support complex logic, such as AND/OR.
3. Negative logic Queries using the new NOT IN operators

   The SMS shall support Query filters that perform AND/OR operations to narrow Query results. The SMS shall also support building complex query operations by use of block filters that perform AND/OR/AND NOT IN/OR NOT IN operations to further narrow Query results.
4. The SMS shall provide a Journal Query Assistant as a special method of the Query engine to query on XML fields within Journal Messages. This method shall allow the user to build queries on Journal messages. The Journal Query Assistant shall support Card Admitted, Card Rejected, Operator Login and Operator Activity message types, Area Activity, Object Changed State and Manual Action message types.

ZZ. Guard Tour

1. The SMS shall support Guard Tours.
2. A Guard Tour shall consist of a series of predetermined Stops requiring a Guard to check-in at each Stop to complete the Tour within the specified time. The Guard Tour shall consist of any combination of Doors, Elevators, and Inputs.
3. The SMS shall support a maximum of two hundred Guard Tours.
4. The maximum number of Stops per Guard Tour shall be one hundred.
5. The SMS shall support up to a maximum of fifty simultaneous running Guard Tours.
6. The SMS shall support two types of Guard Tours: Sequential and Random requiring the Guard to check all Stops in sequence or in a random order.
7. A sequential tour shall be configured with a minimum and maximum time that a guard shall have between stops.
8. Each Tour shall be configured with a specific group of guards that shall be allowed to execute the Tour.
9. The following Tour states shall be available to activate preconfigured events in the SMS:
   a. Activated
   b. Started On Time
   c. Started Early
   d. Started Late
   e. Suspended
   f. Suspended too Long
   g. Resumed
   h. Cancelled
   i. Completed
   j. Completed Early
   k. Completed Late
   l. Inactive
   m. Not completed On Time

n. Failed To Start
o. Error Occurred

10. A guard Tour shall have the ability to be initiated from:
    a. The reader configured as the first Stop of the Tour
    b. An Event (Manually activated or on a Schedule)
    c. A manual Action from an Operator at the SMS Monitoring Workstation
11. The SMS shall support sending an email notification to a Guard of the impending start of the scheduled Tour.
12. A Guard shall be required to complete check-ins at all Guard Tour Stops before the maximum completion time expires and shall be required to spend at least the minimum amount of time on the Tour.
13. A Tour shall be canceled by either an error, event action or a manual action from an Operator at the SMS Monitoring Application.
14. Each Tour shall be able to be configured with a minimum and maximum time of completion.
15. The system shall indicate that a Tour Stop was reached early and started early if a guard checks in at the first stop before the minimum stop time expires.
16. The system shall indicate that a Tour Stop was reached late when a guard checks in at the first Stop after the maximum time expires.
17. The System shall indicate that a Tour Stop was not reached on time when a guard has not checked in after the maximum Stop time expires.
18. In the SMS Monitoring Station Application, it shall be possible to display the details of all the Guard Tour Stops and the current status of the Tour.
19. Each Guard Tour shall have the ability to attach up to a maximum of ten documents explaining the details of the configured Guard Tour.
20. Each Guard Tour shall support Predefined Log Messages or Message Groups.
21. Tour status shall be available from the SMS Monitoring Station Application and shall provide the following information:
    a. Tour Type
    b. Last Tour Status
    c. Current Tour Status (Running/Not Running)
    d. Guard Name (if active)
    e. Last Completed Stop
    f. Percentage Completed.
22. The SMS shall provide the ability to configure an icon on an SMS MAP representing a Guard Tour. An Operator shall have the ability to start the Tour and manually assign a specific Guard responsible for completing the Tour from the MAP.
23. The icon representing the Tour shall change appearance based upon the current state of the tour.
24. The SMS shall provide the ability to run a Journal Report providing the details of any completed or active Tour including:
    a. Time scheduled
    b. Guard assigned

c. Activation time

d. Stop status

AAA. Hand Held Reader

1. The SMS shall support a portable hand-held reader that shall provide identity verification. The portable hand-held reader shall support the following:
   a. The portable hand-held reader shall work on an Android device
   b. This android device shall support Bluetooth communication to three types of Multi technology readers.
   c. The readers shall be capable of reading:
      (1) HID Proximity and iCLASS SE PACS data
      (2) HID Proximity and custom MIFARE sector with key
      (3) HID Proximity and (Mifare, Desfire) csn
   d. Act as a single door controller much like a conventional door in online or offline modes. Offline modes shall support the following functions:
      (1) Offline mode shall support 100,000 cardholders
      (2) All card transactions shall be stored locally and uploaded to the SMS when the unit is placed online.
      (3) Offline mode shall support storing 10,000 transactions
   e. Online mode shall support all cardholders in the SMS
   f. Shall securely communicate to the SMS using web services (encrypted using TLS) supporting (3G/4G or Wi-Fi)
   g. Allow Operators with appropriate permissions to log into the device using single sign on authentication
   h. Specific cardholders shall be downloaded to the device based on clearance assignment
   i. Shall have the ability to display
      (1) access grant
      (2) denial of access
      (3) cardholders portrait
      (4) card number
   j. It shall be possible to set the amount of time that the display shows the last card transaction
   k. Shall be available to download from the Google Play app store
   l. Shall support phones and tablets running Android OS 5.0 and higher
2. Roll Call
   a. The portable hand-held reader shall be able to perform a Roll Call feature.
   b. As cardholders present their cards at this mobile device, the SMS shall have the ability to remove the cardholder from their current area and place them in a muster area.
   c. During a Roll Call, it shall be possible for an operator, from the SMS, to display a list of cardholders including their names and portraits in their respective areas.

BBB. Random Screening

1. The SMS shall support a Random Screening feature.

2. The Random Screening feature shall allow SMS doors to be configured to randomly reject cardholders for the purpose of identity verification or baggage searches etc.
3. The SMS shall allow each door to be configured with a percentage value to define the frequency of the random screening action.
4. The SMS shall provide a Random Screening event for each door that shall be activated when a cardholder is rejected for Screening. The event shall be used for notifying the proper Personnel of the Screening activity.
5. The SMS shall log all Screening activity for reporting or auditing purposes.

CCC. CCTV Integration / Digital Video

1. The SMS shall provide extensive integration with American Dynamics DVR/NVR solutions.
2. The SMS server shall be connected to the DVR/NVR during the configuration process enabling the SMS to query the DVR/NVR for setup information.
3. The SMS shall use tree controls to drag and drop video servers or cameras directly into the interface for intuitive and instantly active video integration.
4. The SMS shall provide live camera display during configuration.
5. The SMS shall provide the ability to drag cameras into tours.
6. The SMS shall provide the ability to identify and automatically configure all cameras on a controller.

DDD. General Purpose Interface

1. The SMS shall support a licensable General Purpose Bi-directional Serial Interface.
2. The General Purpose Interface shall be a programmable bi-directional communication protocol that shall provide a general mode of communication between the SMS General Purpose Interface driver and a third-party device.
3. The third-party device shall send pure ASCII messages via a serial port (RS-232) or remotely via a TCP/IP port (via a Terminal Server) into the General Purpose Interface driver.
4. The SMS shall interpret messages in two ways:
   a. As journal messages recorded into the SMS historical journal.
   b. As any of five Monitoring Point status changes configured to trigger an SMS event.
5. The General Purpose Interface supports the following functionality:
   a. Input: where the input strings are sent from the device through the Serial/Network port to the SMS Server. The General Purpose Message Protocol object is used to define and parse the information.
   b. Output: where the output is an Action and requests a response from the device.
   c. Poll: where the poll is an action that requires a response from the device.

EEE. ID Badging Subsystem

1. The SMS shall include an embedded ID Badging Subsystem. The ID Badging subsystem shall utilize a common database with and be an integral part of the SMS. The ID Badging Subsystem shall provide the ability to capture cardholder images and design and print user-defined badge layouts. The Badging Subsystem shall support the following capabilities:
   a. Unlimited number of badge design layouts.
   b. WYSIWYG badge designer.
   c. Background color detection in the portrait image.

d. Threshold level selection to apply to background detection.
e. User-defined selection of background color.
f. User-defined selection of replacement color or transparency setting.
g. Edge-detection setting, to aid in replacing only the selected background and not any matching color within the portrait image.
h. Capture, import, and display portraits.
i. Capture, import, and display signatures.
j. Capture and display fingerprints.
k. Insert, import, and display foreground and background images.
l. Print two-sided badges.
m. Encode magnetic data onto personnel badges.
n. Insert 1D or 2D bar codes.
o. Insert or replace color and transparent effects for image and background display.
p. Support a variety of image formats including .bmp, .jpg, .tif, and .wmf.
q. Custom functions using the Expression builder.
r. Multiple images per cardholder.
s. Diagonal and Square borders. Each type of border shall support a user-defined width and height setting, and individual color settings for each border side.
t. Proper Case (first letter in string is set to uppercase, all other characters set to lowercase).
u. Year display (four- or two-digit).
v. Month display (full or abbreviated name, or numeric).
w. Day display (full or abbreviated name, or week/month numeric).
x. Hour display (12 or 24 hour format).
y. Minute display.
z. Second display.

FFF. Visitor Management

1. The SMS shall support an optional, embedded Visitor Management feature. The SMS shall support the creation and management of visitor appointments. The Visitor Management feature shall serve as a replacement for paper-based visitor log books and shall support the organization and tracking of visitors. The Visitor Management feature shall support the following features:
   a. Keep track of visits (and Visitors) in progress
   b. Single-/multi-visitor group appointment scheduling
   c. Temporary credential issuance
   d. Visitor check-in/check-out
   e. Visit Templates
   f. Visit Sites
   g. e-mail notification of visitor arrivals
   h. Manage unplanned visits and anonymous visitors
   i. Manage the return of credentials and the end of a visit
   j. Configure Instructions for the visit

k. Configure personnel as visit hosts

l. The capability to check-in and check-out visitors by presenting a valid card at a designated reader.

m. The ability to scan a license or a passport when adding a new visitor. Each field associated with a license or passport can be individually selected for import.

n. Run reports and queries on both scheduled or completed visits

2. The SMS shall provide the ability to schedule a nightly event that shall perform an automatic checkout of all visitors per partition.

3. The SMS shall support an optional Visitor Management Web portal that shall allow a host to create and manage visits and visitors via a standard web browser. The initial browser logon shall allow customization to display a unique name.

4. The SMS Visitor Management Web portal shall support the following Web Browsers:

   Internet Explorer

   Chrome

   FireFox

   Safari on IOS

5. An SMS Operator shall be able to perform the following Visit Site functions:

   a. Create and Configure Visit sites

   b. Customize the Portal for each visit site

   c. Assign a custom image that represents the visit site

   d. Assign the visit site to a partition

   e. Create and configure visitor templates for a site (which can include Clearances for the Visit)

   f. Create and configure a Visit Template for a site

   g. Specify what fields are to be used when creating a new visitor in a site

   h. Individually select which fields are mandatory

   i. Add additional details to a visit site including user definable fields

   j. Designate which hosts can access a site to create a visit

   k. Assign a document to a visit site

   l. Configure the details for the welcome Email to hosts

   m. Configure a Visitor Management Door Action for card swipe check-in and checkout

6. A Host using the Visitor Management Web portal shall be able to do the following:

   a. Create, edit and delete Visits

   b. Utilize Visit Templates to create Visits

   c. Search for existing Visits

   d. Add instructions for the visit and attach pertinent documents to the visit

   e. Add additional Hosts to a Visit

   f. Create New Visitor records and add Visitors to Visits

   g. Email all visitors and hosts associated with the created visit

7. The SMS shall support a Kiosk for self-visitor check-in
    a. The SMS system shall support an unlimited number of Check-in sites. Each Check-in site shall be configured with a Kiosk application that operates on an iPad. This Kiosk application shall be used to allow a visitor to self-check-in as a new or pre-enrolled visitor. Each site shall have the ability to customize how the Kiosk Check-in application works. The Kiosk shall provide the following features:
    b. Each Kiosk shall support the creation of custom messages for each check-in site:
        (1) Welcome message
        (2) Visitor not found message
        (3) Check-in complete message
        (4) Registration complete message
    c. The Kiosk shall have the ability to accept unregistered visitors (Optional) via the following steps:
        (1) Enter a new visit (First, Last, Email)
        (2) Take a picture
        (3) Enter and assign Host via context sensitive lookup that shall show the host name and image as you type
        (4) Require acknowledgement of an NDA or other document (Optional)
        (5) Automatically email host when check-in is complete
        (6) Automatically check-in visitor (optional)
    d. The Kiosk shall have the ability to add a Pre-enrolled visitor via the following steps:
        (1) Find visitor by either Email Address or First/ Last Name via context sensitive lookup
        (2) Take a picture
        (3) Require acknowledgment of an NDA or other document (Optional)
        (4) Automatically email host when check-in is complete
        (5) Automatically check-in visitor (optional

GGG.Access Management Workflow

1. The SMS shall support an Access Management Workflow feature including a Web Portal. This workflow shall allow different types of requests and approvals to automate the assignment of clearances. The following features shall be supported by the Access Management Workflow feature:
    a. The creation of an unlimited number of Access Request Sites
    b. Each access request site shall be uniquely configurable with the following:
        (1) Show selected personnel fields from requesters
        (2) Display General site information
        (3) Show additional user definable fields
        (4) Select authorized requesters
        (5) Select available clearances
        (6) Select Personnel for access request assignment
    c. The Access web portal shall support the following:
        (1) Customized portal name display

(2) Single Sign on authentication

(3) Creation of Access requests, which shall provide the following:

(a) Name of the request

(b) Available site clearance selection

(c) Justification statement

(d) Request Status

(e) Personnel associated with the request

(f) Attach a document relative to the request

(g) Ability to save the request without submittal

(h) Ability to submit the request

(4) Access approval with the following capabilities:

(a) List the assigned submitted pending requests

(b) Show all details pertaining to the request

(c) Ability to approve or deny the request

(d) Provide comments on the reason for the approval/denial

(e) Review the history (audit) of previously submitted requests

(f) Provide the ability to revoke a previously approved request

d. The SMS shall provide the following Internal Request features:

(1) Clearances shall be configurable with the following approval rules:

(a) Auto approve

(b) Any approver from a partition

(c) Any selected approvers

(d) Only allow assignment via approved request

(2) Door activity shall also provide the ability to automatically generate an approval request which shall be:

(a) Subject to a schedule

(b) Subject to direction of the swipe (in/out)

2. All generated requests shall viewable within the SMS showing current status and details.

HHH. Smart Card / Proximity Card Enrollment

1. The SMS shall provide a smart card enrollment feature as part of the ID Badging Subsystem. The smart card enrollment feature shall allow a user to enroll MIFARE, iCLASS or DESFire cards utilizing a USB wedge reader or a Manufacturer-approved badge printer.

2. The SMS shall provide a proximity card enrollment feature as part of the ID Badging Subsystem. The proximity enrollment feature shall allow a user to enroll the card number of proximity cards on a Fargo HDP 5000 printer that is equipped with an OMINKEY CardMan 5x25 encoder.

3. The ID Badging Subsystem shall support the creation of Smart Card Templates to define the smart card configuration. Templates shall be used to define the data transfer between the physical card and the Personnel Record. Templates shall define the card type as MIFARE, iCLASS or DESFire. When programming a card, the system shall be able to read and write to all relevant data such as personnel fields, card fields or card formats. The Badging Subsystem

shall provide the ability to Enroll MIFARE, iCLASS or DESFire. The Badging Subsystem shall provide the ability to Program and Enroll MIFARE.

4. Templates shall also be utilized to define the Security Keys needed to access the data on the smart card. Templates shall be assignable to the enrollment device (wedge reader or printer).
5. The ID Badging Subsystem shall support both the enrollment (reading of data from the card) and programming (writing of data to the card) for MIFARE cards. The ID Badging Subsystem shall support the enrollment of DESFire cards and shall support Card Serial Number data only. The ID Badging Subsystem shall support the enrollment of iCLASS cards and shall support Card Serial Number data only.
6. The ID Badging Subsystem shall support the creation of Custom read/write Keys. Custom Keys are private keys supplied by a third party. Custom Keys shall be assigned to Software House Readers via Program Cards supplied by the Manufacturer.

III. System Parameters (Based on a single credential per cardholder)

1. The SMS shall have a maximum capacity of:
   a. 5,000 online readers
   b. 20,000 online inputs
   c. 20,000 online outputs
   d. 500,000 enabled Personnel Records
   e. 256 Simultaneous Clients (256 is a design capability while the tested limit is 100)
2. The SMS shall support a Master Application Server (Enterprise Architecture) with maximum capacity of:
   a. 40 Satellite Application Servers (tested limit)
   b. 500,000 Global enabled Personnel Records
   c. 100 Simultaneous Clients
3. The SMS shall support an Enterprise Architecture (based on 40 SAS) with a maximum capacity of:
   a. 200,000 online readers
   b. 800,000 online inputs
   c. 800,000 online outputs
   d. 20,000,000 local enabled Personnel Records
   e. 500,000 Global enabled Personnel Records
   f. 20,500,000 Total enabled Personnel Records

2.4 OPERATION

A. The SMS shall provide the following operational functionality:

1. The system shall control access to a designated area.
2. The system shall validate cardholder credentials by use of downloaded personnel records, card formats, PINs, biometric enrollment and multiple active cards. The system shall compare the time, location, and unique credential number of an attempted entry with information stored in memory.
3. Access to a designated area will be validated only when a user's credential has a valid number for its facility and the number is valid for the current time and for the reader where it is used.
4. The system shall access the hardware that validates the person and monitor the security of a

building by use of controllers, doors, readers, elevators, inputs and outputs. When access has been validated, a signal to the door locking device shall be activated to enable alarm-free access at that location.

5. The system shall configure itself as required by use of an Administrative application, and shall provide Configuration templates.
6. The system shall monitor access control activities by use of Monitor Station, Alarm configuration, NetVue, CCTV, and dynamic Graphical Maps display of alarm, door, and event activity (Maps based on CAD data).
7. The system shall restrict administrative and Monitoring Station activity by use of Privileges and Authentication (User Password) using Microsoft Windows OS Password Function.
8. The system shall report on various aspects of the system by use of Reports (canned and configurable). Reports shall be able to export to a printer.
9. The system shall have the capability to report off-normal security device conditions both audibly and visually.
10. The system shall control hardware from the monitoring station by use of Manual actions, Events, and cause lists.
11. The system shall provide Record and Data Management by use of Historical Journal (archive and replay), Full Audit Trail and automated and manual import and export (data and images).
12. The system shall allow for data to be imported from other products by use of database Migration tools (Card Holder data and configuration data) from, C·CURE 800/8000 and 3rd party applications via XML formatted data exchange.

2.5 EQUIPMENT

A. Server Requirements

1. The SMS Server shall meet or exceed the SMS Manufacturers requirements for the current version and series of the SMS software.

B. Client Workstation Requirements

1. The SMS client workstation shall meet or exceed the SMS Manufacturers requirements for the current version of the SMS software.

C. Badging Station Requirements

1. The SMS badging workstation shall meet or exceed the SMS Manufacturers requirements for the current version of the SMS software.

D. Controllers

The SMS shall support the following controller hardware:

1. GENERAL: The access control system design is based on the iSTAR Ultra 32-reader Network Door Controller by Software House. Provide Network Door Controllers as indicated on the project plans, located centrally in relation to the doors controlled, to minimize wiring. Each iSTAR Ultra shall be an independent, stand-alone network controller, providing local access control decision-making, a local database of cardholders, and alarm and event buffering in the event communications to the host is lost. The iSTAR Ultra shall serve as the data collection and communications interface between the System Server and the various field devices such as card readers, wireless locksets, alarm inputs and control outputs. Systems that rely on a host server for the access control decision will not be considered.

   The system design, where noted on the plans, shall also utilize IP-ACM Ethernet door modules to act as distributed door interface units. Each IP-ACM shall be able to control either one or two doors, and shall rely on the iSTAR Ultra Network Door Controller for the access control

decision. The Network Door Controller shall support up to 32 readers, including readers attached to IP-ACM units.

a. Manufacturer: Network Door Controllers and Ethernet Door Modules shall be as manufactured by Software House, a unit of Tyco Security Products, 6 Technology Park Drive, Westford, MA 01886 (+1-978-577-4000). No substitutions are allowed.

b. Warranty: The Network Door Controllers and IP-ACM Ethernet Door Modules shall be warranted against defects in materials and workmanship for a period of at least 5 years from date of manufacture.

c. Regulatory Approvals:

(1) The Network Door Controllers and Ethernet Door Modules shall be tested by and certified by Underwriters Laboratories (UL) to meet the following regulatory requirements:

(a) UL/cUL 294, Standard for Access Control Systems and Equipment

(b) UL/cUL 1076, Standard for Proprietary Alarm Units

(2) The Network Door Controller and Ethernet Door Module shall also meet the following regulatory requirements

(a) FCC Part 15 Class A

(b) CE

(c) IEC 60950

(d) C-Tick

(3) The controller shall incorporate Advanced Encryption Standard (AES) 256-bit encryption for controller-to-host and controller-to-controller communications. The encryption shall be certified by the National Institute for Standards and Technology (NIST) as compliant with the U.S. Government's Federal Information Processing Standard (FIPS) 197.

(4) The controller shall be tested and certified by the National Institute for Standards and Technology (NIST) as compliant with the U.S. Government's Federal Information Processing Standard (FIPS) 140-2, Cryptographic Module Validation Program (CMVP). The controller shall be rated at FIPS 140-2 Level 2 or higher.

(5) The Controller shall communicate to its Ethernet Door Modules using AES 256-bit encryption.

(6) The controller shall be manufactured in strict compliance with the European Union's Directive 2002/95/EC on the Restriction of Hazardous Substances (RoHS), and shall display a RoHS mark on the exterior of its enclosure.

2. NETWORK DOOR CONTROLLER HARDWARE

a. Processor and Memory

(1) The Network Door Controller's microprocessor shall be of sufficient speed and power to provide on-board AES 256-bit encryption without use of an external encryption device, while providing access decisions within 500 ms on a fully loaded system. The controller shall have at least 2GB of on-board memory for cardholder and event storage. There shall be at least 16GB of on-board FLASH memory that shall be used for boot code and operating system code, and for memory backup.

(2) The controller shall be able to locally store at least 500,000 card holders, using five cards/person and with 10 clearances/person, while also providing room for a transaction buffer of 10,000 alarms and events (minimum) in case communications to

the host is lost.

b. Memory Retention and Real Time Clock Backup: The Network Door Controller must include automatic means to back up the system memory, including card holder records, configuration information, and alarm/event information, to onboard non-volatile flash memory in the event of AC power loss or Battery Low alarm. During the power interruption, the system's real time clock shall be backed up using a lithium coin cell battery such that the time is current when power is restored.

c. Dual Ethernet Network Ports: The Network Door Controller shall have two on-board 10/100/1Gb Ethernet ports, using standard RJ-45 connectors. The network ports must support full duplex communications. The controller must provide visual LED indication of transmit and receive activity for the Ethernet communications port. Controllers that do not offer full duplex 1Gb connectivity will not be accepted.

(1) Secondary Communications: Using the dual network ports, the controller must support a primary network communications path and secondary communications path to the system server. Failover operation is described later in this document.

d. Field I/O Wiring Modules (ACMs): The Network Door Controller shall provide terminations for field wiring through the use of modular ACM boards (Access Control Modules). Each module shall support up to 8 readers and 8 doors, and a Network Door Controller may utilize either one or two ACMs, for a total of 16 readers.

(1) Upgrades: An eight-reader Network Door Controller shall be able to easily upgraded in the field to a 16-reader controller, through the addition of a second ACM board.

(2) USB Communications: Communications from each ACM to the Network Door Controller's GCM (General Control Module) shall be made using a standard USB connection.

e. Ethernet Door Modules (IP-ACMs): Ethernet Door Modules shall be located near the doors they control, to reduce the wiring needs of the access control system. Each Ethernet Door module shall provide terminations for the field wiring needs of one or two access control doors.

(1) Network Connectivity: The Ethernet Door Module shall have one Ethernet port, for TCP/IP communications to the Network Door Controller. The Ethernet port shall support GigE Ethernet compatibility, as well as 10/100bT Ethernet. Door modules that do not support GigE connectivity shall not be considered. Communications to the Network Door Controller shall be encrypted with AES 256-bit encryption.

f. Wireless Locksets: The Network Door Controller shall provide monitoring and control of up to 32 wireless locksets, using a local RS485 bus to interface to the wireless lockset hub network. The Network Door Controller shall support either the Schlage AD300 and AD400 series of locksets, or the ASSA ABLOY Aperio series of locksets. When ACM I/O modules are used, the number of wireless locksets supported shall be reduced such that the overall reader count remains at 32 per Network Door Controller.

g. Power Requirements: The Network Door Controller shall be powered from a low voltage 12VDC power source, within a range of +/- 15%. 12VDC power is used to power the controller electronics, plus, reader power and RS485 bus power.

(1) Lock Power Management: In addition to system power, each ACM I/O module shall be capable of managing and controlling lock power, such that separate individual fused relay boards or lock isolation relays shall not be required. Each ACM shall provide two lock power inputs in addition to system power; each output relay on the ACM shall be configurable via jumper to use lock power feed 1, lock power feed 2, or dry contact.

Lock power feeds may be either 12VDC or 24VDC. All power feeds to outputs shall be power limited via resettable PTC devices.

(2) Power Requirements Design: The system designer shall be responsible for calculating the overall power requirements for the Network Door Controller, including locking devices, readers, annunciators, and PIR exit devices. A power calculation spreadsheet shall be used to verify system power requirements, and a safety factor of 50% shall be used when sizing power supplies.

h. Wall Mount System Enclosure: The Network Door Controller shall be housed in a locking 18 gauge steel enclosure, suitable for wall mounting in accordance with UL 294. All cabinet locks shall be keyed alike. The cabinet shall be suitably sized to allow installation of the controller and associated field wiring. The cabinet shall measure 25" in height by 22" in width and 5" in depth. There shall be a power indicator on the door which shall be visible when power is applied to the controller. A single, Normally Closed (NC) tamper switch shall be incorporated into the door. There shall be at least 12 knockouts on the enclosure of various sizes to facilitate conduit and wire routing.

(1) Expansion: The wall mount enclosure shall be sized to accommodate up to two ACM I/O boards.

i. Rack Mount System Enclosure: Alternatively, the Network Door Controller shall be able to be mounted in a standard 19" rack, using standard rack mounting hardware. A modular rack mounting arrangement shall be provided such that the GCM module is housed in a separate rack enclosure that is 2U high (3.5"), while each ACM is housed in a 4U enclosure (7" in height). Each rack enclosure will be made of 18 gauge galvanized steel, painted black. The enclosures shall be suitably sized to allow installation of the controller and associated field wiring. A single, Normally Closed (NC) tamper switch shall be incorporated into the door.

(1) Tamper Switches: Each rack mount enclosure shall have its own NC tamper switch, incorporated into the body of the enclosure and activated whenever the cover is removed or partially removed.

j. Environmental Requirements: The Network Door Controller shall be capable of operation in temperatures between 0º and 50º C (32º - 122º F), and within humidity levels between 5% and 95%, non-condensing.

k. Reader Inputs: The controller shall provide for direct connection of up to 16 Wiegand read heads. The read heads connected to these ports shall conform to the industry standard Wiegand Output format and shall support multiple card technologies including contactless smart card, Wiegand, proximity, barium ferrite, bar code and biometrics. Wiegand readers directly connected to the controller may reside up to 500 ft. from the controller with the proper 18 AWG wiring. Any direct Wiegand reader port may be disabled and an RM series reader shall be connected in its place, through the reader bus, to extend the distance from the controller to the read head. Wiegand reader inputs must be capable of receiving and decoding a bit stream of at least 256 bits.

(1) LED Control: In addition to accepting card data from the read heads, the controller shall control the LEDs at the reader, supporting industry standard 2-wire or 1-wire control. The controller shall also provide a signal line to control an external beeper at the reader with an active low going signal. The LED control shall support three LEDs - red, amber and green. The System Server shall support the configuration of these LEDs such that certain LEDs shall illuminate or not illuminate or pulse to indicate various System status conditions. These LEDs shall indicate the following status conditions as a default:

- On-line Indication — Amber LED on steady
- Off-line Indication — Red LED on steady
- Card Accepted — Green LED pulses for door open time
- Card/PIN — Amber LED pulses to enter PIN. Subsequent red/green LEDs mimic card input
- Alarm Condition — All LEDs pulse in alternating pattern

(2) Wiegand Keypad Support: The direct Wiegand reader ports shall support Wiegand readers with integrated Wiegand output keypads. The supported data format shall conform to industry standard 4 bit or 8 bit (4 bits plus 4 bits complemented) Wiegand keypad data.

(3) Power for Readers: The controller shall provide +12VDC power for each reader, up to 1.5A each, on separate wiring terminals.

(4) Support for RS485 Readers, with Display/Keypad: The controller shall support RS485 readers, to accommodate door control at distances greater than the 500 foot Wiegand distance limit, and to provide support for Software House RM series readers with a custom user display. The controller shall support up to 16 RM series card readers, and can also be configured to use a mix of Wiegand and RM readers, such that the overall reader count from Wiegand and RS485 readers does not exceed 16.

(5) Support for RS485 OSDP Secure Channel Readers: The controller shall support OSDP (Open Supervised Device Protocol) RS485 readers, to provide support for open standard readers that conform to the OSDP 2.1.6 standard, as published by the SIA (Security Industry Association). The unit must support OSDP secure channel, utilizing AES 128-bit encryption and supporting automatic custom key management.

l. Supervised Inputs

(1) Twenty four (24) Class A Supervised inputs shall be provided on each ACM module, providing three inputs per reader. All supervised inputs in the system shall be field-configurable to accept either 1K, 5K or 10K ohm terminating resistor networks which may be configured to accept Normally Open (NO) or Normally Closed (NC) switches or contacts. Each EOL resistor network shall be configured such that the circuit reports unique messages for a secure circuit, alarm condition, and an open or shorted input (supervision alarm). Each input must also be capable of reading a non-supervised circuit.

(2) Each two-wire input must be able to be configured individually for its supervisory circuit type.

(3) Each two-wire input must be terminated on its own connector, and must not share a connector with another input.

(4) The Monitoring Application Interface shall provide the current status of the inputs and shall log changes in input status. Supervised inputs shall be able to be taken offline for diagnostic purposes and each input shall support being linked directly to an output or to a system event. All input activations shall be reported to the Monitoring Application and stored in the Historical Journal on the System Server.

m. General Inputs: The Network Door Controller shall provide dedicated, normally-closed inputs for:

(1) Enclosure Tamper: In a wall-mount cabinet, the tamper input on the GCM shall be pre-wired to the enclosure door to report opening of the door as a tamper event. In a rack-mount enclosure system, each enclosure's tamper switch shall be pre-wired to

either the GCM or ACM tamper input.

(2) Power Fail: A dedicated input shall be provided for a power failure alarm. When using an external DC power supply to power the unit, this input shall be wired to the power supply's alarm output

(3) Low Battery: A dedicated input shall be provided for a low battery alarm. When using external DC power supply to power the unit, this input shall be wired power supply's low battery alarm output

n. Outputs: The Network Door Controller shall provide 16 separate outputs on each ACM module, configurable through on-board jumpers as either "wet-lock1" (power sourcing), "wet-lock2" (power sourcing) or as dry contact form C relays. The outputs shall be used to control door locks, local annunciators, and other output devices as required.

(1) Output Protection and Power Ratings

(a) Each output shall be individually protected with a PTC resettable fuse, transzorbs and snubbers so that power can be directly provided to locking devices without damage to the controller.

(b) When sourcing power to the outputs, one or both lock power inputs may be used. Outputs shall be able to provide at least 0.75A at 12VDC or 24VDC.

(c) Eight of the output relays shall be socketed, designed to control lock circuits, and shall be rated for 5.0A, 30VAC/DC when used as a dry contact control relay.

(d) The other eight relays shall be non-socketed, designed to control local door annunciator devices, and shall be rated for at least 1.0A at 30 VAC/30 VDC when used as a dry contact control relay.

(e) The controller shall provide a LED for visual indication of each output's status.

(f) Each output must be terminated on its own connector, and must not share a connector with another output.

(g) The Monitoring Application Interface shall provide the current status of each output and shall allow the manual activation of each output individually or in user-defined groups for diagnostic purposes. All output activations shall be reported to the Monitoring Application and stored in the Historical Journal on the System Server.

(2) Fire Alarm Interlock

(a) Each lock output shall be capable of being controlled directly from a fire alarm input on the ACM board, based on a local dip switch setting for each output. When the fire alarm input is activated, the lock output shall be controlled to the door open state, if its fire alarm dip switch was enabled for that lock. Fire alarm control shall be hard-wired and not dependent on any software or firmware function to operate. Fire alarm functionality shall be tested and listed per UL.

(b) A separate fire alarm key switch latch input shall be provided. This input shall be used if manual intervention is required after a fire alarm before the locks are able to return to their normal (locked) condition. The ACM module shall have a key switch enable switch to enable this feature.

o. Local Display

(1) The controller shall include a local, on-board two-line LCD for status and field diagnostic messages. Provide local switches on the controller to set the LCD messaging and diagnostic modes.

(2) For normal operations, the LCD shall be configured to display status messages. For troubleshooting operations, the LCD shall be configured to display diagnostic messages for readers and card data, inputs, outputs, network ports and other connected devices.

(3) As a minimum, status messages shall include:

- iSTAR boot information
- Date and time
- Firmware version
- Controller status information.
- Configured power and measured power
- IP address and MAC address of controller
- Host connectivity status

(4) The LCD shall also provide diagnostic information for:

- Cards/Readers – display raw card data, number of bits, reader number
- Inputs – display changes in input state
- Outputs – test each output in sequence
- Ethernet ports – test operation of the port

p. I/O Expansion

(1) The Network Door Controller shall support input and output expansion, through the use of RS485-based input/output modules. Each ACM module shall support up to 16 I8 modules, each providing eight supervised inputs, and up to 16 R8 eight-output form C relay modules. Form C relays shall be rated at 2A resistive and 1A inductive at 30VAC/DC.

(2) The controller's wall mount enclosure shall be able to accommodate up to four modules mounted internally, without need for an external enclosure of any kind.

(3) The controller must provide, at least, eight RS-485 expansion ports. Each port must have LED indication of transmit and receive communications activity. End-of-line (EOL) termination resistors shall be provided for each port to satisfy RS-485 multi-drop requirements. The termination resistors must be selectable, by switch, to provide the possibility of a "Y" wiring arrangement.

(4) Each RM reader expansion bus must provide +12VDC power to its associated devices, through on-board power terminals. Each RM device may be powered from the controller, or through a local +12VDC source.

q. Wiring Connectors: All connectors shall be screw down type and pluggable, to facilitate field replacements and simplify testing. Connector spacing shall be such that connectors cannot be placed on the wrong wiring terminals.

3. Network Door Controller Software

a. Firmware and OS: The Network Door Controller shall utilize a standard off the shelf Linux operating system, including kernel and base OS image. Firmware updates to the controller shall include updates to the OS if applicable, including security patches. It shall not be necessary to independently manage updates to the OS outside of the access control application.

b. Communications: The Network Door Controller shall utilize standard Ethernet network connectivity for communications, to the host server or to other network controllers.

Controllers shall be wired at any point on a Local Area Network (LAN)/Wide Area Network (WAN) via industry standard Ethernet utilizing the TCP/IP protocol. The Network Door Controllers shall be able to communicate back to the System database server through industry standard network switches and routers and shall not be required to reside on the same subnet as the System Server. Any activity or event within the controller network shall be routed to any client workstation(s) on the network, regardless of the controller that handles the activity. The System Server shall manage any message routing issues, thus isolating the subsystem applications from network-specific communication details.

The controller to System Server communication, and controller to controller communication within the same cluster, shall include authentication and a minimum of 256-bit AES encryption.

Upon losing and then restoring communications between the controller and the System Server, database synchronization between the System Server database and the local database in each controller shall be fast and efficient. When communications are restored, database synchronization shall occur immediately and without System Operator intervention. Any changes made to the System Server database while the controller was off-line shall also be simultaneously downloaded to all required controller databases.

(1) Protocols

(a) Communication between the System Server and the controller, and from controller to controller, is via TCP/IP only.

(b) The controller shall support DHCP. Each controller may be configured to accept an IP address and device name from local DHCP (Dynamic Host Configuration Protocol), WINS (Windows Internet Naming Service) or DNS (Domain Name System) servers.

(c) The controller shall have two 10/100/1000bT Ethernet (RJ-45) ports on-board and shall not require external devices to connect to the network.

(2) Clustering

(a) The Network Door Controllers shall support peer-to-peer communications, without the need for host intervention. A cluster is a user-defined grouping of Network Door Controllers used to define peer-to-peer communications.

(b) Peer-to-peer communications within a cluster shall be used for input/output linking between controllers, and for anti-passback control within a cluster.

(c) Each cluster has a master controller. The master is the primary connection between the cluster and the System Server. Communication from the System Server to the master shall be through a TCP/IP supported physical medium.

(d) The other cluster controllers are referred to as members. Member controllers do not communicate directly to the System Server or to each other; rather their communication path to the System Server and to each other shall be through the master. Communication within a cluster is always through a TCP/IP supported physical medium.

(e) Each master controller shall support an alternate Ethernet communications path to the System Server. In the event of a primary communications path failure, the master shall immediately attempt to utilize the secondary or alternate communications path. The alternate Ethernet path can be configured to use a different host IP address and subnet.

(3) Polling: The Network Door Controllers shall support peer-to-peer communications, without the need for host intervention. Communication between the System Server and the controller shall be asynchronous. The Network Door Controller shall not require any poll messages between the System Server and the controller. Messages shall only be transmitted when required and messages can be initiated by any controller or by the System Server. The controller shall transmit a network heartbeat to the System Server to satisfy UL requirements.

(4) AES Encryption and Key Management

(a) The controller to System Server communication, and controller to controller communication within the same cluster, shall include authentication and a minimum of 256-bit AES encryption. The controller shall offer both default key management and custom key management.

(b) For a secure environment, the controller must be able to accept and use a customer-supplied custom encryption key, supplied either from the host or from the controller. The controller must use a public key infrastructure (PKI) arrangement and certificates to authenticate keys between the host and the controller. The controller shall provide an on-board USB port to load a local encryption key.

c. Common System Services

(1) System Watchdog: The System Watchdog shall constantly monitor all internal processes and if it detects a problem, it shall reboot the controller. A hardware watchdog shall also run and reboot the controller if the system software fails to strobe it. The controller's internal clock shall be updated by the controller's real-time clock upon restart.

(2) Software Update Service: The system shall provide the ability to update the controller firmware stored in FLASH remotely from the host, directly within the C•CURE 9000 user interface. If the update image becomes corrupted, the controller can fall back to an original boot image. The boot image shall restart the controller and inform the host to re-send the update image. This feature allows the controller firmware to be easily upgraded to add new features.

d. Event Handling Services: The controller system firmware shall provide a service that will serve as a clearinghouse for all activities generated on a Network Door Controller. The System Server shall download a list of action definitions and a list of events to each controller. The system software shall provide an interface for reporting activities or events in real time as they occur.

(1) Event Linking: Event linking shall tie an activity on one controller to the triggering of an action on the same or different controller. The Server Controller shall support three types of event linking:

(a) Local Event Linking: When the source device and the target device are linked through an activity on the same controller, local event linking shall occur.

(b) Cluster Event Linking: When the source device and the target device being linked are on different controllers in the same cluster, cluster event linking shall occur. The transmission of the action request from one controller to another shall occur (routed through the master controller) with no System Server intervention.

(c) Global Event Linking: When the source device and the target device being linked are on different clusters, global event linking shall occur. This cross-cluster linking will require that the action request be routed through the System Server. The event link definitions shall be created on the System Server and shall be

downloaded to the appropriate controllers. The System Server shall also insure that the event link definitions are valid and that there are no recursive links.

(2) Action Scheduling: The system software shall provide an action scheduling service that will execute actions on devices residing on the same or other controllers at a predefined time, frequency and time interval. The action definitions shall be the same System Server-defined actions utilized by event linking. The actions and the action schedule shall be defined by the System Server software and shall be downloaded to the appropriate controllers.

(3) Offline / Online Reporting: The system shall provide a mechanism to report activities to the System Server for display, reporting and archiving. If a System Server is not currently connected to the cluster of controllers, the activity reports will be buffered until the System Server reconnects to the cluster. Should the user-configured, activity buffer limit be exceeded before the System Server reconnects, the first in first out rule shall apply. Provide a minimum of 10,000 events in the offline buffer.

(4) Time Management Services: The system shall provide a service to manage user-defined time periods. These time periods shall be defined on the System Server and downloaded to all controllers. The time management services shall also ensure that all controllers have a synchronized time clock.

e. Access Control Functionality: The controller shall perform basic access control operations with or without communications to a host server, including unlocking a door based on a valid credential, unlock based on a valid PIN, unlock based on card plus PIN, unlock based on schedule, unlock based on a pre-defined sequence or event, and unlock based on a manual action initiated by a system operator. In addition, the Network Door Controller shall be capable of the following:

(1) Custom Defined Card Formats: The user shall be able to define custom card formats, up to 10 per controller, and each format shall be able to be at least 256 bits in length. The user shall be able to define and use government card formats such as the 200-bit GSA format with HMAC.

(2) Elevator Control: The controller shall be able to perform elevator control, using either inputs and outputs hard-wired to the elevator control system, or, using a network interface through the host server. Card readers may be located in the elevator lobbies or elevator cabs. Upon a valid card read, the controller shall decide which floors the person is authorized for.

(3) Intrusion Zones: Doors on the controller shall be able to be defined as intrusion zones that are armed and disarmed by various methods through a RM keypad/display reader.

Inputs on the controller shall be able to be defined as included in intrusion zones, and may be defined as 24-hour inputs, such as glass-break sensors, or as inputs that may be shunted during a time period, such as motion sensors.

(4) Double Swipe Custom Event: The controller shall be capable of performing a pre-defined sequence of events if two duplicate card reads are seen within a certain period of time. It must be possible to select which personnel will activate the double swipe feature on each door.

f. Diagnostic Web Server: The Diagnostic Web Server shall generate real-time operational and diagnostic information on a Network Door Controller to be viewed by system installers, troubleshooters and tech support personnel from a standard web browser, such as Internet Explorer. This web server, residing on each controller, shall answer requests from a standard web browser and shall generate and serve up HTML pages that indicate

controller status and diagnostic information.

(1) Compatibility: The Diagnostic Server shall be compatible with standard browsers, such as Internet Explorer, Google Chrome and Mozilla Firefox.

(2) Functional Requirements: The Diagnostic Web Server shall query the appropriate controllers to determine the following information and shall display it in an organized fashion to the user via a web browser.

(a) Total and Available Memory (RAM): The Diagnostic Web Server shall display the total amount of memory (in bytes) on the controller and the amount of memory (in bytes) that is currently free.

(b) Current Time Information: The Diagnostic Web Server shall display the controller's current time and time zone.

(c) Boot Time: The Diagnostic Web Server shall display the time at which the controller was last rebooted.

(d) Firmware and Operating System Versions: The Diagnostic Web Server shall display the Firmware Version and build number and the operating system Version Number.

(e) MAC and IP Address Information: The Diagnostic Web Server shall display the controller's unique MAC Address as well as its IP Address.

(f) Controller Type (Cluster): The Diagnostic Web Server shall display the controller type within the cluster – Master or Member.

(g) Connection Status: The Diagnostic Web Server shall display the controller's current connection status with its parent (System Server or Master Controller).

(h) Parent Information: The Diagnostic Web Server shall display the hardware MAC and IP Addresses of its parent (System Server or Master Controller).

(3) Security: The Diagnostic Web Server shall support multiple simultaneous users and should have minimal impact on the normal operation of the controller. The Diagnostic Web Server shall utilize a standard security scheme that requires a user to log in using a password that shall be set via the System Server or the iSTAR Configuration Utility (ICU).

It shall be possible to disable the diagnostic web server if desired.

(4) Database Information: The Diagnostic Web Server shall display all controller database information, along with the number of records contained, the amount of memory (in bytes) utilized and the percentage of memory that each one consumes.

(5) Run-Time Diagnostics/Debug Information: The user shall have the ability, via the web browser, to enable the output of real-time debugging information. This information shall be displayed on the browser. The information may also be output via the serial Debug Port of the controller and can be viewed (and captured) by standard tools such as HyperTerminal.

E. Clustering

1. The SMS shall support a user-defined grouping of iSTAR controllers defined as a cluster. iSTAR controllers within a cluster shall be able to communicate in a peer-to-peer scheme should the SMS server lose communication with the cluster.

2. Clustering shall support the following features:

a. Assignment of Master controllers for cluster communication to the SMS server

b. Primary and backup communication paths to the SMS server

c. Up to 16 controllers per cluster
d. Logical event linking between controllers in a cluster independent of SMS server communication
e. Antipassback control within a cluster shall be independent of SMS server communication
f. Asynchronous communication via TCP/IP (Polled devices shall not be acceptable)
g. Dialup Communications. Dialup shall only be supported on iSTAR Pro and iStar Ultra SE (in Pro Mode)
h. Encrypted communications

3. The SMS shall support iSTAR clusters in two types: Encrypted and Non-Encrypted. Encrypted clusters shall support iSTAR Edge/eX/Ultra controllers. Unencrypted clusters shall support iSTAR Classic/ iSTAR Pro/unencrypted Ultra controllers.
4. Network communications between a cluster master and the host, and between a cluster master and cluster members, shall be done using AES 256 bit symmetric encryption, tested and verified by an independent lab and listed for FIPS 197.
5. Encrypted iSTAR controllers shall be listed for FIPS 140-2, which meets the necessary physical, operational, and cryptographic requirements for a cryptographic module for the National Institute of Standards (NIST).

PART 3 – EXECUTION

3.1 TESTING

A. The software shall be entered into the SMS computer systems and debugged. The Contractor shall be responsible for documenting and entering the initial database into the system. The Contractor shall provide the necessary blank forms with instructions to fill in all the required data information that will make up the database. The database shall then be reviewed by the Contractor and entered into the system. Prior to full operation, a complete demonstration of the computer real-time functions shall be performed. A printed validation log shall be provided as proof of operation for each software application package. In addition, a point utilization report shall be furnished listing each point, the associated programs utilizing that point as an input or output and the programs which that point initiates.

B. Upon satisfactory on-line operation of the system software, the entire installation including all subsystems shall be inspected. The Contractor shall perform all tests, furnish all test equipment and consumable supplies necessary and perform any work as required to establish performance levels for the system in accordance with the specifications. Each device shall be tested as a working component of the completed system. All system controls shall be inspected for proper operation and response.

C. Tests shall demonstrate the response time and display format of each different type of input sensor and output control device. Response time shall be measured with the system functioning at full capacity. Computer operation shall be tested with the complete data file.

D. The Contractor shall maintain a complete log of all inspections and tests. Upon final completion of system tests, a copy of the log records shall be submitted as part of the as-built documentation.

3.2 TRAINING

A. The Contractor shall provide a competent trainer who has extensive experience on the installed systems and in delivering training to provide the instruction. As an alternative, the Contractor may propose the use of factory training personnel and coordinate the number of personnel to be trained.

3.3 MAINTENANCE

A. The Contractor shall offer a Software House Software Support Agreement (SSA) in order for

Software House Technical Support Specialists to reactively troubleshoot system problems.

B. As part of the agreement, 5x9 telephone support (Standard and Enhanced SSA) will be provided to the Contractor by Certified Technicians. An option of 7x24 Standby telephone support (Enhanced SSA) shall be offered.

C. As part of the agreement, Flashable and Non-Flashable (Chips) firmware and documentation shall be provided.

D. As part of the agreement, access to SMS patches and software release updates shall be provided.

E. The SSA shall cover the current SMS release one full version back, and associated controller hardware.

3.4 SPARE EQUIPMENT

A. This Contractor shall provide the district two hundred (200) additional programmable security cards, in addition to the required project amount, as attic stock.

END OF SECTION 28 0727

SECTION 28 0728

CCTV – NETWORK DIGITAL VIDEO MANAGEMENT SYSTEM

PART 1 – GENERAL

1.1 SYSTEM DESCRIPTION

A. The Network Digital Video Management System ("Network DVMS") shall be a feature-rich IP video distributed solution, designed for multi-site and multiple-server installations requiring 24/7 video surveillance.

B. The Network DVMS shall consist of the following major components:

1. Client Viewer.
2. NVR (Network Video Recorder) Server.
3. Add on: Transaction Data Integration Module.
4. Add on: Central Alarm Management Module.
5. Add on: PDA Server and PDA Client

C. The Network DVMS - Client Viewer ("Client Viewer")

1. The Client Viewer shall be the central operating control point for the Network DVMS system. The Client Viewer shall provide the end-user full video monitoring and control for a fully distributed solution for either single-site or multi-site applications for single-server or multiple-server installations requiring 24/7 surveillance with support for devices from different vendors.
2. The Client Viewer shall uniquely integrate a multitude of disparate solutions into a single feature-rich application including seamless integration with a fully distributed, centralized-managed video surveillance platform.
3. The Client Viewer shall provide an easy to use, fully integrated GUI (Graphical User Interface) that supports within the same application the following features:
   a. Scalability - For enterprise and other high-end users, the Client Viewer shall scale to provide support for an unlimited number of cameras using multiple NVR servers. Overall, the Client Viewer shall be fully scalable to support a varying number of cameras based on the NVR server selected by the end-user, including the following other options:
      (1) For small-to-medium (SMB) users, the Client Viewer shall scale to provide support for a maximum of 25 cameras using a single NVR server.
      (2) For commercial users, the Client Viewer shall scale to provide support for a maximum of 64 cameras using a single NVR server.
   b. Touch Screen Controls - The Client Viewer shall support intuitive touch-screen controls, menus and video navigation. Through the touch-screen interface the end-user shall be able to navigate menus directly from the video viewing monitor without the aid of a keyboard or mouse (no need to right click, etc.).
   c. NVR Management - The Client Viewer shall support the management of a single Network Video Recorder (NVR), and an entire system of NVRs.
   d. Intelligent Menus and Controls - The Client Viewer shall provide intelligent menus that automatically appear and disappear as needed by the operator to only show those controls necessary to perform the end-user function. For example, for a PTZ camera, the GUI shall intelligently show a virtual joystick to control optical zoom, digital zoom and preset controls within the camera view. The GUI shall react to the user's actions and only present those controls and tools required by the current mode of operation.

e. Kinetic / Horizontal Timeline – The Client Viewer shall provide a user interface to allow for "kinetic" manipulation of a graphical timeline representation of recorded video. The user shall uniquely be able to kinetically (i.e., via the momentum and speed of mouse movement) vary the speed that the recorded video timescale is moved forward/backward in time.

f. Instant Video Playback and Analysis "Timeslicer" - The Client Viewer shall provide for instant video playback and analysis of video content/events by providing a spectrum of video thumbnails over a period of time for quick end-user analysis.

g. Integrated Event Management - The Client Viewer shall provide integrated event management including automation of event push video, pop-up events, and alerts without the need of additional software modules or add-on software.

h. Mapped Based Navigation - The Client Viewer shall provide a map-based navigation of cameras and/or camera groups.

i. Integration of Data for Multiple-Users – The system shall provide the ability to share and store common bookmarks and event handling data across multiple users.

j. Interactive Carousel - The Client Viewer shall provide fully interactive video carousel functionality, whereas a series of video camera views will presented to the end-user as a rotating carousel. For the rotating carousel, the end-user shall have the full capability to interact with the video including the ability to interrogate the video as a clip, expand the video view for the video shown, control the camera, etc.

D. The Network DVMS – NVR

1. A single NVR Server or multiple NVR Servers shall provide video recording for the Network DVMS. The NVR Server shall consist of the following software components which may be resident on a single server, or installed on multiple servers within an overall Network DVMS:

   a. Recording and Image server

   b. Administrator Application

   c. PDA Server.

2. The Network DVMS shall support multiple NVR Servers. Each of the NVR Servers shall be assignable as either a master or a slave NVR Server.

3. The NVR Server shall be used for recording video feeds and for communicating with cameras and other devices.

4. The system shall support an unlimited number of NVR Servers. One or more NVR Servers may be used in a system depending on the number of cameras or physical system configuration.

5. The NVR Server shall support the use of pre and post recording on motion/event recording. The pre and post recording time period shall be selectable in seconds.

6. Logging – The Network DVMS shall provide an overall System log, an Event log, and an Audit log.

E. Transaction Data Integration Module

1. The Network DVMS shall include support for an add-on Transaction Data Integration Module designed to integrate with Point of Sale (POS) or Automated Teller Machine (ATM) data and time-link video recordings with POS or ATM transactions.

F. Central Alarm Management Module

1. The Network DVMS shall include support for an add-on graphical Central Alarm Management application module. The alarm management module shall allow for the

continuous monitoring of the operational status and event-triggered alarms from system servers, cameras and other external devices. The alarm management module shall support graphical displays with interactive icons to display the status of cameras and other inputs.

G. PDA (Personal Digital Assistant) Server and Client

1. The Network DVMS shall include support for add-on PDA Servers and PDA Clients to allow for viewing using a remote wireless PDA.

H. Certified Installer Program

1. The Network DVMS software vendor shall provide a certified partner program, whereby training and certification programs shall qualify the suitability of the installers. The vendor shall provide various levels of training including advanced training (i.e., "Gold" level).

I. Network Topology

1. The Network DVMS System shall support the use of separate or common networks, VLANS or switches for connecting cameras to the NVR servers/clients. This shall provide physical network separation between the camera and servers/clients.

J. Virtual Computing

1. The Network DVMS System shall support the use of VMware to run NVR servers and client applications on virtual computers, servers, and networks.

PART 2 – PRODUCTS

2.1 NETWORK DVMS – CLIENT VIEWER

A. The main end-user interface and therefore the core application for the DVMS shall be the Client Viewer. The Client Viewer shall support the following features:

1. A scalable solution that is frontward and backward scalable with an entire line of Network Video Recorders (NVRs).
2. Intuitive, touch screen-enabled interface.
3. Intelligent GUI that reacts to the user's actions at any given moment, presenting only the controls and tools required by the current mode of operation.
4. Kinetic / Horizontal Timeline – The following features shall be supported:
   a. Kinetic variability (i.e., via the momentum and speed of mouse movement) of the speed that the recorded video timescale is moved forward/backward in time. The faster the mouse is "swiped", the faster the timeline will move.
   b. The timeline GUI shall provide intelligent pop-up controls for controlling forward, reverse, pause, etc. controls.
   c. The timeline GUI shall provide simple "+" and "-" controls to quickly change the scale of the timeline.
   d. The timeline GUI controls shall provide an intuitive "odometer" like numerical interface for reading and changing the recorded time viewed.
5. Exporting Clips – The Client Viewer shall provide multiple methods to export video clips including:
   a. The ability to export a video segment via clicking on start and stop times (via icons) of recorded video using a timeline.
   b. The ability to export a video segment via the use of the tool bar.
   c. Export options shall include the ability to export to print, individual frames, and create bookmarks (on the timeline).

6. "Timeslicer" Instant Video Playback and Analysis - The Client Viewer shall provide for instant video playback and analysis of video content/events by providing a spectrum of video thumbnails over a period of time for quick end-user analysis. The user shall have the ability to vary the thumbnail intervals based on:
    a. Time – Intervals shall be selectable.
    b. Motion – Intervals shall be based on time or amount of motion.
    c. Alerts.
    d. Sequences.
7. PTZ Controls – The Client Viewer shall provide a wide variety of PTZ controls:
    a. Both optical PTZ (if the camera is a PTZ camera) and digital PTZ controls shall be provided, including:
        (1) Point to a location to re-center the pan-tilt field of view.
        (2) Drag a rectangle within the current field of view to zoom into.
        (3) Virtual joystick with intelligent pop-up menus.
        (4) Preset overlays.
    b. Digital PTZ controls shall be provided for both fixed cameras and PTZ cameras. Digital PTZ controls shall include instant investigation in live monitoring mode as well as for stored video. A window-in-window view shall be provided to show both the zoomed in area, as well as the full field of view of the camera.
8. Highly configurable carousel mode with controls for previous/next camera in sequence, pause/resume carousel, instant investigation capability, and optical and digital PTZ control.
9. Automated (on-event) or manual (peer-to-peer) push live video.
10. Shared and private views, configurable for up to 64 cameras from multiple servers (in multiple server installations).
    a. Multiple hotspots.
    b. Carousel views.
    c. Push video views.
    d. Web pages.
11. Multiple screen support for dual-screen and quad-screen systems.
12. Instant camera change. Quickly substitute one or more of a view's cameras with other cameras.
13. Control PTZ (Pan/Tilt/Zoom) and 360° view cameras, including a virtual PTZ joystick.
14. Use digital zoom on live as well as recorded video.
15. Manually activate surveillance system events.
16. Manually activate external outputs (e.g. sirens or lights).
17. Use sound notifications for attracting attention to detected motion or system events.
18. Get quick overviews of video sequences with detected motion.
19. Get quick overviews of detected alerts or system events.
20. Perform "Smart Searches" to quickly search selected areas of video recordings for motion.
21. Skip gaps during playback of recordings.
22. Configure and use several different joysticks.

23. Print images, with optional comments.
24. Copy images for subsequent pasting into word processors, e-mail, etc.
25. Export recordings (e.g. for use as evidence) in AVI (movie clip), JPEG (still image), and surveillance system database formats. The AVI and database formats can include audio.
26. Select between language versions, independent of the language used on the main surveillance system.

B. Log-on and Authentication

1. The Client Viewer log-on shall provide the option to select either Basic or Windows based authentication.
   a. Basic Authentication – The Client Viewer shall support logon using an account database which requires user name and password credentials.
   b. Windows Authentication – The Client Viewer shall support Microsoft Active Directory Support – The Client Viewer shall support logon using the NTLM (NT LAN Manager) challenge handshake with Microsoft Domain Controllers in conjunction with a local Microsoft Windows user account database.

C. GUI Menu Options Supported

1. The Client Viewer shall provide a main GUI menu uncluttered from other menu panes. Intelligent menu items shall appear as necessary. For instance, when a camera view is right-clicked or left-click/touched and held for 1 second, various relevant selection options shall be available to the end-user:
   a. A camera icon – to instantly select another camera; a selection of available cameras will be presented.
   b. A clipboard icon – to save the current view to the clipboard.
   c. A push video icon – to push video to a recipient; a selection of available recipients will be presented.
   d. A remove camera icon – to remove the camera from the pane.
2. In addition to the main camera view, the Client Viewer main GUI menu shall provide the end-user the following controls when “mouse” over occurs:
   a. Select View Setup/Editing Utility
   b. Exit
   c. About
3. Tool Bar - In addition to the main camera view, the Client Viewer main GUI menu shall at a minimum, provide the following tool bar selections:
   a. View Setup/Editing Utility.
      (1) Edit Views – Camera Views and Groups shall be organized as folders and the GUI shall provide an intuitive interface to select and change views and groups in a file folder manner. The Edit Views menu shall allow the options to add/delete shared or private views, add/delete groups, and perform other folder management functions. Camera matrix view setup options shall include: 1 x 1, 1 + 3 wide, 2 x 2, 1 + 5, 2 + 4 wide, 1 + 7, 1 + 8 wide, 3 x 3, 2 + 8, 4 x 3 wide, 4 x 4, 5 x 5, 6 x 6, 7 x 7, and 8 x 8 camera views. Edit Views shall provide utilities to configure either Shared Views or Private Views as follows:
         (a) Shared Views – The Client Viewer shall provide both the viewing and setup for Shared Views. These Shared Views shall typically be setup by a system

administrator. The Shared Views shall be stored on the NVR and accessed by the end-user based on their log-on.

(b) Private Views – The Client Viewer shall provide the capability for each end-user to create their own Private Views.

(2) Cameras

(a) Server – Within the folder "Server", the Client Server shall list the cameras by name and type of camera available within a given NVR. The Client Viewer shall allow easy manipulation of cameras and views by supporting "drag and drop" capability.

(b) Hotspot – The Client Viewer shall support Hotspots which are typically used in the main (larger) viewing pane, surrounded by smaller panes. This feature shall allow one position of a view to be designated as a Hotspot. Specific to the Hotspot, settings for the Hotspot shall include:

i. Image Quality.

ii. Framerate.

(c) Carousel – The Client Viewer shall support a Carousel feature for viewing of sequential multiple cameras. The setup menus for the Carrousel feature shall include:

i. Image Quality.

ii. Framerate.

iii. Default Dwell Time – for each camera to be viewed.

(d) Web Page – The Client Viewer shall provide the ability to view a "Web Page" by inputting a Web URL within a text box or a JPEG image based on inputting the image file path.

(e) Push Video – The Client Viewer shall provide the ability to display on-event live video streams and alerts. The events will be displayed in a first-in-first-out order and rotate between the different push video panes. Within the Push Video display, the setup menus for the Push Video feature shall be:

i. Image Quality.

ii. Framerate.

iii. TCP/IP Port.

iv. Password.

(3) Image Properties – The following shall be the image quality settings (may vary based on type of camera):

(a) Quality – The Client Viewer shall provide the ability to vary picture quality. The options shall be:

i. Full – Native camera resolution.

ii. Super High.

iii. High.

iv. Medium.

v. Low.

(b) Framerate – The Client Viewer shall provide the ability to vary the Framerate. The options shall be:

i. No limit (full Framerate).

ii. Medium.

iii. Low.

(c) Audible Alert – The Client Viewer shall produce audio alerts based on events. The options shall be:

i. Never.

ii. On Motion.

iii. On Event.

iv. On Motion or Event.

(d) Aspect Ratio – The Client Viewer shall provide the ability to present the video as follows:

i. Keep Original.

ii. Fit to Window.

D. Client Viewer System Requirements

1. The Client Viewer shall allow the use of computer, servers, storage and switches from any manufacturer with components that meet the minimum requirements.

2. The following are the minimum requirements for the computers running the Client Viewer software:

a. The Client Viewer shall support Microsoft Windows XP Professional in conjunction with the Microsoft .Net 2.0 Framework, and DirectX 9.0 or newer.

b. CPU – Intel P4 or higher (Intel Core 2™ recommended), minimum 2.4 GHz.

c. RAM – Minimum of 1 GB.

d. Network – Ethernet (100 megabit or higher recommended).

e. Graphics Adapter – AGP or PCI-Express, 128 MB RAM, Direct 3D supported.

2.2 NETWORK DVMS - NVR SERVER

A. Video Compression Format - The NVR Server shall support H.264, MPEG-4 (both ASP and SP), and MJPEG video compression formats for the video stream from all devices including analog cameras connected to encoders, DVRs, and IP cameras connected to the system.

B. Multi-Stream Support - The NVR Server shall support multi-stream support - The NVR Server shall support H.264 / MPEG-4 / MJPEG optimized multi-streaming. The system shall allow a single video stream from a device to be independently recorded at one specified frame rate by the NVR Server, and viewed by Client Views at a different Framerate setting.

C. Storage and Archiving - Each NVR Server shall have a default storage area. A storage area is a directory where the database content, primarily recordings from the connected cameras is stored. Recordings from the connected cameras shall be stored in individual camera databases. The system shall allow an unlimited amount of storage to be allocated for each connected device. The system shall allow archiving to be enabled on a per camera basis and allow the user to define which archiving drive shall be used for each camera.

D. NAT Firewall Support - The system shall support port forwarding, which shall allow clients from outside of a Network Address Translation (NAT) firewall to connect to NVR Servers without using a VPN.

E. Supported Devices

1. The system shall support devices from the following manufacturers at a minimum: ACTi,

Advantech, AgileMesh, Appro, Arecont Vision, Axis Communications, Baxall, Bosch, Canon, CBC Ganz, Convision, Digimerge, Discrete, D-Link, , DVTel, Etrovision, Extreme CCTV, FLIR Systems, GE Security, Hitron, Hunt, Infinova, Intellinet, Ipix Corporation, ipx, IQinvision / IQeye, JVC, Linudix, Lumenera, Mobotix (including support of MxPEG), Panasonic, Pelco, Pantax, Philips, Pixord, Polar, Samsung, Samsung Techwin, Sanyo, Sony, Speco, Stardot, Toshiba, Toshiba Teli, Vantage, Veo, Verint, Videology, Vivotek, Webgate, Xview.

2. The system shall support specific devices, where the specific supported model numbers shall be listed for each manufacture on an up-to-date on-line web-site.

F. Administrator Application – The Administrator Application shall provide a feature-rich administration window for system configuration and day-to-day administration of the system. Within the Administrator Application, the following shall be selectable to allow specific system administration setup functionality. This shall include: A Service Manager, A Scheduler, General Settings, Archive Setup, the ability to Add/Edit/Remove a Device, I/O Setup and Control, and Event Setup. Sub-features shall be the ability to setup PTZs, route messages and alerts including email and SMS messaging setup, and archive setup. Specific features supported by the Administrator Application shall be:

1. Audio Settings including the ability to associate an audio feed to a video input and 2-way audio support.
2. Motion Detection Settings including the ability to trigger video recording and events on motion.
3. Image Quality including settings for Compression Level, Brightness, Contrast, Color, Rotate Image, and Bandwidth Control/Priority
4. Event Notifications including how end-users will be notified when events occur.
5. Outputs Configuration including the ability to control outputs on devices based on motion, manual control or other settings.
6. I/O Setup including that ability to Add, Edit, Name, Enable/Disable Events and optionally assign timers to end an event sequence.
7. Event Buttons for manually triggered events.
8. I/O Control including a graphical mapping of all system events.
9. User Administration including the ability to add either Basic Users or Windows (Active Directory) Users, plus the ability to Delete Users, Change Passwords, set Global User Rights, and set Camera User Rights.

G. Outside Network Access – A user interface shall be provided to select if the system can be accessed from a client PC that has an IP address that is outside of the local IP address range. This function is used to allow access from a remote PC over the Internet. The configuration settings shall include the ability to select an Outside IP Address, Outside IP Port, Local IP Ranges, and Maximum Number of Clients

H. NVR Server System Requirements

1. The following are the minimum requirements for the computers running the NVR Server:
   a. CPU – Intel P4 or higher (Intel Core 2 Duo recommended), minimum 2.4 GHz.
   b. RAM – Minimum of 1 GB (2 GB recommended).
   c. Network – Ethernet (100 megabit or higher recommended).
   d. Graphics Adapter – AGP or PCI-Express, minimum 1024x768 (1280x1024 recommended), 16 bit color.

e. Hard Disk Type – E-IDE, PATA, SATA, ISCSI, SCSI, SAS (7200 RPM or faster).

f. Hard Disk Space – Minimum 80 GB free (depends on number of cameras and recording settings).

g. Operating System – Microsoft Vista Business/Enterprise/Ultimate (32 bit or 64 bit running as a 32 bit application), Windows 2003 Server (32 bit or 64 bit running as a 32 bit application), and Windows XP Professional (32 bit or 64 bit running as a 32 bit application).

2.3 TRANSACTION DATA INTEGRATION MODULE

A. The Transaction Data integration module shall allow the operator to search and view Transaction Data from third-party systems time-linked with video recordings of when the transaction activities occurred.

B. The module shall integrate digital video surveillance images with Point of Sale (POS) or Automated Teller Machine (ATM) transaction data. The module shall allow the operator to efficiently answer questions critical to an investigation.

C. The module shall allow the ATM or POS transaction data to be integrated with the system via an open interface supporting a serial server, serial cable or IP connection. The module shall be compatible with any TCP/IP or serial ASCII data source.

D. The module shall include a filter to allow the user to edit the transaction data and remove unwanted or unnecessary data from the ATM or POS database.

E. The module shall allow the user to search for transactions by register/ATM, camera, date, time or free text. All Transaction Data shall be stored in a SQL database.

F. The module shall utilize a client / server architecture using HTTP or TCP directly for communication.

2.4 CENTRAL ALARM MANAGEMENT MODULE

A. The alarm management module shall allow for continuous monitoring of the operational status and event-triggered alarms from servers, cameras and other devices. The alarm management module shall provide a real-time overview of alarm status or technical problems while allowing for immediate visual verification and troubleshooting.

B. The alarm management module shall provide an interface and navigational tools through the client. The module shall provide a detailed listing of all active or incoming alarms with the ability to reassign alarms to other operators.

C. The module architecture shall be .NET based with the server component accessed through a client application running on Windows XP Professional or Windows Server 2003 servers. Central logging of incoming alarms and system information in a SQL database.

2.5 PDA CLIENT

A. The PDA Client shall allow for the viewing of live and recorded images within the Network DVMS using a wireless PDA.

B. The PDA Client shall provide a camera menu to select a camera to view, PTZ controls including presets, recorded video playback controls, and event management.

2.6 PDA SERVER

A. PDA Server shall be provided as an optional front-end add-on module to the NVR Server.

B. The PDA Server shall provide an interface between NVR Server and the remote PDA clients

C. The PDA Server shall use the Microsoft IIS (Internet Information Services) and .Net framework.

SECTION 3 – WARRANTY

3.1 Provide a 2-year warranty on all equipment, parts, and labor. Warranty to start from date of substantial completion.

END OF SECTION 28 0728

SECTION 31 20 00

EARTH MOVING

PART 1 - **GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Preparing subgrades for all aspects of construction shown on the plans.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Subbase course for concrete walks pavements.
5. Subbase course and base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.
8. Excavating well hole to accommodate elevator-cylinder assembly.
9. Warning Tracks
10. Pitching Mounds

B. Related Sections:

1. Division 01 Section "Construction Progress Documentation" for recording pre-excavation and earth moving progress.
2. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.
3. Division 03 Section "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
4. Division 14 Section "Hydraulic Elevators" and "Hydraulic Freight Elevators" for excavating well hole to accommodate elevator-cylinder assembly.
5. Divisions 21, 22, 23, 26, 27, 28, and 33 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.
6. Division 31 Section "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.

7. Division 31 Section "Dewatering" for lowering and disposing of ground water during construction.
8. Division 31 Section "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
9. Division 31 Section "Drilled Concrete Piers and Shafts" for excavation of shafts and disposal of surplus excavated material.
10. Division 32 Section "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
11. Division 32 Section "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.
12. Division 33 Section "Sub-drainage".

C. Delaware Department of Transportation (DelDOT) Standard Specifications.

D. Delaware Department of Natural Resources and Environmental Control (DNREC) Sediment and Erosion Control Handbook.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material 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. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

G. Fill: Soil materials used to raise existing grades.

1.4 SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Controlled low-strength material, including design mixture.

1.5 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

B. Pre-excavation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify Miss Utility (1-800-282-8555) for area where Project is located before beginning earth moving operations.

C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Division 31 Section "Site Clearing are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

1. All on-site borrow, subbase material, base course and drainage course shall be as shown on the plans and in accordance with the DelDOT Standard Specifications.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters meeting Mirafi 140N or approved equal.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters meeting Mirafi 600X or approved equal.

2.3 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; 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.
6. Green: Sewer systems.Porous Fill Under Infields: Use AASHTO #57, well consolidated, under all skinned areas. (ALTERNATE?)

2.4 ATHLETIC FIELDS

A. Pea Gravel Choke Layer: Use a washed uniform pea gravel, maximum 3/8" size, as choke/separator layer between crushed aggregate base and all skinned infield areas, as detailed.

B. "Skinned" Infield Mix – At all infield areas, provide 4 -1/2" "Martins Infield Mix", Martins Quarry, Bechtelsville, PA (610) 367-2011, or approved equal as Diamond Tex, etc. Submit samples for approval by Owner and Architect.

C. Warning Track – Provide 4" manufacturer's mix specifically blended for this use, as detailed. Submit samples for approval by Owner and Architect.

D. Clay Mix for Pitching Mounds and Batter's Box Area – Use bag clay specifically formulated for this use in high-wear forward area of mound, and at batter's box area, placed as top 4" of material, and covering the forward 30% of the mound, as well as entire batter's box area. Submit samples for approval by Owner and Architect.

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 earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. All excavation shall be as shown on the plans and in accordance with the DelDOT Standard Specifications and the DNREC Sediment and Erosion Control Handbook.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, 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 Footings and Foundations: 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.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Cut and protect roots according to requirements in Division 01 Section "Temporary Tree and Plant Protection."

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 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 the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches **eac**h side of pipe or conduit.

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.

3.8 SUBGRADE INSPECTION

A. Notify Architect/Engineer/Construction Manager when excavations have reached required subgrade.

B. If Architect/Engineer/Construction Manager determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 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, with 28-day compressive strength of 2500 psi may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly as shown on the plans and in accordance with the DelDOT Specifications.

3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. 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, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03 Section Cast-in-Place Concrete.

D. Backfill voids with satisfactory soil while removing shoring and bracing.

E. Place and compact final backfill of satisfactory soil to final subgrade elevation.

3.13 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. 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.
4. Under building slabs, use engineered fill.

5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil 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.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place and compact fill as shown on the plans and in accordance with the DelDOT Standard Specifications.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free of 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.

3.17 SUBSURFACE DRAINAGE

A. Sub-drainage Pipe: Specified in Division 33 Section "Sub-drainage."

B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade.

3.18 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place as shown on the plans and in accordance with the DelDOT Standard Specifications.

3.19 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

3.20 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

D. 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 and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft or less of paved area or building slab, but in no case fewer than three tests.
2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than two tests.

E. 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 materials to depth required; re-compact and retest until specified compaction is obtained.

3.21 INFIELD “SKINNED AREAS”

A. Rough and finish grade the field, establishing precision grade at base lines and corners, and pitcher’s mound. Subgrade shall be 10” below finished grade of skinned area, except for pitching mound, which shall be 6” below finished grade. Trim edges of excavated subgrade with vertical faces.

B. Finish grade a 4-1/2” thickness of the mix, spread uniformly over the rough grade and compacted to a 4” thickness with a light power roller. Cover rolled mixture with a ½” thick layer of the mix, and roll lightly, then rake to a uniformly smooth surface, removing all stones.

C. Finish grade of skinned area shall be completely flush with surrounding topsoiled areas, so as to show no change in grade at the juncture of these areas.

D. Repair all low spots, depressions, wash-outs within 30 days of installation to Owner’s satisfaction.

3.22 WARNING TRACKS

A. Strip topsoil and excavate 4” for track area, per plan. Track shall be 15 Feet wide. Extend track 1’ beyond line of chain link fence as shown. Slope subgrade at 2.0% toward fence.

B. Trim edges of excavated soil with clean, vertical faces.

C. Provide the warning track material, spread evenly and compacted.

D. Repair all low spots, depressions, wash-outs within 30 days of installation to Owner’s satisfaction.

3.23 PITCHING MOUNDS

A. Construct with clay base soil material, shaping and compacting. Utilize manufactured clay for top 3” at forward portion of mound (pitchers landing area), as detailed. Construct top 3” of batter’s box with equal clay material. (12’ wide x 16’ deep, encompassing batters box and catcher’s area)

3.24 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 Architect; reshape and re-compact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill 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 greatest extent possible.

3.25 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 20 00

SECTION 316219 - TIMBER PILES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes round timber piles.

1.2 UNIT PRICES

A. Contract Sum: Base Contract Sum on number and dimensions of piles indicated from tip to cutoff, plus not less than 12 inches (305 mm) of overlength for cutting piles at cutoff elevations.
   1. Provide 25-ton, 12 inch diameter timber piles as per the length recommended in the geotechnical report by Duffield & Associates.

B. Work of this Section is affected as follows:

   1. Additional payment for pile lengths in excess of that indicated, and credit for pile lengths less than that indicated, is calculated at unit prices stated in the Contract, based on net addition or deduction to total pile length as determined by Architect and measured to nearest 12 inches (305 mm).

      a. Additional payment for splices required to extend pile lengths in excess of that indicated is calculated at unit prices stated in the Contract.

   2. Additional payment for number of piles in excess of that indicated, and credit for number of piles less than that indicated, is calculated at unit prices stated in the Contract.
   3. Unit prices include labor, materials, tools, equipment, and incidentals for furnishing, driving, cutting off, capping, and disposing of cutoffs.
   4. Test piles that become part of permanent foundation system are considered as an integral part of the Work.
   5. No payment is made for rejected piles, including piles driven out of tolerance, defective piles, or piles damaged during handling or driving.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For timber piles. Show fabrication and installation details for piles, including details of driving shoes, tips or boots, and pile butt protection.

1.5 INFORMATIONAL SUBMITTALS

A. Round timber pile treatment data.

B. Pile-Driving Equipment Data: Include type, make, and rated energy range; weight of striking part of hammer; weight of drive cap; and, type, size, and properties of hammer cushion.

C. Pile-driving records.

D. Field quality-control reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handle and store piles at Project site to prevent breaks, cuts, abrasions, or other physical damage and as required by AWPA M4. Do not drill holes or drive spikes or nails into pile below cutoff elevation.

PART 2 - PRODUCTS

2.1 TIMBER PILES

A. Round Timber Piles: ASTM D 25, unused, clean peeled, one piece from butt to tip; of the following species and size basis:

1. Manufacturers: Subject to compliance with requirements.

2. Species: Coastal Douglas fir or Southern yellow pine.
3. Size Basis: Butt circumference Class B.

B. Pressure-treat round timber piles according to AWPA U1 as follows:

1. Service Condition: UC4C Ground Contact, Extreme Duty
2. Treatment: Waterborne preservative, creosote or creosote solution, or oil-borne preservative.

2.2 PILE ACCESSORIES

A. Driving Shoes: Fabricate from ASTM A 1011/A 1011M, hot-rolled carbon-steel strip to suit pile-tip diameter.

2.3 FABRICATION

A. Pile Tips: Cut and shape pile tips to accept driving shoes. Fit and fasten driving shoes to pile tips according to manufacturer's written instructions.

B. Pile Butt: Trim pile butt and cut perpendicular to longitudinal axis of pile. Chamfer and shape butt to fit tightly to driving cap of hammer.

C. Field-Applied Wood Preservative: Treat field cuts, holes, and other penetrations according to AWPA M4.

D. Pile-Length Markings: Mark each pile with horizontal lines at 12-inch (305-mm) intervals; label the distance from pile tip at 60-inch (1524-mm) intervals. Maintain markings on piles until driven.

PART 3 - EXECUTION

3.1 DRIVING PILES

A. General: Continuously drive piles to elevations or penetration resistance indicated. Establish and maintain axial alignment of leads and piles before and during driving.

B. Heaved Piles: Redrive heaved piles to tip elevation at least as deep as original tip elevation with a driving resistance at least as great as original driving resistance.

C. Driving Tolerances: Drive piles without exceeding the following tolerances, measured at pile heads:

1. Location: 4 inches (102 mm) from location indicated after initial driving, and 6 inches (152 mm) after pile driving is completed.
2. Plumb: Maintain 1 inch (25 mm) in 48 inches (1219 mm) from vertical, or a maximum of 4 inches (102 mm), measured when pile is aboveground in leads.
3. Batter Angle: Maximum 1 inch (25 mm) in 48 inches (1219 mm) from required angle, measured when pile is aboveground in leads.

D. Withdraw damaged or defective piles and piles that exceed driving tolerances, and install new piles within driving tolerances. Fill holes left by withdrawn piles as directed by Architect.

E. Cut off butts of driven piles square with pile axis and at elevations indicated.

1. Cover cut-off piling surfaces with minimum three coats of preservative treatment according to AWPA M4.

F. Pile-Driving Records: Maintain accurate driving records for each pile.

3.2 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Pile foundations.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Tests and Inspections:

1. Dynamic Pile Testing: High-strain dynamic monitoring shall be performed and reported according to ASTM D 4945 during initial driving and during restriking on 3 percent of piles.

END OF SECTION 316219

SECTION 32 1800
SYNTHETIC TURF SHOCK PAD

PART I – GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. General Conditions, Special Conditions and Section "Scope of Work" are part of and govern work under this section.

B. Construction of the aggregate base layer
   a. Section 32 3114 - Subgrade and Stone Aggregate Drainage Layer.

C. Synthetic turf carpet,
   a. Section 32 1813 - Synthetic Turf Carpet.

1.2 SCOPE OF WORK

A. Furnish all labor, materials, tools, and equipment necessary to install, in place, a 19 mm E-layer pad, as indicated on the plans and as specified herein. The installation of all new materials shall be performed in accordance with these specifications, in strict accordance with the manufacturer's written installation instructions, and in accordance with all approved shop drawings.

1.3 SUBMITTALS

A. Submit with bid:

1. Elastic-Layer Shock Pad - one (1) sample, approximately 100 sq.in. x 19 mm thick.
2. Manufacturer's data offering product technical documentation.
3. Certified list of existing installations.

B. Prior to order of materials, the Contractor shall submit details on construction, especially any details that may deviate from these plans and specifications.

1.4 QUALITY ASSURANCE

A. Bidder/Manufacturer/Installer's experience:

1. The Bidder/Prime Contractor shall have been actively and directly engaged in constructing stadium athletic fields for a period of five (5) years or more.
2. The Contractor shall employ only qualified, experienced supervisors and technicians skilled in the installation of this system. All E-layer technicians shall be full-time statutory employees of the installer.

1.5 EXISTING CONDITIONS

A. Contractor will be responsible for any damage to any existing pavement, curbs, utilities, vegetation or structures and shall restore any damage to original or better condition.

1.6 SURFACE AREA

A. See Site Plans for layout. Contractor to verify all measurements.

1.7 UTILITIES

A. Owner will supply necessary water, adequate lighting and electricity for installation.

PART 2 – PRODUCTS

2.1 MATERIALS - BASIC REQUIREMENTS - BASE BID

A. Provide a paved in-place elastic layer pad (E-layer), minimum thickness of 19 mm, installed with specialized paving equipment, designed for this purpose. Characteristics shall include a thorough blending of SBR rubber granules bound in a single-component polyurethane binder, with thorough percolation capacity. Pad firmness shall be coordinated with the carpet and infill to provide proper shock absorption and player safety without compromising footing and surface stability.

B. The pad system, as installed, shall provide a uniform, comfortable and safe playing surface, free from defects and consistent and uniform placement in all directions.

C. Impact Absorption (force reduction) of the finished field surface and underlying pad shall provide the current industry standard of less than 165 G-max over the entire surface, measured at any given test point throughout the entire warranty period. It is understood that G-max values may vary from point-to-point. Initial G-max shall not

exceed 110, or be less than 85 at the time of installation. Note! Coordinate with selected turf manufacturer/installer to insure this criteria is met.

PART 3 - EXECUTION

3.1 GENERAL

A. All installation operations shall be performed by personnel directly employed by the manufacturer, fully familiar with the materials and their application, under the full-time direction and supervision of a qualified technical supervisor employed by the installer of the E-layer. Installation supervisors shall have a minimum of five (5) year's experience and job resumes shall be submitted to the Owner with the bid.

B. The surface to receive the E-layer pad shall be inspected and certified by the manufacturer as ready for the installation of the system, must be perfectly clean as installation commences, and shall be maintained in that condition throughout the process.

C. Furnish a written Certification or Letter of Acceptance of the porous aggregate base construction, prior to commencing installation of the E-layer pad.

3.2 INSTALLATION – ELASTIC LAYER PAD

A. The aggregate drainage base shall be inspected by the Contractor and checked with a laser level for proper slope and planarity utilizing a minimum of 400 elevation shots; and make corrections as specified herein as required including proper stability and consolidation. Turf installer shall not approve the aggregate base layer as acceptable for pad placement without reviewing also survey elevations.

B. The Contractor shall thoroughly inspect all pad materials delivered to the site both for quality and quantity to assure that the entire installation shall have sufficient material to maintain proper mixing ratios.

C. The elastic layer pad shall be installed by the manufacturer's personnel per the manufacturer's specification and installation procedures, utilizing specified placement, edging and seaming techniques.

D. Specialized paving equipment shall be operated by a minimum of two skilled technicians at all times. Seams shall be hand rolled and troweled. Cold joints shall be
primed with polyurethane primer. Pad thickness shall be continuously monitored for consistency, as well as the mixing ratio. The finished surface shall not vary more than 1/8" in 10 feet as measured in any direction with a 10 foot straight edge.

E. Testing of the E-layer shock pad, shall be performed as a "system" in conjunction with the synthetic turf, and shall be performed by a recognized sports testing facility.

3.3 CLEAN UP

A. Contractor shall provide the labor, supplies and equipment as necessary for final cleaning of surfaces and installed items.

B. The Contractor shall keep the area clean throughout the project and clear of debris.

C. Surfaces, recesses, tuck slot, etc., shall be cleaned as necessary to leave the work area in a clean, immaculate condition ready for immediate occupancy and use by the synthetic turf Contractor in installing the finished carpet.

3.4 ALTERNATE BIDS - PREFABRICATED SHOCK PAD

PART 1 - SCOPE

A. Provide a prefabricated synthetic base shock pad underlayment material utilizing 19-23mm thick sectional panels, manufactured and installed in accordance with the manufacturer's latest revised specification. Basic requirements include insuring optimum safety of the playing surface (impact attenuation/surface playability) and high capacity subsurface drainage of the installed playing field.

B. Submit all technical data, samples MSDS sheets, warranty, and installation history as part of this alternate.

C. Specifications shall comply with applicable ASTM standard test methods. All other specifications and tolerances listed shall be defined under standard ANSI and/or ISO drawing and specification rules.

PART 2 - QUALITY ASSURANCE

A. The shock pad material shall to be manufactured in an ISO-9000 certified facility.

B. Product must demonstrate 10 successful installations in the United States within the last (3) years.

C. Manufacturer must provide documentation of material content and MSDS sheet with submittal package.

D. Product to be shipped as flat panels on prepackaged pallets. Pallets to be wrapped with heavy-duty barrier for protection from moisture and UV exposure.

E. Seams should be mechanically placed/locked by hand without use of additional materials, glue, fasteners or secondary processes and equipment.

F. Material shall be installed using manufacturer's guidelines, without exception.

G. Manufacturer shall provide written installation instructions to selected turf supplier/installer.

PART 3 - SUBMITTALS

3.1 Product Data: Submit 10" x 10" product sample and technical data sheet.

3.2 Shop Drawings: Submit cross-sectional view showing product installation in relation to sub-base and synthetic turf (including edge attachment).

3.3 Test Data: Submit listing of all applicable test data for compliance to specifications. All testing to be performed by independent sources following applicable ASTM or other internationally recognized standards and procedures.

3.4 Installation: Submit copy of product installation instructions. Submit copy of turf installation recommendations.

3.5 Warranty: Submit copy of warranty coverage.

PART 4 - PRODUCTS

4.1 Alternate No1: Resilient Polypropylene Base Shock Pad; as Brock Power Base, manufactured by Brock International, Boulder, CO 80301, (303) 544-5800, www.brock-international.com

4.2 Alternate No 2: Resilient Recycled Compressed Rubber Crumb Pad; as Ecore BL-41, manufactured by Ecore, Lancaster, PA (866) 795-2732, ecoreathletic.com.

4.3 Alternate No 3: Resilient Closed Cell, Cross- Linked Recycled Foam Pad: as Pro-Play Sport 23-D; manufactured by Schmitz Foam Products, Coldwater, MI

49036, (208) 720-7266, sales@proplayus.com

PART 5 – INSTALLATION

5.1 ALTERNATE PAD INSTALLATION

A. All installation operations shall be performed by personnel, fully familiar with the materials and their application, under the full-time direction and supervision of a qualified technical supervisor employed by the installer of the shock pad. Installation supervisors shall have a minimum of five (5) year's experience and job resumes shall be submitted to the Owner with the bid.

B. The surface to receive the shock pad shall be inspected and certified by the manufacturer as ready for the installation of the system, must be perfectly clean as installation commences, and shall be maintained in that condition throughout the process.

C. Furnish a written Certification or Letter of Acceptance of the porous base base construction, prior to commencing installation of the prefabricated pad.

-- END --

SECTION 32 1813
SYNTHETIC TURF CARPET

PART I – GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. General Conditions, Special Conditions and Section "Scope of Work" are part of and govern work under this section.

B. Crushed stone aggregate base layer
   a. Section 32 3114 - Subgrade and Stone Aggregate Drainage Layer
   b. Section 33 4100 – Storm Utility Drainage Piping
   c. Section 33 4600 – Subdrainage

C. Elastomeric layer shock pad
   a. Section 32 1800 – Synthetic Turf Shock Pad.

1.2 SCOPE OF WORK

A. Furnish all labor, materials, tools, and equipment necessary to install, in place, all synthetic turf carpet, as indicated on the plans and as specified herein. The installation of all new materials, including testing, shall be performed in accordance with these specifications, in strict accordance with the manufacturer's written installation instructions, and in accordance with all approved shop drawings.

1.3 SUBMITTALS

A. Submit with bid:

1. Synthetic Turf - one (1) sample, approximately 100 sq.in., one with infill, properly labeled.

2. Elastic-Layer shock pad - one (1) sample, approximately 100 sq.in.

3. Seam - one (1) sample, seam length of 6" minimum, sewn or glued, properly labeled.

4. Knitted-in 4" white line.

5. Manufacturer's data offering full product technical documentation.

6. Submit to Owner for approval three (3) copies of quality assurance information as required herein, for initial testing and installation, and for ongoing testing responsibility.

7. Certified list of existing installations, including owner representative and telephone number, attesting compliance with quality assurance information.

8. Laboratory test reports for fabric, backing, ribbon, in accordance with ASTM designated test numbers. Tests shall include, but not be limited to pile height and weight, tuft bind, grab tear strength, backing strength.

9. Laboratory test data for rubber crumb infill.

10. Complete warranty information, including sample warranty.

B. Additional submittals required for this Bid are:

1. Five years of audited financial statements, or as a minimum, five years of financial statements.

2. Litigation in the past five years.

3. Projects that have not been completed on time.

4. Principals of the firm with background information.

5. Disclosure of bankruptcies in which any of the principals have been involved in the past ten years.

6. Disputes over warranty claims in the past five years.

C. Prior to order of materials, the Contractor shall submit the following:

1. Field layout indicating striping plans for all specified sports.

2. Seam layout of the field.

3. Details on construction, especially any details that may deviate from these plans and specifications, including, but not limited to edge details, goal post details, other inserts, covers, etc.

D. Prior to Final Acceptance, the submit to the Owner three (3) copies of Maintenance Manuals, which will include all necessary instructions for the care and preventative maintenance of the synthetic turf system, including painting and striping.

E. Prior to the beginning of installation, the manufacturer/installer of the synthetic turf as well as the shock pad subcontractor shall inspect the existing stone aggregate base layer and shock pad, and supply a Certificate of Acceptance for both surfaces for obtaining manufacturer's warranty for the finished synthetic playing surface.

1.4 SHOP DRAWINGS

A. Shop drawings shall be prepared at the scale of the construction documents and contain all pertinent information regarding installation. These drawings shall be submitted to the Owner for approval prior to the manufacturing and shipment of materials.

B. Submit drawings for:

1. Seaming plan; seams of pad are not to coincide with seams of synthetic turf nor interfere with subsurface drain system.

2. Installation details; edge detail, goal post detail, other inserts, etc.

3. Striping plan; lay-outs for football and soccer for all fields, showing field lines, markings and boundaries as required by the respective sports sanctioning organization.

1.5 QUALITY ASSURANCE

A. Bidder/Manufacturer/Installer's experience:

1. The Bidder/Prime Contractor shall have been actively and directly engaged in constructing stadium athletic fields for a period of five (5) years or more.

2. The manufacturer and installer shall have been actively and directly engaged in constructing stadium athletic fields for a period of five (5) years or more, and provide proof of ten (10) or more tufted, polyethylene grass-like fabric sports field installations completed by them within the last three (3) years, five of which must be synthetic turf fields in locations and operating conditions similar to those in Delaware.

3. The manufacturer/installer must provide a quality control program, for initial installation and testing, and for ongoing testing regarding responsibility, methodology and protocol. An independent recognized third party testing facility, experienced with synthetic turf, acceptable to the Owner and Architect shall be utilized to test for compliance and acceptance.

4. In addition, the Owner may make such investigations as he deems necessary to determine the ability of the bidder to perform the work, and the bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of such bidder fails to satisfy the Owner that such bidder is properly qualified to carry out the obligations of the contract and to complete the work specified herein.

5. The Contractor shall employ only qualified, experienced supervisors and technicians skilled in the installation of this system. All turf technicians shall be full-time statutory employees of the turf manufacturer/installer. Submit resumes of the top two (2) technicians and supervisors with the bid.

B. Prospective bidders must meet the following criteria:

1. Have proper license, in good standing, and have never had a license revoked.

2. Are able to substantiate currently available bonding capacity in excess of $1,000,000 per project and an aggregate bonding line in excess of $5,000,000.

3. Have not had a Surety or Bonding company finish work on any contract within the last five (5) years.

4. Have not been disqualified or barred from performing work for any public Owner or other contracting entity.

5. Shall have demonstrated financial strength to fully service and warrant the systems throughout the provision of audited financial statements for the past three years.

B. Warranty: The Manufacturer's Warranty, which guarantees usability and playability of the synthetic turf system shall not be prorated nor limited to the amount of usage. The form of warranty must be furnished and submitted together with the bid for consideration by the Owner and Owner's legal counsel.

1. The warranty submitted must have the following characteristics and must be satisfactory to Owner in all other respects:

   (a) Must provide full coverage without pro-ration or reduction in amount, for eight (8) years from the date of Substantial Completion.

   (b) Must warrant materials, workmanship, installation and performance.

   (c) Must warrant that the materials installed meet or exceed product specifications.

   (d) Must have a provision to either repair or replace, without cost to Owner, such portions of the installed materials that are no longer adequate as a serviceable and playable surface. The repair or replacement must provide a serviceable and playable surface comparable to a new surface.

   (e) Must be a warranty from a single source covering workmanship, installation and all self-manufactured or procured materials.

   (f) Guarantee the availability of replacement materials for the synthetic turf system installed for the full warranty period.

   (h) The insured warranty policy must be from an A+ "rated" or better carrier, and must be in force at time of bid, and shall have a minimum of $1 million dollars per Claim and minimum $25 million annual policy aggregate.

   (g) The warranty shall be insured by a third party, written to the owner, and be fully pre-paid in advance and be non-pro-rated, and shall have no deductible amounts or self-retention participation

2. Full warranty information regarding the warranty offered and warranty performance of each warrantor shall be provided with the bid, for evaluation by the Owner and Architect.

1.6 EXISTING CONDITIONS

A. Contractor will be responsible for any damage to any pavement, curbs, fencing, utilities, vegetation or structures during installation of the synthetic turf system, and shall restore any damage to original or better condition.

1.7 SURFACE AREA

A. See Site Plans for layout. Contractor to verify all measurements.

1.8 UTILITIES

A. Owner will supply necessary water, adequate lighting and electricity for installation.

PART 2 - PRODUCTS

2.1 MATERIALS – BASIC REQUIREMENTS

A. The synthetic turf and all components shall be of national reputation with previous acceptance at all levels of competition, including professional and collegiate levels of baseball, football, soccer, field hockey, lacrosse, etc. The turf fabric shall be manufactured and installed by a sole responsible entity -"jobbers" or installation "subcontractors" shall not be permitted.

B. All components and their installation method shall be designed and manufactured for use on outdoor athletic fields. The materials as hereinafter specified, should be able to withstand full climatic exposure in Delaware, be resistant to insect infestation, rot, fungus and mildew; to ultra-violet light and heat degradation, and shall have the basic characteristic of flow through-drainage allowing free movement of surface run-off through turf and pad where such water may flow to the prepared subbase and into the field drainage system.

C. The finished playing surface shall appear as mowed grass with no irregularities and shall afford excellent traction for conventional athletic shoes of all types. The finished surface shall resist abrasion and cutting from normal use. The Synthetic Turf Carpet shall be designed for multi-sport use, primarily football and soccer.

D. Synthetic Turf Carpet: Shall be a nominal 1-3/4" height, and shall exhibit suitable ultraviolet resistance, tufted into a backing system having primary, secondary and tertiary layers for dimensional stability and longevity, utilizing polyurethane coating(s). Backing shall be water-permeable, utilizing perforations or other acceptable methods for drainage. Total carpet weight - not less than 86 oz./square yard, utilizing a blended top fiber consisting of equal proportions of monofilament and split film fibers, as well as a textured root zone fiber. Carpet infill shall be comprised of 80% SBR rubber (10-20 sieve size), and clean, sub-angular silica sand, proportions as acceptable to the Owner, and as compatible for multi-sport capability installed over an E-layer shock pad, as selected. The carpet shall exhibit and demonstrate appropriate infill retention, fiber memory retention, and long wear capability, acceptable to the Owner and Architect.

(1) Turf carpet shall be furnished in 15 feet width rolls, field-attached to the next with a seam to form the fabric of the field. Seams shall be glued with supplemental backing material and/or seaming tape, and adhered with a UV and moisture-resistant adhesive between the carpet backing and the seaming tape. The fabric utilized for the seaming tape shall provide dimensional strength and proper surface texture to permit a tight, secure and hazard free bond to the carpet utilizing the adhesive, and a subsequent bond between adjacent turf panels. The same applies for inlaid or "cut-in" lines, letters, numbers and field marking or graphics.

(2) The carpet shall be anchored to the new track drain and/or concrete curbing, in accordance with the drawings and manufacturer's recommended details, which shall be submitted for approval.

(3) Lines and field markings shall be installed as specified, utilizing manufactured lines at the end of each 15' roll and inlaid lines and markings as specified.

(4) The entire carpet and pad system shall provide a uniform, comfortable and safe playing surface, free from defects and providing consistent footing in all directions. Footing includes wet and dry traction, slip resistance and rotational resistance. The design of the turf fibers shall minimize skin abrasions, and minimize fly-out of rubber crumb infill.

(5) Impact Absorption (force reduction) of the finish field surface and underlying pad shall provide the current industry standard of less than 165 G-max (ASTM F355) over the entire surface, measured at any given test point throughout the entire warranty period. It is understood that G-max values may vary from point-to-point. Initial G-max shall not exceed 110 nor be less than 85 at the time of installation. Submit test results in accordance with Part 4, Post Installation Testing.

(6) Finished field surfaces shall provide adequate stability for athlete body control, and provide consistent and predictable ball performance reaction characteristics.

(7) The finished field surfaces shall have15 ft. turf panels, each possessing consistent color and shade, without significantly noticeable streaks, irregularities, or off-color areas, when observed in any direction.

2.2 SYNTHETIC TURF SYSTEM

A. Provide complete synthetic turf carpet system, as:

1. (Base Bid 1) SPIKE ZONE "PRO 1.75" system, as manufactured by Shaw Sports Turf, (866) 703- 4004, shawsportsturf.com.

2. (Base Bid 2) ASTROTURF "3D3" system, as manufactured by Astroturf (800) 723-8873, astroturfusa.com

3. (Base Bid 3) ULTRABLADE "DFE EXTREME 52" system, as manufactured by Sprinturf, (877) 686-8873, sprinturf.com

B. All materials, installation and warranty shall be in accordance with the latest manufacturer's specification and in accordance with the Contract Documents.

2.3 ATTIC STOCK

A. Provide a minimum of 750 square feet of synthetic turf carpet for the Owners use for future repairs for each field to be installed.

2.4 ATTIC STOCK

A. Provide a minimum of 750 square feet of synthetic turf carpet for each field for the Owners use for future repairs.

PART 3 - EXECUTION

3.1 GENERAL

A. The installation shall be performed in full compliance with approved shop drawings.
B. Inspect synthetic materials prior to installation for damage or defects, missing goods or insufficient quantities, correct turf pile height, correct backing perforation spacing and diameter, and other materials out-of-tolerance with the specification.

C. All installation operations shall be performed by personnel directly employed by the manufacturer, fully familiar with the materials and their application, under the full-time direction and supervision of a qualified technical supervisor employed by the

turf manufacturer. Installation supervisors shall have a minimum of five (5) year's experience and job resumes shall be submitted to the Owner with the bid.

D. The surface to receive the synthetic turf shall be inspected and certified by the manufacturer as ready for the installation of the system and must be perfectly clean as installation commences and shall be maintained in that condition throughout the process.

E. Furnish a written Certification of Acceptance of the porous aggregate base and shock pad construction, as applicable, prior to commencing installation of the turf carpet.

3.2 INSTALLATION – SYNTHETIC TURF CARPET

A. The stone aggregate base and shock pad shall be inspected by the Contractor and checked with a laser level and string line for slope and planarity, and require corrections as may be required. Turf installer shall not approve the stone aggregate base and the shock pad as acceptable for carpet placement without reviewing and approving the complete installation as specified herein.

B. Testing prior to shipment shall be performed by random sampling of carpet rolls by the manufacturer, certifying that they meet specifications. Testing shall be for pile composition, pile weight, total height, tuft bind and grab tear strength. Test results shall be conveyed in writing, and provided with the shipment(s).

C. Synthetic turf shall be installed across the playing field and attached to the perimeter edge detail in accordance with the manufacturer's specification and installation procedures. Turf shall be of sufficient length to permit full cross playing field installation. No head or cross seams will be allowed. The turf carpet system shall be installed to provide stability that will prevent panels from shifting or bunching.

D. Seams shall be sewn or glued per the manufacturer's specification and installation procedures. Seams shall be flat, tight, and permanent with no separation or fraying. Seam gaps shall be uniform, width not to exceed the gauge of the tufting.

E. Infill installation is critical to performance and must closely follow manufacturer's recommendations. In addition:

1. Apply when in a dry condition, and when the field is dry.
2. Install uniformly, properly mixed infill and glue materials.

3. Equipment utilized for infill must erect the fiber, place the infill materials, and incorporate a metering method to provide consistent distribution. Equipment shall not distort or displace any base materials, or damage the system.

F. Fiber conditioning: It is essential to maintain the integrity and uniformity of the fiber throughout the manufacturing, shipping handling, installation and maintenance, in order to prevent damage which could alter performance.

3.3 FIELD LAYOUT AND MARKINGS

A. The synthetic turf fields will have inlaid football lines, soccer lines, football numbers and football hash marks, as shown and detailed on the plans and per approved shop drawings; approved by the Owner and the Architect.

3.4 CLEAN UP

A. Contractor shall provide the labor, supplies and equipment as necessary for final cleaning of surfaces and installed items.

B. All usable remnants of new material shall become the property of the Owner. Provide sufficient material for suitable repairs of minor tears, burns, or other minor damage.

C. The Contractor shall keep the area clean throughout the project and clear of debris.

D. Surfaces, recesses, enclosures, etc., shall be cleaned as necessary to leave the work area in a clean, immaculate condition ready for immediate occupancy and use by the Owner.

PART 4 – POST INSTALLATION TESTING

4.1. The Contractor shall test for the following:

(1) After receipt of turf on site – When requested, verify turf identification specification by examination of approximately 2 square feet from two turf rolls taken on delivered material. Examination shall include a DSC (Differential Thermal Scan) for identification of the fiber.

(2) Perform in-situ testing of the installed turf for Force Reduction.

(3) When requested, verify the amount of infill: (minimum 3 locations) Vacuum the infill from 1 square foot, dry and sieve and weigh.

(4) When requested, provide additional performance tests on the completed turf and pad system at 5 locations (UEFA pattern) for Standard Deformation, Ball Rebound, Rotational Resistance (Traction) and Ball Roll.

G-max testing is required for all fields, per (2) above.

4.2. Tests shall be performed by a professional and experienced testing laboratory specializing in Sports Testing, acceptable to the Owner and the Architect.

4.3. Contractor shall provide a quality control, post construction testing program requiring testing at the end of year one, and at the end of year three, and providing the above tests for the Owner's records. Testing thereafter will be at the Owner's discretion, throughout the life of the surface.

PART 5 – MAINTENANCE

5.1. Long-term maintenance is necessary for the turf to obtain its maximum useful life. The turf Contractor shall provide detailed written maintenance instructions, suggested guidelines for the system, and training of the Owner's maintenance personnel.

5.2. Maintenance consists of but is not limited to cleaning, stain removal, minor seam repairs, dragging or redistribution of any infill material, and management of infill compaction, as well as proper utilization of maintenance equipment.

5.3. It will be the Owner's responsibility to maintain a log of field maintenance performed, as recommended and warranted by the turf Contractor.

5.4. Periodic cleaning, utilizing sweeping and vacuuming with equipment compatible with field surface will be performed by the Owner per guidelines provided by the turf Contractor.

- - END - -

SECTION 32 1814
SUBGRADE AND STONE AGGREGATE DRAINAGE LAYER

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. General conditions, special conditions, and Section "Scope of Work" are a part of and govern this section.

B. Excavation and subgrade compaction
   a. Section 31 2000 – Earth Moving

C. Field perimeter curb
   a. Section 03 3000 – Cast-In-Place Concrete

D. Site storm drainage
   a. Section 33 4100 – Storm Utility Drainage Piping
   b. Section 33 4600 – Subdrainage

E. Elastomeric layer pad
   a. Section 32 1800 – Synthetic Turf Shock Pad

1.2 SCOPE OF WORK

A. Furnish and install a new vertically-drained stone base layer utilizing a stable subgrade, aggregate drainage layer and drainage network.

B. The design requirements contained in this subsection cover the general minimum considerations in geometric layout and materials. For specific requirements referencing technical testing societies, organizations, associations, etc. see the subsection on Technical Requirements.

C. The work of this Section includes, but is not necessarily to be limited to:

1. Engineering layout.
2. Erosion and sediment controls.
3. Excavation and grading.
4. Removal of excess earth and topsoil from the site.
5. Construction of a stable subgrade.

6. Construction of the permeable aggregate base layer and underdrain system.
7. Verification of drainage (permeability).
8. Verification of finished surface slope and planarity.
9. Cleanup.
10. Guarantee.
11. Maintenance.

1.3 CONTRACTOR QUALIFICATIONS

A. The Contractor shall have been actively and directly engaged in constructing stadium athletic fields for a period of five (5) years or more, and provide proof of ten (10) or more sports field installations completed by them within the last three (5) years, five of which must be synthetic turf fields.

B. In addition, the Owner may make such investigations as he deems necessary to determine the ability of the bidder to perform the work, and the bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of such bidder fails to satisfy the Owner that such bidder is properly qualified to carry out the obligations of the contract and to complete the work specified herein.

1.4 WORK BY OTHERS

A. This Contractor shall afford other Contractors reasonable opportunity for the introduction and storage of their materials and equipment and the execution of their work and shall properly connect and coordinate his work with theirs.

B. Where any part of the Contractor's work depends for proper execution or results upon the work of any other separate Contractor, the Contractor shall inspect and promptly report to the Architect any apparent discrepancies or defects in such work that render it unsuitable for such proper execution and results. Failure of the Contractor to inspect and report shall constitute an acceptance of the other Contractor's work as fit and proper to receive his work, except as to defects which may develop in the other separate Contractor's work after the execution of the Contractor's work.

C. Should the Contractor cause damage to the work or property of any separate Contractor on the project, the Contractor shall, upon due notice, settle with such other Contractor by agreement or arbitration.

1.5 CONDITIONS

A. All the conditions, shown and/or specified, and the incidental conditions in or about the project site and structure, shall be considered mandatory parts of the Contract Documents.

1.6 SUBCONTRACTORS

A. The Contractor shall furnish, within five (5) days after notification, a list of subcontractors he proposes to employ in the work. The approval of subcontractors shall be a condition precedent to award of the contract. All subcontractors shall be subject to the approval of the Architect and/or the Owner.

1.8 MATERIAL SAMPLES AND INSPECTIONS

A. Submit samples of all dry materials and labels of liquids or wettable powders to be used in construction ten (10) days or more before beginning work.

1.9 ENGINEERING LAYOUT

A. The Contractor shall employ a registered engineer, landscape architect or surveyor to lay out all lines, grades and construction staking. Periodically throughout this project, the Architect may request the Contractor to verify the required construction elevations.

1.10 SITE PREPARATION - GENERAL

A. Keep excavation, stored materials, and other areas, free from excess rain or subsurface water at all times.

B. Excess material excavated, including suitable fill material and topsoil shall be removed.

C. Any piping, conduits or wiring encountered that are not required to be removed or otherwise encountered shall be temporarily supported and maintained until permanent support has been restored.

D. Utilize Geotechnical Consultant or Site Engineer for on-site work, inspecting during entire excavation, subgrade stabilization, underdrain system and porous aggregate base layer construction, utilizing a competent Testing Laboratory to evaluate soil conditions and drainage properties. Submit test results, as required, indicating compliance.

E. Backfill and compact around structures, walls, trenches and where concrete curbs are installed.

F. Rutting in the subgrade created by offloading and placement of the aggregate material shall be thoroughly repaired, by filling with competent material and compacting and rolling, in accordance with procedures specified herein.

G. Utilizing laser-guided equipment perform rough and precision grading in areas required, to the lines and grades required for the permeable aggregate base, and in accordance with recommended tolerances.

H. Keep excavations and the remainder of site free from dirt and debris at all times during the progress of the work, and in accordance with other applicable sections of the specifications.

1.11 CONSTRUCTION OF PERMEABLE AGGREGATE BASE LAYER, AND UNDERDRAIN SYSTEM

A. EXCAVATION

1. The site shall be excavated to a depth that the subgrade becomes stable. Topsoil shall be stripped and removed from the site. All other excavated soil shall be removed from the site.

2. When the proper sub-grade elevation is established, the entire area shall be proof-rolled with a ten ton (static weight) smooth-wheeled roller, to delineate localized loose, or soft zones. All such material shall be undercut to competent material.

3. The Site/Geotechnical Engineer will determine whether the materials in the excavated areas are suitable for use as backfill. All unsuitable material shall be removed and all new materials shall be approved before use.

4. The sub-grade shall be constructed using the approved backfill material. This material shall be placed in lifts not greater than 6" (15.24 cm) in depth. Each lift (layer) shall be compacted separately. The moisture in the soil, at the time of compaction, shall be uniformly distributed and should be within 90 and 120 percent range of the optimum. Within these limits, the Site Engineer will determine the proper moisture level to be used.

5. The backfill material in the first layer shall be rolled until the course has been uniformly compacted to over 95 percent of the maximum dry density. The second and succeeding courses shall be placed and mixed and then compacted as specified in the first course.

6. The finished surface of the sub-grade shall have a finished grade as shown. Sub-grade shall be established to within the tolerance of +0.0' or -0.02' of the design sub-grade elevation.

7. Excavate collector trenches, width and depth as required for the collector drain plus 6 inches on each side of the pipe. Trenches shall be excavated and sloped for drainage. The trenches shall be excavated with the indicated percent slope starting from the high point of the drainage system extending toward the storm drain connection points.

8. All loose debris shall be removed from the tops, edges and inside trenches. The trenches shall then be compacted by tamping or other approved means to 95 percent of the maximum dry density.

B. UNDERDRAIN SYSTEM

1. GEOTEXTILE

Verify that surface elevations of finished sub-grade conform to elevations shown on drawings prior to under drain system construction and that the sub-grade surface is uniform and free of depressions, voids, and irregularities. Provide nonwoven, porous geotextile (DOT Class 1)

in accordance with manufacture's written recommendations and DOT Specifications, over the entire field sub-grade. Collector drain trenches shall be lined with non-porous geotextile.

Additionally, overlap joints a minimum of 8". All laps shall be overlapped in the direction the stone aggregate is to be spread. Place a suitable amount of ballast on the fabric to prevent movement by the wind. Ballast shall be in a form which will not damage fabrics. Direct loading on fabric by traffic will not be permitted. Fabric must completely cover perimeter trenches.

2. FIELD COMPOSITE DRAINS

Install perforated under drain conduits at 16 feet on-center as a 45-degree angle on top of the geotextile, securing to fabric every 10-15 linear feet with duct tape, or other suitable material. These conduits shall be a composite drainage system as J-Drain 12 as manufactured by JDR Enterprises, Inc., (800) 843-7569, or acceptable equivalent. Connect ends of these composite drains into the perimeter collector drain pipe, or otherwise direct downward into 50% of the trench depth.

3. COLLECTOR DRAINS

Place perforated under drain pipes in the collector trenches, size per plan. Centerline of the pipe shall coincide with centerline of trench. The pipes shall be capable of withstanding the anticipated loading without deformation. Pipe meeting ASTM standard F-405 (stiffness at 5 percent deflection if 40 psi (2.8 kg/cm^2) minimum and the stretch resistance is 10 percent maximum) are suitable for use as under drain. Collector drains must be connected as shown on plans.

(a) A minimum of 2" of clean, drainable crushed stone aggregate (AASHTO #57) shall be placed in the bottom of the collector trenches, on top of moisture barrier. Compact to 95 percent.

(b) Place a minimum of 6" of the clean, crushed aggregate on the sides of the under-drain pipes and headers, and 6" minimum of the aggregate on top of the pipe network. Compact suitably.

(c) Prior to placement of the aggregate layer, verify the planarity of the subgrade to tolerance specified, and remove all “lipping” at

both sides of all collector drain trenches, to ensure no impediment of surface flow of water into the trenches.

C. AGGREGATE LAYER

1. A uniformly mixed aggregate shall be placed over the entire sub-base which has been covered with the geotextile filter fabric. The aggregate shall comprise a minimum of 6" of compacted, stable, permeable crushed limestone aggregate. Care shall be taken to maintain the grade designed for the sub-base. The capability of the aggregate drainage layer to meet the stability and permeability requirement must be determined by a certified laboratory or Contractor prior to construction of the course. It is recommended that the aggregate layer be consolidated to a density of 90 percent. A nuclear density gauge should be used during aggregate placement and rolling to ensure adequate compaction.

2. Submit procedure how contractor proposes to for place, level and consolidate the stone aggregate drainage layer, for Owner and Architect approval.

3. Material shall be a minimum of 75 percent fractured with at least one fractured face by mechanical means on each individual particle larger than 1/4". Material shall be clean of mineral fines.

4. Typical aggregate or aggregate blends found acceptable as an aggregate drainage course conform to the following gradation: (PennDOT OGS (Open-Graded Stone) may meet the above requirements)

Sieve	Sieve -Metric (mm)	Percent Passing by Weight
1-1/2"	38.1	100
1"	25.4	95 - 100
3/4"	19.0	80 - 100
1/2"	12.7	60 - 80
3/8"	9.52	30 - 50
No. 4	4.75	20 - 40
No. 8	2.38	10 - 30
No. 40	0.42	5 - 17
No. 200	75 mm	1 – 4

D. PLACEMENT OF PERMEABLE AGGREGATE BASE

1. Install permeable aggregate base to the lines and grades indicated.

2. The Contractor shall shape the complete surface of the aggregate base to receive the overlying elastomeric layer pad base and continue until the deviation from the required elevation does not exceed a compensating maximum deviation from grade of 1/8" in 10'.

3. The surface of the aggregate base course shall be well drained at all times. The permeability of the aggregate shall be checked by using 10" diameter cylinder and five (5) gallons of water to drain in less than one (1) minute. Test samples shall be taken (at a minimum of) one sample per every 5,000 square feet or as otherwise directed.

4. All test results will be logged and documented by the Contractor or Site Engineer. If, at any time, the aggregate base does not meet specifications, it shall be the Contractor's responsibility to restore, at his expense, the aggregate base to the required grade, cross section, density and permeability.

5. Moisture Content:

   Aggregate must contain 3.5 percent to 4.0 percent moisture content to ensure that fines do not migrate and to facilitate proper compaction. This is critical. Contractor shall ensure that aggregate leaving the source plant meets this requirement and is required to apply water to aggregate on site to attain and maintain this minimum moisture content.

6. Placement:

   (a) Prior to aggregate placement, remove any excess or contaminated backfill from the drainage trenches.

   (b) The sub-grade surface must be free of standing water prior to aggregate placement.

   (c) Ruts in the subgrade created by offloading and placement of the aggregate material shall be thoroughly repaired, by filling with competent material and compacting and rolling, in accordance with procedures specified herein.

(d) The aggregate should be placed in one lift.

(e) The aggregate layer must be spread uniformly with equipment that will not cause perceptible separation in gradation (segregation of the aggregates), preferably a self-propelled paving machine.

(f) Should this occur, during any stage of the spreading or stockpiling (a separation of the materials or particles), the contractor must immediately remove and dispose of segregated material and correct or change handling procedures to prevent any further separation.

(g) The Contractor shall utilize dual-plane laser-guided slope and grade equipment control systems for the grading of the permeable aggregate to ensure accuracy in the grade tolerances.

7. Compaction and Planarity:

(a) The aggregate layer shall be compacted (consolidated) to a minimum density of 90 percent of maximum dry density, utilizing a static, tandem drum-type roller, and as determined by ASTM 0698 and measured using a nuclear method, and to where it is stable.

(b) Proof roll wherever possible and mark "soft spots" for additional compaction. Use static tandem drum-type roller of not less than five (5) tons weight (non-vibratory roller), to consolidate. Excess rolling will produce segregation of fines and shall be avoided.

(c) The finished surface shall not deviate (tolerance-to-grade) from designated compacted grade. This means that the surface shall not deviate more than 1/8" in 10' (any direction) when placed under a 10' long straight edge. This tolerance is required over the entire field.

(d) Provide survey elevation of finish graded aggregate base layer specified for verification of field slope and planarity, as specified in Section 02535, 3.2 (A).

Areas that deviate should be marked with spray paint and corrected with material and rolled tight. Such remedial actions should be done by hand.

8. Contractor shall provide written certification that the sub-grade and aggregate base has been properly constructed, tested for drainage, slope and planarity, and meet the requirements of the specifications.

-- END --

SECTION 32 1824
SYNTHETIC RUNNING TRACK SURFACING

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. General Conditions, Special Conditions and section "Scope of Work" are a part of and govern work under this section.

B. Paving
   a. Section 32 1216 – Asphalt Paving
   b. Section 31 1313 – Concrete Paving

C. Pole vault box
   a. Section 12 9300 – Athletic Equipment

D. Track perimeter drain
   a. Section 33 4100 – Storm Utility Drainage Piping
   b. Section 33 4600 – Subdrainage

1.2 SCOPE

A. Accept finished bituminous pavement as suitable for these operations. Provide new finished running surface over entire track and field event areas complete with all markings, certifications, testing and warranty. Repair any damage on existing areas or facilities caused by these operations to original or better condition.

B. Color of synthetic surface shall be red. Overall surface thickness shall not be less than 13 mm.

1.3 STANDARDS

A. Contractor experience: Contractor shall demonstrate experience in the installation of at least five full sized synthetic polyurethane tracks within the last two years, utilizing the selected surfacing system. Polyresin or water-bound latex systems will not be acceptable. Any contractor wishing to offer an “or equal” must provide a sample, references, installation list and test results from an independent testing lab stating that the proposed product has been tested and

meets the requirements of IAAF performance specifications for synthetic track surfaces.

B. Manufacturer experience: Documented experience producing polyurethane athletic sports surface, as specified herein.

C. Quality control: Provide ISO 9001 certification for product design, manufacture and distribution for surfacing product / system utilized.

D. The primary surfacing materials utilized in the construction shall have proven compatibility and shall be obtained from a single manufacturer

E. Coordinate installation of synthetic surface with related work in all sections, including placement and acceptance of bituminous pavement.

F. Quantities of materials: The Contractor will be held accountable for all quantities of material utilized as measured on site, and in accordance with manufacturers printed specifications. Containers shall be labeled, and proof shall be furnished of quantities delivered, stockpiled and utilized.

G. Utilize only the highest quality materials and precision machinery. Installation and construction shall be first class, utilizing experienced, skilled workmen, installers and supervisors.

H. Warranty: A written manufacturer's/installer's warranty shall be furnished for all surfacing material for a period of five years from final acceptance for the track and field event surfaces. Warranty shall be against defects in material, workmanship, installation (including adherence to the asphalt), merchandising and fitness. Any defects occurring within the warranty period shall be promptly repaired upon written notification, at no cost to the Owner. Track striping and markings shall be warranted for a period of 2 years.

I. Certification: All markings shall be certified in writing by qualified personnel that the track has been marked and measured to be in accordance with NFHS requirements. Track and field event surface shall be monitored for performance requirements; established to measure imperfections, surface flatness, surface thickness, force reductions, vertical deformation, friction, tensile properties, color, and drainage characteristics. A letter of certification shall be provided to the Architect that the finished surfaces are furnished and installed in accordance with the manufacturer's printed specification.

J. Maintenance: The installer shall supply the Owner with written instructions for care of this surface.

PART 2 – PRODUCTS

2.1 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and installation instructions for track surface material.

B. Submit (3) samples of track surfacing material. Minimum size 3"x 4".

2.2 TRACK AND FIELD EVENT SURFACE

A. Synthetic Surface: Provide a black, paved, polyurethane-bound base mat system utilizing SBR rubber with multiple applications of a pigmented (red) structural spray, utilizing EPDM rubber, as Spurtan "BS", in accordance with the manufacturer's latest revised specification, as furnished by Advanced Polymer Technology, Harmony, Pa, (856) 767-3088, or approved equal.

2.2 MATERIALS

A. Primers: Polyurethane based primers specifically formulated to be compatible with the base and track surfacing material.

B. Black SBR Granules: The rubber granules for the base mat shall be recycled SBR (styrene Butadiene Rubber) rubber, processed and chopped to 1-3 mm size containing less than 4% dust.

C. EPDM Granules: The rubber granules for the structural spray wearing coats shall be EPDM peroxide cured, man-made rubber containing a minimum of 20% EPDM and having a specific gravity of 1.5 +/-0.1. The EPDM rubber will be 0.5mm to 1.5mm EPDM granules. EPDM granules shall be the color of the track surface.

D. Polyurethane Binder: Binder for the black rubber mat shall be an MDI-based mono-component, polyurethane binding agent. The binding agent shall not have a free TDI monomer level above 0.2%, must be clear in color, not milky, and must be solvent free. The binding agent must be specially formulated for compatibility with SBR stranded or rubber crumb.

E. Structural Spray Coating: The spray coating shall be the MDI-based mono-component, moisture cured, pigmented polyurethane, specifically formulated for compatibility with EPDM granules. The coating shall be red.

F. Line Marking Paint: The line marking paint shall be polyurethane-based paint specifically manufactured to be compatible with polyurethane synthetic track surfaces.

PART 3 - EXECUTION

3.1 BITUMINOUS SURFACE

A. Curing: Bituminous paving shall be allowed to cure a minimum of fourteen days prior to track surfacing application. It shall be the responsibility of the surfacing contractor to determine if the paving has cured sufficiently to allow application of the track surfacing.

B. Bituminous paving shall be verified for pitch and planarity and in accordance with Section _____; and flooded with water to check for depressions or low spots, prior to installation of final running surface.

3.2 PREPARATION

A. The entire area of the new bituminous paving to receive synthetic surface shall be thoroughly cleaned with mechanical air blowers, removing all loose and foreign material. All areas having dirt in the bituminous pores shall be cleaned by means of a high-pressure washer, flushing the surface with clean water. The area shall then be inspected for pitch and planarity in accordance with the requirements of this and the paving section. Areas not found to be in conformance shall be repaired.

3.3 INSTALLATION OF SURFACE

A. Apply primer and selected surfacing system in strict accordance with manufacturer's printed specification. An additional third spray coat shall be applied to all areas of the field events, as well as the inside two lanes of the track, the start areas for the 200m and 300m intermediate hurdles, and the entire sprint straight (home side). The third spray coat shall be applied at a rate of 1.0 pounds per square yard, in addition to the two coats applied at the standard manufacture's rate of 1.80 pounds per square yard per coat.

B. Priming: The primer shall be spray-applied in accordance with the manufacturer's specifications. Only those areas which can be installed the same day should be primed.

C. Mixture Composition: Job mix formulas shall be as follows:

1. Black Mat
   SBR Rubber 1-3mm
   Binding Agent 20% of total rubber weight
   Application Temperature Min. 45 Degrees F.

2. Structural Spray Top Coats 2 or 3 as indicated
   Structural Spray 60% by weight
   EPDM Rubber 0.5 – 1.5mm 40% by weight
   Application Temperature Min. 45 Degrees F.

D. Black Mat: The black rubber granules and polyurethane binding agent are blended together in a suitable mixer for a period of 2 to 3 minutes. The blended materials are then spread onto the asphalt/concrete base by means of a mechanical tandem leveler at a rate of 16 to 16.5 lbs. per square yard. The tandem leveler shall have a heated oscillating screed bar to obtain both smoothness and compaction. The heated screed bar normally works at a temperature of 158 to 176 degrees F.

The layering procedure shall be bay-to-bay and limiting the length of the passes so as not to have any cold (cured) joints between the bays. At the beginning of each day's work, the traverse joint from the previous day shall be tack coated to ensure a good bond. Small irregularities still in the surface after the tandem leveler has passed may be removed using a light polyethylene or teflon roller.

The surface hardens through the reaction of the binding agent with humidity. The speed of the reaction depends on temperature and relative humidity. Usually the surface may be walked upon the next day.

E. Structural Spray Wearing Coats: After the black mat has properly cured, apply a thixotropic mixture, using red Spurtan polyurethane binder and red EPDM granules, mixed in a metal container using a drill and mixing paddle and spray applied with approved air spray equipment designed for this use.

F. Physical Properties (ASTM)

Thickness:	½" (12-13mm) or as specified
Shore A Hardness (ASTM D-2240):	55 +/- 5
Elongation at break (ASTM D-412):	Approx. 90%
Tensile Strength (ASTM D-412):	0.75 N/mm^2 @ 70F
Compression Set Recovery (ASTM D-412):	90% to 95% @ 70F over a 24-hour period
Abrasion Resistance (ASTM D-501):	0.25 grams loss after 1000 cycles
Chalking (ASTM D-822):	No change after 1000 hours in weather meter.
Coefficient of Friction (ASTM D-1984):	Dry: 0.70 to 0.75 Wet: 0.60 to 0.65
Resilience (ASTM D-2632):	37% to 39%
Tear Resistance (ASTM D-624):	50-65 psi

3.4 OFFICIAL TRACK MARKINGS

A. Contractor shall provide the Owner with a color-coded working drawing showing all necessary track and field event markings. Submit for review and comment prior to any layout or line striping. The track markings shall include all necessary lane lines, start and finish line, relay exchange zones, hurdle markings, lane numbers and all other necessary markings in accordance with NFHS requirements. The paint for all markings shall be an approved polyurethane-based product specifically manufactured to be compatible with the running surface, installed by experienced personnel.

3.5 CERTIFICATIONS

A. Contractor shall provide the Owner with a document identifying and certifying that all calculations and markings are accurate in accordance with Paragraph 1.3.I. This document shall be field-verified and certified by a registered surveyor or professional engineer experienced in this work.

- - E N D - -

SECTION 32 8000
SITE IRRIGATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
1. Criteria and requirements for the design and construction of an underground, automatically controlled sports field irrigation system including electrical connections, water main connections, and accessories.

B. Related Requirements
1. Earthwork - Trenching, backfill, and compaction for utilities.
2. Water Distribution Systems.
3. Planting.
4. Planting Soils.
5. Erosion Control.

1.2 REFERENCES

A. ASTM International (ASTM)
1. ASTM D2239 - Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
2. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR-Series).
3. ASTM D2564 - Solvent Cement for poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
4. ASTM D2609 - Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.
5. ASTM D2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
6. ASTM D3350 – High Density Polyethylene (PE)

B. National Fire Protection Agency (NFPA)
1. NFPA 70 - National Electrical Code (NEC).

C. American Society of Safety Engineers
1. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers.
2. ASSE 1015 - Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies.

1.3 SUBMITTALS

A. Submittal process: Provide all required submittals within 30 days after contract award. Submittals shall be available at all times to the Construction Manager.

B. Quality Assurance Submittals:
1. Irrigation Contractor Qualifications: Provide minimum of 3 references and list of similar projects with owner's names, addresses, and telephone numbers.

C. Test Reports

D. Closeout Submittals:
1. As-Built Drawings:
a. Electronic: 2 CD/DVD with PDF and CAD file of irrigation plan.

b. Hardcopy: Furnish three sets, noting exact locations of elements and changes to Construction Drawings as well as Field notes (as-built completed by the in-field lead irrigator/Irrigation tech).

2. Operation Manual:
   a. Format
      1) Electronic: 2 CD/ DVD of manual.
      2) Hardcopy: Furnish three copies in a 3 ring binder.
   b. Manuals shall include the following:
      c. Approved submittals as specified herein.
      d. Installation instructions including mounting details for control valves.
      e. Operating Instructions:
         1) Winterization procedures.
            Recommended operation sequence, frequency, and length of operation cycle, as per relationship to estimated absorption rate, evaporation rate, plant type and anticipated flow. Provide schedule for winterization procedures.
      f. Maintenance Instructions:
         1) Manufacturers' product data, installation, and maintenance instructions.
            Copies of completed warranty information. Contractor to complete and mail necessary warranty registration information to manufacturer keeping copies for Owner.
3. Supply friction loss calculations for each zone within system.
4. Controller Chart: Prepare color coded chart reduced in size, mounted on the inside of the controller cabinet, containing same plan information as as-built drawings, and laminated in plastic on both sides, with following specific information:
   a. Note routing of main line, control wires, and controller location.
   b. Identify valves as to size, station number shown on controller, and type of irrigation head (e.g. micro spray head, rotary head) for each valve with estimated GPM.
   c. Delineate each station's limits of coverage by color-coding, with each station having different color showing its zone with zone number designation.
   d. Size, piping type, distance, and location to the distribution water source from POC to isolation valve.
   e. Size, type, and location of water source.
5. Meetings and Inspections Log.

1.4 QUALITY ASSURANCE

A. Contractor Qualifications: Minimum of 3 consecutive years' experience in area of project and having installed other jobs of similar size and scope.

B. Pre-Work Meeting and Conference Call: Convene a pre-work meeting and conference call at the Project site prior to commencing subgrade preparation for site paving to review conditions of operations, procedures and coordination with related work. Require attendance of parties directly affecting work of this Section including but not limited to Contractor, irrigation contractor, site work contractor, and Landscape Architect.
   1. Discuss conditions of Project site.
   2. Review approach and schedule for, but not limited to, the following items:
      a. Water source.
      b. Mainline routing and installation.
      c. Zone installation and site preparation.
      d. Material availability.
      e. Sleeve installation, installation of curb and paving markings for sleeve locations and coordination with site work contractor.
      f. Status of irrigation schedule
      g. Potential conflicts between irrigation and other site utilities
      h. Required Inspections.

C. Meeting and Inspection Log: Contractor to maintain log of required meetings and inspections. Record the date; time; weather conditions; and a brief summary of the discussions, decisions, and agreements reached. Landscape Architect will review and sign log at the conclusion of the each meeting and inspection. Furnish copy of log to each party attending.

1.5 MEETING AND INSPECTION NOTIFICATIONS

A. Provide the following notifications to the Owner's Civil Engineering Consultant within the time period listed below. Engineer will notify Owner, Landscape Architect, and other necessary sub consultants:
1. Pre-Work Conference Call: Minimum 14 calendar days prior to meeting date.
2. Static Pressure Test: 14 calendar days prior to inspection date.
3. Mainline Inspection and Hydrostatic Test: 7 calendar days prior to beginning irrigation work.
4. Substantial Completion Inspection: 7 calendar days prior to irrigation substantial completion.
5. Final Inspection: 7 calendar days prior to irrigation final inspection date.
6. Warranty Inspection: 14 calendar days prior to inspection date.

B. Provide notifications by email or other written means to show proof of delivery.

1.6 PROJECT CONDITIONS

A. Irrigation contractor to visit site and become familiar with nature and location of work, existing conditions, and conditions that will exist during installation.

1.7 WARRANTY

A. Guarantee Site Irrigation System for a period of 12 months following the Final Inspection approval in accordance with the following:
1. Defects in material, equipment, and workmanship.
2. Repair of damage to premises resulting from leaks or other defects in material, equipment, and workmanship to satisfaction of Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers shall include:
1. Hunter Industries, Inc., (800) 733-2823
2. Wilkins, (800) 767-1234.
3. The Toro Company - Irrigation Division, (888) 384-9939.
4. Site One Landscape Supply, (800) 748-3663
5. Harco Fittings, (434) 845-7094

2.2 PIPE

A. Polyvinyl Chloride (PVC): All PVC pipe shall be Schedule 40 or Class 200

B. Schedule 40 Flexible Polyethylene (PE): Pipe shall conform to ASTM D2239, SDR 11, SDR 21, PE23, rated at 160 PSI, National Sanitation Foundation (NSF) approved. Subject to approval of Owner, PE shall be used for laterals in areas where ground is subject to freezing for extended periods of time each year.

C. Class 200 Flexible Polyethylene (PE): Pipe shall conform to ASTM D2241, SDR 21, rated at 200 PSI, National Sanitation Foundation (NSF) approved. Subject to approval of Owner, PE shall be used for laterals in areas where ground is subject to freezing for extended periods of time each year.

D. Joints:
1. Pipe sizes 3 inch or smaller shall have ball and socket joints. Thrust blocking shall be required in accordance with industry standards.
2. Pipe sizes larger than 3 inch shall have ductile iron irrigation fittings with knuckle restrains used on the changes in direction. Thrust blocking shall be required in accordance with industry standards.
3. Harco DI service tee with lateral 90 should be used at all valve connections.

E. Pipe used for reclaimed water shall be appropriate color and marked as designated for such use.

F. Fittings:
1. Polyvinyl Chloride (PVC) Fittings: Fittings shall conform to ASTM D2241, Schedule 40, and Molded.
2. Flexible Polyethylene (PE) Lateral Line Fittings: Fittings shall conform to ASTM D3350, Type 1 PVC insert fittings designed for used with this type of pipe. Pipe and fittings shall be joined with stainless steel pinch clamps or worm gear clamps, including stainless steel screw where pressure levels deem necessary.

G. Risers above finished grade shall be black in color or receive 2 coats of black exterior semi-gloss enamel paint if a color other than black.

2.3 ACCESSORIES

A. Sleeves: Sleeves for pipes passing beneath paving shall conform to ASTM D2241, Schedule 40. Minimum diameter of 2 inch or 2 sizes larger than pipe scheduled to pass through them. Piping under the roads should be Schedule 40 with pipe 2x diameter of the pipe scheduled to pass through it.

B. PVC Solvent Cement: Cement shall conform to ASTM D2564.

C. Swing Joint Connections: Connections between heads and laterals shall be thick wall, flexible, polyethylene pipe, with fittings that have male barbs on one end and either male or female screw ends opposite. Glue fittings and female barb adapters are not allowed.

2.4 RECLAIMED WATER PRODUCTS AND MATERIALS

A. Irrigation products used with reclaimed water shall be the appropriate color and marked as designated for such use.

2.5 CUTOFF OR ISOLATION VALVES

A. 3 inches or Smaller: Provide full port brass ball valves with 600 WOG rating as manufactured by Red-White Valve Corporation, Carson, CA or equal.

B. Larger than 3 inches: Provide cast iron and bronze mechanical joint valves, fusion bonded epoxy coated exterior and interior, Resilient Wedge Valve as manufactured by Clow Valve Co., Oskaloosa, IA.

C. Provide a valve key and cast iron cylindrical valve box with top with each valve.

2.6 QUICK COUPLER VALVES

A. Provide the following as shown on the plans:
1. Hunter model HQ-5LRC with model HK-55 Key.

B. Provide each valve with key having 3/4 inch male top pipe threads for hose connection.

2.7 ELECTRIC CONTROL VALVES

A. Provide the following as shown on the plans:
   1. Hunter ICV Series electric remote control valves

B. Provide 3M DBY watertight connectors.

2.8 SPRINKLER HEADS

A. Full or Part Circle Pop-up Gear Driven Rotor Sprinkler:
   1. Acceptable Products:
      a. Hunter I-25 series pop-up rotors, with check valve. (4” and 6” popup heads)

2.9 DECODERS

A. Provide the following as shown on the plans:
   1. Hunter ICD-100 Single-station decoder with surge suppression and ground wire
   2. Hunter IDC -200 2-Station decoder with surge suppression and ground wire
      a. The minimum recommended level of protection is to have one decoder grounded at the end of each wire path and one decoder grounded every 500 feet.
      b. Both the controller and the decoders are to be grounded to ground rods or plates with less than 10 ohms resistance.

2.10 VALVE BOX

A. Valve boxes shall be manufactured by Ametek, Plymouth Products Division, Sheboygan WI., RainBird Corporation or equal by acceptable manufacturer. No irrigation valve box shall be placed in pavement areas or sports field unless otherwise shown on the Drawings.
   1. When used with single valve, provide Economy Turf Box or Rain Bird model VB-RND with green colored snap fit cover labeled "Valve Box".
   2. When used with 2 or more valves, provide Jumbo Box or Rain Bird model VB-STD with 20 inch x 14 inch cover opening with cover labeled "Control Valve".
   3. Support bases of valve boxes with at least 1(one) brick layer to distribute weight over valve box and reduce valve box sinking due to general landscape equipment (I.E ZTR mowers, gators, etc.). If more than one brick layer is required, alternate brick stack pattern.

2.11 MANUAL DRAIN VALVES

A. Manual drain valves shall be provided by acceptable manufacturers specified above.

2.12 CONTROL WIRE

A. Number 14-size minimum copper wire, U. L. approved for underground direct burial.

2.13 BACKFLOW PREVENTOR

A. Comply with requirements and codes of local governing authority regarding backflow prevention.

B. Provide the necessary materials, insulation/draining capabilities, and insulated hotbox fiberglass enclosure, dark green in color.

C. Backflow preventers shall be type suitable for use in high hazard cross connection to potable water system as manufactured by one of the following manufacturer's: Watts Regulator Company, Febco, or Wilkins.
   1. Reduced pressure backflow preventers shall be ASSE # 1013 and labeled accordingly.
   2. In absence of local codes or requirements, provide double check assembly backflow preventer installed in strict accordance with manufacturer's written instructions.

2.14 METER

A. Contractor to provide appropriate meter.

B. Meter and meter box shall conform to requirements of local utility company.

2.15 RAINFALL / FREEZE SENSOR

A. Rainfall / Freeze Sensor:
   1. Hunter Wireless Rain/ Freeze Sensor

2.16 FLOW SENSOR
   1. Acceptable product:
      a. Toro TFS Flow Sensor

2.17 MASTER VALVE
   1. Acceptable product:
      a. Hunter IBV – to be Commercial Grade, Brass

2.18 AUTOMATIC CONTROLLER
   1. Acceptable Product:
      a. Hunter ACC2-PED-SS
      b. Controller shall have an integral weatherproof, lockable stainless steel pedestal cabinet with internal transformer.
      c. Provide necessary electrical power per local and federal code.
      d. Mounting controller to surface provided by contractor if applicable.
      e. Setting the forms, conduit, and cement per manufacturers specs provided by the contractor if applicable.

PART 3 - EXECUTION

3.1 CONSTRUCTION PREPARATION

A. Pressure/Flow Test: Perform calculations according to the Irrigation Association's 3-Step Method. Provide written calculations to the Owner's Engineer including the following site information:
   1. Static or residual pressure at the POC.
   2. Calculation of pressure for "worst case" sprinkler head.
   3. Calculation of GPM per zone.

B. Prior to installation, receive approval from General Contractor to proceed with construction.

C. Contractor shall field verify all aboveground and underground utilities prior to start of work.

3.2 EXCAVATION

A. Trenching and Backfilling:

1. Trenching and backfilling shall conform to Earthwork Specifications.
2. Excavate trench to proper depth as shown or specified.
3. Minimum trench width shall be 3 1/2 inches.
4. Over excavate trenches deeper than required in soils containing rock or other hard material that might damage pipe and backfill to proper depth with selected fine earth or sand.
5. Backfill and hand tamp over excavation prior to installing piping. No depressions or sunken lines should be evident along trenched paths or swing joints. All grading should be maintained through the warranty.
6. Keep trenches free of obstructions and debris that would damage pipe.
7. Irrigation piping shall not be installed in same trench as heating duct, electric ducts, storm and sanitary sewer lines, water and gas mains.

B. Do not cut sidewalks, paved areas, or curb and gutter when trenching for piping unless otherwise noted on the Drawings.
   1. Provide sleeves as specified in Part 2 above under paving prior to installation of paving.
   2. Auger, bore, or tunnel under existing paving without disturbing pavement. Damaged pavement shall be removed and replaced in accordance with Paving Specifications.

3.3 WATER METER

A. Provide water meter box and meter for irrigation system as shown.

3.4 PIPING INSTALLATION

A. Minimum cover from top of piping to finished grade shall be provided as follows:
   1. Lawn and planting areas:
      a. Mains and Control Valves: 18 inches.
      b. Laterals: 12 inches.
   2. Drives or parking areas: 24 inches.

B. Clearances: Maintain 3 inch minimum horizontal clearance between parallel lines in same trench or vertical clearance between lines crossing at angles.

C. Special Requirements - PVC and PE pipe:
   1. Snake pipe in trench at least 1 foot per 100 feet of pipe to allow for thermal expansion.
   2. Pipe laterals shall be laid to drain to low point drains located at lowest elevations of each zone.

D. Rest full length of pipe section on bed of trench, excavating recesses to accommodate joints. Do not lay pipe on unstable material or blocking, or when in opinion of Owner deems the conditions are unsuitable.

E. Threaded Plastic Pipe Jointing:
   1. Do not use solvent cement on threaded joints.
   2. Wrap joints with Teflon tape or use virgin Teflon lubricant.

F. Bell and Socket Plastic Pipe Jointing: Cement joints in accordance with ASTM D2855.

3.5 QUICK COUPLER AND AUTOMATIC LOW POINT DRAIN VALVES

A. Provide quick coupler valves as shown on the drawings to accommodate winterization.

B. Provide automatic low point drain valves on all zones. Provide two valves at lowest point of each zone with each drain installed above a 12 inch by 12 inch by 12 inch deep area of coarse washed gravel.

3.6 SLEEVING

A. Provide sleeves for both piping and control wiring where either passes under paved surfaces.
   1. Depths of sleeves shall be same as that required for piping at each location or condition.
   2. Extend sleeves 12 inches beyond paving at each end.
   3. Install permanent benchmark at top of curbs for reference to sleeve locations.
   4. Maximum depth of sleeves will be no more than 24" (inches).

3.7 VALVES

A. Do not locate beneath paved surfaces.

B. Install plumb to within 1/16 inch.

C. Locate within valve box with 6 inch deep layer of coarse gravel beneath bottom of valve.

D. Install PVC ball valve for plastic valves, or brass gear isolation valves for brass valves immediately before (up-stream) all valves and PVC ball valves prior to swing joint, but within valve box of quick couplers matching size of pipe prior to valve or quick coupler

E. Top of quick coupler valves shall be 6 inches to top of valve box. Top of gravel layer shall be 3 inches below top of valve. Support with 2 (two) metal rods with stainless steel worm gear clamp. Purple valve lid and purple quick coupler cap to be used.

F. Master Valve:
   1. Locate immediately behind backflow preventer.
   2. Valve shall be energized by master valve circuit on automatic controller.
   3. Provide 6 wires to connection plus two sets of three of which the color must differ from red and white.

3.8 SPRINKLERS

A. Install plumb to within 1/16 inch with top collar, not nozzle, flush with finish grade.

B. Provide swing joint with each sprinkler except where entire head is raised above grade and/or where rigid riser piping is required.

C. Heads adjacent to paving and curb: Locate 6" (inches) from edge of paving or back of curb to prevent car overhang to conflict with a fully extended sprinkler.

3.9 ELECTRICAL CONNECTIONS AND CONTROL WIRE

A. Conform to the National Electrical Code (NEC) and local electrical codes.

B. Provide electrical connection to system as designated on the Drawings and as specified herein.

C. Wire Placement:
   1. Do not run control and power supply wiring in same conduit.
   2. Provide continuous runs of wire between controller and valves. Splices shall be made with one of following:
      a. Watertight in ground electrical junction boxes. DBR/Y 600
      b. Water-tight connectors, such as utilized for valves, and located within valve box for ease of locating.
      c. The location of electrical splices shall be shown on the As-Built drawings.
   3. Bury control wire beside pipe in same trench. Bundle and tape together at not more than 10 ft intervals

D. Expansion Loops: Construct by wrapping wire around 1/2 inch diameter pipe to create coil. A 3 foot section of wire shall be used to create 12 inch coil with 6 foot section being used to create 24 inch coil.
   1. Provide 12 inch coils at each wire splice, not including valves, and at each change of wire direction.
   2. Provide 24 inch coils at each control valve, master valve, flow meter and where each valve enters conduit for automatic controller.

3.10 BACKFILLING

A. Sand or fine-grained soils free of weeds, debris, and rock shall be used for initial backfill to sufficient depth to prevent damage to pipe from rocks or other debris during compaction of subsequent backfill.

B. Fill trench to within 3 inches of finish grade with excavated soil and compact in accordance with Earthwork Specifications.

C. Fill top 3 inches with existing topsoil in planting or turf areas and wheel roll until compaction of backfill is same as surrounding soil.

D. Grade backfilled trench uniform with surrounding grades.

3.11 BACKFLOW PREVENTOR

A. Comply with local codes for installation of backflow preventer. In absence of local codes, install in accordance with manufacturer's written instructions.

3.12 RAINFALL / FREEZE SENSOR

A. Location and installation shall be as shown on the Drawings and per manufacturer’s written recommendations.

3.13 FLOW SENSOR

A. Location and installation shall be as shown on the Drawings and per manufacturer’s written recommendations.

3.14 MASTER VALVE

A. Location and installation shall be as shown on the Drawings and per manufacturer’s written recommendations.
   1. Master valve normal operating position shall be open and shall be electronically actuated.

3.15 AUTOMATIC CONTROLLER

A. Location and installation shall be as shown on the Drawings and approved by Owner prior to installation.

B. Install rigid conduits for both power supply and control wiring.
   1. Control wire conduit shall extend to 18 inches below grade.
   2. Pull spare wires for future valves and extend to area outside paved surfaces.

C. Install electrical grounding for controller in accordance with manufacturer's written instructions.

D. All wires (valves and spares) to be labeled within the control box with professional typed lettering labels, numbered and installed in order.

3.16 FIELD QUALITY CONTROL

A. Irrigation Inspections: Conduct the following inspections during the course of the work in the presence of the Landscape Architect, (each to be notified electronically/over the phone) to verify conformance to specification requirements. Notify Engineer for observation of inspection by the Landscape Architect. Correct noted deficiencies during each inspection prior to proceeding with subsequent work.
   1. Mainline/lateral line Inspection: Inspect the installed main line, electronic control valves, Valve box, wiring and wiring splices, quick-coupler valves, isolation valves prior to backfilling.
   2. Substantial Completion Inspection: Inspect all completed irrigation work. Landscape Architect will develop a punch list of deficient or incomplete items and deliver to Contractor within 3 calendar days of inspection date.
   3. Final Inspection: Within 30 days of project substantial completion date and subsequent to correction of punch list deficiencies, convene a final inspection of all irrigation work.
   4. Warranty Inspections: Convene a warranty inspection each 60 calendar days, till expiration of warranty period specified in Landscape Specifications.

B. Inspection and Adjustments: Following installation and prior to Substantial Completion Inspection, make final adjustments to site irrigation including but not limited to the following:
   1. Flush system completely, with nozzles and screens removed and drip lines ends open to extract debris.
   2. Verify sprinkler operation (head to head spacing), depth, and alignment for direction of throw. Correct as necessary.
   3. Check rotors for proper arc of spray with no overthrow onto pavement. Adjust nozzles as necessary for proper throw and matched precipitation rate.
   4. Ensure uniform distribution exists.
   5. Ensure proper irrigation head operational after landscaping and/or sod installation.

C. Main Line and lateral lines Inspection and Hydrostatic Tests:
   1. Owner's Landscape Architect, Maintenance personnel and/or Irrigation Designer will observe testing.
   2. Center load piping with small amount of backfill to prevent arching or slipping under pressure.
   3. Install risers and caps on mainline and sub-main lines. Apply continuous and static water pressure of 120 psi for a minimum of 3 hours when welded plastic joints have cured at least 3 hours.
   4. Allowable Leakage:
      a. Utilize the following formula to calculate the allowable leakage for O-ring gasket pipe.

         $L=SD(P)^{0.5}$
         133,200
         In which: L=Allowable leakage in gallons per hour
         S=Length of pipe tested in feet
         D=Pipe diameter in inches
         P=Average test pressure in PSI gauge
      b. No allowable leakage shall be acceptable with solvent based mainline system.
   5. Repair leaks and retest.

3.17 CLOSEOUT ACTIVITIES.

A. Demonstration: Following final adjustment, operate entire irrigation installation to demonstrate complete and successful operation of equipment.

B. Cleanup: Contractor to have all excess materials removed from site and the site in proper order for closeout.

END OF SECTION

SECTION 32 12 16

ASPHALT PAVING

PART 1 - **GENERAL**

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cold milling of existing hot-mix asphalt pavement.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving.
4. Hot-mix asphalt paving overlay.
5. Pavement-marking paint.

B. Related Sections:

1. Division 02 Section "Structure Demolition" for demolition, removal, and recycling of existing asphalt pavements, and for geotextiles that are not embedded within courses of asphalt paving.
2. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.
3. Division 32 Sections for other paving installed as part of crosswalks in asphalt pavement areas.
4. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants and fillers at paving terminations.

C. Delaware Department of Transportation (DelDOT) Standard Specifications.

D. Delaware Department of Natural Resources and Environmental Control (DNREC) Erosion and Sediment Control Handbook.

1.3 DEFINITION

A. Hot-Mix Asphalt Paving Terminology: See DelDOT Standard Specifications.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1. Job-Mix Designs: For each job mix proposed for the Work.

B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

C. Material Certificates: For each paving material, from manufacturer.

D. Material Test Reports: For each paving material.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by DelDOT.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of DelDOT for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

D. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
b. Review condition of subgrade and preparatory work.
c. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: See DelDOT Standard Specifications

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: All aggregates for asphalt paving are in accordance with the DelDOT Standard Specifications.

2.2 ASPHALT MATERIALS

A. All asphalt materials are in accordance with the DelDOT Standard Specifications.

B.

2.3 AUXILIARY MATERIALS

A. Paving Geotextile: AASHTO M 288, nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.

B. Joint Sealant: Per the DelDOT Standard Specifications.

C. Pavement-Marking Paint: As shown on the project plans and in accordance with the DelDOT Standard Specifications.

2.4 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by DelDOT and in accordance with the DelDOT Standard Specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

D. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

3.2 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

1. Mill to a depth of 2 inches.
2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
3. Control rate of milling to prevent tearing of existing asphalt course.
4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
6. Transport milled hot-mix asphalt to asphalt recycling facility.
7. Keep milled pavement surface free of loose material and dust.

3.3 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving in accordance with the DelDOT Standard Specifications.

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.

C. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.4 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Prime Coat: In accordance with the DelDOT Standard Specifications.

C. Tack Coat: Apply uniformly to surfaces of existing pavement in accordance with the DelDOT Standard Specifications.

3.5 PAVING GEOTEXTILE INSTALLATION

A. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches and transverse joints 6 inches.

1. Protect paving geotextile from traffic and other damage and place hot-mix asphalt paving overlay the same day.

3.6 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 in accordance with the DelDOT Standard Specifications.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.7 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time.
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.

3.8 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers in accordance with the DelDOT Standard Specifications.

B. 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.

C. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

D. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.9 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the tolerances found in the DelDOT Standard Specifications.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the tolerances found in the DelDOT Standard Specifications.

3.10 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for 14 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

1. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

C. In-Place Density: In accordance with the DelDOT Standard Specifications.

3.12 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an DNREC approved landfill.

END OF SECTION 32 12 16

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SECTION 32 13 13

CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Walks.
   2. Concrete Pavement
   3. Concrete Pads
   4. Concrete Curb

B. Related Sections:

   1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
   2. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

C. Delaware Department of Transportation (DelDOT) Standard Specifications.

D. Delaware Department of Natural Resources and Environmental Control (DNREC) Sediment and Erosion Control Handbook.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

C. Other Action Submittals:

1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

D. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Admixtures.
4. Curing compounds.
5. Applied finish materials.
6. Bonding agent or epoxy adhesive.
7. Joint fillers.
8. Aggregates and sand materials.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with the DelDOT Standard Specifications.

B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

C. Pre-installation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:
   a. Quality control of concrete materials and concrete paving construction practices.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:

   a. Contractor's superintendent.

b. Concrete paving subcontractor.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces in accordance with the DelDOT Standard Specifications.

B. Form-Release Agent: In accordance with the DelDOT Standard Specifications

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from steel wire into flat sheets as shown on the plans and in accordance with the DelDOT Specifications.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
   a. Portland Cement: Per the DelDOT Standard Specifications.

B. Normal-Weight Aggregates: Per the DelDOT Standard Specifications.

C. Water: Per the DelDOT Standard Specifications.

D. Air-Entraining Admixture: Per the DelDOT Standard Specifications.

2.4 CURING MATERIALS: All curing shall be in accordance with the DelDOT Standard Specifications.

2.5 RELATED MATERIALS

A. Joint Fillers: In accordance with the DelDOT Standard Specifications.

2.6 CONCRETE MIXTURES

A. All concrete shall be Type “B” (3,000 PSI) in accordance with the DelDOT Standard Specifications.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete in accordance with the DelDOT Standard Specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Division 31 Section "Earth Moving."

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: In accordance with the DelDOT Standard Specifications.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Provide tie bars at sides of paving strips where indicated.
3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet for paving and 20 feet for sidewalks and curbing unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness at 25-foot intervals for paving and 5-feet for sidewalks.

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes.

3.6 CONCRETE PLACEMENT

A. Placement of concrete shall be as shown on the plans and in accordance with the DelDOT Standard Specifications.

3.7 FLOAT FINISHING

A. Float finishing shall be in accordance with the DelDOT Standard Specifications.

3.8 CONCRETE PROTECTION AND CURING

A. Concrete protection and curing shall be in accordance with the DelDOT Standard Specifications.

3.9 PAVING TOLERANCES

A. Paving tolerances shall be in accordance with the DelDOT Standard Specifications.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: In accordance with the DelDOT Standard Specifications.
2. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
3. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.

a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Concrete paving will be considered defective if it does not pass tests and inspections.

F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.11 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 13 13

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Chain-link fences and gates.

2. Swing Gates

B. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete" for cast-in-place concrete for equipment bases/pads for gate operators and controls and post footings.
2. Division 26 Sections for electrical service and connections for motor operators, controls, limit and disconnect switches, and safety features and for system disconnect switches.

1.3 PERFORMANCE REQUIREMENTS

a. Structural Performance: Chain-link fence and gate framework shall withstand the effects of gravity loads.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences and gates.

1. Fence and gate posts, rails, and fittings.
2. Chain-link fabric, reinforcements, and attachments.
3. Gates and hardware.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show accessories, hardware, gate operation, and operational clearances.

1.5 QUALITY ASSURANCE

A. Pre-installation Conference: Conduct conference at Project site.
   1. Review required testing, inspecting, and certifying procedures.
   2. Coordination of new fencing installation and removal of existing fencing.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer/Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.

   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with CLFMI Product Manual and with requirements indicated below:

   1. Fabric Height: As indicated on Drawings.
   2. Steel Wire Fabric: Wire with a diameter of 0.192 inch (6 gauge).

      a. Mesh Size: 2 inches.
      b. Zinc-Coated Fabric: ASTM A 392, Type II, Class 1, 1.2 oz./sq. ft. with zinc coating applied after weaving.

      c. Coat selvage ends of fabric that is metallic coated before the weaving process with manufacturer's standard clear protective coating.

   3. Selvage: Twisted top and knuckled bottom.

2.2 FENCE FRAMING

A. Posts and Rails: Comply with ASTM F 1043 for framing, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 based on the following:

1. Fence Height: As indicated on Drawings.

2. Heavy Industrial Strength: Material Group IA, round steel pipe, Schedule 40.

   a. Line Post: 4.0 inches.
   b. End, Corner and Pull Post: 4.0 inches.

3. Horizontal Framework Members: Top and bottom rails complying with ASTM F 1043, 1 5/8 inch diameter.

4. Brace Rails: Comply with ASTM F 1043, 1 5/8 inch diameter.
5. Metallic Coating for Steel Framing:

   a. Type A, consisting of not less than minimum 2.0-oz./sq. ft. average zinc coating per ASTM A 123/A 123M.

2.3 SWING GATES

A. General: Comply with ASTM F 900 for gate posts and single swing gate types.

1. Gate Leaf Width: As indicated.
2. Gate Fabric Height: As indicated.

B. Pipe and Tubing:

1. Zinc-Coated Steel: Comply with ASTM F 1043 and ASTM F 1083; protective coating and finish to match fence framing.
2. Gate Posts: Round tubular steel.
3. Gate Frames and Bracing: Round tubular steel.

C. Frame Corner Construction: Welded.

D. Hardware:

1. Hinges: 180-degree inward swing.
2. Latches permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
3. Padlock and Chain: Owner will provide locks.
4. Lock: Closer: Manufacturer's standard.

2.4 FITTINGS

A. General: Comply with ASTM F 626.

B. Rail and Brace Ends: For each gate, corner, pull, and end post.

C. Rail Fittings: Provide the following:

1. Top Rail Sleeves: Round-steel tubing not less than 6 inches long.
2. Rail Clamps: Line and corner boulevard clamps for connecting bottom rails in the fence line-to-line posts.

D. Tension and Brace Bands: Pressed steel.

E. Tension Bars: Steel length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

F. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.

G. Tie Wires, Clips, and Fasteners: According to ASTM F 626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:

a. Hot-Dip Galvanized Steel: 0.106-inch; galvanized coating thickness matching coating thickness of chain-link fence fabric.

H. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. zinc.

2.5 GROUT AND ANCHORING CEMENT

A. Non-shrink, Nonmetallic Grout: Premixed, factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Erosion-Resistant Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer, for exterior applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading is completed unless otherwise permitted by Architect/Engineer/Construction Manager.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 INSTALLATION, GENERAL

A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements indicated.

3.4 CHAIN-LINK FENCE INSTALLATION

A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

B. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.

C. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.

D. Line Posts: Space line posts uniformly at 10 feet o.c.

E. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail

at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

F. Bottom Rails: Install and secure to posts with fittings.

G. Chain-Link Fabric: Prior to placing fabric, excavate trench for placement of fence anchoring concrete. Apply fabric to outside of enclosing framework. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released. Pour anchoring concrete as shown on the plans embedding 3-inches of the fabric in the concrete.

H. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches o.c.

I. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.

1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.

J. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

3.5 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.6 FIELD QUALITY CONTROL

3.7 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware, gate operator, and other moving parts.

END OF SECTION 32 3113

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SECTION 32 9200
GRASS ATHLETIC FIELD CONSTRUCTION

PART 1- GENERAL

1.1 SECTION INCLUDES

A. Grass athletic field reconstruction

B. Root zone preparation for athletic fields.

C. Seeding, sodding and turf grass establishment for athletic fields.

D. Grow-in maintenance.

1.2 RELATED SECTIONS

A. Section _____ – Quality Requirements.

B. Section _____ – Product Requirements.

1.3 RELATED DOCUMENTS

A. Erosion and Sediment Control Plan and DNREC requirements for temporary seeding, permanent stabilization, site stabilization during construction as approved DNREC.
B. Topsoil Test Report.

1.4 DEFINITIONS

A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

B. Athletic Field:

1. Multi-purpose Field: Playing area as dimensioned on Drawings, including sideline area as extending a minimum of 10-feet from the perimeter of the playing area or to adjacent perimeter fence, not to exceed 25-feet.

2. Baseball and Softball Fields: Playing area as dimensioned on Drawings, including limit of outfield area and extending around entire playing field area to adjacent foul line fence, not to exceed 50-feet.

C. Root Zone: Area of amended topsoil and soil backfill for establishing turf grass

D. Erosion and Sediment Control Plan: Includes all plans, narratives, calculations, and conditions of the as approved and issued by the DNREC. A copy of the approved plans and permit must be available on-site at all times during construction.

1.5 QUALIFICATIONS

A. Work of this Section shall be performed by a company with a minimum of five years documented experience in athletic field construction with a minimum of 25-acres of documented athletic field construction, turf grass installation, and turf grass maintenance.

B. Have at least one senior staff member who carries a current "Certified Field Builder – Natural Turf" certification as issued by the American Sports Builders Association.

C. Contractor shall submit at the time of bid a list and description of a minimum of three projects completed within the last five years of projects of similar scope, including brief description of the work, location, name of owner and contact person.

D. The Owner reserves the right to evaluate the qualifications of any Contractor or subcontractor and may disqualify any Contractor, or subcontractor, at its sole discretion based on the documented experience of the Contractor.

1.6 STANDARDS

A. All seed varieties contained in the seed mixtures shall be certified seed by the State where the seed was manufactured.

B. All chemical applications shall be performed in accordance with local, state, and federal regulations utilizing EPA registered materials and methods of application. All

chemical applications shall be performed under the supervision of a Licensed Certified Applicator.

1. All concentrate materials shall be stored in bulk containers and clearly labeled, including material safety data. No containers shall be stored or left on site.

2. Dispense chemicals from concentrate tanks.

3. Provide spillage containment for concentrates and chemicals.

1.7 SUBMITTALS FOR REVIEW

A. Seeding and Sodding:

1. Manufacturer's Certified Analysis: Submit manufacturer's certified analysis for each seed mix showing percentage of each variety in mix, percent pure live seed, net weight by variety in mix, age of seed, and date of production.

2. Sod Certification: Submit certification from sod supplier indicating State of origin, percentage of grass varieties in sod blend, and State sod certification.

3. Laboratory Test: Submit a minimum of three samples of the existing topsoil, mixed with the organic material and other amendments, consistent with the proportions of the root zone mix to be installed, to approved testing laboratory. Provide Architect with test results prior to installation of root zone mix.

4. Soil Amendments and Turf Establishment Program: Based on the provided Topsoil Test Report, prepare and submit a schedule of soil amendments and fertilization required for each seed mix, time and method of application, a schedule indicating when areas will be seeded, anticipated dates of Substantial Completion, fertilization practices during establishment, application of preemergent and post emergent herbicides, and other practices that will be incorporated as part of the Work. The Architect will consider the submittal for informational purposes only.

5. Product Data: Submit product data, manufacturer's installation instructions, specifications, catalog cuts, and manufacturer's standard shop drawings as required by Section 01330.

1.8 SUBSTITUTIONS

A. Pre-bid: The Contractor shall make every reasonable effort to find the seed varieties and materials specified. Make recommendations for substitutions if desired seed mix or variety is unavailable, or, in the Contractor's opinion, unsuitable for the site, location to be planted, or other reasons that may result in the failure successfully establish. Notify the Architect if disease resistant or insect resistant species can be substituted for the selected pest-prone species or variety.

B. Post-Bid: Requests for substitutions following bid shall be approved by the Engineer. Contractor shall submit request in writing, state the reasons for the substitution, and state the variety or mix to be substituted.

1.9 COORDINATION

A. Coordinate and schedule Work to permit seeding or sodding to occur during regular planting seasons. Where Work cannot occur during regular planting seasons, employ methods as required to address seasonal conditions at time of seeding or sodding.

B. Coordinate Work under provisions of Section 01310 and so as to avoid conflict with other operations. Contractor shall be responsible for regrading and stabilizing any areas damaged due to a failure to coordinate or schedule construction activities.

C. Notify Owner a minimum of three days in advance of all maintenance work including regrading, fertilizing and mulching through substantial completion.

1.10 PLANTING SEASONS

A. Spring: The spring seeding season is March 15 to May 30. Spring seeding shall be conducted during this period unless approved by the Architect to begin seeding earlier or perform summer seeding. No seeding shall be done on frozen ground, when the air temperature is less than 32-degrees farenheit, or when the soil temperature is less than 50-degrees Fahrenheit regardless of the date of seeding.

B. Fall: The fall seeding season is August 31 to October 31. Fall seeding shall be conducted during this period unless approved by the Architect to perform seeding earlier or to perform late fall seeding. . No seeding shall be done on frozen ground, when the air temperature is less than 32-degrees Fahrenheit, or when the soil temperature is less than 50-degrees Fahrenheit regardless of the date of seeding.

Permission to seed November 1 to March 14 will only be given when completion of the project is imminent and the environmental conditions are conducive to acceptable growth.

1.11 INSPECTION AND ACCEPTANCE

A. Minimum area required for inspection and acceptance: Architect will consider requests for inspection to determine Substantial Completion only where the entire athletic field turf has been established. Request for partially completed field areas will only be accepted where Owner schedule has limited completion to a partial area.

B. Pre-Inspection requirements and certifications: Submit written request to Architect for Substantial Completion inspection. Written request shall include the following:

1. Identification of the field, or field areas to be inspected.

2. Date required Inspection Maintenance would be completed.

3. Performance certifications: Submit following certifications from soil testing laboratory, that the following performance criteria have been met. A minimum of four tests per field is required to determine consistency of the Work:

   a. Organic matter content must be between 3 – 6 percent.
   b. Compaction of the field must be no greater than 80-percent as determined by ASTM D1557, Modified Proctor.
   c. Minimum root depth must be at least 3-inches.
   d. Organic matter and nutrients must be consistently incorporated to a depth of at least 3-inches.

4. Tolerance of Final Surface for Acceptance: Once fine grading is complete and prior to installation of seed or sod perform a survey of the field. The finished plane of field surface shall not vary by more the ¼-inch when measured along any point of the plane, whether perpendicular or parallel to the contour. Finished slope shall be within one tenth of a percent (0.10%) of the design gradient.

   a. Survey Certification: Submit a plan, prepared and sealed by a registered professional surveyor, with spot elevations on a grid interval of twenty-five feet. Grid shall tie to a minimum of two field

corners and shall be based on project datum. Plan shall be considered for verification of finished field grade tolerance.

C. Inspection: Upon completion of the Work as defined in Paragraph 1.13.A, request an inspection to determine substantial completion. Request shall be made to the Architect in writing and Architect shall complete inspection within two weeks of receipt of request for inspection. Contractor shall clearly note in request for inspection which areas are substantially complete if not requesting inspection for the entire installation.

1. Architect will issue a notice of Substantial Completion following inspection where Work is substantially in conformance with the specified requirements and Drawings. Minor deficiencies shall be noted and Contractor shall correct all deficiencies within two-weeks of receiving notice.

2. Where Architect determines that Work is not substantially complete due to significant deficiencies, Contractor shall take immediate corrective action. Upon completion of corrective measures, Contractor shall again request inspection to determine if Substantial Completion has been obtained.

D. Inspection Maintenance: Grass shall be cut to specified height, including hand trimming, turf area substantially free of weed growth and perimeter of infield areasnd along walkways edged a maximum of three days prior to requesting inspection for Substantial Completion.

1.13 WARRANTY

A. For athletic fields that do not include installation of subsurface irrigation systems the warranty for the turf areas shall be forty-five (45) days from the date of completion of the Substantial Completion punch list and written acceptance of the field by the Owner. Rebuild, repair, or replace any areas of turf that have proven defective due to failure to comply with the Specifications in any way.

1. Contractor is not responsible for defective areas due to vandalism, areas that have been damaged by the Owner or Owner's use, or as a result of the Owner's failure to execute maintenance procedures following substantial completion.

1.14 GROW-IN PERIOD MAINTENANCE SERVICE

A. Maintain seeded and sodded areas immediately after placement until grass is well established. Maintain all seeded areas until a vigorous, weed free, healthy growing condition is present and Substantial Completion is established.

1. Seeded Areas: A request for inspection to determine Substantial Completion will not be considered until a vigorous uniform growth over at least 90% of the seeded area is present.

2. Sodded Areas: A request for inspection to determine substantial completion will not be considered until the sodded area has been in place for a minimum of 45 calendar days and sod exhibits a vigorous growing condition.

B. Where seeding or sodding is required outside of the Spring or Fall Planting seasons, perform additional maintenance, provide additional mulch, frost protection blanket, compost, increased seeding rate, over-seeding, and other Work as required to improve germination conditions.

PART 2 - PRODUCTS

2.1 TOPSOIL INSTALLATION AND GRADING EQUIPMENT

A. General: All equipment operation in the root zone area shall be rubber floatation turf tires or rubber tracks.

B. Deep-Tine Aeration: Turf grass aeration machine having 3/4-inch solid tines capable of penetration a minimum of twelve-inches with hole spacing no greater than 5-inches. Unit shall be PTO driven with a rear roller on unit. Tractor shall have a minimum horsepower rating of 55, turf tires, and a lift capacity of 3,600 pounds.

C. Soil Screener: Portable “star” type screener capable of screening a minimum of 1,500 cubic yards of dry soil per day

D. Rough Grading and Finished Grading: Grader equipped with dual laser pickup with dual laser grade range mode. The laser pickup shall operate the blade elevation controls automatically once locked on the laser beam. Laser source shall be capable of operating in either the positive or negative angle configuration without physically moving the laser source head.

1. Laser source accuracy: One thousandth of a percent (0.000).

2. Grader shall have rubber flotation turf tires.

E. Tilling: Reverse-sifting tiller, Roto-dairon or equivalent, operating at a minimum of 110 horsepower and capable of ground speeds of 1/3 mph.

2.2 TOPSOIL

A. On-site available topsoil or approved imported topsoil. The Contractor shall be responsible for providing satisfactory topsoil as required to meet the quantities necessary for the Work.

B. Soil Testing: Soil tests shall be done prior to seeding by Contractor. The soil test shall include a mechanical analysis to determine soil texture, pH, magnesium, phosphorus, and potassium. Testing shall also measure organic matter and soluble salts. The minimum number of soil tests shall be six spaced randomly throughout the field to obtain the most thorough sampling. Topsoil shall not be tested until it has been stripped and stockpiled. All imported topsoil shall be approved by the Architect before the material is delivered to the site.

C. Soil Amendments: Amend topsoil as determined by the soil tests to adjust soil conditions to obtain required organic matter content, soil reaction, and nutrient availability in the root zone.

1. The presence of conditions affecting fertility, germination, high or low organic content, soil compaction, or similar conditions does not alleviate the Contractor of responsibility to provide required growing and germination conditions.

D. All topsoil shall be free of stones, lumps, plants, roots, and other debris over 3/4inch at time of initial placement on finished subgrade. Topsoil shall be free of weeds, weed seeds, foreign grasses, and toxic substances, such as pesticides, that are harmful to plant growth.

2.3 FERTILIZER

A. All fertilizer shall be uniform in composition, free flowing and suitable for application by mechanical spreaders. Fertilizers shall be delivered in sealed containers showing

percentage by weight of all components and shall bear the name, trade name, and warranty of the producer.

1. Application rate: Per soil test.

B. Starter Fertilizer: Ratio of 1-2-1, consisting of 50% Nutralene. Apply at a rate of 1 lb. Nitrogen/1,000 square feet

2.4 LIME

A. Lime material shall be ground or pulverized limestone that contains at least 50percent total oxides, calcium oxide plus magnesium oxide. Limestone shall be ground to such fineness that at least 50-percent will pass through a 100-mesh sieve and not less than 98-percent will pass through a 20-mesh sieve. Granular or pelletized lime may also be used subject to the requirements for pulverized limestone.

1. Application rate: Per soil test.

2.6 ORGANIC MATTER

A. Commercially available uniform compostion meeting the following:

PH:	6.5 – 8.5
Moisture Content:	30% - 55%
Soluble Salts:	<4.0 mmhos/(cm)
C:N Ratio:	25:1
Particle Size:	<3/8”
Organic Matter Content:	>40% (dry weight basis)
Ash Content	<60%
Nitrogen	0.5% to 3%
Phosphorous	>0.2%

(Equal to Terra-Gro, Terre Hill, PA 17581. Phone number 1-800-359-1384.)

B. Other equal naturally occurring organic product blended for turf grass use.

2.7 HYDROMULCH

A. Mulch: Mulch shall be wood cellulose fiber, containing no growth or germination inhibiting substances; a soil-binding agent (tackifier) is required; mulch shall be dyed a suitable color to facilitate placement. Features also defined in Section 2.10B below.

B. Liquid Mulch Binder: Non-asphaltic or petroleum based, Reinco, RMB plus (1800-526-7687), Finn A 500 Hydro-Stik (1-800-873-3321), or equal capable of controlling wind and water erosion of mulch.

2.8 SEED MIX

A. Seed Mixture: 100% Turf Type Tall Fescue with any three of the following varieties: Hemi, Turbo, Bullseye, Rebel Exeda, Summer, No Net

1. Seed shall be a minimum of 80-percent endophyte enhanced, consist of a minimum of 98-percent pure seed with 0-percent weed seed, and have a minimum 90-percent germination rate.

2. Seeding Rate: Turf Type Tall Fescue – 11 pounds per 1,000 SF

B. Apply all seed mixtures at half-rates in two cross-directions.

2.9 SOD

A. Provide machine cut sod with maximum deviation from width and length being 5percent. Must be big roll sod (4’ wide x 62’ long). Broken rolls and torn or uneven ends are not acceptable. Sod shall be utilized at all baseball infields and for an 8 ft wide perimeter strip at the outside edge of all baseball and softball skinned infield areas, including first and third base line and batters circle, as shown on plans.

B. Do not provide sod that has been harvested or transplanted under drought conditions.

C. Sod shall be harvested, delivered, and installed within a period of 24-hours.

D. Turf grass sod, consisting of 90% Tall Fescue and 10% Kentucky Bluegrass from Sporting Valley Turf Farms, Manheim, PA 17545.

2.10 MULCHING MATERIALS

A. Salt Hay: Free of rot, mildew, noxious weed seeds and shall be small-grained, such as wheat or barley. Apply at a rate to lightly cover soil, approximately 100 lbs. per 1,000 square feet.

B. Cellulose Fiber: Specially prepared cellulose processed into a uniform fibrous physical state. The fiber mulch, including dye, shall not contain germination or growth inhibiting factors. The material shall be manufactured and processed in such a manner that the cellulose fiber mulch will remain uniform in suspension in water under agitation and will blend with seed, fertilizer, and other additives to form homogenous slurry. The mulch shall cover and hold grass seed in contact with the soil without inhibiting growth of the seedlings. Contractor may utilize other mulches, such as recycle paper and wood blend, recycled paper, and companion binding accessories at his discretion in hydro-seeding. The rate of cellulose fiber shall be 50 pounds per 100 gallons of water or as otherwise recommended by the County Agriculture Cooperative Extension

2.11 MULCH ANCHORING MATERIALS

A. Mechanical Method: Tractor-drawn implement designed to punch and anchor mulch into the soil surface.

B. Cellulose Fiber: Cellulose fiber shall be applied at a net dry weight of 750 pounds per acre.

C. Liquid Mulch Binder: Non-asphaltic or petroleum based, Reinco, RMB plus (1-800526-7687), Finn A 500 Hydro-Stik (1-800-873-3321), or equal capable of controlling wind and water erosion of mulch.

D. Mulch Netting: Prefabricated wood shaving mat with woven photodegradable netting.

2.12 EROSION CONTROL FABRIC

A. As specified on the Drawings.

2.13 <u>WATER</u>

A. Clean, potable, free of chemicals or impurities harmful to germination or turf growth.

B. Public water, Owner supplied following installation of site water service. If either the pressure or supply of public water is insufficient to properly irrigate the athletic fields,

alternative methods such as tankers and pumps can be considered upon review and approval by the Owner.

C. For grow in maintenance on a field that does not have a permanent subsurface irrigation system a temporary above ground irrigation system is to be used consisting of series of pipes and sprinkler heads connected to the Owner's water supply. System shall be used until field is ready for inspection.

2.15 HERBICIDE

A. Broadleaf: depending upon weeds being encountered and Owner's preference of use.

B. Pre-emergent: Tupersan, or approved equal. This is to be used on both seeded and sod fields.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification:

1. Verify that topsoil has been placed to the minimum depths required. Verify that topsoil has been screened and all rocks and debris greater that 3/4-inch removed from the topsoil area that will comprise the root zone.

2. Verify that all products for installation are undamaged and are correct Models specified. Reject damaged or incorrect products.

B. Do not sow seed or initiate seeding operations when ground is wet or muddy following a rain event, when the ground surface is excessively dry and dusty, or when wind velocity will result in an uneven distribution of seed.

3.2 ROOT ZONE PREPARATION – NEW FIELDS

A. Scarify the subsoil and remove stones and debris larger than 6"

B. Spread the topsoil with a LGP laser controlled dozer

C. Decompact the field to a minimum depth of 12”: two times over in a crossing pattern. Use a shatter harrow or subsoiler. Rubber floatation tired tractors only to be used.

D. Rough grade the field to within +/- 1” of finished grade. Rubber floatation tired tractors only to be used

A. Incorporate organic matter and other nutrients into root zone after topsoil is rough graded to achieve desired percentages and nutrient levels. Incorporate into the soil with a Lely Roterra or reverse tine tiller. Organic matter shall be incorporated in the topsoil at a consistent depth of three-inches over the athletic field area. Rubber floatation tired tractors only to be used.

B. Fine grade field to required grade, plane, and elevation as indicated on Drawings. Use rubber floatation tired laser guided grader.

3.3 SEEDING

A. Perform required as-built survey of the field to confirm work meets finished field grade tolerance. Any areas not found in compliance shall be repaired to meet required tolerances.

B. Perform seeding operations within 24-hours of completing fine grading operations including repairs if necessary.

C. Sow seed at the rates specified in one-half rates evenly in two intersecting directions using a broadcast, drop-type spreader or cultipacker. Roll surface to establish seed contact with soil using a smooth drum roller weighing no more than one ton.

D. Manually sow seed where areas are not accessible to mechanized seeding equipment. Seed shall be evenly distributed and rake in to the top ¼-inch of the soil.

E. After seeding, apply starter fertilizer.

F. Mulching: Apply mulching material to retain moisture and minimize erosion. Apply straw mulch as required by the Erosion and Sediment Control Plan. Anchor mulch to prevent displacement by tracking in or using commercial tackifier.

G. Apply water with a fine spray after each seeded area has been mulched. Water sufficiently to saturate upper three – four inches of root zone.

H. Place signs, rope off, or otherwise protect newly seeded areas from encroachment. Maintain protection until seeded areas are accepted by Owner.

3.4 SODDING

A. Perform required as-built survey of the field to confirm work meets finished field grade tolerance. Any areas not found in compliance shall be repaired to meet required tolerances.

B. Begin sodding once grades have been verified to meet required tolerances.

C. Lay the first row of sod in a straight line with subsequent rows placed parallel a tight. Lateral joints shall be staggered to promote uniform growth. Do not stretch or overlap sod. Shape sod to form to the line and contour of play areas or infield areas when required. Edge sod if required to form clean line. All work shall be performed using a rubber tracked or turf tire sod installer.

D. Lightly water sod during installation to prevent drying. Roll sod as sections are completed.

E. Thoroughly irrigate sod following installation so that the entire sod pad is wet and soil below the pad is wet.

F. If an automatic, underground irrigation system is not installed as a part of this project the contractor is responsible to provide a temporary irrigation system to irrigate the new sod. Continue to water until sod is well established. Keep sod moist at all times for two weeks following installation. Watering maybe required several times a day. Continue watering until sod is well rooted.

G. Roll sod with 2-3 ton pull type roller and turf tractor approximately 45-days following installation.

3.5 EROSION CONTROL

A. Temporary Seeding

1. Perform temporary seeding and mulching work when required to stabilize construction areas in accordance with the requirements of the Erosion and Sediment Control Plan.

2. Prior to final seeding, any temporarily seeded area shall have the existing stand of turf completely killed to prevent invasive growth of the temporary seed variety in the final seeding.

B. Reseeding and Overseeding

1. During grow-in period, immediately repair areas that have washed or become eroded and perform additional measures as required to stabilize. When directed by Architect, as authorized by a Change Order, sod may be installed at areas where stabilization is difficult.

2. Where areas have failed to germinate, mechanically reseed.

3.7 GROW – IN MAINTENANCE SERVICE

A. Scheduling: Perform all maintenance until the required growing condition is present and Substantial Completion has been established. Notify Owner a minimum of three days in advance prior to performing any maintenance operation.

B. Apply 3-1-2 fertilizer at a rate of 1 lb. Of Nitrogen per thousand square feet.

C. General Procedures:

1. Edging: Edge along perimeter of all sidewalks, paved areas, landscape beds, infield areas, and slabs a maximum of three days prior to request for Substantial Completion inspection.

2. Mowing: Cool season grasses, including bluegrass, tall fescue, and perennial ryegrass shall be maintained at a height of 2-1/2- inches to 3-1/2inches in the spring and fall. During the summer, the mowing height shall not be less than three-inches. No more than 1/3 of the blade shall be removed in a single cutting.

a. Perform a minimum of one mowing a minimum of three days prior to requesting an inspection for Substantial Completion for any turf area included in the request for Substantial Completion inspection.

b. During the period from initial seeding / sodding through Substantial Completion, mow, when the average height of the grass three-inches.

3. Fertilizing: Fertilize seeded areas as required until Substantial Completion is established. Base fertilization on the requirements of the turf species, time of year, and soil test results. Obtaining additional soil test results when required for fertilization between initial seeding and establishment of Substantial Completion.

4. Lawn/Weed Control: Apply a pre-emergent soil applied herbicide for all spring and summer seedings to control the germination of crabgrass and other annual weed seeds. Prior to a request for Substantial Completion inspection, a post emergent, foliar applied, herbicide shall be applied to prevent the growth of broadleaf weeds in mid to late May to control summer weeds and in late September or early October to control fall weeds. Selection and proper use of herbicides is the Contractor's responsibility. All chemical applications shall be performed under the supervision of a licensed certified applicator.

5. Insect and Disease Control: Monitoring all newly established lawn areas for insect damage and disease and taking any corrective measures as required. The Contractor shall only be responsible for disease and insect control until Substantial Completion is established.

6. Irrigation: Maintain sufficient moisture in the soil during germination and as required for turf establishment until Substantial Completion.

7. Repair: Repair all areas that have washed or eroded, correct surface irregularities for areas that have settled and pond water, and remedy damage from improper use of herbicides or over fertilization.

--END --

SECTION 32 9200
GRASS ATHLETIC FIELD CONSTRUCTION

PART 1- GENERAL

1.1 SECTION INCLUDES

A. Grass athletic field reconstruction

B. Root zone preparation for athletic fields.

C. Seeding, sodding and turf grass establishment for athletic fields.

D. Grow-in maintenance.

1.2 RELATED SECTIONS

A. Section 31 0000 – Earth Moving

1.3 RELATED DOCUMENTS

A. Erosion and Sediment Control Narrative and Erosion and Sediment Control Plan: Requirements for temporary seeding, permanent stabilization, site stabilization during construction as approved by the County Conservation District and the Department of Environmental Protection as it relates to the requirements of the NPDES Permit and Related Regulations.

1.4 DEFINITIONS

A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

B. Athletic Field:

1. Multi-purpose Field: Playing area as dimensioned on Drawings, including sideline area as extending a minimum of 10-feet from the perimeter of the playing area or to adjacent perimeter fence, not to exceed 25-feet.

2. Baseball and Softball Fields: Playing area as dimensioned on Drawings, including limit of outfield area and extending around entire playing field area to adjacent foul line fence, not to exceed 50-feet.

C. Root Zone: Area of amended topsoil and soil backfill for establishing turf grass

D. Erosion and Sediment Control Plan: Includes all plans, narratives, calculations, and conditions of the NPDES Permit, as applicable, as approved and issued by the County Conservation District and the Department of Environmental Protection. A copy of the approved plans and permit must be available on-site at all times during construction.

1.5 QUALIFICATIONS

A. Work of this Section shall be performed by a company with a minimum of five years documented experience in athletic field construction with a minimum of 25-acres of documented athletic field construction, turf grass installation, and turf grass maintenance.

B. Have at least one senior staff member who carries a current "Certified Field Builder – Natural Turf" certification as issued by the American Sports Builders Association.

C. Contractor shall submit at the time of bid a list and description of a minimum of three projects completed within the last five years of projects of similar scope, including brief description of the work, location, name of owner and contact person.

D. The Owner reserves the right to evaluate the qualifications of any Contractor or subcontractor and may disqualify any Contractor, or subcontractor, at its sole discretion based on the documented experience of the Contractor.

1.6 STANDARDS

A. All seed varieties contained in the seed mixtures shall be certified seed by the State where the seed was manufactured.

B. All chemical applications shall be performed in accordance with local, state, and federal regulations utilizing EPA registered materials and methods of application. All chemical applications shall be performed under the supervision of a Licensed Certified Applicator.

1. All concentrate materials shall be stored in bulk containers and clearly labeled, including material safety data. No containers shall be stored or left on site.

2. Dispense chemicals from concentrate tanks.

3. Provide spillage containment for concentrates and chemicals.

1.7 SUBMITTALS FOR REVIEW

A. Seeding and Sodding:

1. Manufacturer's Certified Analysis: Submit manufacturer's certified analysis for each seed mix showing percentage of each variety in mix, percent pure live seed, net weight by variety in mix, age of seed, and date of production.

2. Sod Certification: Submit certification from sod supplier indicating State of origin, percentage of grass varieties in sod blend, and State sod certification.

3. Soil Test Report: Submit copy of soil test reports as prepared by State Cooperative Extension or approved laboratory determining existing soil parameters as included in Paragraph 2.2.B. Test reports shall be submitted for information only and for evaluating soil amendments recommended by Contractor.

4. Laboratory Test: Submit a minimum of three samples of the existing topsoil, mixed with the organic material and other amendments, consistent with the proportions of the root zone mix to be installed, to approved testing laboratory. Provide Architect with test results prior to installation of root zone mix.

5. Soil Amendments and Turf Establishment Program: Based on soil test reports, prepare and submit a schedule of soil amendments and fertilization required for each seed mix, time and method of application, a schedule indicating when areas will be seeded, anticipated dates of Substantial Completion, fertilization practices during establishment, application of pre-emergent and post emergent herbicides, and other practices that will be incorporated as part of the Work. The Architect will consider the submittal for informational purposes only.

6. Product Data: Submit product data, manufacturer's installation instructions, specifications, catalog cuts, and manufacturer's standard shop drawings as required by Section 01330.

1.8 SUBSTITUTIONS

A. Pre-bid: The Contractor shall make every reasonable effort to find the seed varieties and materials specified. Make recommendations for substitutions if desired seed mix or variety is unavailable, or, in the Contractor's opinion, unsuitable for the site, location to be planted, or other reasons that may result in the failure successfully establish. Notify the Architect if disease resistant or insect resistant species can be substituted for the selected pest-prone species or variety.

B. Post-Bid: Requests for substitutions following bid shall be approved by the Architect. Contractor shall submit request in writing, state the reasons for the substitution, and state the variety or mix to be substituted.

1.9 COORDINATION

A. Coordinate and schedule Work to permit seeding or sodding to occur during regular planting seasons. Where Work cannot occur during regular planting seasons, employ methods as required to address seasonal conditions at time of seeding or sodding.

B. Coordinate Work under provisions of Section 01310 and so as to avoid conflict with other operations. Contractor shall be responsible for regrading and stabilizing any areas damaged due to a failure to coordinate or schedule construction activities.

C. Notify Owner a minimum of three days in advance of all maintenance work including regrading, fertilizing and mulching through substantial completion.

1.10 PLANTING SEASONS

A. Spring: The spring seeding season is March 15 to May 30. Spring seeding shall be conducted during this period unless approved by the Architect to begin seeding earlier or perform summer seeding. No seeding shall be done on frozen ground, when the air temperature is less than 32-degrees farenheit, or when the soil temperature is less than 50-degrees Fahrenheit regardless of the date of seeding.

B. Fall: The fall seeding season is August 31 to October 31. Fall seeding shall be conducted during this period unless approved by the Architect to perform seeding earlier or to perform late fall seeding. . No seeding shall be done on frozen ground, when the air temperature is less than 32-degrees Fahrenheit, or when the soil temperature is less than 50-degrees Fahrenheit regardless of the date of seeding. Permission to seed November 1 to March 14 will only be given when completion of the project is imminent and the environmental conditions are conducive to acceptable growth.

1.11 INSPECTION AND ACCEPTANCE

A. Minimum area required for inspection and acceptance: Architect will consider requests for inspection to determine Substantial Completion only where the entire athletic field turf has been established. Request for partially completed field areas will only be accepted where Owner schedule has limited completion to a partial area.

B. Pre-Inspection requirements and certifications: Submit written request to Architect for Substantial Completion inspection. Written request shall include the following:

1. Identification of the field, or field areas to be inspected.

2. Date required Inspection Maintenance would be completed.

3. Performance certifications: Submit following certifications from soil testing laboratory, that the following performance criteria have been met. A minimum of four tests per field is required to determine consistency of the Work:

   a. Organic matter content must be between 3 – 6 percent.
   b. Compaction of the field must be no greater than 80-percent as determined by ASTM D1557, Modified Proctor.
   c. Minimum root depth must be at least 3-inches.
   d. Organic matter and nutrients must be consistently incorporated to a depth of at least 3-inches.

4. Tolerance of Final Surface for Acceptance: Once fine grading is complete and prior to installation of seed or sod perform a survey of the field. The finished plane of field surface shall not vary by more the ¼-inch when measured along any point of the plane, whether perpendicular or parallel to the contour. Finished slope shall be within one tenth of a percent (0.10%) of the design gradient.

   a. Survey Certification: Submit a plan, prepared and sealed by a registered professional surveyor, with spot elevations on a grid interval of twenty-five feet. Grid shall tie to a minimum of two field corners and shall be based on project datum. Plan shall be considered for verification of finished field grade tolerance.

C. Inspection: Upon completion of the Work as defined in Paragraph 1.13.A, request an inspection to determine substantial completion. Request shall be made to the Architect in writing and Architect shall complete inspection within two weeks of receipt of request for inspection. Contractor shall clearly note in request for inspection which areas are substantially complete if not requesting inspection for the entire installation.

   1. Architect will issue a notice of Substantial Completion following inspection where Work is substantially in conformance with the specified requirements and Drawings. Minor deficiencies shall be noted and Contractor shall correct all deficiencies within two-weeks of receiving notice.

   2. Where Architect determines that Work is not substantially complete due to significant deficiencies, Contractor shall take immediate corrective action. Upon completion of corrective measures, Contractor shall again request inspection to determine if Substantial Completion has been obtained.

D. Inspection Maintenance: Grass shall be cut to specified height, including hand trimming, turf area substantially free of weed growth and perimeter of infield areasnd along walkways edged a maximum of three days prior to requesting inspection for Substantial Completion.

1.13 WARRANTY

A. For athletic fields that do not include installation of subsurface irrigation systems the warranty for the turf areas shall be forty-five (45) days from the date of completion of the Substantial Completion punch list and written acceptance of the field by the Owner. Rebuild, repair, or replace any areas of turf that have proven defective due to failure to comply with the Specifications in any way.

1. Contractor is not responsible for defective areas due to vandalism, areas that have been damaged by the Owner or Owner's use, or as a result of the Owner's failure to execute maintenance procedures following substantial completion.

1.14 GROW-IN PERIOD MAINTENANCE SERVICE

A. Maintain seeded and sodded areas immediately after placement until grass is well established. Maintain all seeded areas until a vigorous, weed free, healthy growing condition is present and Substantial Completion is established.

1. Seeded Areas: A request for inspection to determine Substantial Completion will not be considered until a vigorous uniform growth over at least 90% of the seeded area is present.

2. Sodded Areas: A request for inspection to determine substantial completion will not be considered until the sodded area has been in place for a minimum of 45 calendar days and sod exhibits a vigorous growing condition.

B. Where seeding or sodding is required outside of the Spring or Fall Planting seasons, perform additional maintenance, provide additional mulch, frost protection blanket, compost, increased seeding rate, over-seeding, and other Work as required to improve germination conditions.

PART 2 - PRODUCTS

2.1 TOPSOIL INSTALLATION AND GRADING EQUIPMENT

A. General: All equipment operation in the root zone area shall be rubber floatation turf tires or rubber tracks.

B. Deep-Tine Aeration: Turf grass aeration machine having 3/4-inch solid tines capable of penetration a minimum of twelve-inches with hole spacing no greater than 5-inches. Unit shall be PTO driven with a rear roller on unit. Tractor shall

have a minimum horsepower rating of 55, turf tires, and a lift capacity of 3,600 pounds.

C. Soil Screener: Portable "star" type screener capable of screening a minimum of 1,500 cubic yards of dry soil per day

D. Rough Grading and Finished Grading: Grader equipped with dual laser pickup with dual laser grade range mode. The laser pickup shall operate the blade elevation controls automatically once locked on the laser beam. Laser source shall be capable of operating in either the positive or negative angle configuration without physically moving the laser source head.

1. Laser source accuracy: One thousandth of a percent (0.000).

2. Grader shall have rubber flotation turf tires.

E. Tilling: Reverse-sifting tiller, Roto-dairon or equivalent, operating at a minimum of 110 horsepower and capable of ground speeds of 1/3 mph.

2.2 TOPSOIL

A. On-site available topsoil or approved imported topsoil. The Contractor shall be responsible for providing satisfactory topsoil as required to meet the quantities necessary for the Work.

B. Soil Testing: Soil tests shall be done prior to seeding by Contractor. The soil test shall include a mechanical analysis to determine soil texture, pH, magnesium, phosphorus, and potassium. Testing shall also measure organic matter and soluble salts. The minimum number of soil tests shall be six spaced randomly throughout the field to obtain the most thorough sampling. Topsoil shall not be tested until it has been stripped and stockpiled. All imported topsoil shall be approved by the Architect before the material is delivered to the site.

C. Soil Amendments: Amend topsoil as determined by the soil tests to adjust soil conditions to obtain required organic matter content, soil reaction, and nutrient availability in the root zone.

1. The presence of conditions affecting fertility, germination, high or low organic content, soil compaction, or similar conditions does not alleviate the Contractor of responsibility to provide required growing and germination conditions.

D. All topsoil shall be free of stones, lumps, plants, roots, and other debris over 3/4-inch at time of initial placement on finished subgrade. Topsoil shall be free of weeds, weed seeds, foreign grasses, and toxic substances, such as pesticides, that are harmful to plant growth.

2.3 FERTILIZER

A. All fertilizer shall be uniform in composition, free flowing and suitable for application by mechanical spreaders. Fertilizers shall be delivered in sealed containers showing percentage by weight of all components and shall bear the name, trade name, and warranty of the producer.

1. Application rate: Per soil test.

B. Starter Fertilizer: Ratio of 1-2-1, consisting of 50% Nutralene. Apply at a rate of 1 lb. Nitrogen/1,000 square feet

2.4 LIME

A. Lime material shall be ground or pulverized limestone that contains at least 50-percent total oxides, calcium oxide plus magnesium oxide. Limestone shall be ground to such fineness that at least 50-percent will pass through a 100-mesh sieve and not less than 98-percent will pass through a 20-mesh sieve. Granular or pelletized lime may also be used subject to the requirements for pulverized limestone.

1. Application rate: Per soil test.

2.6 ORGANIC MATTER

A. Commercially available uniform compostion meeting the following:

PH:	6.5 – 8.5
Moisture Content:	30% - 55%
Soluble Salts:	<4.0 mmhos/(cm)
C:N Ratio:	25:1
Particle Size:	<3/8”
Organic Matter Content:	>40% (dry weight basis)
Ash Content	<60%
Nitrogen	0.5% to 3%
Phosphorous	>0.2%

(Equal to Terra-Gro, Terre Hill, PA 17581. Phone number 1-800-359-1384.)

B. Other equal naturally occurring organic product blended for turf grass use.

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A. Mulch: Mulch shall be wood cellulose fiber, containing no growth or germination inhibiting substances; a soil-binding agent (tackifier) is required; mulch shall be

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B. Liquid Mulch Binder: Non-asphaltic or petroleum based, Reinco, RMB plus (1-800-526-7687), Finn A 500 Hydro-Stik (1-800-873-3321), or equal capable of controlling wind and water erosion of mulch.

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A. Seed Mixture: 100% Turf Type Tall Fescue with any three of the following varieties: Hemi, Turbo, Bullseye, Rebel Exeda, Summer, No Net

1. Seed shall be a minimum of 80-percent endophyte enhanced, consist of a minimum of 98-percent pure seed with 0-percent weed seed, and have a minimum 90-percent germination rate.

2. Seeding Rate: Turf Type Tall Fescue – 11 pounds per 1,000 SF

B. Apply all seed mixtures at half-rates in two cross-directions.

2.9 SOD

A. Provide machine cut sod with maximum deviation from width and length being 5-percent. Must be big roll sod (4' wide x 62' long). Broken rolls and torn or uneven ends are not acceptable. Sod shall be utilized at all baseball infields and for an 8 ft wide perimeter strip at the outside edge of all baseball and softball skinned infield areas, including first and third base line and batters circle, as shown on plans.

B. Do not provide sod that has been harvested or transplanted under drought conditions.

C. Sod shall be harvested, delivered, and installed within a period of 24-hours.

D. Turf grass sod, consisting of 90% Tall Fescue and 10% Kentucky Bluegrass from Sporting Valley Turf Farms, Manheim, PA 17545.

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A. Salt Hay: Free of rot, mildew, noxious weed seeds and shall be small-grained, such as wheat or barley. Apply at a rate to lightly cover soil, approximately 100 lbs. per 1,000 square feet.

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slurry. The mulch shall cover and hold grass seed in contact with the soil without inhibiting growth of the seedlings. Contractor may utilize other mulches, such as recycle paper and wood blend, recycled paper, and companion binding accessories at his discretion in hydro-seeding. The rate of cellulose fiber shall be 50 pounds per 100 gallons of water or as otherwise recommended by the County Agriculture Cooperative Extension

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A. Mechanical Method: Tractor-drawn implement designed to punch and anchor mulch into the soil surface.

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C. For grow in maintenance on a field that does not have a permanent subsurface irrigation system a temporary above ground irrigation system is to be used consisting of series of pipes and sprinkler heads connected to the Owner's water supply. System shall be used until field is ready for inspection.

2.15 HERBICIDE

A. Broadleaf: depending upon weeds being encountered and Owner's preference of use.

B. Pre-emergent: Tupersan, or approved equal. This is to be used on both seeded and sod fields.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification:

1. Verify that topsoil has been placed to the minimum depths required. Verify that topsoil has been screened and all rocks and debris greater that 3/4-inch removed from the topsoil area that will comprise the root zone.

2. Verify that all products for installation are undamaged and are correct Models specified. Reject damaged or incorrect products.

B. Do not sow seed or initiate seeding operations when ground is wet or muddy following a rain event, when the ground surface is excessively dry and dusty, or when wind velocity will result in an uneven distribution of seed.

3.2 ROOT ZONE PREPARATION – NEW FIELDS

A. Scarify the subsoil and remove stones and debris larger than 6”

B. Spread the topsoil with a LGP laser controlled dozer

C. Decompact the field to a minimum depth of 12”: two times over in a crossing pattern. Use a shatter harrow or subsoiler. Rubber floatation tired tractors only to be used.

D. Rough grade the field to within +/- 1” of finished grade. Rubber floatation tired tractors only to be used

A. Incorporate organic matter and other nutrients into root zone after topsoil is rough graded to achieve desired percentages and nutrient levels. Incorporate into the soil with a Lely Roterra or reverse tine tiller. Organic matter shall be incorporated in the topsoil at a consistent depth of three-inches over the athletic field area. Rubber floatation tired tractors only to be used.

B. Fine grade field to required grade, plane, and elevation as indicated on Drawings. Use rubber floatation tired laser guided grader.

3.3 SEEDING

A. Perform required as-built survey of the field to confirm work meets finished field grade tolerance. Any areas not found in compliance shall be repaired to meet required tolerances.

B. Perform seeding operations within 24-hours of completing fine grading operations including repairs if necessary.

C. Sow seed at the rates specified in one-half rates evenly in two intersecting directions using a broadcast, drop-type spreader or cultipacker. Roll surface to establish seed contact with soil using a smooth drum roller weighing no more than one ton.

D. Manually sow seed where areas are not accessible to mechanized seeding equipment. Seed shall be evenly distributed and rake in to the top ¼-inch of the soil.

E. After seeding, apply starter fertilizer.

F. Mulching: Apply mulching material to retain moisture and minimize erosion. Apply straw mulch as required by the Erosion and Sediment Control Plan. Anchor mulch to prevent displacement by tracking in or using commercial tackifier.

G. Apply water with a fine spray after each seeded area has been mulched. Water sufficiently to saturate upper three – four inches of root zone.

H. Place signs, rope off, or otherwise protect newly seeded areas from encroachment. Maintain protection until seeded areas are accepted by Owner.

3.4 SODDING

A. Perform required as-built survey of the field to confirm work meets finished field grade tolerance. Any areas not found in compliance shall be repaired to meet required tolerances.

B. Begin sodding once grades have been verified to meet required tolerances.

C. Lay the first row of sod in a straight line with subsequent rows placed parallel a tight. Lateral joints shall be staggered to promote uniform growth. Do not stretch or overlap sod. Shape sod to form to the line and contour of play areas or infield areas when required. Edge sod if required to form clean line. All work shall be performed using a rubber tracked or turf tire sod installer.

D. Lightly water sod during installation to prevent drying. Roll sod as sections are completed.

E. Thoroughly irrigate sod following installation so that the entire sod pad is wet and soil below the pad is wet.

F. If an automatic, underground irrigation system is not installed as a part of this project the contractor is responsible to provide a temporary irrigation system to irrigate the new sod. Continue to water until sod is well established. Keep sod moist at all times for two weeks following installation. Watering maybe required several times a day. Continue watering until sod is well rooted.

G. Roll sod with 2-3 ton pull type roller and turf tractor approximately 45-days following installation.

3.5 EROSION CONTROL

A. Temporary Seeding

1. Perform temporary seeding and mulching work when required to stabilize construction areas in accordance with the requirements of the Erosion and Sediment Control Plan.

2. Prior to final seeding, any temporarily seeded area shall have the existing stand of turf completely killed to prevent invasive growth of the temporary seed variety in the final seeding.

B. Reseeding and Overseeding

1. During grow-in period, immediately repair areas that have washed or become eroded and perform additional measures as required to stabilize. When directed by Architect, as authorized by a Change Order, sod may be installed at areas where stabilization is difficult.

2. Where areas have failed to germinate, mechanically reseed.

3.7 GROW – IN MAINTENANCE SERVICE

A. Scheduling: Perform all maintenance until the required growing condition is present and Substantial Completion has been established. Notify Owner a minimum of three days in advance prior to performing any maintenance operation.

B. Apply 3-1-2 fertilizer at a rate of 1 lb. Of Nitrogen per thousand square feet.

C. General Procedures:

1. Edging: Edge along perimeter of all sidewalks, paved areas, landscape beds, infield areas, and slabs a maximum of three days prior to request for Substantial Completion inspection.

2. Mowing: Cool season grasses, including bluegrass, tall fescue, and perennial ryegrass shall be maintained at a height of 2-1/2- inches to 3-1/2-

inches in the spring and fall. During the summer, the mowing height shall not be less than three-inches. No more than 1/3 of the blade shall be removed in a single cutting.

a. Perform a minimum of one mowing a minimum of three days prior to requesting an inspection for Substantial Completion for any turf area included in the request for Substantial Completion inspection.

b. During the period from initial seeding / sodding through Substantial Completion, mow, when the average height of the grass three-inches.

3. Fertilizing: Fertilize seeded areas as required until Substantial Completion is established. Base fertilization on the requirements of the turf species, time of year, and soil test results. Obtaining additional soil test results when required for fertilization between initial seeding and establishment of Substantial Completion.

4. Lawn/Weed Control: Apply a pre-emergent soil applied herbicide for all spring and summer seedings to control the germination of crabgrass and other annual weed seeds. Prior to a request for Substantial Completion inspection, a post emergent, foliar applied, herbicide shall be applied to prevent the growth of broadleaf weeds in mid to late May to control summer weeds and in late September or early October to control fall weeds. Selection and proper use of herbicides is the Contractor's responsibility. All chemical applications shall be performed under the supervision of a licensed certified applicator.

5. Insect and Disease Control: Monitoring all newly established lawn areas for insect damage and disease and taking any corrective measures as required. The Contractor shall only be responsible for disease and insect control until Substantial Completion is established.

6. Irrigation: Maintain sufficient moisture in the soil during germination and as required for turf establishment until Substantial Completion.

7. Repair: Repair all areas that have washed or eroded, correct surface irregularities for areas that have settled and pond water, and remedy damage from improper use of herbicides or over fertilization.

--END --

SECTION 33 41 00

STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe and fittings.
2. Nonpressure transition couplings.
3. Pressure pipe couplings.
4. Expansion joints and deflection fittings.
5. Drains.
6. Encasement for piping.
7. Manholes.
8. Channel drainage systems.
9. Catch basins.
10. Stormwater inlets.
11. Stormwater detention structures.
12. Pipe outlets.
13. Stormwater disposal systems.
14. Stormwater Management Facilities
15. Sectional Track Perimeter Drain
16. Infield Edge Drains

B. Delaware Department of Transportation (DelDOT) Standard Specifications.

C. Delaware Department of Natural Resources and Environmental Control (DNREC) Sediment and Erosion Control Handbook.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Catch basins: Include plans, elevations, sections, details, frames, covers, and grates.
3. Piping: Include manufacturer's certification for each pipe type.
4. Stormwater Management Facility Outlet Structures.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

D. Handle catch basins according to manufacturer's written rigging instructions.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect/Engineer, Construction Manager and Owner no fewer than two days in advance of proposed interruption of service.

PART 2 - PRODUCTS

2.1 PIPING

A. All storm drainage piping shall be as shown on the plans and in accordance with the DelDOT Standard Specifications.

2.2 MANHOLES

A. All storm water manholes shall be as shown on the plans and in accordance with the DelDOT Standard Specifications.

2.3 CATCH BASINS

A. All catch basins shall be as shown on the plans and in accordance with the DelDOT Standard specifications.

2.4 STORMWATER MANAGEMENT STRUCTURES

A. All structures shall be as shown on the plans and in accordance with either the DelDOT Standard Specifications or the DNREC Erosion and Sediment Control Handbook.

2.5 SECTIONAL TRACK PERIMETER DRAIN

A. Utilize ACO Sport System #4020 at track perimeter and Sport System #2000 at 'D' Areas, as manufactured by Sports Field Specialties, Delhi, N.Y. 13753, (607) 746-8911; Pro Channel Drain #SE426 at track perimeter and 'XT' slot drain at 'D' Areas as manufactured by Sports Edge, ABT, Inc., Troutman, N.C. (800) 334-6057; or approved equivalent. Drain shall be furnished with eight (8) catch basins with removable trash buckets.

B. Drain shall be connected at the 8 catch basin locations to the field's collector drainage system, as shown on plans and detailed.

C. Provide manufacturer's descriptive information for these products for approval as well installation instructions and procedures.

2.6 "HYDROBLOX" INFIELD EDGE DRAINS

A. Hydroblox is a prefabricated thermoplastic non-clogging drainage plank approximately 2"x 9"x 40" long, installed in a single line a 4-5" wide trench that is cut with hand trenching equipment.

B. Provide the hydroblox where shown and detailed at the circular edge of skinned infields starting at the center of the skinned area, and sloping at no less than 0.50% toward either side of the infield to discharge points a shown on plans. The initial high point of the trench should be cut to a level that the top of the hydroblox plank is positioned at or slightly below the level of the subgrade at the circular edge of the infield.

C. Upon completion of trenching and installation of the Hydroblox, backfill and clean excess soil from trenches, ready for seeding.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

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 into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

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. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, non-pressure drainage piping according to DelDOT Standard Specifications.

3.4 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated in accordance with the DelDOT Standard Specifications.

3.5 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated in accordance with the DelDOT Standard Specifications.

3.6 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8-inch thick, brick masonry bulkheads.

B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:

1. Remove manhole or structure and close open ends of remaining piping.

C. Backfill to grade according to Division 31 Section "Earth Moving."

3.7 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

3.8 CLEANING

A. Clean interior of piping of dirt and superfluous materials.

END OF SECTION 33 41 00

SECTION 33 46 00

SUBDRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Perforated-wall pipe and fittings.
2. Geotextile filter fabrics.

B. Delaware Department of Transportation (DelDOT) Standard Specifications.

C. Delaware Department of Natural Resources and Environmental Control (DNREC) Erosion and Sediment Control Handbook.

1.3 SUBMITTALS

A. Product Data:

1. Drainage conduits.
2. Geotextile filter fabrics.

PART 2 - PRODUCTS

2.1 PERFORATED-WALL PIPES AND FITTINGS

A. Perforated PE Pipe and Fittings:
1. Shall meet the requirements of Advanced Drainage Systems, Inc (ADS) for all pipe sizes or approved equal.

2.2 SOIL MATERIALS

A. Soil materials are specified in Division 31 Section "Earth Moving."

2.3 GEOTEXTILE FILTER FABRICS

A. Description: Geotextile fabrics shall meet the requirements of Mirafi 140N or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and areas for suitable conditions where sub-drainage systems are to be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.3 UNDERSLAB DRAINAGE INSTALLATION

A. Excavate for underslab drainage system after subgrade material has been compacted but before drainage course has been placed. Include horizontal distance of at least 4 inches between drainage pipe and trench walls. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.

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.

D. Add drainage course to width of at least 4 inches on side away from wall and to top of pipe to perform tests.

E. Fill to Grade: Place satisfactory soil fill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Fill to finish grade.

3.4 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. Lay perforated pipe with perforations down.
2. 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.

3.5 PIPE JOINT CONSTRUCTION

A. Join perforated PE pipe and fittings with couplings according to manufacture's requirements..

3.6 IDENTIFICATION

A. Arrange for installation of green warning tapes directly over piping. Comply with requirements for underground warning tapes specified in specified in Division 31 Section "Earth Moving."

1. Install PE warning tape or detectable warning tape over ferrous piping.

3.7 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.

3.8 CLEANING

A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION 33 46 00

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