TECHNICAL SPECIFICATIONS FOR WHITING AVIATION PARK FIRE FLOW EXPANSION – PHASE A

(VOLKERT PROJECT NO. 1202201)

SANTA ROSA COUNTY, FLORIDA
BOARD OF COUNTY COMMISSIONERS

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ISSUED FOR BID: JUNE 2024

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PE STAMPS

CIVIL/MECHANICAL

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FIRE SERVICE BOOSTER PUMP STATION

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish, install, test, and place into operation the factory-built, above-grade, skid-mounted fire service booster pump station in strict accordance with the manufacturer's requirements and recommendations.

B. The fire service booster pump station shall be installed complete with all the necessary internal piping, pumps, motors, valves, controls, and other necessary appurtenances installed on a fabricated steel base and enclosed in a modular building as shown on the plans and specified herein.

C. The fire service booster pump station shall be complete to the extent specified herein and shall not require field assembly unless otherwise specified herein.

D. The Contractor shall be required to unload and set the pump onto the foundation designed by the Engineer and as shown in the plan set.

E. The foundation shall be built by the Contractor and as directed by the Engineer.

F. Following the setting of the pump station, the Contractor shall be required to anchor the pump station to the foundation and fill it with concrete according to the manufacturer's specifications.

G. The Contractor shall supply and install the anchor bolts.

H. The Contractor shall be required to attach all loose-shipped items supplied with the fire service booster pump station.

1.02 REFERENCES

A. National Fire Protection Association (NFPA) Publications:

1. 13 "Installation of Sprinkler Systems"
2. 20, 2022 "Standard for the Installation of Stationary Fire Pumps for Fire Protection"
3. 24 "Standard for the Installation of Private Fire Service Mains and Their Appurtenances"
4. 25 "Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems"
5. 70 "National Electrical Code"

1.03 SUBMITTALS

A. General: Submit the following in accordance with the Contract Documents:

1. Prefabricated Pump House Manufacturer shall provide the following:

a. Complete shop drawings and complete wiring diagrams.

b. Complete operating and maintenance instructions.

c. Furnish written certification of the manufacturers listing with Underwriters Laboratories as an approved manufacturer of control panels.

d. Furnish written certification that the manufacturer is listed by ETL/C-ETL as an

approved manufacturer of factory assembled pumping systems for fire protection service.

e. A complete, easily readable functional description of the proposed equipment. Upon completion of the installation, the results of the field and acceptance tests as specified under this section of the specification shall be submitted to the Engineer.

f. Furnish written certification from the manufacturer's representative of the proper installation of the pump house.

g. Provide written certification that the manufacturer is a nationally recognized manufacturer of packaged pump systems and manufactures the pump system for fire protection service. A corporate officer must sign this certification.

h. Operation and maintenance manuals:

1) Submit complete operations and maintenance information for this specific equipment. The Engineer shall review these manuals for completeness. They shall include a complete parts list including manufacturer’s reference and ordering number, the local representative name, address and phone number, and the model and serial number of the system.

2) The manufacturers shall submit a certificate of product liability insurance for no less than five million dollars ($5,000,000)

2. General Contractor shall provide the following:

a. Detail of major elements, components, and systems of fire suppression system and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work.

b. Clearances for installing and maintaining installation.

c. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.

d. Sizes and location of required concrete pads and bases.

e. Scheduling, sequencing, movement, and positioning of large equipment into place during construction.

f. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

1.04 QUALIFICATIONS

A. The manufacturer shall have a minimum of ten years manufacturing and application experience.

B. Upon request from the Engineer, the fire pump house manufacturer shall demonstrate proof of financial responsibility with respect to performance and delivery date.

C. Upon request from the Engineer, the fire pump house manufacturer shall provide proof or evidence of facilities, equipment and skills required to produce the equipment specified herein.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Provide unloading and rigging for fire service booster pump station.

1.06 SEQUENCING AND SCHEDULING

A. Coordinate fire suppression equipment installation with other building components. Arrange for pipe spaces, chases, slots, and other openings in building structure during progress of construction to allow for installation.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.

C. Sequence, coordinate, and integrate installations of fire suppression materials and equipment for efficient flow of the work. Coordinate installation of large equipment requiring positioning.

1.07 BASIS OF DESIGN

A. The fire pump houses specified herein are based on equipment manufactured and assembled by PremierFlow (Tulsa, OK), which shall represent the minimum level of quality, performance, and service acceptable for this equipment. PremierFlow is represented locally by Hydro Technologies.

1. Contact Information

a. Hydro Technologies, Shack Roberts, (251) 444-1639,

b. PremierFlow, Marvin Yoder, (918) 382-6978

B. Engineer-approved equals are acceptable.

1.08 DESIGN CRITERIA

A. Pump House at Existing Utility Yard

1. Type – Duplex Fire Pump House

2. Capacity – 2,000 gpm for each pump

3. Discharge Pressure – 100 psi

4. Electrical Service – 480 volt, 3-phase, 60 Hz, 4-Wire

PART 2 - PRODUCT

2.01 PUMP CONSTRUCTION

A. Pumps shall be of the double-suction, horizontal split case design.

B. Pump shall be hydrostatically tested to 1 ½ times the maximum working pressure but in no case less than 250 PSI.

C. Pump accessories shall include 3 ½” diameter suction and discharge gauges as well as automatic air release valve.

2.02 FIRE PUMP

A. The pumps shall be Aurora, Model 6-481-18C, horizontal split case fire pump, or Engineer-approved equal. Unit shall include a pump, base, coupling, coupling guard, engine drive, necessary fittings and automatic engine controller. The pumps shall be rated for the flows and discharge pressures listed in Section 1.08 of this Specification. Units shall be designed to

deliver not less than 150% of rated capacity and 65% of rated head. Maximum permissible pump speed shall not exceed 1750 RPM.

2.03 ENGINE

A. Diesel engines each shall be Clarke, Model JU6H-UFAD88, or Engineer-approved equal. T3, 237 HP,1760 RPM, and shall be UL-Listed and FM-approved.

B. Each engine shall be provided with the following:

1. Electric starting equipment
2. Charging alternator
3. Factory-installed heat exchanger cooling system with required strainers
4. Pressure gauge
5. Pressure reducing valve
6. Solenoid valve
7. Bypass line with the inlet piped to the pump discharge
8. Lead-acid heavy duty starting batteries
9. Battery rack and cables
10. Flexible exhaust connector
11. Residential type silencer
12. Jacket water heater

2.04 CONTROLLER

A. The diesel engine controllers shall be Eaton, Model FD -140, or Engineer-approved equal, arranged to start the fire pump engine automatically on loss of system pressure with automatic stop.

B. An automatic weekly test timer shall also be standard.

C. The controllers shall be furnished with a built-in battery charger capable of restoring the batteries from a fully discharged condition to a fully charged condition within 24 hours.

2.05 FUEL SYSTEM

A. Furnish an above ground dual wall fuel tank with adequate capacity equal to one gallon per horsepower plus 5% volume for expansion and 5% volume for sump.

B. Furnish the tank with an indicating fuel level gauge.

C. Furnish the following additional accessories:

1. One (1) set of fuel hoses complete with containment piping
2. One (1) containment switch
3. Two (2) vents
4. One (1) fill cap

5. One (1) level gauge
6. One (1) low level switch
7. One (1) high level switch

2.06 JOCKEY PUMP

A. The jockey pump shall be cast iron, stainless steel fitted, mechanical seal, vertical multi-stage centrifugal pump rigid-coupled to a 3HP, 3600 RPM, 460 volts, 3-phase, 60 hertz motor.

B. Operating point shall be 20 GPM @ 130 PSI.

2.07 JOCKEY CONTROLLER

A. The jockey controller shall be a NEMA 2, controller complete with a fusible disconnect, selector switch, overload relay, pressure transducer and minimum run timer.

2.08 SURGE PROTECTION BLADDER TANK

A. Bladder tank shall meet ASME Boiler and Pressure Vessel code.

B. Bladder shall be high-performance, replaceable butyl with a minimum pressure rating of 250 psi.

2.09 VALVES

A. Provide the following:

1. Two (2) 8” UL/FM OS&Y suction grooved gate valves with tamper switches.
2. Two (2) 8” UL/FM Discharge grooved butterfly valves with tamper switches.
3. One (1) 8” UL/FM Discharge grooved style check valves.

B. Note: Common, suction, and discharge headers shall be Schedule 40 black steel.

2.10 ACCESSORIES

A. One (1) 12” Common hose valve header with -12- (qty) 2 ½” NPT thread hose valves, caps and chains complete piping, drain valve, and (1) UL/FM Isolation grooved, butterfly valve, cable tamper switch. (Note: hose valve header, supplied for remote installation).

B. One (1) 12” Common, UL/FM flow meter with piping from discharge back to suction complete with two (2) UL/FM isolation grooved style butterfly valves with cable tamper switches.

C. Two (2) 6 x 10” main relief valve assemblies

D. Two (2) 6” UL/FM main relief valves

E. Two (2) 6” x 10” waste cones

F. Tank Fill assembly:

1. 4”, Model 127-1, altitude tank fill valve
2. One (1) stainless steel sensing line
3. Three (3) 6” UL/FM grooved butterfly valves with tamper switches
4. Schedule 40 black steel piping, as required

G. Provide additional circuit breakers with conduit for FAA tank lights and submersible tank mixer in Power Panel to allow for Owner use.

1. Conduit to run to outside of pump house for external tie-in to applicable equipment.

2.11 PREFABRICATED ENVIRONMENTAL ENCLOSURES

A. General

1. Provide as part of the packaged system, a completely prefabricated environmental enclosure.

a. Refer to Plans for dimensions.

2. Enclosure shall be designed in accordance with applicable federal, state, and local codes and regulations.

a. The structure design and manufacture shall, as a minimum, conform to ASCE (American Society of Civil Engineers) current edition of "Minimum Design Loads for Buildings and Other Structures" and to the MBMA (Metal Building Manufacturers Association) "Recommended Design Practices Manual."

b. The building shall be manufactured and built to satisfy the requirements of the Florida Building Code (FBC) and the National Electrical Code (NEC).

c. Building manufacturer shall supply plans and calculations stamped by a Registered Professional Engineer in the State of Florida and shall be responsible for obtaining any State Industrial Building Commission approvals and third-party Inspections, if required.

3. Enclosure shall be designed by a Structural Engineer licensed in the State of Florida. Plans and calculations shall be provided, sealed and signed.

4. Finish ceiling height shall be no less than 10 feet.

B. Panel Construction

1. Insulated panels shall be fabricated with metal pans adhered securely to interior and exterior of panel to compose tough resilient, shock-resisting surface.

2. All panels shall exhibit 100% urethane poured-in-place, exclusive of metal pans, perimeter bracing and metal fasteners.

3. Perimeter bracing shall be #2 grade, SPF specie wood, tongue-and- grooved for proper alignment and positive sealing.

4. Overall coefficient of heat transfer (“U” factor) shall not exceed 0.029, R-23 for 3-1/2” thick panels and R-30 for 5” thick panels.

5. Nominal panel dimensions shall be fabricated as required.

6. All walls to be one hour fire rated with fire rated board in-between wall panels.

C. Finish

1. Metal finishes shall provide optimum protection plus superior resistance to chemical corrosion and ultraviolet (UV) radiation.

2. Finishes shall maintain complete adhesion to foam insulation.

3. Finishes for both interior and exterior shall be one or combination of following:
    a. Galvanized steel
    b. White (polyester) stucco embossed 24 gauge
    c. Tan (polyester) stucco embossed 24 gauge (standard)

D. Panel Fasteners

1. Provide factory installed cam-lock fasteners. Each cam-lock fastener shall provide a tight and positive seal.
2. Fastener material shall be steel housing, hook and pin with high pressure die-cast zinc cam.
3. Hardened steel hexagonal wrench is used to tighten panel fasteners.
4. The hook of the fastener shall engage over the pin when rotating the wrench and with cam-action, draw the panels tightly together.
5. Opaque white, gray or tank polyethylene snap-in caps cover the wrench hole borings.

E. Panel Gaskets

1. Each joint shall exhibit a polyvinyl chloride (PVC) serrated bulb type, double lined, compression gasket to eliminate water vapor permeability.
2. All gaskets are factory installed and require no additional handling.
3. Gaskets shall be resistant to chemical corrosion and ultraviolet radiation.
4. Gasket operating temperature shall be -34° C to 71° C (-30° F to 160° F).

F. Insulation

1. Insulation shall be thermosetting type polyurethane polymer rigid foam and produced by the reaction of polyisocyanurate with polyether-based resins.
2. Insulation shall be 3 1/2” or 5” thick form, 1 lbs. per cubic foot.
3. Density (poured-in-place, not frothed) according to ASTM C303.
4. The thermal conductivity initial “K” factor shall be 0.118 BTU per house (square foot) (degrees Fahrenheit per inch) according to ASTM C518.
5. Insulation shall remain stable within operating temperature -68° to 121° C (-90° to 250°F).

G. Metal Commercial Doors

1. Door shall be seamless, constructed of two face sheets of 18 gauge cold rolled steel, stretcher-leveled quality or flatness. Vertical edges of doors shall have neat hemmed edges. Seam mechanically interlocked for maximum structural integrity. All hinge reinforcements shall be of 8 gauge steel projection welded to the door.
2. Standard frames shall be 16-gauge cold rolled steel. Frames shall be mitered, face welded and ground smooth. All hinge reinforcements shall be of 8-gauge steel projection welded to frames. Reinforcements for strike and surface shall be furnished with factory installed rubber mutes, three per strike jamb. All frames shall be factory installed into the wall panels (door section).

3. Doors and frames shall be painted as specified. Door hardware, including pinned butt hinges with individual latch set and various accessories, if required, for both interior and exterior doors as follows:

    a. Two (2) 8’ x 7’ double leaf metal commercial doors

    b. Hinges: 1 ½ pair (per door), 4 ½” x 4 ½”, brush chrome finish

    c. Passage latch set: Cylindrical, brushed chrome finish

    d. Head bolt: 6” long with 24” chain, cadmium finish

    e. Foot bolt: 6” long with cadmium finish

    f. Weather-stripping: vinyl in an aluminum frame

    g. Threshold: aluminum

H. Caulking and Sealants

1. Insulated panels shall be set on galvanized “Z” base trim with non-drying butyl caulking.

2. All openings and penetrations through insulated panels shall be sealed with silicone sealant

3. Clean and degrease applicable surfaces.

I. Roof System

1. A prefabricated roof system shall be provided for the enclosure to provide a waterproof and ultraviolet-proof covering for insulated ceiling panels.

2. Roof system shall be galvanized standing seam, 22 gauges, 16 inches wide, sheet metal over ceiling panels with a slope of ¼” per foot.

3. Fasteners shall be corrosion resistant rubber washered TEK screws with length and strength required for metal to be fastened.

J. Installed Accessories

1. One (1) Moment Frames

2. Two (2) sets of 8’ x 7’ double doors

3. One (1) UL/C-UL listed, NEMA 12, Single point lug panel

4. Two (2), NEMA 3R,7-1/2 KVA, MPCS, each with transformer and circuit breaker panel.

5. Two (2) unit heaters with thermostats:10 KW,

6. Two (2) exhaust fans with T-stats

7. Four (4) powered louvers (powered close/spring open on loss of power)

8. Two (2) weather protected exterior mounted light with photocell

9. Eight (8) weather protected 40 watt L.E.D. light fixtures and bulbs

10. Eight (8) weather protected, GFCI convenience outlets (120/1/60)

11. Two (2) weather protected external mounted alarm beacons/horns and resets

12. Two (2) battery powered emergency lights with “EXIT” signs and photocells
13. Two (2) dual wall Muffler piping and bracket
14. Wall penetration sleeves as required
15. Pump house sprinkler system per NFPA -20 and 13 with seismic bracing
16. Two (2) 4”-diameter floor drain piped to skid edge
17. Two (2) cooling loop piping to drain
18. Two (2) gland pockets piped to drain
19. Six (6) rain hoods
20. Two (2) UL/C-UL listed, NEMA 12, gang tamper switch panels, complete with conduit and wiring to all tamper switches.
21. Three (3) stainless steel sensing line assemblies with test trees and orifice unions
22. Two (2) wall mounted eye wash stations
23. Two (2) wall mounted fire extinguishers

PART 3 - EXECUTION

3.01 FABRICATION

A. Factory Fabrication

1. 10” open rectangular perimeter open floor design skid base, complete with all necessary sensing lines, pipe supports, wiring for complete package system.
2. All pipe welding to be performed by ASME Code Section 9 certified welders.
3. All structural steel welding to be ASME D1.1
4. All grooved fittings and couplings shall be of the same manufacturer
5. All steel, piping, flanges, and fasteners shall be of domestic origin
6. Fasteners shall be Grade 7 or Grade * with washers, minimum of 3 threads showing

3.02 FACTORY TESTING

A. The pumping system is to be flow tested at the manufacturer’s facility before shipment. The pump system and all of its components shall undergo a complete operational test at the design flow rate under specified suction and net system pressure conditions.

B. The pump control system shall be tested at the manufacturer’s facility to ensure the specified sequence of operation is met.

C. Data shall be generated showing duty points at full capacity for each pump.

D. Test report shall be furnished to Owner upon shipment. The factory is to use current NIST traceable flow instruments.

E. Copy of test to be kept on file by the manufacturer for troubleshooting references.

F. The Engineer and/or a representative of the Owner shall be given sufficient notice of the testing dates and shall have the opportunity to witness these tests.

3.03 HYDROSTATIC TESTING

A. When the pump house plumbing is complete, the pressure piping within the pump house, including valves, pumps, control valves, and fitting connections making up the entire system shall be hydrostatically tested at a pressure not less than 150% of max system design pressure.

B. The test pressure shall be applied for a minimum of 60 minutes, during which time all joints, connections, and seams shall be checked for leakage.

C. Any deficiencies found shall be repaired and the system shall be re-tested at no expense to the Owner.

3.04 INSTALLATION

A. The Contractor shall unload the packaged pump house using a spreader bar to ensure the lifting cables/slings do not damage the enclosure. The pump house shall be set on a concrete slab or footer of adequate design to suit site conditions.

B. Level the skid using metal wedges or shims if necessary, and as required.

C. Anchor the pump house to the foundation as recommended by the manufacturer.

D. Make system connections. If through-the-floor connections are specified, the final turn-up cut shall not be made until the system is set in place.

E. After making the piping connections, back fill as required.

F. Electrical connections should be completed to the pump house control center, as required.

G. The Contractor shall field install any necessary items that are shipped loose from the manufacturer.

3.05 START-UP SERVICES

A. Without exception, the start-up of the equipment specified herein shall be the responsibility of the pump house manufacturer. The start-up service technician shall be a certified technician employed by the manufacturer. Third party contractors, agents, or representatives shall not be utilized for these services.

B. The manufacturer shall provide for a start-up service technician to be on-site for one day, up to 8-hours, in one trip for the purpose of start-up supervision and one day, up to 8-hours, in one trip for operator training.

C. The manufacturer shall submit a startup service report following startup.

D. Start-up service technician shall provide initial set points and adjustments, as necessary.

3.06 WARRANTY

A. System is warranty-protected from failure due to defects in material and workmanship for a period of 24 months after date of start-up.

3.07 ADDITIONAL INFORMATION

A. The project General Contractor shall be at minimum, but not limited to, the following responsibilities and coordination efforts:

1. All necessary permits and label requirements

2. Unloading and rigging of the prefabricated pump house
3. Pouring of concrete footer
4. Setting, leveling, and mounting
5. Installation of rebar
6. Filling of frame with 10” of concrete and sloping to the floor drain
7. Fill pump/engine base with Non-Ferrous, Non-Shrink Grout
8. Check for loose fasteners, loose items from freight shipment
9. Fabricate and install all piping for and between the pump house and incoming water supply.
10. Fabricate and install all piping for and between the pump house and discharge to the building fire suppression system
11. Heat Trace and insulate complete with jacket
12. Fabricate and install piping connection from floor drain discharge to sanitary sewer
13. Install supplied Test Header, including hose valves, caps, and chains
14. Install supplied muffler and piping
15. Install supplied rain hoods
16. Install and provide vent extension piping
17. Install Electrical service
18. Install Fire Alarm monitoring
19. Supply and/or refill all equipment with required fluids, including but not limited to, diesel fuel, engine coolant, and engine oil
20. Clean, flush and hydro test piping per NFPA
21. Schedule , coordinate startup and final inspection

END OF SECTION 11 2200

SPECIFICATION SECTION 16 0100

GENERAL PROVISIONS, ELECTRICAL

PART 1 – GENERAL

1.01 SUMMARY

A. This section of the specification outlines the provisions of the contract work to be performed under this Division. This section applies to and forms a part of each section of the specifications in Division 16 and all work performed under the electrical contract.

B. In addition, work in this Division is governed by the provisions of the Bidding Requirements, Contract Forms, General Conditions, and all sections under General Requirements.

C. These specifications contain statements which are more definitive or more restrictive than those contained in the General Conditions. Where these statements occur, they shall take precedence over the General Conditions. Where the word "provide" or "provision" is used, it shall be definitely interpreted as "furnishing and installing complete in operating condition." Where the words "as indicated" or "as shown" are used, they shall mean as shown on contract drawings. Where items are specified in the singular, this Division shall provide the quantity as shown on the drawings plus any spares or extras mentioned on drawings or in specifications. All specified and supplied equipment shall be new.

1.02 CODES, PERMITS AND FEES

A. Comply with all applicable laws, ordinances, rules, regulations, codes or rulings of governmental units having jurisdiction, as well as standards of the National Fire Protection Association and serving utility requirements.

B. Obtain and pay for permits, fees, inspections, meters, utility connection and extensions and the like associated with work in each section of this Division.

C. Installation procedure, methods and conditions shall comply with the latest requirements of the Federal Occupational Safety and Health Act (OSHA).

1.03 EXAMINATION OF PREMISES

A. Examine the construction drawings and premises prior to bidding. No allowances will be made for not being knowledgeable of existing conditions.

1.04 REFERENCES

A. American National Standard Institute (ANSI)

B. National Electrical Manufacturers Association (NEMA)

C. Institute of Electrical and Electronic Engineers (IEEE)

D. National Fire Protection Association (NFPA)

E. National Electrical Contractors Association (NECA)

F. International Electrical Testing Association (NETA)

G. Underwriters' Laboratories, Inc. (UL)

1.05 DEFINITIONS

A. Exposed: Not concealed.

B. Unfinished Space: A room or space that is ordinarily accessible only to building maintenance personnel, a room noted on the "Finish Schedule" with exposed and unpainted construction for walls, floor or ceilings, or specifically mentioned as "unfinished".

C. Finished Spaces: Any space ordinarily visible to the visiting public, including exterior areas.

D. "Wiring": Includes, in addition to conductors, all raceways, conduit, fittings, boxes, switches, hangers, and other accessories related to such wiring.

E. "Regulating Authorities": Means all governmental, utility, and fire protection authorities having jurisdiction.

F. Concealed: Hidden from sight, as in trenches, chases, hollow construction, above furred spaces, suspended ceilings (acoustical or plastic type), or exposed to view only in tunnels, attics shafts, crawl spaces, unfinished spaces, or other areas solely for maintenance and repair.

G. Furnish: Means to supply and deliver to the job.

H. “Approved Equal": Means equipment or materials which, in the opinion of the Engineer, is equal in quality, durability, appearance, strength, design, and performance to equipment or material specified and will function adequately in accordance with the general design.

I. "Provide": Means to supply, erect, install, and connect up complete, the particular work referred to, in readiness for regular operation.

1.06 WORK MATERIALS

A. Materials provided under the contract for which the UL label is not normally available shall be mounted in separate enclosures and wired to the labeled units in an acceptable manner.

B. All electrical materials and equipment shall be new and of the type and quality specified, listed by UL and bear their label where standards have been established, in compliance with the applicable standards of NEC (NFPA 70), NFPA, ANSI, IEEE and NEMA. Replace or repair any nonconforming, damaged or defective items at no extra cost to the Owner.

C. Deliver materials or equipment to the Project in the manufactures original, unopened, labeled containers, and adequately protect against moisture, tampering or damage from improper handling or storage. Do not deliver materials to the job before they are ready for installation unless adequate security is provided.

D. Perform all labor in a thorough and workmanlike manner, to the satisfaction of the Engineer. Contractor must staff the project with sufficiently skilled workmen, including a fully qualified superintendent, to complete the work in the time allocated. Superintendent must be qualified to supervise all of the work of this Division.

E. Materials and equipment shall be standard products of a reputable manufacturer regularly engaged in manufacture of the specified item. Where more than one unit is required of any item, furnish by the same manufacturer, except where specified otherwise. Install material and equipment in accordance with manufacturer’s recommendations. Should variance between plans and Specifications occur with these, contact the Engineer immediately so that variations in installation can be known by all parties concerned.

1.07 SHOP DRAWINGS

A. Submit all shop drawings and data in accordance with the Special Conditions and one time for all equipment provided under this Division. The complete electrical shop drawings shall be bound in one hard-cover, 3-ring binder indexed to this Division, or submitted electronically, or on thumb drives.

B. Shop drawing submittals processed are not change orders. The purpose of shop drawing submittals by the Contractor is to demonstrate that the Contractor understands the design concept; he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use. If deviation, discrepancies or conflicts between shop drawings and specifications are discovered, either prior to or after shop drawings submittals are processed, the design drawings and specifications shall control and shall be followed. No equipment or material shall be ordered prior to the return of reviewed shop drawings.

C. Manufacturer's data and dimension sheets shall be submitted giving all pertinent physical and engineering data including weights, cross-sections and maintenance instruction. Standard items of equipment such as receptacles, switches, plates, etc., which are cataloged items, shall be listed by manufacturer.

D. Index all submittals and references to these specifications.

1.08 EQUIPMENT PURCHASES

A. Arrange for purchases and delivery of all materials and equipment within 20 days after approval of submittal. All materials and equipment must be ordered in ample quantities for delivery at the proper time. If items are not on the project in time to expedite completion, the owner may purchase said equipment and materials and deduct the cost from the Contract Sum.

B. Provide all materials of similar class or service by one manufacturer.

1.09 COOPERATIVE WORK

A. Correct without charge any work requiring alteration due to lack of supervision or failure to make proper provisions in time. Correct without charge any damage to adjacent work caused by the alteration.

B. Cooperative work includes: 1) General supervision and responsibility for proper location and size of work related to this Division, but provided under other sections of these specifications. 2) Installation of sleeves, inserts and anchor bolts for work under each section in this Division.

PART 2 – PRODUCTS

2.01 WORK AND MATERIALS

A. All electrical materials and equipment shall be new and of the type and quality specified, listed by UL and bear their label where standards have been established, in compliance with the applicable standards of NEC (NFPA 70), NFPA, ANSI, IEEE and NEMA. Replace or repair any nonconforming, damaged or defective items at no extra cost to the Owner.

B. Perform all labor in a thorough and workmanlike manner, to the satisfaction of the Engineer. Contractor must staff the project with sufficiently skilled workmen, including a fully qualified superintendent, to complete the work in the time allocated. Superintendent must be qualified to supervise all of the work of this Division.

C. Materials provided under the contract for which the UL label is not normally available shall be mounted in separate enclosures and wired to the labeled units in an acceptable manner.

2.02 APPROVAL OF MATERIALS AND EQUIPMENT

A. Refer to Supplementary General Conditions for description of alternate material and equipment.

PART 3 – EXECUTION

3.01 VERIFICATION OF DIMENSIONS

A. Scaled and figured dimensions are approximate only. Before proceeding with work, carefully check and verify dimensions, etc., on Project Plans and drawings, and be responsible for properly fitting equipment and materials together and to the structure in space provided.

B. Drawings are essentially diagrammatic, and many offsets, bends, pull boxes, special fittings and exact locations are not indicated. Carefully study drawings and premises in order to determine best methods, exact locations, routes building obstructions, etc., and install apparatus and equipment in available locations to avoid obstructions, preserve headroom, and keep openings and passageways clear.

3.02 CUTTING AND PATCHING

A. Cut existing work and patch as necessary to properly install new work. As the work progresses, leave necessary openings, holes, chases, etc., in their correct location. If the required openings, holes, chases, etc. are not in their correct location, make the necessary corrections at no cost to the Owner. Avoid excessive cutting and do not cut structural members with the consent of the Engineer.

3.03 CLOSING-IN OF UNINSPECTED WORK

A. Cover not work until inspected, tested and approved. Where work is covered before inspection and test, uncover it, and when inspected, tested and approved, restore all work to original proper condition.

3.04 CONCRETE

A. Where used for structures to be provided under the contract such as bases, etc. concrete work and associated reinforcing shall be as specified under that Division.

B. See other sections for additional requirements for underground vault, cable ducts, etc.

3.05 ACCESSIBILITY

A. All required access doors or panels in wall and ceilings are to be furnished and installed as part of the work under this Division.

B. Provide doors which pierce a fire separation with the same fire rating as the separation.

C. Coordinate work of the various sections to locate specialties requiring accessibility with others to avoid unnecessary duplication of access doors.

D. Refer to "Finish Schedule" for types of walls and ceilings in each area and Project Plans and drawings for rated wall construction.

E. Install all control devices or other specialties requiring reading, adjustment, inspection, repairs, removal or replacement conveniently and accessible throughout.

3.06 FLASHING

A. Flash and counterflash all conduits penetrating roofing membrane.

3.07 CONSTRUCTION FACILITIES

A. General: Under this section of the specifications, execute all work in a manner to provide safe and lawful ingress and egress to the Owner's establishment, and such facilities shall be kept clear of materials or equipment as directed by Engineer.

B. Furnish and maintain from the beginning to completion all lawful and necessary guards, railings, fences, canopies, lights, warning signs, etc. Take all necessary precautions required by city and state laws and OSHA to avoid injury or damage to any persons and property.

C. Temporary power and lighting for construction purposes shall be under this Division. Electrical Contractor shall provide minimum OSHA required lighting levels for construction site as applicable. In addition, Electrical Contractor shall provide task lighting or enhanced lighting levels as required for specific construction activities. Coordinate power and lighting needs with General Contractor. The use of existing facility electrical distribution system to supply power to temporary power and lighting shall be approved by the Owner prior to any installations. All temporary installations shall conform to the requirements of NEC Article 305, Temporary Wiring, as applicable.

3.08 GUARANTEE

A. Guarantee all material, equipment and workmanship for all sections under this Division in writing to be free from defects of material and workmanship for two years from date of final acceptance, as outlined in the General Conditions. Replace without charge any material or equipment proving defective during this period. The guarantee shall include performance of equipment under all conditions of load, installing any additional items of control and/or protective devices as required.

3.09 WIRING OF EQUIPMENT FURNISHED UNDER OTHER SECTIONS

A. All electrical wiring including power wiring and control wiring, including all raceways, wiring, outlet and junction boxes and labor for installation of the wiring and equipment shall be included in this section of the specifications.

B. Wiring diagrams complete with all connection details shall be furnished under each respective section.

3.10 EQUIPMENT ROUGH-IN

A. Rough in all equipment, fixtures, etc. as designated on the drawings and as specified herein. The drawings indicate only the approximate location of rough-ins. The exact rough-in locations must be determined from large scale certified drawings. The Contractor shall obtain all certified rough-in information before progressing with any work for rough-in connections.

B. Be responsible for providing all outlets and services of proper size at the required location.

C. Minor changes in the contract drawings shall be anticipated and provided for under this Division to comply with rough-in drawings.

3.11 OWNER FURNISHED AND OTHER EQUIPMENT

A. Provide all final connections for the following:

1. Electrical equipment furnished under other sections of the specifications (except as otherwise designated).

2. Owner furnished equipment, where shown on the drawings or required by specifications.

3. All equipment furnished under this Division.

3.12 RUSTPROOFING

A. Rustproofing must be applied to all ferrous metals as follows:

1. Hot-dipped galvanized after forming of angle iron, bolts, anchors, etc.

2. Hot-dipped galvanized after the fabrication for junction boxes and pull boxes cast in concrete.

3.13 GENERAL WIRING

A. Drawings, in general, indicate location of motor starting and other equipment. Exact location of motors and other devices are to be determined in field by the Contractor. Provide an electrical feed for all equipment, not smaller than shown or NEC size where size is omitted from drawings, together with a suitable circuit protective device. Verify panel schedules and layout, maintain number of spares of branches indicated.

B. Conductors for branch circuit lighting, receptacle, power and miscellaneous systems must be a minimum of #12 AWG. Wire indicated specifically to be larger than #12 must be increased the entire length of the circuit.

C. Conductors sizes for lighting, receptacles, and small motor branch circuits with less than 20 ampere connected load may not be shown. Conductors for such circuits are sized as follows: for branch circuits 75 feet in length from branch circuit panel to center of load, not smaller than #12 AWG, up to 150 feet not smaller than #10 AWG, up to 200 feet not smaller than #8 AWG.

D. Verify location and mounting height of all receptacles, wall mounted fixtures, switches, and other equipment before roughing in. See drawings for pertinent information. Refer questionable cases to Engineer.

E. Where located adjacent in walls, outlet boxes shall not be placed back to back, nor shall extension rings be used in place of double boxes, all to limit sound transmissions between rooms.

F. Complete rough-in requirements of all equipment to be wired under the contract are not indicated. Coordinate with respective trades furnishing equipment or Engineer, as the case may be, for complete and accurate requirements to result in a neat, workmanlike installation.

G. Provide proper size and type of feeds from proper sources for all such items indicated, checking drawings of all trades to ensure inclusion of all items.

H. A maximum of 3 branch circuits may be installed in an individual conduit run. In addition, a continuous, full size ground wire (the same size as the phase conductors) shall be installed in all branch, feeder or service conduits. All junction boxes, pull or outlet boxes shall be bonded to the ground wire by an approved (listed) means.

I. All branch circuit or feeder conduits runs shall be routed from the switchboard or panelboard (or extension cabinet) to the load or outlet device. The use of large junction boxes, pull boxes or wireways as a collection point for conduit runs shall not be permitted. Multiple circuits shall not be installed in the same pull box except for the multiple circuit conduit runs noted above (maximum of 3 circuits).

J. The Contractor shall not access any fire alarm or emergency power panels without notification of and permission from Owner. It shall be the Contractor's responsibility to coordinate and schedule all such activity with the Owner.

K. When a circuit is de-energized the disconnect device shall be locked in the open position with a tag securely attached. The lock is to be the property of the electrician who opened the device, not a company or shop stock. The tag shall indicate who opened the device, when it was opened and a telephone number for contact. All work being done at a circuit breaker panelboard shall be tagged at the circuit breaker.

L. No bus taps, switches, circuit breakers, etc. shall be installed in or on energized equipment

without the prior knowledge and approval of a facilities electrical supervisor. All such devices shall be locked and tagged in the open position until the work is completed and approved by the facilities electrical supervisor. The Owner will inspect, test (as required) and accept the Contractor's work prior to being energized. Acceptance of any work by the owner does not relieve the Contractor of any responsibility for completing and installing work in accordance with the contract documents.

3.14 SEPARATE CONDUIT SYSTEMS

A. Each system shall be contained in a separate conduit system. This includes each power system, each lighting system, each signal system of whatever nature, telephone, emergency system, sound system, control system, fire alarm system, etc.

3.15 FIRE-STOP

A. Wherever a wall, ceiling, or floor is penetrated with raceways, including but not limited to, conduit, cable tray, and wireway, the hole shall be filled with firestop upon completion of all affected raceways.

B. The firestop material shall restore the wall to the same fire rating as it had before the penetration was made. Solid firestop material may be used to block up the largest part of the hole. Expanding, sprayed-on foam shall be used to finish filling in around cables and filling all small holes.

C. This provision shall apply to all walls, interior and exterior. In the event any side of such a wall is in a finished area, the penetration shall be made to match the wall finish with the application of matching materials.

3.16 CLEANUP

A. In addition to cleanup specified under other sections, thoroughly clean all parts of the equipment. Where exposed parts are to be painted, thoroughly clean off any spattered construction materials and remove all oil and grease spots. Wipe the surface carefully and scrape out all cracks and corners.

B. Use steel brushes on exposed metal work to carefully remove rust, etc., and leave smooth and clean.

C. During the progress of the work, keep the premises clean and free of debris.

3.17 PAINTING

A. Paint all unfinished metal with one coat of rust-inhibiting primer. (Galvanized and factory painted equipment shall be considered as having a sub-base finish.)

3.18 CONNECTIONS TO SERVICES

A. Furnish all connections to electrical services furnished under other Divisions, except as otherwise specifically designated. Provide all necessary connections, etc., required to properly connect all services and equipment.

3.19 PROJECT CLOSEOUT

A. Prior to completion of project, compile a complete equipment maintenance manual for all equipment supplied under sections of this Divisions, as described below.

3.20 EQUIPMENT LISTS AND MAINTENANCE MANUALS

A. Prior to completion of job, Contractor shall compile a complete equipment list and maintenance

manual. The equipment list shall include the following items for every piece of material and equipment supplied under this section of the specifications:

1. Name, model and manufacturer with complete parts drawings and list and local supplier for parts and replacement and telephone number.

2. All tags, inspection slips, instruction packages, etc., removed form equipment as shipped from the factory, properly identified as to the piece of equipment it was taken from.

3. Maintenance manuals shall be furnished for each applicable section of the specifications, shall be suitably bound with hard covers, and shall include all available manufactures' operation and maintenance instructions, together with as-builds drawings and lists herein before specified and all other diagrams and instructions necessary to properly operate and maintain the equipment. The equipment list and maintenance manuals shall be submitted in duplicate to the Engineer for approval not less than 10 days prior to the completion of the job. The maintenance manuals shall also include the name, address and phone number of the General Contractor and all subcontractors involved in any of the work specified herein. The maintenance manuals shall be finally provided in six copies.

3.21 TESTING

A. Motors shall be operating in proper rotation and control devices functioning properly. Check all motor controllers to determine that properly sized overload devices are installed. Check all electrical equipment for proper operation.

B. Upon completion of the electrical work, the entire installation shall be tested and demonstrated to be operating satisfactorily. Wiring shall be tested for continuity, short circuits and/or accidental grounds. All systems shall be entirely free from grounds, short circuits, and any and all defects.

C. Test and adjustments shall be made prior to acceptance of the electrical installation by the Engineer, and a certificate of inspection and acceptance of the electrical installation by local inspection authorities shall be provided.

D. All equipment or wiring provided, which when tested, prove to be defective or operating improperly, shall be corrected or replaced promptly, at no additional cost to the Owner.

E. The insulation of all feeder (100 amps or larger), switchboard, motor control starters, panelboards and motors shall be checked and verified by performing a megger test. The megger test voltage and resulting ohm values shall be as specified by National Electrical Testing Association standards. The Contractor shall keep a record of all megger testing to indicate the date, the equipment tested, testing values and test results. These records shall be made available as requested and shall be included with the project record documents.

END OF SECTION 16 0100

SECTION 16 0550

ARC-FLASH HAZARD ANALYSIS AND COORDINATION STUDY

PART 1 – GENERAL

1.01 SCOPE

A. The contractor shall provide an engineering analysis and coordination study for the entire electrical system of the facility being modified starting at the utility service entrance. Assume infinite short circuit current at the primary of each existing utility transformer. The basic analysis shall include a short-circuit analysis with protective device evaluation, and a protective device coordination study. In addition, the study shall include an Arc Flash analysis. After the results of the Coordination Study, if actual available fault current is higher than that listed on switchboard and panel schedules, the General Contractor and Electrical Contractor are responsible to have breakers coordinate correctly.

B. The project shall begin at the point of utility service for the facility and continue down through the system, to all downstream distribution and branch panelboards, motor control centers and significant motor locations.

C. The project shall include any new generators and any associated emergency power distribution equipment, including automatic transfer switches and generator ground fault protection.

1.02 RELATED DOCUMENTS

A. Single line diagrams

B. Specifications

1.03 SUBMITTALS

A. General. Submit the following according to Conditions of the Contract Documents:

B. Submit for review six copies of the protective coordination study.

C. Shop drawings for equipment effected by the coordination study will not be reviewed until the coordination study has been submitted and approved.

D. Qualification data for firms and persons specified in the “Quality Assurance” Article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Engineer and Owner, and other information specified.

E. A one-line diagram of the system shall be included.

F. The final report shall be bound in a three-ring binder.

G. The final report shall contain individual, tabbed sections for each section. Each tabbed section shall contain the information as outlined in Part 2 of this document. Tab 1 shall list the manufacturer’s name, address, general business phone number, after hours service phone number, spare parts phone number, distributor’s name, address, general business phone number, after hours service phone number and spare parts phone number. Tab 2 shall contain Section 2.2’s short-circuit analysis with protective device evaluation. Tab 3 shall contain Section 2.3’s protective device coordination study. Tab 4 contains Section 2.4’s information and so on.

1.04 RELATED STANDARDS

A. All studies shall be performed in accordance with the latest applicable IEEE and ANSI standards.

1.05 QUALITY ASSURANCE

A. Preparer Qualifications: Firm experienced in the analysis, evaluation, and coordination of electrical distribution systems and similar to the system for this project. Firm must have at a minimum a 5-year record of successful in-service performance.

B. The study shall be prepared in accordance with the latest edition of NETA Std. ATS, NFPA 70B, the “National Electrical Code”, ANSI C2” National Electrical Safety Code”, and ANSI/IEEE Guidelines, as well as manufacturer’s recommendations.

C. Short-Circuit Analysis and Coordination Study shall be performed by a registered Professional Engineer registered in the state where the project site is located. Study shall be signed and sealed by the Engineer. The Engineer shall have a minimum of eight years experience in the analysis, evaluation, and coordination of electrical distribution systems.

D. The firm conducting the study shall have Professional Liability Insurance in addition to standard general insurance.

1.06 DELIVERY, STORAGE AND HANDLING

A. The six sets of submittals shall be submitted for review and approval to release.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Engineering analysis and coordination study shall be performed by the switchgear manufacturer.

2.02 SHORT-CIRCUIT ANALYSIS WITH PROTECTIVE DEVICE EVALUATION

A. Systematically calculate fault currents based on the available fault current at the facility service entrance. Study preparer shall obtain the available fault current from the local utility.

B. Short-circuit calculations shall be prepared by means of a digital computer utilizing a commercially available software package. Motor contribution shall be incorporated in determining fault levels. Results of short-circuit calculations shall be presented in tabular form and shall include momentary and interrupting fault values for three-phase and phase-to-ground faults.

C. Analyze the short-circuit currents by preparing a tabulation comparing the fault levels to the device interrupting ratings. Indicate areas in which integrated/series ratings are utilized. The following information shall be included in the tabulation:

1. Bus identification number.
2. Location identification.
3. Voltage
4. Manufacturer and type of equipment.
5. Device rating.
6. Calculated short-circuit current.

2.03 PROTECTIVE DEVICE COORDINATION STUDY

A. Prepare coordination time-current characteristic curves to determine the required settings/sizes

of the protective devices to maximize selectivity. The utility upstream protective device feeding the facility shall be maintained as the upper limit for coordination. These settings shall be obtained by the preparer, along with any other protective device setting requirements. The coordination curves shall be prepared on log-log paper and illustrate adequate clearing times between series devices. The curves shall be created through the use of the study software package, but must reflect actual protective devices to be installed. Adequate time-current curves shall be generated to depict coordination. In addition, protective device characteristics shall be suitably determined to reflect calculated short-circuit levels at the location.

B. A narrative analysis shall accompany each coordination curve sheet and describe the coordination and protection in explicit detail. All curve sheets shall be multi-color for improved clarity. Areas lacking complete coordination shall be highlighted and reasons provided for allowing condition to remain or provide solution to resolve situation. System coordination, recommended ratings, and setting of protective devices shall be accomplished by a registered professional electrical engineer with a minimum of eight years of current experience in the coordination of electrical power systems.

C. The following information shall be provided on all curve sheets.

1. Device identification and associated settings/size.
2. Voltage at which curves are plotted.
3. Current multiplier.
4. ANSI frequent fault damage curve.
5. Cable insulation damage curves.
6. Transformer inrush point.
7. Single-line for the portion of the system.
8. Motor starting profiles (where applicable).

2.04 ARC FLASH ANALYSIS

A. An arc flash analysis will be performed based on existing short circuit values provided by the customer or in conjunction with a short circuit study. The results from the short circuit study will be used to determine arc energy levels at each defined location in the facility for a specified working distance. Based on the arc energy at each defined point, the proper PPE will be determined and if the arc energy level exceeds available PPE ratings, the locations will be noted. Labels will be provided for each evaluated location that lists the hazard levels along with the required PPE while working in that area. Analysis will be provided to determine if any changes can be made in protection system to reduce arc energy levels.

2.05 SINGLE-LINE DIAGRAM

A. The final report shall include a multi-color single-line diagram of the electrical distribution system within the scope of the project. The single-line shall include:

1. Transformer rating, voltage ratio, impedance, and winding connection.
2. Feeder cable phase, neutral and ground sizes, length of cable, conductor material, and conduit size and type.
3. Switchgear, switchboards, panelboards, MCC’s, fuses, circuit breakers, ATS’s and switches continuous current ratings.

4. Protective relays with appropriate device numbers and CT's and PT's with associated ratios.

5. Detailed legend indicating device type identification and other significant details.

PART 3 – EXECUTION

3.01 SUMMARY

A. The results of the system studies shall be summarized in a final report.

B. Where required, copies of the final report shall be submitted to the power company for their review and approval. Approved copies of the report shall be submitted to the Design Engineer.

3.02 FIELD SETTINGS

A. The contractor shall engage the manufacturer's service group or alternately a qualified independent testing firm to perform field adjustments of the protective devices as required for placing the equipment in final operating condition. The settings shall be in accordance with the approved short circuit study and protective device evaluation/coordination study.

B. Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved short-circuit and protective device coordination study, shall be carried out by manufacturer's service group.

END OF SECTION 16 0550

SPECIFICATION SECTION 16 0600

GROUNDING AND BONDING

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding components, including grounding electrodes and conductors, equipment grounding conductors, and bonding to complete grounding system consisting of:

1. Metal underground water pipe
2. Metal frame of the building
3. Rod electrodes
4. Main Ground Bar

1.02 REFERENCES

A. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association.

B. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.03 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 5 ohms

1.04 SUBMITTALS

A. In accordance with project Specifications

B. Test Reports: Indicate overall resistance to ground.

C. Project Record Documents: Record actual locations of components and grounding electrodes.

D. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.05 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience with service facilities within 100 miles of Project.

C. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Cooper Power Systems.

B. Framatome Connectors International.

C. Lightning Master Corporation.

D. Substitution: Engineer-approved equal.

2.02 CONNECTORS AND ACCESSORIES

A. Exothermic Connections:

1. Product: CADWELD.

2. Substitution: Engineer-approved equal (no mechanical connections will be accepted; only exothermic).

B. Wire: Stranded copper.

Grounding Electrode Conductor: Size as indicated on drawing.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify existing conditions prior to beginning work.

B. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.02 INSTALLATION

A. Install ground electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.

B. Provide grounding electrode conductor and connect to reinforcing steel in foundation footings where applicable. Bond steel together.

C. Provide bonding to meet requirements described in Quality Assurance.

D. Bond together any metal siding not attached to grounded structure; bond to ground.

E. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

F. Interface with site grounding system where applicable.

3.03 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA STD ATS except Section 4.

END OF SECTION 16 0600

SPECIFICATION SECTION 16 0700

HANGERS AND SUPPORTS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Conduit and equipment supports

B. Anchors and fasteners

1.02 REFERENCES

A. NECA (INST) - NECA Standard of Installation; National Electrical Contractors Association.

B. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.03 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Thomas & Betts

B. THREADCO

C. Threaded Rod Company

D. Substitution: Engineer-approved equal

2.02 MATERIALS

A. Hangers, Supports, Anchors, and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.

B. Supports: Fabricated of structural steel or formed steel members; galvanized.

C. Anchors and Fasteners:

1. Do not use powder-actuated anchors, spring clips, or beam clamps.

2. Concrete Structural Elements: Use precast inserts, expansion anchors, or preset inserts.

3. Steel Structural Elements: Use beam clamps, steel spring clips, steel ramset fasteners, or welded fasteners.

4. Concrete Surfaces: Use self-drilling anchors or expansion anchors.

5. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts or hollow wall fasteners.

6. Solid Masonry Walls: Use expansion anchors or preset inserts.

7. Sheet Metal: Use sheet metal screws.
8. Wood Elements: Use wood screws.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Locate and install anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
   1. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
   2. Do not drill or cut structural members.

B. Rigidly weld support members or use hexagon-head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

C. Install surface-mounted cabinets and panelboards with minimum of four anchors.

D. In wet and damp locations, use steel channel supports to stand cabinets and panelboards 1 inch off wall.

E. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

END OF SECTION 16 0700

SPECIFICATION SECTION 16 0750

ELECTRICAL IDENTIFICATION

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Nameplates and labels

B. Wire and cable markers

C. Conduit markers

D. Field-painted identification of conduit

1.02 REFERENCES

A. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.03 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Seaton Name Plate Company

B. Substitution: Engineer-approved equal

2.02 NAMEPLATES AND LABELS

A. Nameplates: Engraved phenolic, black letters on white background.

B. Locations:

1. Disconnect switch
2. Transformers
3. Each electrical distribution and control equipment enclosure
4. Circuit breakers
5. Communication cabinets
6. Control switches

C. Letter Size:

1. Use 1/8-inch letters for identifying individual equipment and loads.
2. Use 1/4-inch letters for identifying grouped equipment and loads.

D. Labels: Embossed adhesive tape, with 3/16-inch white letters on black background. Use only for identification of individual wall switches, receptacles, and control device stations.

2.03 WIRE MARKERS

A. Manufacturers:

B. Description: split sleeve type wire markers

C. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, junction boxes, and each load connection

D. Legend:

1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.

2. Control Circuits: Control wire number indicated on schematic and interconnection diagrams on drawings.

2.04 CONDUIT MARKERS

A. Location: Furnish markers for each conduit longer than 6 feet.

B. Spacing: 20 feet on center

2.05 UNDERGROUND WARNING TAPE

A. Description: 4-inch-wide plastic tape, detectable type colored red with suitable warning legend describing buried electrical lines.

PART 3 – EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive nameplates and labels.

3.02 INSTALLATION

A. Install nameplates and labels parallel to equipment lines.

B. Secure nameplates to equipment front using screws.

C. Secure nameplates to inside surface of door on panelboard that is recessed in finished locations.

D. Identify underground conduits using underground warning tape. Install one tape per trench at 3 inches below finished grade.

END OF SECTION 16 0750

SPECIFICATION SECTION 16 1230

WIRE AND CABLE

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Wire and cable for 600 volts and less

B. Wiring connectors and connections

1.02 REFERENCES

A. NECA (INST) - NECA Standard of Installation; National Electrical Contractors Association

B. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association

C. NFPA 70 - National Electrical Code; National Fire Protection Association

1.03 SUBMITTALS

A. In accordance with the project Specifications

1.04 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.

C. Products: Furnish products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 – PRODUCTS

2.01 WIRING REQUIREMENTS

A. Concealed Dry Interior Locations: Use only building wire with Type THHN, TWHN, or as specified insulation in raceway.

B. Exposed Dry Interior Locations: Use only building wire with Type THHN, TWHN or as specified insulation in raceway.

C. Above Accessible Ceilings: Use only building wire with Type THHN, TWHN or as specified insulation in raceway.

D. Wet or Damp Interior Locations: Use only building wire with Type THHN, TWHN, or as specified insulation in raceway.

E. Exterior Locations: Use only building wire with Type THHN, TWHN, or as specified insulation in raceway.

F. Underground Installations: Use only building wire with Type THHN, TWHN or as specified insulation in raceway.

G. Motor Branch Circuits: Use three- or four-conductor Type TC cable or single conductor Type THHN, TWHN wire, or as specified on the plans. Where single conductor wire is used, each

single-phase motor circuit must include 3 conductors and each three-phase circuit must include 4 conductors.

H. Use solid conductor for feeders and branch circuits 10 AWG and smaller.

I. Use stranded conductors for control circuits.

J. Use conductor not smaller than 12 AWG for power and lighting circuits.

K. Use conductor not smaller than 14 AWG for control circuits.

L. All conductors shall be copper unless otherwise indicated.

M. Use 10 AWG conductors for 20 Ampere, 120 Volt branch circuits longer than 75 feet.

N. All cable insulation shall be rated for 75 degrees C, minimum.

2.02 BUILDING WIRE

A. Description: Single conductor insulated wire.

B. Conductor: Copper.

C. Insulation Voltage Rating: 600 volts.

D. Insulation: NFPA 70, Type THHN, TWHN, as required.

2.03 MOTOR BRANCH AND BRANCH POWER CABLE

A. Description: Single conductor insulated cable.

B. Conductor: Copper, stranded.

C. Insulation Voltage Rating: 600 volts.

D. Insulation: NFPA 70, Type THHN, TWHN, or as scheduled on the plans.

E. Conductors shall be color coded or taped with colored tape within 24 inches of the end of the conductor to indicate a color code. The color code shall be the same as that for multi-conductor cable listed above.

2.04 CONTROL CABLE

A. Description: Single conductor insulated wire.

B. Conductor: Copper, stranded.

C. Insulation Voltage Rating: 600 volts.

D. Insulation: NFPA 70, Type THHN, TWHN, or as specified on the plans.

E. Conductors shall be covered by cross-linked polyethylene insulation (minimum thickness 20 mils). Conductors shall be color coded or taped with colored tape within 24 inches of the end of the conductors to indicate a color code.

2.05 INSTRUMENTATION CABLE

A. Description: Single or multi- twisted pair cables.

B. Conductor: Copper, stranded.

C. Insulation Voltage Rating: 300 volts, minimum.

D. Insulation: PVC. Multi-pair cable shall have PVC jacket.

E. Conductors shall be in twisted pairs. Each cable shall have an aluminum/polyester tape overlapped to provide 100% coverage, and a 7-strand tinned copper drain wire, same size as the conductors. In multiple pair cable, each pair shall be individually shielded in addition to the overall cable shield, also with an aluminum/polyester tape and drain wire.

F. Conductor size is given on drawings. If the instrumentation manufacturer recommends a different size from that on the drawings, use the size recommended by the instrumentation manufacturer.

2.06 ETHERNET CABLE

A. Description: Category 6 (min) Unbonded-Pair Cables

B. Conductor: Copper, solid.

C. Insulation: Polyolefin, blue PVC jacket.

D. Conductors shall be in twisted pairs. Each cable shall have an overall foil shield, and drain wire. Cable shall be RJ-45 compatible.

E. Cables shall be 4 pair, 24AWG.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that mechanical work likely to damage wire and cable has been completed.

C. Verify that raceway installation is complete and supported.

3.02 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.03 INSTALLATION

A. Route wire and cable as required to meet project conditions.

1. Wire and cable routing indicated is approximate unless dimensioned.

2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.

B. Install wire and cable in accordance with the NECA "Standard of Installation."

C. Use wiring methods indicated.

D. Pull all conductors into raceway at same time.

E. Use suitable wire pulling lubricant for building wire 4 AWG and larger. Lubricants shall be talc, powdered soapstone, or non-hardening compounds approved for pulling by UL and the cable manufacturer.

F. Neatly train and lace wiring inside boxes, equipment, and panelboards.

G. Clean conductor surfaces before installing lugs and connectors.

H. Make taps and terminations to carry full ampacity of conductors with no perceptible temperature rise. Splices shall not be made.

I. Use split bolt connectors for copper conductor taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.

J. Use solderless pressure connectors with insulating covers for copper conductor taps, 8 AWG and smaller.

K. Use insulated spring wire connectors with plastic caps for copper conductor taps, 10 AWG and smaller.

L. Identify and color code wire and cable under provisions of Section 16 0750. Identify each conductor with its circuit number or other designation indicated.

M. Instrumentation cable (cable carrying 4-20 mA signals) shall be run in steel conduit only.

N. Instrument signal cable shields shall be continuous along the entire cable length. Shields shall be grounded only at the panel.

END OF SECTION 16 1230

SPECIFICATION SECTION 16 1310

CONDUIT

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Conduit, fittings and conduit bodies

1.02 REFERENCES

A. ANSI C80.5 - American National Standard Specification for Rigid Aluminum Conduit

B. ANSI C80.3 - American National Standard Specification for Electrical Metallic Tubing -- Zinc Coated

C. NECA (INST) - NECA Standard of Installation; National Electrical Contractors Association

D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies; National Electrical Manufacturers Association

E. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80); National Electrical Manufacturers Association

F. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing; National Electrical Manufacturers Association

G. NFPA 70 - National Electrical Code; National Fire Protection Association

1.03 SUBMITTALS

A. In accordance with project Specifications

B. Project Record Documents: Accurately record actual routing of all conduits.

1.04 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept conduit on site. Inspect for damage.

B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

C. Protect PVC conduit from sunlight.

PART 2 – PRODUCTS

2.01 CONDUIT REQUIREMENTS

A. Conduit Size: Comply with NFPA 70.

1. Minimum Size: 3/4 inch unless otherwise specified.

B. Underground Installations:

1. More than Five Feet from Foundation Wall: Use thickwall non-metallic conduit.
2. Within Five Feet from Foundation Wall: Use thickwall nonmetallic conduit.
3. Under Slab on Grade: Use thickwall non-metallic conduit.
4. Minimum Size: 1 inch.

C. Outdoor Locations Above Grade: Use rigid aluminum conduit. Extend conduit from above grade to a point at least one foot below grade.

D. Dry Locations:

1. Concealed: Use rigid aluminum conduit.
2. Exposed: Use rigid aluminum conduit.

E. Within Concrete Slab: Conduit run within a concrete floor slab shall be rigid aluminum. Use bituminous coating on conduit.

F. Instrumentation Conduit: Conduit carrying instrumentation cables shall be rigid aluminum at any point where the instrumentation conduit is within two (2) feet of a power conduit, whether above- or under-ground

2.02 MANUFACTURERS

A. Essex Group, Inc.

B. Hubbell Power Systems.

C. Tyton Hellermann Corporation.

D. Substitution: Engineer-approved equal.

1. Allied Tube & Conduit.
2. Beck Manufacturing, Inc.
3. Wheatland Tube Company.
4. Substitution: Engineer-approved equal.

E. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

F. Rigid Aluminum Conduit ANSI C80.5

2.03 FLEXIBLE METAL CONDUIT

A. Manufacturers:

1. AFC Cable Systems.
2. Electri-Flex Company.
3. International Metal Hose.
4. Substitution: Engineer-approved equal.

B. Description: Interlocked aluminum construction.

C. Fittings: NEMA FB 1.

1. AFC Cable Systems.
2. Electri-Flex Company.
3. International Metal Hose.
4. Substitution: Engineer-approved equal.

D. Description: Interlocked aluminum construction with PVC jacket.

E. Fittings: NEMA FB 1.

2.04 NONMETALLIC CONDUIT

A. Manufacturers:

1. AFC Cable Systems.
2. Electri-Flex Company.
3. International Metal Hose.
4. Substitution: Engineer-approved equal.

B. Description: NEMA TC 2; Schedule 40 PVC.

C. Fittings and Conduit Bodies: NEMA TC 3.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on drawings.

B. Verify routing and termination locations of conduit prior to rough-in.

C. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.02 INSTALLATION

A. Install conduit in accordance with NECA Standard of Installation.

B. Install nonmetallic conduit in accordance with manufacturer's instructions.

C. Arrange supports to prevent misalignment during wiring installation.

D. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

E. Where conduit racks are utilized, use stainless-steel Unistrut and stainless-steel hardware. Provide 75% spare capacity in all conduit racks for future use.

F. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.

G. Fasten conduit supports to building structure and surfaces under provisions of Section 16 0700.

H. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary

supports.

I. Do not attach conduit to ceiling support wires.

J. Arrange conduit to maintain headroom and present neat appearance. Unsupported spans shall be limited to 10 feet.

K. Route conduit parallel and perpendicular to walls.

L. Route conduit installed above accessible ceilings parallel and perpendicular to walls.

M. Route conduit in and under slab from point-to-point.

N. Maintain adequate clearance between conduit and piping.

O. Maintain 12 inches clearance between conduit and surfaces with temperatures exceeding 104 degrees F.

P. Cut conduit square using saw or pipe cutter; de-burr cut ends.

Q. Bring conduit to shoulder of fittings; fasten securely.

R. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

S. Install no more than equivalent of four 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender to fabricate bends in metal conduit larger than 2-inch size.

T. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

U. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control, and expansion joints.

V. Provide suitable pull string in each empty conduit except sleeves and nipples.

W. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

X. Ground and bond conduit under provisions of Section 16 0600.

Y. Identify conduit under provisions of Section 16 0750.

Z. Provide Carlon conduit spacers to stack/organize conduit in all multi-conduit trenches. Use rock free foundry sand up to 18” depth followed by local soil.

END OF SECTION 16 1310

SPECIFICATION SECTION 16 1380

BOXES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Wall and ceiling outlet boxes

B. Pull and junction boxes

1.02 REFERENCES

A. NECA (INST) - NECA Standard of Installation; National Electrical Contractors Association; latest edition

B. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies; National Electrical Manufacturers Association; latest edition

C. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; National Electrical Manufacturers Association; latest edition

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; latest edition

E. NFPA 70 - National Electrical Code; National Fire Protection Association; latest edition recognized by the AHJ

F. ANSI/SCTE-77 Tier 22 – Specification for Underground Enclosure Integrity

G. ASTM C857 A-16 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

1.03 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Provide products listed and classified by Underwriters Laboratories, Inc., as suitable for the purpose specified and indicated.

PART 2 – PRODUCTS

2.01 OUTLET BOXES

A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel

1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2-inch male fixture studs where required.

B. Wall Plates for Finished Areas: As specified in Section 16 1400.

2.02 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel

B. Cast Metal Boxes: NEMA 250, Type 4, flat-flanged, surface-mounted junction box

1. Material: Stainless steel

2. Cover: Furnish with ground flange, neoprene gasket, and stainless-steel cover screws

C. Pull boxes: Quazite PG series or equal.

D. Handholes in non-traffic areas: ANSI/SCTE-77 Tier 22, ASTM C857 A-16

1. Body

a. Material: DuoMold Composite

b. Size (nominal): 36”W x 60”L; 24” and 36” depths

c. Weight: 24” Depth: 190 lbs; 36” Depth: 222 lbs

d. Wall Type: Straight

e. Bodies are stackable to depths of 48”, 60”, or 72”, and are assembled with fasteners to form a single unit at the factory.

2. Cover

a. Style: Flush Solid

b. Material: DuoMold Composite

c. Size (nominal): 36” x 60”

d. Weight: 358 lbs

e. Fasteners: 1/2-13 Stainless Steel Hex Head Bolt, Self-Locating Insert

f. Options: provide ‘ELECTRIC’ Logo

g. Surface: Slip Resistant

h. Coefficient of Friction: >0.6 ASTM 1028

E. Handholes in traffic areas: H-20 rated in addition to above specifications.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify locations of outlets in offices and work areas prior to rough-in.

3.02 INSTALLATION

A. Install boxes in accordance with NECA "Standard of Installation."

B. Install in locations as shown on Drawings, and as required for taps, wire pulling, equipment connections, and as required by NFPA 70.

C. Coordinate installation of outlet boxes for equipment connected under Section 16 1550.

D. Set wall mounted boxes at elevations to accommodate mounting heights indicated.

E. Orient boxes to accommodate wiring devices oriented as specified in Section 16 1400.

F. Maintain headroom and present neat mechanical appearance.

G. Install boxes to preserve fire resistance rating of partitions and other elements.

H. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

I. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.

J. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

K. Use flush mounting outlet box in finished areas.

L. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

M. Use stamped steel bridges to fasten flush mounting outlet box between studs.

N. Use adjustable steel channel fasteners for hung ceiling outlet box.

O. Do not fasten boxes to ceiling support wires.

P. Support boxes independently of conduit.

Q. Use gang box where more than one device is mounted together. Do not use sectional box.

R. Use cast outlet box in exterior locations exposed to the weather and wet locations.

S. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.

T. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.03 ADJUSTING

A. Adjust flush-mounting outlets to make front flush with finished wall material.

B. Install knockout closures in unused box openings.

3.04 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

B. Clean exposed surfaces and restore finish.

END OF SECTION 16 1380

SPECIFICATION SECTION 16 1390

CABINETS AND ENCLOSURES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Hinged cover enclosures

B. Cabinets

C. Terminal blocks

D. Accessories

1.02 REFERENCES

A. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association

C. NEMA ICS 4 - Industrial Control and Systems: Terminal Blocks; National Electrical Manufacturers Association

D. NFPA 70 - National Electrical Code; National Fire Protection Association, latest edition recognized by the AHJ

1.03 SUBMITTALS

A. Product Data: Provide manufacturer's standard data for enclosures and cabinets.

B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.04 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 – PRODUCTS

2.01 ENCLOSURE MANUFACTURERS

A . Cooper B-Line: www.bline.com.

B. Robroy Industries: www.robroy.com.

C. Hoffman.

D. Substitution: Engineer-approved equal.

2.02 HINGED COVER ENCLOSURES

A. Construction: NEMA 250, Type 4X stainless steel enclosure.

B. Covers: Continuous hinge, held closed by flush latch operable by screwdriver.

C. Provide interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.

D. Enclosure Finish: Manufacturer's standard enamel.

2.03 CABINETS

A. Boxes: NEMA 4X, Stainless Steel.

B. Backboard: Provide 3/4-inch thick plywood backboard for mounting terminal blocks. Paint matte white.

C. Fronts: Steel, surface type with concealed trim clamps, door with concealed hinge, and flush lock.

D. Provide metal barriers to form separate compartments wiring of different systems and voltages.

E. Provide accessory feet for free-standing equipment.

2.04 TERMINAL BLOCKS

A. Manufacturers:

1. Allen-Bradley/Rockwell Automation: www.ab.com.

2. Cooper Bussmann: www.bussman.com.

3. Substitution: Engineer-approved equal.

B. Terminal Blocks: NEMA ICS 4.

C. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.

D. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.

E. Provide ground bus terminal block, with each connector bonded to enclosure.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install securely, in a neat and workmanlike manner, as specified in NECA 1.

B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner under the provisions of Section 16 0700.

C. Install cabinet fronts plumb.

3.02 CLEANING

A. Clean electrical parts to remove conductive and harmful materials.

B. Remove dirt and debris from enclosure.

C. Clean finishes and touch up damage.

END OF SECTION 16 1390

SPECIFICATION SECTION 16 1400

WIRING DEVICES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Wall switches

B. Receptacles

C. Device plates

1.02 REFERENCES

A. NECA (INST) - NECA Standard of Installation; National Electrical Contractors Association; 1993

B. NEMA WD 1 - General Requirements for Wiring Devices; National Electrical Manufacturers Association; 1983 (R1989)

C. NEMA WD 6 - Wiring Device -- Dimensional Requirements; National Electrical Manufacturers Association; 1988

D. NFPA 70 - National Electrical Code; National Fire Protection Association; latest edition recognized by the AHJ

1.03 SUBMITTALS

A. In accordance with project Specifications

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

1.04 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Products: Provide products listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 – PRODUCTS

2.01 WALL SWITCHES

A. Wall Switches: NEMA WD 1, Heavy Duty, AC only general-use snap switch.

1. Body and Handle: Gray plastic with toggle handle.

2. Ratings:

a. Voltage: 120 - 277 volts, AC.

b. Current: 20 amperes.

B. Switch Types: Single pole, double pole, 3-way, and 4-way.

2.02 RECEPTACLES

A. Receptacles: NEMA WD 1, Heavy duty.

1. Device Body: Gray plastic.

2. Configuration: NEMA WD 6, type as specified and indicated.

B. Convenience Receptacles: Type 5 - 20.

C. Duplex Convenience Receptacles.

D. GFCI Receptacles: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.03 WALL PLATES

A. Decorative Cover Plates: Gray, Smooth plastic

B. Jumbo Cover Plates: Gray, Smooth plastic

C. Weatherproof Cover Plates: Shall have hinged cover plate and allow a weatherproof rating with cords plugged into receptacle.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify that outlet boxes are installed at proper height.

B. Verify that wall openings are neatly cut and will be completely covered by wall plates.

C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean debris from outlet boxes.

3.03 INSTALLATION

A. Install in accordance with NECA "Standard of Installation."

B. Install devices plumb and level.

C. Install switches with OFF position down.

D. Install receptacles with grounding pole on top.

E. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

F. Install decorative plates on switch, receptacle, and blank outlets in finished areas.

G. Connect wiring devices by wrapping conductor around screw terminal.

3.04 INTERFACE WITH OTHER PRODUCTS

A. Install wall switch 48 inches above finished floor.

B. Install convenience receptacles in process areas 48 inches above finished floor.

3.05 FIELD QUALITY CONTROL

A. Perform field inspection, testing, and adjusting in accordance with Section 01401.

B. Inspect each wiring device for defects.

C. Operate each wall switch with circuit energized and verify proper operation.

D. Verify that each receptacle device is energized.

E. Test each receptacle device for proper polarity.

F. Test each GFCI receptacle device for proper operation.

3.06 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.07 CLEANING

A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION 16 1400

SPECIFICATION SECTION 16 1800

STARTERS, CONTACTORS, CIRCUIT BREAKERS AND SWITCHES

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes standalone motor starters, contactors, circuit breakers, and disconnect switches.

1.02 REFERENCES

A. Applicable Standards:

1. National Fire Protection Association (NFPA):

a. 70 - National Electrical Code (NEC), latest edition recognized by the AHJ

2. National Electrical Manufacturers Association (NEMA). Comply with applicable requirements of the following standards:

a. 250 - Enclosures for Electrical Equipment (1,000V maximum)

b. KS1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

c. AB1 - Molded-Case Circuit Breakers

d. ICS - Industrial Controls and Systems

3. Underwriters Laboratories (UL). Comply with applicable requirements of the following standards:

a. 50 - Enclosures for Electrical Equipment.

b. 98 - Enclosed and Dead-Front Switches.

c. 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

d. 508 - Industrial Control Equipment.

e. 869 - Service Equipment.

f. 894A - Switches for Use in Hazardous (classified) Locations.

g. 977 - Fused Power Circuit Devices.

1.03 SUBMITTALS

A. Includes, but not limited to, the following:

1. Enclosure details

2. Schematic diagrams

3. Cut sheets of each product used

B. Final documentation shall include the following:

1. Information listed above

2. “As-Built” drawings
3. Operation and maintenance manuals

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Allen Bradley
B. Siemens
C. Substitutions: Engineer-approved equal

2.02 DESIGN REQUIREMENTS

A. Phenolic nameplate on cover of each unit with wording as approved by Engineer.

2.03 COMBINATION MAGNETIC MOTOR STARTERS

A. Full-voltage, non-reversing, reversing or two speed, NEMA style, with motor circuit protector (MCP) type disconnect
B. Minimum NEMA Size 1
C. Motor Circuit Protector:
    1. Shall be provided with an external handle that clearly indicates when the MCP is "ON," "OFF," or "TRIPPED" and be lockable in the "OFF" position.
    2. Molded-case, manually-operated, 3-pole
    3. Adjustable, instantaneous-trip, magnetic-only-type circuit breaker
    4. Coordinated unit rating for circuit protector and starter
D. Interrupting rating of 22,000A RMS Symmetrical minimum unless indicated otherwise.
E. Provide with solid-state, self-powered overload relay sized for and adjusted to full load current of motor being protected. Overload relay shall be manually reset and provide phase loss protection.
F. External manual reset of overload relay from outside of the enclosure.
G. Built-in 480/120V control transformer on 480V units of adequate capacity for all control devices as indicated on Contract Drawings.
H. Auxiliary contacts as required by Contract Drawings.
I. Momentary or maintained start-stop push buttons, selector switches, control switches, control relays, and indicating lights to implement control sequence indicated.
    1. Heavy duty, 30 mm units.
    2. Start pushbuttons shall have a green operator.
    3. Stop pushbuttons shall have a red operator.
    4. 120Vac cluster LED, push to test type indicating lights.
    5. Green lights shall indicate “Equipment On”.

6. Red lights shall indicate “Equipment Off”.
7. Amber lights shall indicate “Equipment Failure”.

J. Unless otherwise indicated, provide with the following NEMA enclosures:
1. NEMA 4X stainless steel enclosures for outdoor and interior process areas.
2. NEMA 1 enclosures for finished areas and electrical rooms.

2.04 LIGHTING CONTACTORS

A. Magnetically held contactor
B. Rated 600Vac
C. Number of poles: As indicated or required
D. 30 Amp rated contacts
E. Auxiliary control devices, push buttons, and indicating lights as indicated
F. Unless otherwise indicated, provide with the following NEMA enclosures:
1. NEMA 4X stainless steel enclosures for outdoor and interior process areas
2. NEMA 1 enclosures for finished areas and electrical rooms

2.05 DISCONNECT SWITCHES

A. Provide as required by NEC, specified or indicated.
B. Positive quick-make, quick-break mechanism, visible blades, and line terminal shield.
C. Provide number of poles as indicated.
D. Provide auxiliary contact for interlocking with motor starter when indicated.
E. Fused type where indicated with Bussman low-peak fuses.
F. Coordinate fuses with the ratings of the switch and the overload relays in the magnetic starter.
G. Furnish heavy-duty type.
H. Unless otherwise indicated, provide with the following NEMA enclosures:
1. NEMA 4X stainless steel enclosures for outdoor and interior process areas.
2. NEMA 1 enclosures for finished areas and electrical rooms.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install starters, contactors, circuit breakers and switches, at locations indicated or as follows:
1. Wall mounted enclosures shall be surface-mounted on walls or columns approximately 4 feet to center line above the floor when possible.
2. Provide structural support rack when required
3. Level, shim, and anchor to floor or structure with bolts or concrete anchors, and grout all

floor-mounted equipment.

4. Install all necessary wiring or interconnections as required.
5. Make all internal and external connections as required.
6. Arrange with proper clearances from other equipment and material to obtain accessibility for operation and maintenance.
7. Provide engraved phenolic nameplates on cover of each device identifying the loads connected.
8. Set overload relays for proper operation.
9. Place arc flash label on equipment.

END OF SECTION 16 1800

SECTION 16 3000

SURGE PROTECTION DEVICES FOR INSTRUMENTATION AND CONTROL EQUIPMENT AND DATA LINE PROTECTION

PART 1 – GENERAL

1.01 SUMMARY

A. Description: This section describes surge protective devices (SPD) to be furnished to protect dedicated 120VAC circuits within control panels; network CAT5E or CAT6 data transmission circuits; 24VDC low-voltage field instrumentation circuits; low-voltage loop powered networks; as well as 120VAC and low-voltage point-of-use loads whether scheduled or not. The devices will protect the following:

1. Dedicated 120, 120/208, 277, and 480 volt AC circuits, series connected.
2. Dedicated 120 volt control signals.
3. Analog instrumentation signal, field mounted.
4. Network Cable, High-Speed Data Circuit

1.02 QUALITY ASSURANCE

A. Referenced Codes and Standards:

1. ANSI/IEEE Std C62.41.1™-2002, IEEE Guide on the Surge Environment in Low- Voltage (1000 V and Less) AC Power Circuits
2. ANSI/IEEE Std C62.41.2™-2002, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
3. ANSI/IEEE Std C62.45™ -2002, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits
4. ANSI C84.1, American National Standard for Electric Power Systems and Equipment – Voltage Ratings (60 Hertz)
5. ANSI/IEEE Standard 1100-2005, IEEE Recommended Practice for Power and Grounding Electronic Equipment (Emerald Book) - Clause 8.6.1
6. National Fire Protection Association (NFPA) 70 (N.E.C.) – 2002 - Article 285
7. ANSI/UL Standards 1449-2006 Listed (UL 1449 Third Edition), UL 1283 Listed, CUL Listed & CE compliant “low-voltage directive.”
8. IEEE Standard C62.72™ - 2007 – IEEE Guide for the Application of Surge-Protective Devices for Low-Voltage (1000 V or less) AC Power Circuits
9. UL 1283, Standard for Safety Electromagnetic Interference Filters

1.03 DEFINITIONS

A. Let-Through Voltage (LTV) – The voltage that is measured at the end of the output leads of the surge protective device (SPD) measured from the zero voltage reference to the peak of the surge when the applied surge is induced at a specified phase angle; i.e., 90 or 270 degree phase angle.

B. Clamping Voltage – The voltage level where the SPD begins to conduct and handle the excess energy of the surge thus providing a low-resistance direct path for the surge.

C. Maximum Continuous Operating Voltage (MCOV) – The maximum steady state voltage at which the SPD can operate and meet its specification. This is the maximum designated root-means square (RMS) value of the power frequency voltage that may be continuously applied to each mode of protection of the SPD.

D. Protection Modes: This parameter identifies the modes for which the SPD has directly connected protection elements; i.e. line-to-neutral (L-N), line- to-ground (L-G), and neutral-to-ground (N-G).

E. Peak Surge Current (PSC): The maximum 8 x 20 microsecond surge current pulse the SPD device is capable of surviving on a single-impulse basis without suffering either performance degradation or more than 10 percent deviation of clamping voltage at a specified current.

F. System Peak Voltage: The electrical equipment supply voltage sine wave peak (i.e., for a 120 volt system the L-N peak voltage is 170 volts).

G. EMI/RFI Filtering (Electromagnetic/Radio Frequency Interference): This filter is designed to attenuate unwanted electromagnetic and radio frequency signals (such as noise and interference) generated from electromagnetic sources.

H. Frequency Responsive Circuitry/Sine Wave Tracking (SWT): A term used to describe the circuitry of a low-pass filter designed to attenuate “switching” or “ring wave” transients/surges.

1.04 SUBMITTALS

A. Surge suppression submittals shall include, but shall not be limited to the following items:

1. Complete schematic data for all suppressors indicating part numbers, conductor sizes, etc.

2. Dimensioned drawing of each suppressor type indicating mounting arrangement.

3. Data documenting ANSI/IEEE C62.41-2002 performance and the ability of the device to meet or exceed all requirements of this specification. Include complete let-through voltage/measured limiting voltage test data (not Voltage Protection Rating), test graphs, and scope traces for each mode for each product submitted for Category’s C, B, A (including Cat A, 2 kV, 67 A, 100 kHz ring wave at both 90 & 270 degree electrical phase angles).

4. Letter from manufacturer stating products are in strict compliance with the recommendations of IEEE Standard 1100-2005, Clause 8.6.1 and incorporate individual dedicated discrete modes of protection for each mode including direct line-to-line components. (Reduced-mode variations will not be accepted).

5. Statement of manufacturer’s warranty duration and replacement policy.

1.05 WARRANTY

A. All SPD devices shall be warranted to be free from defects in materials and workmanship under normal use in accordance with the instructions provided for a period of five (5) years from date of purchase unless otherwise specified below.

B. Any SPD device that shows evidence of failure or incorrect operation, including damage as the result of lightning strikes, during the warranty period shall be replaced as a complete unit (not

just modules, subassemblies, or components) by the manufacturer at no charge to the owner. Warranty will provide for multiple exchanges of any inoperable devices at any time during the warranty period that starts at the date of substantial completion of the system to which the surge suppressor is installed.

C. SPD manufacturers whose warranty does not meet the requirements listed above standard shall submit a letter on Corporate Letterhead Stationery and signed by a Corporate officer extending the warranty to meet these standards with the product submittal

PART 2 – PRODUCTS

2.01 MANUFACTURER QUALIFICATIONS

A. The surge suppressor manufacturer shall provide unlimited free replacement of the entire SPD for all inoperable SPD units during the warranty period.

B. The use of any mechanical or electro-mechanical thermal/over-current protection (i.e. moving parts and/or springs and shutters), in combination with or for the protection of the suppression elements are expressly prohibited and will be rejected

C. The listing of a manufacturer as “acceptable” does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included herein. Subject to compliance with requirements, provide products by the following manufacturers and specific models listed below only:

1. Surge Suppression Incorporated or USAES, LLC (Contact ITD of Huntsville, LLC at 888-212-2728 or surgesuppression@comcast.net) or Pre-approved manufacturers.

2. Pre-Approval submittals for products by manufacturers not listed above must be submitted not less than ten (10) business days prior to bid date to allow ample engineering time for review of submitted products. Products not submitted within this timeframe will not be reviewed.

3. Submit proper documentation showing detailed (line-by-line) compliance with this specification. Prior approvals not received by the deadline date defined above will not be considered.

4. Along with the line-by-line comparison from manufacturers not listed herein, pre-approval surge suppression submittals shall include all of the items listed in Part 2.2, below.

5. Incomplete submittal packages will not be reviewed.

2.02 REQUIREMENTS

A. Dedicated 120 Volt AC Control Power Circuit Protection (Surge Suppression Incorporated Model USPT1P1-21):

1. Maximum Continuous Operating Voltage: 150 volts

2. Maximum Continuous Operating Current: 30 Amps

3. Peak Surge Current: 40 kA per mode; 120 kA total

4. SPD circuitry shall include only solid-state clamping components consisting of a multi-stage hybrid design. Device shall be bi-directional, enclosed in a UL listed/recognized encapsulated thermal stress reducing compound.

5. Discrete and dedicated protection components must be provided for each mode of protection (L-N, Normal Mode) (L-G, N-G Common Mode).
6. Frequency Responsive Circuitry (sine-wave tracking) must be provided for each mode of protection. Products utilizing basic EMI/RFI filter performance (dB insertion loss rating) will not be considered.
7. Let-Through Voltages of product tested with the IEEE C62.41.1 & C62.41.2-2002; 100 KHz Ring Wave and Combination Wave must be equal to or better than the following:
    a. Cat A, 30 Ohm 100 kHz Ring Wave, 2 kV-67 kA @ 270 degree Phase Angle
        1) P-N: ≤ 25 volts
        2) P-G: ≤ 100 volts
        3) P-G: ≤ 75 volts
8. Enclosure: ABS Plastic, UL 94-5VA Flame Rating (UL's highest rating) and must be electrically non-conductive.
9. Warranty: 25 Years Unlimited Free Replacement

B. Analog Signal/Current Loop (4-20 mA) Circuit Protection (**USAES, LLC** Model CLP24A6DINS-B-21 can accommodate up to three 2- wire loops)

1. Maximum Continuous Operating Voltage: 36 volts DC
2. Maximum Continuous Operating Current: 500mA
3. Series Resistance: 5 Ohms per wire (10 Ohms loop)
4. Maximum Data Rate: 2 Mbps
5. Peak Surge Current: 10 kA per mode; 20 kA total per loop.
6. SPD circuitry shall include only solid-state clamping components consisting of a multi-stage hybrid design. Model shall be bi-directional and encapsulated in a high dielectric compound.
7. Discrete and dedicated protection components must be provided for each mode of protection. (L-L, Normal Mode) (L-G, Common Mode)
8. Let-Through Voltages of product tested with the IEEE C62.41.1 & C62.41.2-2002; Cat B, 2 Ohm Impulse (Combination) Wave, 6kV/3k Amp @ 90 degree Phase Angle must be equal to or better than the following:
    a. P-P < 40 volts
    b. P-G < 40 volts
9. Enclosure: Devices shall be enclosed in an enclosure constructed of a temperature and fire-rated material (UL94 5VA high-range temperature material) and must be electrically non-conductive. DIN rail mounted.
10. Warranty: 5 Years Unlimited Free Replacement

C. Dedicated 480 Volt Single Phase (P, P, G) AC Site Pole Lighting Circuit Protection (Surge Suppression Incorporated Model USPW2N4-21) Requires 30 Amp Class R Inline Fusing:

1. Maximum Continuous Operating Voltage: 552 volts
2. Maximum Continuous Operating Current: 30 Amps
3. Peak Surge Current: 40 kA per mode; 120 kA total
4. SPD circuitry shall include only solid-state clamping components consisting of a multi-stage hybrid design. Device shall be bi-directional, enclosed in a UL listed/recognized encapsulated thermal stress reducing compound.
5. Discrete and dedicated protection components must be provided for each mode of protection (L-N, Normal Mode) (L-G, N-G Common Mode).
6. Frequency Responsive Circuitry (sine-wave tracking) must be provided for each mode of protection. Products utilizing basic EMI/RFI filter performance (dB insertion loss rating) will not be considered.
7. Let-Through Voltages of product tested with the IEEE C62.41.1 & C62.41.2-2002; 100 KHz Ring Wave and Combination Wave must be equal to or better than the following:
    a. Cat A, 30 Ohm 100 kHz Ring Wave, 2 kV @ 270 degree Phase Angle
        1) P-P ≤ 75 volts
        2) P-G ≤ 75 volts
8. Enclosure: ABS Plastic, UL 94-5VA Flame Rating (UL's highest rating) and must be electrically non-conductive. Dimensions not to exceed L=5.22", W=3.12", H=1.88" to permit installation inside of pole inspection port.
9. Warranty: 25 Years Unlimited Free Replacement

D. Dedicated 277 or 208 Volt Single Phase (P, N, G) AC Site Pole Lighting Circuit Protection (Surge Suppression Incorporated Model USPW1P2-21) Requires 30 Amp Class R Inline Fusing:

1. Maximum Continuous Operating Voltage: 320 volts
2. Maximum Continuous Operating Current: 30 Amps
3. Peak Surge Current: 40 kA per mode; 120 kA total
4. SPD circuitry shall include only solid-state clamping components consisting of a multi-stage hybrid design. Device shall be bi-directional, enclosed in a UL listed/recognized encapsulated thermal stress reducing compound.
5. Discrete and dedicated protection components must be provided for each mode of protection (L-N, Normal Mode) (L-G, N-G Common Mode).
6. Frequency Responsive Circuitry (sine-wave tracking) must be provided for each mode of protection. Products utilizing basic EMI/RFI filter performance (dB insertion loss rating) will not be considered.
7. Let-Through Voltages of product tested with the IEEE C62.41.1 & C62.41.2-2002; 100 KHz Ring Wave and Combination Wave must be equal to or better than the following:
    a. Cat A, 30 Ohm 100 kHz Ring Wave, 2 kV @ 270 degree Phase Angle
        1) P-N ≤ 25 volts

2) P-G ≤ 100 volts

3) N-G ≤ 75 volts

8. Enclosure: ABS Plastic, UL 94-5VA Flame Rating (UL's highest rating) and must be electrically non-conductive. Dimensions not to exceed L=5.22", W=3.12", H=1.88" to permit installation inside of pole inspection port.

9. Warranty: 25 Years Unlimited Free Replacement

E. Dedicated 120 Volt Single Phase (H, N, G) AC Site Pole Lighting Circuit Protection (Surge Suppression Incorporated Model USPW1P1-21) Requires 30 Amp Class R Inline Fusing:

1. Maximum Continuous Operating Voltage: 150 volts

2. Maximum Continuous Operating Current: 30 Amps

3. Peak Surge Current: 40 kA per mode; 120 kA total

4. SPD circuitry shall include only solid-state clamping components consisting of a multi-stage hybrid design. Device shall be bi-directional, enclosed in a UL listed/recognized encapsulated thermal stress reducing compound.

5. Discrete and dedicated protection components must be provided for each mode of protection (L-N, Normal Mode) (L-G, N-G Common Mode).

6. Frequency Responsive Circuitry (sine-wave tracking) must be provided for each mode of protection. Products utilizing basic EMI/RFI filter performance (dB insertion loss rating) will not be considered.

7. Let-Through Voltages of product tested with the IEEE C62.41.1 & C62.41.2-2002; 100 KHz Ring Wave and Combination Wave must be equal to or better than the following:

a. Cat A, 30 Ohm 100 kHz Ring Wave, 2 kV @ 270 degree Phase Angle

1) P-N ≤ 25 volts

2) P-G ≤ 100 volts

3) N-G ≤ 75 volts

8. Enclosure: ABS Plastic, UL 94-5VA Flame Rating (UL's highest rating) and must be electrically non-conductive. Dimensions not to exceed L=5.22", W=3.12", H=1.88" to permit installation inside of pole inspection port.

9. Warranty: 25 Years Unlimited Free Replacement

F. Network Cable – Ethernet High Speed Data Circuit Protection (**USAES, LLC** Model D2RJ45##C8DIN-B-21) (## equals voltage; i.e. 5, 12, 24, 48, or 140 volts)

1. SPD devices shall be rated for the class of service necessary for the application.

2. Signal/Operating Voltage: 14 to 200 Volts.

3. Maximum Continuous Operating Current: 1.5 Amps

4. Series Resistance: Zero Ohms per wire

5. Data Rates: Up to 100 Mbps

6. SPD circuitry shall include only solid-state clamping components consisting of a multi-stage hybrid design. Device shall be bi-directional, enclosed in a UL listed/recognized encapsulated thermal stress reducing compound.

7. Protection Modes: Data transmission pairs shall be protected Line-to- Line and Line-to-Ground. Shield or signal ground protections shall be provided to ground only.

8. Each data carrying conductor shall have no internal series resistance per wire and no internal series resistance on the shield or signal ground conductor.

9. Each pair of data conductors must have a peak surge current rating of 1,500 Wpk per mode.

10. The device must be designed to be series connected and mounted internally to control panels for protection of equipment connected to data lines.

11. Enclosure: Devices shall be enclosed in a plastic enclosure constructed of a superior temperature/fire-rated material (UL94 5VA high-range temperature material) and must be electrically non- conductive. DIN rail mounted.

12. Warranty: **5 Years** Unlimited Free Replacement. SPD manufacturers whose warranty does not meet the requirements and standards listed above shall submit a letter on the SPD manufacturer's corporate letterhead stationery and signed by a corporate officer extending the warranty to meet these standards with the product submittal.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Connect the Ground of the SPD to the grounding bar of the control cabinet using a minimum of No. 10 AWG wire. Further, the grounding bar of the cabinet shall be connected to the basic grounding system using a minimum of No. 6 AWG wire.

B. All labor, materials, equipment, and services necessary for, and incidental to the installation of the SPDs as specified, shall be provided by the Electrical Contractor.

C. Provide low voltage surge products on BOTH ends of ALL 4-20mA signal circuits leaving the Electrical Building or ALL 4-20mA circuits exceeding 150 feet in length. Provide DIN rail mounted surge products installed within control cabinets. Provide surge units rated Class 1 Div 2 for all surge units mounted in valve pits. All surge units mounted exterior to the Electrical Building shall be rated for corrosive environments and listed as NEMA 4X, water-proof.

D. Provide low voltage surge products on BOTH ends of ALL copper Ethernet circuits leaving the Electrical Building or ALL copper Ethernet circuits exceeding 225 feet in length. Provide DIN rail mounted surge products installed within control cabinets. All surge units mounted exterior to the Electrical Building shall be rated for corrosive environments and listed as NEMA 4X, water-proof.

E. Provide low voltage surge products on BOTH ends on ALL proprietary network circuits leaving the Electrical Building. Provide DIN rail mounted surge products installed within control cabinets. All surge units mounted exterior to the Electrical Building shall be rated for corrosive environments and listed as NEMA 4X, water-proof.

F. When installing a series connected SPD, bind the supply side conductors separately and away from the load side conductors.

END OF SECTION 16 3000

SECTION 16 3100

SURGE PROTECTION DEVICES FOR POWER DISTRIBUTION

PART 1 – GENERAL

1.01 SUMMARY

A. This section describes the quality, performance, and installation of Parallel Connected, AC Power, Panel Type, Surge Protective Devices (SPDs).

1.02 QUALITY ASSURANCE

A. All Surge Protective Devices (SPDs) shall be tested and listed to ANSI/UL 1449-Current Edition by an independent testing agency, with the experience and capability to conduct the testing indicated, that is a Nationally Recognized Testing Laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction. This agency must comply with ANSI/IEEE C62.45 test procedures for all categories established in C62.41 (1991). “Manufactured in accordance with UL 1449” is not equivalent to being certified and listed to ANSI/UL 1449 and does not meet the intention of this specification. In addition to being UL 1449 listed, Type 2 SPDs shall be Complimentary Listed to UL 1283.

1.03 CODES AND STANDARDS

A. ANSI/IEEE Std C62.41.1™-2002, IEEE Guide on the Surge Environment in Low- Voltage (1000 V and Less) AC Power Circuits

B. ANSI/IEEE Std C62.41.2™-2002, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

C. ANSI/IEEE Std C62.45™ -2002, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits

D. ANSI C84.1, American National Standard for Electric Power Systems and Equipment – Voltage Ratings (60 Hertz)

E. ANSI/IEEE Standard 1100-2005, IEEE Recommended Practice for Power and Grounding Electronic Equipment (Emerald Book) – Clause 8.6.1

F. National Fire Protection Association (NFPA) 70 (N.E.C.) –Article 285/242

G. ANSI/UL Standards 1449, UL 1283 Listed, CUL Listed & CE compliant “low- voltage directive.”

H. C62.62-2018 - IEEE Standard Test Specifications for Surge-Protective Devices (SPDs) for Use on the Load Side of the Service Equipment in Low Voltage (1000 Volts and less) AC Power Circuits

I. IEEE Standard C62.72™ - 2016 –IEEE Guide for the Application of Surge-Protective Devices for Use on the Load Side of Service Equipment in Low-Voltage (1000 V or Less, 50 Hz or 60 Hz) AC Power Circuits

1.04 MANUFACTURER QUALIFICATIONS

A. All surge protective devices shall be manufactured by an ISO 9001-2015 certified company normally engaged in the design, development, and manufacture of such equipment, with at least 10 years of engineering experience in the design and manufacture of permanently connected SPD devices.

B. The surge protective device manufacturer shall provide unlimited free replacement of the entire

SPD for all inoperable SPD units during the warranty period.

C. All SPDs shall be manufactured by the same manufacturer.

D. The listing of a manufacturer as “acceptable” does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included herein. Subject to compliance with requirements, provide products by the following manufacturers and models listed below only:

E. Surge Suppression, LLC-(Advantage Series) No exceptions 256-797-5097

1.05 SUBMITTALS

A. Surge protective device submittals shall include, but shall not be limited to the following items:

1. Complete data for all SPD indicating part numbers, conductor sizes, etc.

2. Dimensioned drawing of each suppressor type indicating mounting arrangement. Manufacturer’s ANSI/UL 1449 listing classification page and listing number(s).

3. Manufacturer’s UL 1283 listing classification page and listing number(s).

4. Certified test data documenting ANSI/IEEE C62.41-2002 performance

5. and the ability of the device to meet or exceed all requirements of this specification. Include complete let-through voltage/measured limiting voltage test data (not Voltage Protection Rating), test graphs, and scope traces for each mode for each product submitted for Category’s C, B, A (including Category A 2kV, 30 Ohm Ring Wave at both 90 & 270 degree electrical phase angles).

6. Letter from manufacturer stating products are in strict compliance

7. with the recommendations of IEEE Standard 1100-2005, Clause 8.6.1 and incorporate 10 individual dedicated discrete modes of protection for three-phase Wye systems, including direct line-to-line components. (Reduced-mode variations will not be accepted).

8. Statement of manufacturer’s warranty duration and replacement policy.

1.06 REQUIREMENTS

A. Surge Protective Devices (SPDs) shall be installed on all Motor Control Centers (MCCs), Switchboards, Low-Voltage Switch Gear, Mini-Powers Zones, Local Required Safety Switches, Feeder Safety Switches, and Branch Circuit and Distribution Panelboards, whether scheduled or not.

B. All SPDs shall be tested and listed to ANSI/UL 1449 by a Nationally Recognized Testing Laboratory (NRTL) (i.e. CSA, UL, etc.). Type 2 SPDs shall be Complimentary Listed to UL1283.

C. All SPDs shall be Type 2 SPDs unless otherwise directed by the specifying engineer; Type 4 SPDs are not permitted. (Definitions: Type 1 SPD – Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service equipment overcurrent device, as well as the load side, including watt- hour meter socket enclosures and intended to be installed without an external overcurrent protective device. Type 2 SPD – Permanently connected SPDs intended for installation on the load side of the service equipment overcurrent device; including SPDs located at the branch panel.

D. The SPD shall be tested and listed by an NRTL as a complete assembly to a Short-Circuit Current Rating (SCCR) greater than or equal to the available fault current at the location of

installation at the connected panel without the need for upstream over current protection, in accordance with NEC Article 285/242 and shall be marked with the Short-Circuit Current Rating (SCCR). If the available fault current is unknown, then the SCCR of the SPD shall be 200 kAIC. The SPD shall have a sufficient Short-Circuit Current Rating (SCCR) for the point of application without relying upon any upstream circuit interrupt device (i.e. circuit breaker or fuse).

E. Permanently connected surge protective devices mounted parallel to the service, distribution, and sub panels are required. SPD device drawings shall be made available upon request.

F. The service entrance SPD shall have a Nominal Discharge Current (I_n) of 20 kA. All other SPDs shall have a Nominal Discharge Current (I_n) of 10 kA.

G. Fusing:

1. The SPD shall provide as a minimum, over-current, over temperature protection in the form of component-level thermal fusing to ensure safe failure and prevent thermal runaway. This component-level fusing shall be an integral part of the MOV itself and not silver wire (or other) independently laid across each MOV. SPDs without thermal fuses or disconnects, or SPDs with shared thermal devices that disconnect more than one MOV are not acceptable

2. Surge protective devices shall contain integral short circuit current safety fusing within each device for over-current requirements of the NEC. This fusing will be independent of the “component-level” fusing and be specifically for over-current protection and shall be constructed utilizing surge rated, cartridge fuses and not rated ‘silver-fuse-wire’ (or other).

3. Any SPD that is connected directly to the bus on a panel, panelboard, or MCC must have a properly sized breaker in the circuit between the SPD and the bus to permit the SPD to be serviced without the requirement to remove the power from the gear.

4. The fusing mechanisms employed must effectively coordinate their performance in conjunction with the high current abnormal over-voltage testing under ANSI/UL 1449.

5. The use of any mechanical or electro-mechanical thermal/over- current protection (i.e. moving parts and/or springs and shutters) in combination with or for the protection of the suppression elements is expressly prohibited and will be rejected. Large-Block 34mm (50kA) square Thermal Protected MOVs are expressly prohibited and will not be accepted.

H. MCOV: The SPD shall have a maximum continuous operating voltage (MCOV) capable of sustaining 115% of nominal RMS voltage continuously without degrading.

I. Component Limitations: The SPD shall only use solid-state clamping components to limit the surge voltage and divert the surge current. SPD components that “crowbar” short-circuit the AC power system (e.g. spark gaps, gas tubes, selenium cells, or SCR’s) shall not be acceptable. Device circuitry shall be bi-directional, enclosed in a UL listed encapsulated thermal stress reducing compound, and be of a parallel design.

J. Per Phase Ratings: ‘Per-Phase’ ratings for a three-phase Wye-connected SPD are determined by multiplying the kA per mode times the number of discrete modes of protection (directly connected suppression components), minus the value for the Neutral to Ground mode, divided by the number of phases.

1. Per-Phase = (((kA per mode) X (# of modes))-(N-G mode kA)) / (# of phases)

K. Protection Modes: The SPD system shall provide (per IEEE Std. 1100-2005- 8.6.1) dedicated,

independent, distinct, individual protection circuitry for every possible mode in the electrical distribution system at the point of SPD application. For example, a 277/480V, 3-phase Wye, 4-wire plus ground system has 10 distinct modes that require independent and dedicated protection (i.e., L1-L2, L2-L3, L3-L1, L1-N, L2-N, L3-N, L1-G, L2-G, L3-G, N-G). None of these modes of protection depend on protection elements purposed for other protection modes. Reduced mode SPD with only 3, 4, or 7 dedicated, distinct, independent protection modes are not acceptable and are not to be submitted. For 6 mode delta systems, 6 dedicated, independent, distinct protection modes are required (L1-L2, L2-L3, L3-L1, L1-G, L2-G, L3-G). When a mode of protection is specified, the protective mode must be specifically included. Thus, Line-to-Neutral-to-Line is not acceptable where Line-to-Line is specified.

L. Frequency Responsive Circuitry (FRC) (a.k.a. Sinewave Tracking Capability): The power panels and MCCs serving sensitive electronic equipment shall utilize voltage independent, dedicated Frequency Responsive Circuitry (FRC) intended to mitigate the effects of switching or ringing surges that is specifically designed so that it can survive the surge environment. EMI/RFI filtering specifically will not be considered as equal to FRC. The performance of FRC is defined by the level to which it mitigates Ring Wave transients and can be demonstrated in the test results of IEEE C62.41.2-2002, Category A 2kV, 30 Ohm Ring Wave.

M. To demonstrate the FRC capability of the submitted devices, manufacturers shall submit 3rd party, independent tests results for units claiming FRC capability. Such tests shall include testing under the standards of ANSI/IEEE C62.41 and C62.45 Category A (2kV, 67A, 100kHz ring wave) applied at the 270-degree phase angle, positive polarity. On a 3-phase Wye device, on each of the following modes: line-to-neutral, line-to-ground, and line-to-line (dynamic tests with normal voltage applied to the unit under test), and neutral-to-ground (static test with no normal voltage applied to unit under test) shall be tested. The “let-through voltage” derived from each of these tests shall have a maximum amplitude of less than 50V peak deviation from the insertion point of the surge on the sine wave to the peak of the transient. Measurement of the let-through voltage shall be made with six-inches of lead length external to the SPD housing in accordance with ANSI/UL 1449. Performance requirements are as stated in the table in Section VIII below (ANSI/IEEE C62.41 Let-Through Voltage) at Test Category A Ring Wave (2kV).

N. Status Indicators: SPD units shall have panel front status monitors as a minimum to indicate a continuous positive status of each protected phase. A remote audible alarm option must be supplied where the specifying engineer deems it necessary and cost effective under the circumstances. Refer to the appropriate drawings and schedules for these details.

O. Equipment Certification: Items shall be listed to ANSI/UL 1449-Current Edition, shall bear the seal of the NRTL, shall bear the Marking “Listed to UL 1449”, shall have been tested under ANSI/UL 1449-Current Edition, and shall be marked in accordance with the referenced standard. SPD units shall be UL 1283 Listed as an Electromagnetic Interference Filter and marked accordingly. All surge suppression devices shall be manufactured by an ISO 9001-2015 certified company normally engaged in the design, development, and manufacture of such equipment.

P. Circuit Configuration: The circuit configuration of the suppression units shall be bi-directional, thermal stress reducing, encapsulated, custom parallel connected, and solid state. (Series units or units equipped with “load carrying” components are expressly prohibited due to the possibility of single point series failures causing power interruption to protected loads.)

Q. Enclosures: Unless otherwise noted, provide NEMA 1 or better enclosures for indoor mounting and NEMA 4X enclosures or better for all outdoor locations. All units will contain Form C, N/O or N/C, dry relay contacts, if so specified, and weatherproof fittings to maintain the required NEMA integrity.

R. Maintenance Restrictions: No suppression unit shall be supplied which requires scheduled preventive maintenance or replacement parts. Units requiring functional testing, special test equipment, or special training to monitor surge protection device (SPD) status are not acceptable. SPD shall require NO routine maintenance. SPD devices are considered non-repairable items and shall be fully replaced upon failure.

S. Commonality: All SPDs at the service entrance, distribution panels, and sub- panels shall be from the same manufacturer.

T. Performance Criteria: All SPDs shall meet or exceed the performance criteria shown in the Peak Surge Current & Performance Table below. SPDs must meet the Let-Through Voltage criteria as shown in the Section VII, below.

1.07 ANSI/IEEE C62.41 LET-THROUGH VOLTAGE

A. The SPD shall meet the Let-Through Voltage requirements shown in the tables below for voltage and locations specified. All voltages shall be peak (±10%), Positive Polarity, Time base = 10µs, Sampling Rate = 500 Mega samples per second to ensure maximum transient capture. [These settings assure Let-through Voltage test results are accurate]. Surge voltages shall be measured from the insertion of the surge on the sine wave to the peak of the surge. All tests are Static (unpowered), except for the 120V circuits that are Dynamic (powered). Let-through voltages on static tests calculated by subtracting sine wave peak from let-through measured from zero. All tests shall be performed in accordance with UL144 latest edition with measurements performed at a point on the leads 15.24 cm (6 inches) outside of the device enclosure. No data measured at a module, lugs, component, or undefined location will be accepted. These settings assure Let-through Voltage test results are accurate. SPDs shall meet the following criteria:

1. Service Entrance ANSI/IEEE Cat. C Impulse Wave: The let-through voltage based on ANSI/IEEE C62.41 and C62.45 recommended procedures for the ANSI/IEEE Cat. C (High) (10,000 amps), shall be less than (values are total let-through voltage (LTV) measured from the insertion point of the transient on the sine wave to the peak of the transient):

Mode / Voltage	120/208Y	277/480Y	480V, 3Ø Δ
L-N	1075V	1340V	N/A
L-L	1390V	1990V	1990V
L-G	1056V	1310V	2150V
N-G	1441V	1730V	N/A

2. Distribution and Branch Panels/Panelboards (Non-Electronics): ANSI/IEEE Cat. A Combination Wave Impulse Let-Through Voltage: The let-through voltage based on ANSI/IEEE C62.41 and C62.45 recommended procedures for the ANSI/IEEE Cat. A Combination Wave Impulse (6kV, 200 amps) at the 90 degree phase angle, shall be less than; (values are total let-through voltage (LTV) measured from the insertion point of the transient on the sine wave to the peak of the transient):

Mode / Voltage	120/208Y	277/480Y	480V, 3Ø Δ
L-N	315V	437V	N/A
L-L	467V	535V	515V
L-G	340V	424V	515V
N-G	597V	960V	N/A

3. Branch Panels/Panelboards (Electronics) ANSI/IEEE Cat. A Ring Wave Let- through-Voltage: The let-through voltage based on ANSI/IEEE C62.41 and C62.45 recommended procedures for the ANSI/IEEE Category A 2kV, 30 Ohm Ring Wave at the 270 degree phase angle, shall be less than (values are total let-through voltage (LTV) measured from the insertion point of the transient on the sinewave to the peak of the transient):

Mode / Voltage	120/208Y	277/480Y	480V, 3Ø Δ
L-N	30V	60V	N/A
L-L	40V	70V	114V
L-G	55V	85V	1605V
N-G	65V	70V	N/A

4. In addition to the above requirements, Service Entrance, Distribution Panels, Mini-Powers Zones, and Panelboards directly feeding Electronics or where the specifying engineer deems Frequency Responsive Circuitry to be necessary shall meet the requirements of 3 above whether scheduled or not.

1.08 ANSI/UL 1449 LATEST EDITION VOLTAGE PROTECTION RATING

A. Voltage Protection Rating (VPR) is a rating selected from a list of preferred values as detailed in ANSI/UL 1449-1449 latest edition and assigned to each mode of protection. The value of a VPR is determined as the nearest highest value taken from a list of preferred values (as detailed in ANSI/UL 1449-1449 latest edition compared to the measured limiting voltage determined during the transient voltage surge suppression test using the combination wave generator at a setting of 6 kV, 3 kA.

B. The SPD shall have Voltage Protection Ratings (VPRs) no greater than those shown below:

Nominal System Voltage	Mode	VPR
Single-Phase 120/240	L-N L-G N-G L-L	600 V 600 V 700 V 1000 V
Three-Phase 120/240 Delta	L-N HL-N L-G HL-G N-G L-L HL-L	600 V 1200 V 600 V 1200 V 700 V 1000 V 1000 V
120/208 Wye	L-N L-G N-G L-L	600 V 600 V 700 V 1000 V

277/480 Wye	L-N L-G N-G L-L	1200 V 1200 V 1200 V 1800 V
480 No Neutral (Delta)	L-G L-L	1800 V 1800 V

1.09 WARRANTY

A. All SPD devices shall be warranted to be free from defects in materials and workmanship under normal use in accordance with the instructions provided for a period of twenty-five (25) years from date of substantial completion.

B. Any SPD device that shows evidence of failure or incorrect operation, including damage as the result of lightning strikes, during the warranty period shall be replaced as a complete unit (not just modules, subassemblies, or components) by the manufacturer at no charge to the owner. Warranty will provide for multiple exchanges of any inoperable devices at any time during the warranty period that starts at the date of substantial completion of the system to which the surge suppressor is installed.

C. SPD manufacturers whose warranty does not meet the requirements and standards listed above shall submit a letter on the SPD manufacturer's corporate letterhead stationery and signed by a corporate officer extending the warranty to meet these standards with the product submittal.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 INSTALLATION

A. GENERAL: There are a few basic principles for the installation of SPDs in electrical panels. They are:

1. For proper performance, the SPD shall be installed with the wires as short and straight as humanly possible. Any sharp bend in the wire is unacceptable! This applies to phase, neutral, and ground leads. The objective is to reduce the lengths of wire provided on each unit, not add to it. The priority is to the phase leads, then the neutral, and then the ground lead.

2. Install the breaker for the SPD close to the neutral bus, if present, on the neutral bus side of the panel. If no neutral circuit is present in the electrical panel, install the breaker close to the ground bus if possible.

3. Install the SPD on a dedicated breaker. If the unit is piggybacked on a breaker that feeds other equipment, when that breaker is turned off to service the other equipment, you have lost the surge suppression for that panel.

4. Mount the SPD directly across from the breaker. While holding the SPD on the wall or side of the panel, determine the shortest distance between the hub on the SPD and the hub to be installed on the panel. If using the flexible conduit supplied with the SPD, cut the flexible conduit to the shortest length possible to fit securely over both hubs. Twist the trimmed flexible conduit onto the extra hub. Slide the conduit and hub over the wires of

the SPD and twist the conduit onto to the hub of the SPD. Connect the extra hub to the panel and mount the SPD to the wall or the panel.

5. The breaker, the neutral bus, and the SPD should be close together to keep the wires as short and straight as humanly possible. Twist the phase and neutral wires together for 3 or 4 twists between the SPD and the breaker. Then these wires should be cut short as possible and connected to the breaker or the neutral bus, as appropriate, with no sharp bends in the wire.

6. The ground wire should be connected to the panel ground bus if it is close to the SPD. If this is not possible, connect the ground wire to a ground lug installed near the SPD in the can or frame as they are grounded. If necessary, once this is done, the ground wire can be extended from the lug to the ground bus if the AHJ requires this connection.

7. These same principles apply to installation on switchboards and MCCs. On MCCs, locate the SPD as close to the main bus as possible so that the lead lengths are short.

8. If possible, when installing an SPD in an MCC, install it in a bucket with a feeder breaker and use a remote light mounted on the door. The Remote Light Kit (option –LP) must be ordered with the SPD. It cannot be ordered to add to the SPD as an in-the-field modification.

B. SPECIFIC:

1. Provide surge protective devices at each building service entrance and at other distribution and panelboard locations as indicated on the drawings. The SPD shall be located immediately adjacent to the switchboard or panelboard being protected (close-nipple to panel-boards). The SPD may not be located integral (switchgear manufacturer installed) within the switchboard or panelboard(s) unless the switchgear manufacturer providing such SPD products expressly meets or exceeds ALL parameters of this specification for the SPD. These SPDs shall be individually tested and Listed to ANSI/UL 1449 according to their type (Type 1 or Type 2) and not be listed solely as part of the larger assembly. SPD devices not meeting or exceeding the performance of this specification will be deemed unacceptable.

2. Do not energize or connect service entrance equipment and panelboards to their sources until SPD devices are properly installed and connected.

3. Do not perform insulation resistance tests of the distribution wiring equipment with the SPD installed. Disconnect all conductors including the neutral and/or ground before conducting insulation resistance tests, and reconnect immediately after the testing is over.

4. Install the SPD with #10 AWG conductors to dedicated 30-amp breaker(s) in panel per manufacturer’s installation instructions and close to the Neutral Bus. The dedicated breaker shall serve as a means of service disconnect for the SPD so that the electrical panel remains energized during SPD servicing. The installer may rearrange breaker locations to ensure the shortest and straightest leads to the SPD. If a dedicated breaker is not provided, an SPD with internal 30-amp fuse or a UL Listed disconnect switch shall be installed as a minimum. The conductors (neutral and phase wires) serving the SPD shall be twisted together (3 or 4 twists per 12” of wire) to reduce the SPD system input impedance and shall be kept at the minimum length. The SPD shall be installed in strict accordance with the manufacturer’s recommended practices and in compliance with N.E.C. requirements, State, and Local Codes.

5. If any lead lengths exceed 18”, the Contractor responsible for installation must contact the

specifying electrical engineer and the surge-protective device manufacturer or distributor (256-797-5097) for installation assistance.

6. The electrical contractor shall verify the proper application of the SPD (i.e., voltage, phases, etc.). The electrical contractor shall ensure that all Neutral conductors are bonded to the system ground at the service entrance the serving isolation transformer prior to installation of the associated SPD. The electrical contractor will ensure that neutral-to-ground bonds do not exist at locations that are not service entrances or newly derived power sources.

7. The electrical contractor shall furnish all labor, materials, equipment, and

8. services necessary for and incidental to the installation of the SPD system components as specified herein.

9. The electrical contractor shall coordinate with other electrical work as necessary to interface installation of the transient voltage surge suppression systems with other work on the site.

10. The SPD installation shall be completed by a certified or licensed electrician to ensure that the installation is in accordance with the manufacturer's recommendations, applicable electrical code requirements and the requirements of the specification above. Any deficiencies noted shall be corrected by the Contractor. Provide written documentation of this inspection as part of the closeout documentation.

END OF SECTION 16 3100

SPECIFICATION SECTION 16 4710

AUTOMATIC TRANSFER AND BYPASS ISOLATION SWITCHES

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall install, test, and place into operation the automatic transfer switch and bypass-isolation switch (ATS/BPS) system(s) with number of poles, amperage, voltage, withstand and close-on ratings as shown on the plans. The ATS/BPS will be Owner-Furnished. The Contractor shall be responsible for picking up the Owner-Furnished equipment from the Owner's storage location and delivering it to the site of final installation. Costs associated with these requirements shall be included in their Pay Item.

B. Each automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation.

C. All automatic transfer and bypass-isolation switches and controllers shall be the products of the same manufacturer.

1.02 SINGULAR NUMBER

A. All reference made to any item in the singular number shall apply equally to as many identical items that the work may require.

1.03 CODES AND STANDARDS

A. The automatic transfer switches and controls shall conform to the requirements of:

1. UL 1008 - Standard for Transfer Switch Equipment
2. IEC 947-6-1 Low-voltage Switchgear and Controlgear; Multifunction equipment; Automatic Transfer Switching Equipment
3. NFPA 70 - National Electrical Code
4. NFPA 110 - Emergency and Standby Power Systems
5. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
6. NEMA Standard ICS10-1993 (formerly ICS2-447) - AC Automatic Transfer Switches

1.04 ACCEPTABLE MANUFACTURERS

A. Automatic transfer and bypass-isolation switches shall be ASCO 7000 Series. Model number 7-AUB-A-4.

B. Any alternate shall be submitted for approval to the Engineer at least 15 days prior to bid, and must list any deviations from this specification.

C. Equivalent products by the Generator manufacturer or Russ Electric/Siemens will be considered.

1.05 SUBMITTALS

A. Provide the Owner with electronic versions of the approved O & M manual in .PDF format.

1.06 OPERATING AND MAINTENANCE DATA

A. Provide the Owner with electronic versions of the approved O & M manual in .PDF format.

B. Maintenance Data: Include all required operational, routine maintenance requirements, troubleshooting, including specific operational and maintenance instructions.

PART 2 – PRODUCTS

2.01 MECHANICALLY HELD TRANSFER SWITCH

A. The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism. Main operators which include overcurrent disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.

B. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.

C. The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.

D. All main contacts shall be silver composition. Switches rated 400 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.

E. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 400 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.

F. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.

G. The ATS shall be provided with fully-rated neutral transfer contacts.

2.02 BYPASS-ISOLATION SWITCH

A. A two-way bypass-isolation switch shall provide manual bypass of the load to either source and permit isolation of the automatic transfer switch from all source and load power conductors. All main contacts shall be manually driven.

B. Power interconnections shall be silver-plated copper bus bar. The only field installed power connections shall be at the service and load terminals of the bypass-isolation switch. All control interwiring shall be provided with disconnect plugs.

C. Separate bypass and isolation handles shall be utilized to provide clear distinction between the functions. Handles shall be permanently affixed and operable without opening the enclosure door. Designs requiring insertion of loose operating handles or opening of the enclosure door to operate are not acceptable.

D. Bypass to the load-carrying source shall be accomplished with no interruption of power to the load (make before break contacts). Designs which disconnect the load when bypassing are not acceptable. The bypass handle shall have three operating modes: "Bypass to Normal," "Automatic," and "Bypass to Emergency." The operating speed of the bypass contacts shall be the same as the associated transfer switch and shall be independent of the speed at which the

manual handle is operated. In the "Automatic" mode, the bypass contacts shall be out of the power circuit so that they will not be subjected to fault currents to which the system may be subjected.

E. The isolation handle shall provide three operating modes: "Closed," "Test," and "Open." The "Test" mode shall permit testing of the entire emergency power system, including the automatic transfer switches with no interruption of power to the load. The "Open" mode shall completely isolate the automatic transfer switch from all source and load power conductors. When in the "Open" mode, it shall be possible to completely withdraw the automatic transfer switch for inspection or maintenance to conform to code requirements without removal of power conductors or the use of any tools.

F. When the isolation switch is in the "Test" or "Open" mode, the bypass switch shall function as a manual transfer switch.

G. Designs requiring operation of key interlocks for bypass isolation or ATSs which cannot be completely withdrawn when isolated are not acceptable.

2.03 MICROPROCESSOR CONTROLLER

A. The controller’s sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.

B. A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to + 1% of nominal voltage. Frequency sensing shall be accurate to + 0.2%. The panel shall be capable of operating over a temperature range of -20 to +60 degrees C and storage from -55 to +85 degrees C.

C. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multi-layer printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of the operator’s manuals.

D. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.

E. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:

1. IEEE472 (ANSI C37.90A) Ring Wave Test.
2. ENC55011 1991 Class A Conducted and Radiated Emission.
3. EN61000-4-2 Electrostatic Discharge Immunity, Direct Contact and Air Discharge.
4. EN61000-4-3 Radiated Electromagnetic Field Immunity.
5. EN61000-4-4 Electrical Fast Transient Immunity.
6. EN61000-4-5 Surge Immunity.
7. ENV50141 HF Conducted Disturbances Immunity.

2.04 ENCLOSURE

A. The ATS/BPS shall be furnished in a NEMA type 3R, free standing stainless steel or aluminum enclosure.

B. All standard and optional door-mounted switches and pilot lights shall be 16-mm industrial grade type or equivalent for easy viewing and replacement. Door controls shall be provided on a separate removable plate, which can be supplied loose for open type units.

C. A pressure disconnect link shall be provided to disconnect the normal source neutral connection from the emergency and load neutral connections for 4 wire applications. A ground bus shall be provided for connection of the grounding conductor to the grounding electrode. A pressure disconnect link for the neutral to ground bonding jumper shall be provided to connect the normal neutral connection to the ground bus.

2.05 SURGE PROTECTION DEVICES

A. Provide surge protection device (SPD) for utility and generator inputs and transfer switch output. Refer to Section 16 3000 and 16 3100 for SPD requirements.

2.06 SWITCH RATINGS

A. Switch assemblies to be rated for 480Y/277V 3PH 4W, 100 Amps at Existing Utility Site.

PART 3 – EXECUTION

3.01 CONTROLLER DISPLAY AND KEYPAD

A. A four-line, 20-character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller:

1. Nominal line voltage and frequency
2. Single or three phase sensing
3. Operating parameter protection
4. Transfer operating mode configuration
5. (Open transition, Closed transition or Delayed transition)

B. All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

3.02 VOLTAGE, FREQUENCY AND PHASE ROTATION SENSING

A. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout and trip setting capabilities (values shown as % of nominal unless otherwise specified):

Parameter	Sources	Dropout/Trip	Pickup/Reset
Under Voltage	N & E, 3-Ph	70% - 90%	85% - 100%
Over Voltage	N & E, 3-Ph	102% - 115%	2% Below Trip
Under Frequency	N & E	85% - 98%	90% - 100%

Over Frequency	N & E	102% - 110%	2% Below Trip
Voltage Unbalance	N & E	5% - 20%	1% Below Dropout

B. Repetitive accuracy of all settings shall be within plus/minus 0.5% over an operating temperature range of -20 deg C to 60 deg C.

C. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.

D. The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).

E. Source status screens shall be provided for both normal and emergency to provide digital readout of voltage on all 3 phases, frequency, and phase rotation.

3.03 TIME DELAYS

A. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 24 VDC power supply.

B. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.

C. Two time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.

D. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.

E. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0 to 5 minute time delay in any of the following modes:

1. Prior to transfer only.
2. Prior to and after transfer.
3. Normal to emergency only.
4. Emergency to normal only.
5. Normal to emergency and emergency to normal.
6. All transfer conditions or only when both sources are available.

F. The controller shall also include the following built-in time delays for optional Closed Transition and Delayed Transition operation:

1. 1 to 5 minute time delay on failure to synchronize normal and emergency sources prior to closed transition transfer.
2. 0.1 to 9.99 second time delay on an extended parallel condition of both power sources

during closed transition operation.

3. 0 to 5 minute time delay for the load disconnect position for delayed transition operation.

G. All time delays shall be adjustable in 1 second increments, except the extended parallel time, which shall be adjustable in .01 second increments.

H. All time delays shall be adjustable by using the LCD display and keypad or with a remote device connected to the serial communications port.

3.04 ADDITIONAL FEATURES

A. A three position momentary-type test switch shall be provided for the test / automatic / reset modes. The test position will simulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal.

B. A set of DPDT gold-flashed contacts rated 10 amps, 32 VDC shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.

C. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.

D. LED indicating lights (16 mm industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).

E. LED indicating lights (16 mm industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.

F. The following features shall be built-in to the controller, but capable of being activated through keypad programming or the serial port only when required by the user:

1. Provide the ability to select “commit/no commit to transfer” to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.

2. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial port.

3. An inphase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The inphase monitor shall be specifically designed for and be the product of the ATS manufacturer. The inphase monitor shall be equal to ASCO Feature 27.

4. The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.

5. Engine Exerciser - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:

a. Enable or disable the routine.

b. Enable or disable transfer of the load during routine.

c. Set the start time

1) time of day

2) day of week

3) week of month (1st, 2nd, 3rd, 4th, alternate or every)

4) Set the duration of the run.

d. At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period.

6. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.

7. System Status - The controller LCD display shall include a “System Status” screen which shall be readily accessible from any point in the menu by depressing the “ESC” key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position. For example:

a. NORMAL FAILED

b. LOAD ON NORMAL

c. TD NORMAL TO EMERG 2MIN15S

8. Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the operator’s manual, are not permissible.

9. Self Diagnostics - The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.

10. Communications Interface – The controller shall be capable of interfacing, through an optional serial communication module, with a network of transfer switches, locally (up to 4000 ft.) or remotely through modem serial communications. Standard software specific for transfer switch applications shall be available by the transfer switch manufacturer. This software shall allow for the monitoring, control and setup of parameters.

11. Data Logging – The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:

a. Event Logging

1) Data and time and reason for transfer normal to emergency.

2) Data and time and reason for transfer emergency to normal.

3) Data and time and reason for engine start.

4) Data and time engine stopped.

5) Data and time emergency source available.

6) Data and time emergency source not available.

b. Statistical Data

1) Total number of transfers.

2) Total number of transfers due to source failure.

3) Total number of days controller is energized.

4) Total number of hours both normal and emergency sources are available.

3.05 ADDITIONAL REQUIREMENTS

A. Withstand and Closing Ratings

1. The ATS/BPS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS/BPS terminals, or as shown on the plans.

2. The ATS/BPS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1½ and 3 cycle, long-time ratings. ATS/BPSs which are not tested and labeled with 1½ and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable.

3.06 INSTALLATION

A. Install per manufacturer's recommendations and contract documents. Coordinate installation with adjacent work to ensure proper sequence of construction, clearances and support.

B. Units to be floor mounted on 4 inch thick reinforced concrete housekeeping pads, unless otherwise indicated. Units to be secured to concrete pad with stainless steel bolts and expansion inserts, as recommended by manufacturer. Maintain proper clearances to ventilation, servicing, and inspection.

3.07 IDENTIFICATION AND LABELS

A. Provide engraved labels for switch assembly, indicating ID designation, voltage, phase, number of wires, and major components. Engraved labels to be laminated plastic with 1/2" high primary letters and 5/16" high secondary letters (white letters on black surface). Labels to be secured with at least two small Phillips head screws or pop rivets.

3.08 TESTS AND CERTIFICATION

A. The complete ATS/BPS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.

B. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.

C. The ATS/BPS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.

3.09 SERVICE REPRESENTATION

A. The ATS/BPS manufacturer shall maintain a national service organization of company-employed personnel located throughout the contiguous United States. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.

B. The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

END OF SECTION 16 4710