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ACKNOWLEDGEMENT PAGE

DATE: **September 10, 2024**

PAGE: **1 of 58 (INCLUDING THIS PAGE)**

TO: **ALL CONTRACTORS**

FROM: **DENISE KING**

PROJECT: **SOUTH WATER TREATEMENT PLANT**
FOR THE UTILITIES BOARD OF THE CITY OF FOLEY, ALABAMA D/B/A RIVIERA UTILITIES
GMC PROJECT NO. CMOB220112

RE: **ADDENDUM #2**

PLEASE COMPLETE BELOW AND RETURN IMMEDIATELY.

Ashley Morris
Email: Ashley.Morris@gmcnetwork.com

I, the undersigned, hereby acknowledge receipt of this Addendum.

_____ _____
Authorized Representative of Contractor Date

_____ _____
Company Name Telephone

_____
Contractor's License Number (if applicable)

ADDENDUM NUMBER 2

SOUTH WATER TREATMENT PLANT

FOR

THE UTILITIES BOARD OF THE CITY OF FOLEY, ALABAMA D/B/A RIVIERA UTILITIES

GMC PROJECT NO. CMOB220112

1. General

1.1 The following revisions are hereby added as Addendum No. 2 to the referenced Project Manual and Plans and shall be considered when preparing bids.

2. Revisions to Project Manual

2.1 Specification 33 11 13 – Water Supply Wells has been revised and is included as an attachment to this addendum.

2.2 Specification 43 23 13 – Vertical Turbine Pumps has been revised and is included as an attachment to this addendum.

2.3 Specification 26 43 13 – Surge Protection for Low-Voltage Electrical Power Circuits has been revised and is included as an attachment to this addendum.

2.4 Specification 26 43 20 – Surge Protection for Controls and Communication Circuits has been revised and is included as an attachment to this addendum.

2.5 Specification 26 24 13 – Switchboards has been revised and is included as an attachment to this addendum.

2.6 Referring to BCU-1 and OHP-1, Sheet M-103, add 10,000 hour coating to evaporator and condenser coils, the condensing section with all exposed copper tubing and refrigerant circuit components, and the interior cabinet of air stream.

3. Questions

3.1 **Question: Sheet E-935 shows the disconnect schedule. Disconnect P6230 show NF (Non-Fused) but also is noted to fuse per manufactures requirements. Is this a fused disconnect?**
Answer: It is intended to be a non-fusible disconnect. Disregard referenced note.

3.2 **Question: On sheet E-101 three junction boxes are shown. Are these intended to be in ground handholes or surface mounted N4X junction boxes? What size are they required to be?**
Answer: They are intended to be tier 15 handholes with covers (Quazite, typically), each labeled per contents (i.e. Power, Communications, Controls, etc.) The contractor is required to size them and submit for approval based on the size and quantity of conduits being installed. Minimum 12”x12”x12”, but will vary particularly for the 480V power handholes.

3.3 **Question: On sheet E-112 a camera is shown. Who is to furnish and install the camera system?**

Answer: The camera system is to be furnished and installed by contractor, to be coordinated with Owner and their IT Department.

3.4 **Question: On sheet E-201, detail #1, four PB (Pull Boxes) are shown. Are these intended to be in ground handholes or surface mounted N4X junction boxes? What size are they required to be?**
Answer: They are intended to be tier 15 handholes with covers (Quazite, typically), each labeled per contents (i.e. Power, Communications, Controls, etc.) The contractor is required to size them and submit for approval based on the size and quantity of conduits being installed. Minimum 12"x12"x12", but will vary particularly for the 480V power handholes.

3.5 **Question: On sheet E-201, detail #2, four junction boxes are shown. Are these intended to be in ground handholes or surface mounted N4X junction boxes? What size are they required to be?**
Answer: They are intended to be tier 15 handholes with covers (Quazite, typically), each labeled per contents (i.e. Power, Communications, Controls, etc.) The contractor is required to size them and submit for approval based on the size and quantity of conduits being installed. Minimum 12"x12"x12", but will vary particularly for the 480V power handholes.

3.6 **Question: On sheet E-301, three in ground junction boxes are shown. What size are they required to be?**
Answer: They are intended to be tier 15 handholes with covers (Quazite, typically), each labeled per contents (i.e. Power, Communications, Controls, etc.) The contractor is required to size them and submit for approval based on the size and quantity of conduits being installed. Minimum 12"x12"x12", but will vary particularly for the 480V power handholes.

3.7 **Question: Sheet E-936 contains the light fixture schedule. The fixture schedule has fixtures AE, BE, CE, F, FL, SE, S1, S1E, S2, S2E shown but not in the floor plans. Where are these fixtures located on the plans?**
Answer: Fixtures not called out on plan sheets are not required in this project. Fixtures AE, BE, CE, F, FL, SE, S1, S1E, S2, S2E can be disregarded.

3.8 **Question: Sheet 901, detail #3 shows stainless steel angle to be used. Can aluminum angle be used in lieu of the stainless steel to reduce cost?**
Answer: Please bid as specified.

3.9 **Question: Sheet 901, detail #6 shows stainless steel framing to be used with aluminum back plate. Can the frame also be made of aluminum to reduce cost?**
Answer: Please bid as specified.

3.10 **Question: Spec section 26 05 33 calls for GRC (galvanized rigid steel conduit) to be installed in most areas above grade. Can this be changed to ARC (aluminum rigid conduit)? It doesn't rust and it is less expensive.**
Answer: Yes, ARC can be utilized (including the underground sweeps or 90s) but they shall be wrapped with bitumastic tape where in contact with earth or concrete. ARC shall not be installed where in direct contact with concrete.

3.11 **Question: Spec section 26 05 33 calls for GRC on interior conduits and a minimum size of 3/4". Is it acceptable inside the building, inside walls and above ceilings to install EMT and change the size to 1/2" minimum?**
Answer: EMT is acceptable inside the building where not in chemical rooms/corrosive environments, but ¾" shall remain the minimum size.

3.12 **Question: Spec section 26 29 23 VFD's state only Yaskawa drives will be accepted. Can this spec be changed to allow other drives such as Eaton, Square D and Allen Bradly?**

Answer: No, please bid as specified.

3.13 **Question: Spec section 26 32 13 Generator supplier is to be Cummins, Generac or Caterpillar. Can this spec be changed to allow Kohler and Taylor also?**
Answer: No, please bid as specified.

3.14 **Question: Spec section 26 36 00, ATS is to be Asco or Eaton. Can this spec be changed to allow ATS from the Generator manufactures such as Kohler's ATS, Generac's ATS, and Cummins ATS?**
Answer: The ATS specification is no longer directly applicable. Power transfer shall be handled in the paralleling/power exporting switchgear.

3.15 **Question: Spec section 26 41 13 required a UL master labor to be obtained at completion of the lightning protection system. Some LP companies provide a Lightning Protection Institute (LPI) Inspection and Master Installation Certification at completion. Is an LPI certification acceptable in lieu of the UL Master Label?**
Answer: No, please bid as specified.

3.16 **Question: Spec section 26 36 00 ATS specifies an automatic transfer switch but the drawings do not show an ATS. The drawings show a SE rated, paralleling/power exporting switchgear but a specification for said gear is not included in the specs. Please provide a specification or clarification on the requirements of this paralleling switchgear.**
Answer: The ATS specification is no longer directly applicable. Power transfer shall be handled in the paralleling/power exporting switchgear. See the revised switchgear specification included as an attachment to this addendum.

3.17 **Question: The paralleling switch that is shown on drawings E-911. Is this to be provided by the generator manufacture or by the panel and power gear manufacturer?**
Answer: Ideally it would be provided by the generator manufacturer as a complete system.

3.18 **Question: In spec section 26 05 36-2.4-B-1&2 regarding the cable tray, #1 calls for aluminum tray and #2 calls for stainless steel tray. Is the cable tray to be aluminum or stainless steel?**
Answer: Either material is acceptable for use in the electrical room.

3.19 **Question: Spec section 26 05 36-1.3- "C" calls for a delegated design for seismic restraints. It appears that the contractor is responsible for hiring a structural engineer to design the cable tray supports and seismic bracing in a geographical area that doesn't typically have issues with earthquakes. Is a separate structural engineer's design required for the cable tray on this project?**
Answer: Delegated design for seismic restraints is not required.

3.20 **Question: On Sheet E-911 the feeder between the paralleling switchgear and the MSB-A switchboard is labeled as "1600-4WG" which is not shown on the conductor schedule located on sheet E-933. Please specify what you want installed for this feeder.**
Answer:

1600	5[(2-400 KCMIL & 1#3/0 G) 2 1/2"C]	5[(3-400 KCMIL & 1#3/0 G) 3"C]	5[(4-400 KCMIL & 1#3/0 G) 3 1/2"C]

4. Acknowledgement of Receipt

4.1 Receipt of Addendum shall be acknowledged in two ways:

4.1.1 Bidder acknowledges receipt of "Addendum No. 2" and date of "September 10, 2024".

AND

4.1.2 EMAIL GMC office immediately at ashley.morris@gmcnetwork.com with the signed transmittal which confirms the addendum has been received and is legible.

5. Conclusion

5.1 This is the end of Addendum Number 2, dated Tuesday, September 10, 2024.

SECTION 33 11 13 – WATER SUPPLY WELLS (ADDENDUM 2)

PART 1 - GENERAL

1.1 GENERAL:

A. The production well was drilled by Johnson Well Drilling in July 2024. The well outer and inner casing, screens, and gravel pack were installed and capped above ground as part of the well drilling project. The Well Construction Diagram is included at the end of this Section. The outer casing has a 20-inch O.D. and a wall thickness of 0.375-inch. The inner casing has a 14-inch O.D. and a wall thickness of 0.375-inch.

B. The work covered under this Contract consists generally of the installation of the well pump and motor and related appurtenances inside the well and the construction of the pump foundation, discharge head and concrete apron around the well. Also covered under this Contract is the installation of the well head enclosure, above-ground piping, valves, meters, etc. for the well, which are covered in other Specifications in this manual.

C. All work and materials shall be in accordance with applicable sections of AWWA A100.

D. The well pumping equipment shall be installed by a licensed and certified well driller that has experience in constructing public water supply wells and related work. The well driller may be required to submit a satisfactory experience and qualification record to the Owner/Engineer.

E. All requirements concerning licensed well contractors, well construction, water samples, water quality and well testing and other related matters contained in the latest release of Regulations Governing Public Water Supplies issued by the Alabama Department of Environmental Management Water Supply Division are hereby incorporated into these Specifications.

F. There is a required one (1) year warranty on the well pumping equipment manufacture and installation as specified elsewhere in these Specifications.

1.2 PROCEDURES AND METHODS:

A. Notwithstanding any general clauses, wording, paragraphs, or other references contained in the plans, specifications, general conditions or elsewhere in the Special Provisions the Engineer is not charged with the responsibility of directing the actual procedures and detail methods of construction to be used by the Contractor in accomplishing the work contained in the contract between the Owner and the Contractor, nor is the Engineer responsible to act as superintendent, foreman, or safety engineer for the Contractor, nor for the safety of the Contractor’s personnel.

1.3 REGULATIONS:

A. All work, test procedures, etc., shall be in accordance with the latest Administrative Code, Division 7, Alabama Department of Environmental Management, herein referred to as the Regulations.

1.4 SUBMITTALS:

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information for materials of construction and fabrication.

C. Shop Drawings:

1. Submit detailed dimensions for materials and equipment, including wiring and control diagrams, performance charts and curves, installation and anchoring requirements, fasteners, and other details.
2. Include manufacturer's specified displacement tolerances for vibration at operational speed specified for pumps.

D. Critical Speed Analysis: Identify speeds at which pumps will be prone to damaging vibrations.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements. Include separate Paragraphs for additional certifications.

F. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures, anchoring, and layout.

G. Source Quality-Control Submittals: Indicate results of shop/factory tests and inspections.

H. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

I. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions

PART 2 – PRODUCTS

2.1 WELL PUMP:

A. Description:

1. The pump to be installed shall be a water-lubricated, vertical turbine line-shaft well pump of heavy construction throughout and suitable for continuous operation at the conditions specified.

B. Manufacturer:

1. Xylem-Goulds Water Technology
2. American Marsh Pumps (Wilo)
3. Peerless
4. Or Approved Equal

C. Performance and Design Criteria:

1. Design Flow Rate: 1,000 GPM
2. Design Total Dynamic Head: 126 FT
3. Minimum Efficiency at Design Flow: 80%
4. Minimum Column Diameter: 8-inch

5. Pump Discharge Size: 10-inch
6. Pump Setting: 230’ depth below ground surface. This is the basis of design setting, but the pump installer shall submit the recommended pump setting if differs from this setting.

D. Pump Base:

1. The pump base shall be of extra heavy construction throughout and of sufficient size to properly support the column, bowl and driver. It shall be of cast iron or carbon steel construction, fitted with a flanged outlet connection, a machine steel sole plate. The sole plate shall have an extra heavy separate steel baseplate machined to provide water tight seal against the sole plate. The baseplate shall be perfectly leveled and permanently grouted into the concrete foundation. The grouting shall provide a water proof seal. The discharge flange shall be faced and drilled to match ANSI Class 125 steel flange connections. The design shall permit the vertical hollow shaft motor drive shaft to be coupled above the stuffing box. The discharge head shall be of the shrouded type with a 1/2-inch, minimum, NPT drain connection so that the relief water from the stuffing box and water leaking around the packing gland can be collected and piped away from the well site. The discharge base will be designed to withstand the pressure produced by the pump at shut off head as the pump may be operated against a closed valve. The motor drive shaft shall be the same diameter as the line shaft and shall be manufactured of 416 stainless steel. The coupling to connect the motor drive shaft to the line shaft shall be manufactured of 416 stainless steel and the O.D. of the coupling shall be machined. The shaft above the stuffing box shall be equipped with a rubber water slinger to protect the motor. The discharge base shall also be fitted with a connection for the pre-lubrication water line.

2. Cast iron stuffing box shall be of the deep bore type with a minimum of five (5) rings of packing and a seal cage. Connections for grease inlet and pressure relief shall be provided. The packing gland shall be of the bronze split type and severed in place with ASTM A193, Grade B8 stainless steel studs and silicon bronze nuts. The bottom of the stuffing box casting shall be provided with a bronze bearing of adequate length to prevent shaft deflection through the box and to serve as a throttle bushing. The stuffing box will be designed to withstand pressure produced by the pump at shutoff head as the pump will operate against a closed valve.

3. The pump base shall be equipped with two fittings through which to pass a 3/8” air line and install a 2” cap.

E. Column Pipe:

1. Column assembly shall be flanged-connected to the discharge head. Column pipe shall be of ASTM A53, Grade B steel pipe. Ends shall be machined with 8 threads per inch and faced. Intermediate sections of column shall not exceed ten feet (10’). Top and bottom section of column pipe shall not exceed five feet (5’). All column pipe couplings shall be steel, long pattern, fully threaded to allow the installation of a machined SAE 43 bronze drop-in spider bearing retainer that has a 3/4” thick web for column pipe joints to tightly butt against. The line shaft bearing shall be of synthetic rubber (R-3). The external shape of the bearing shall be such as to retain it in the spider without use of auxiliary collars or rings. The shape of the bearings shall be polygon to provide minimum friction contact to the shaft. Replacement bearings shall be capable of being installed by hand without special tools. Line shafts shall be of A276, Type 416 stainless steel ground and polished with a surface not to exceed 40 rms. Shaft diameter selection shall be based on a combined shear stress of not more than eighteen percent (18%) of the

ultimate strength or not in excess of thirty percent (30%) of the elastic limit in tension. Intermediate shaft sections shall be interchangeable and shall not exceed ten feet (10') in length. The butting ends shall be machined square to the axis of the shaft and shall be threaded and coupled by stainless steel couplings designed with a safety factor of 1 1/2 times the shaft factor.

2. Column Pipe: 8" x 0.322" carbon steel epoxy coated

F. Pump Bowls:

1. The pump bowls shall be constructed of ASTM A48 Class 30 cast iron and shall be so designed to operate in accordance with the pumping conditions as specified. Each bowl interior shall be enameled to provide smooth passage of water and increase efficiency. The bowl exterior shall be epoxy coated. The impeller shaft shall be Type 416 stainless steel and of sufficient size to carry the full load of the impellers. Each stage shall be fitted with a removable bowl wear ring and the impellers shall be of the fully enclosed type, non-overloading and so designed that the motor will not be overloaded nor the pump break suction in the event the above ground head is removed from the pump. The impellers, wear rings and bushings shall be bronze, SAE 43 or SAE 660. The bowls shall be set with a minimum submergence of 30 feet below the drawdown level attained when pumping at the rated capacity.

G. Suction Pipe:

1. The pump bowl shall be equipped with not less than thirty (30') feet of standard weight suction pipe. The inlet shall include a Type 304 stainless steel inlet strainer.

H. Air Line:

1. The pump assembly will be equipped with an air line for monitoring water levels. The air line shall be 3/8-inch (minimum inside diameter) red brass pipe, 3/8-inch copper tubing or 3/8-inch polyethylene tubing attached to the discharge column from the pump head to a point 20 feet below the pump bowls. The installation shall be made in such a manner as to prevent the intrusion of foreign matter. Piping, fittings, air valves and a pressure gauge indicating pressure in feet shall be provided and mounted to facilitate water level and drawdown monitoring.

2. In addition, a 2-inch diameter casing access portal shall be installed and capped to allow direct measurement of the water level by tape or 3/4-inch probe.

2.2 MOTOR:

A. The electric motor shall be manufactured by U.S. Motors. The electrical motor shall conform in construction and performance with the National Electrical Manufacturers Association standards for motors as last revised. It shall be of the squirrel cage, low starting current type in vertical, weather-protected frame. The motor shall be the vertical hollow shaft type for high trust with 40-degree centigrade rise, Class B insulation WP-1 enclosure with epoxy encapsulated windings. The service shall be 480V, 3-Ph, 60 Hz; WP-1 "Premium Efficiency Inverter Duty Rated". Motor shall be rated with 1.15 service factor, and shall have a non-reverse ratchet.

B. The rotors shall run in the ball bearings provided with adequate means of continuous lubrication. The thrust bearing shall be of ample size to carry the thrust load of the pump, the

weight of the shaft, couplings and impellers without overheating. It shall be of ample size to ensure long life when operating continuously in carrying maximum load. Minimum thrust rating allowable as by Anti-Friction Bearing Manufacturers Association (A.F.B.M.A.) is 175% of Standard High Trust. The motor shall be overloaded, operating continuously or intermittently at any point on the pump operating curve.

2.3 MISCELLANEOUS:

A. Data Plates: The pump shall be equipped with a data plate securely fastened to the pump that contains the manufacturer's name, pump size and type, serial number, pump speed, impeller data, capacity and head rating, and any other pertinent information.

B. Testing: The pump shall be performance tested prior to shipment to confirm pump performance. Test shall comply with ANSI/HI 14.6 Grade 1U requirements, and shall include, but not be limited to, checking the unit at its rated speed, capacity, head, efficiency, and brake horsepower at such conditions of head and capacity so as to properly establish the actual performance curve. Certified copies of the test reports shall be submitted for review prior to shipment. The Standards of the Hydraulic Institute shall govern the procedures and calculations for the prescribed testing.

PART 3 - EXECUTION

3.1 DISINFECTION:

A. Before mobilizing any drill rig or other equipment potentially having contact with the aquifer through physical contact or through the transport of fluids, such equipment shall be decontaminated using steam, mechanical cleaning, or disinfection with a chlorine bleach solution applied by a hand sprayer. Thereupon, the exterior of all drill rigs, tools, and equipment shall be cleaned. The purpose of the decontamination shall be the prevention of the introduction of iron bacteria or other bacteriological contaminants to the aquifer.

B. After the pumping equipment has been installed and the well is completed, the installation shall be disinfected by introducing a chlorine solution into the well and starting and stopping the pump until the solution has been thoroughly mixed with the water. The solution shall contain 50 ppm of chlorine and shall remain in the well for a period of 12 hours. The well shall then be pumped to waste until an orthotolidine test indicates that all chlorinated water has been pumped out.

C. The Contractor shall secure three (3) sterilized sample bottles from the nearest State Testing Laboratory and carefully obtain samples of the water. The bottles shall be promptly delivered to the nearest branch Laboratory. If the report on the samples is not satisfactory, the Contractor shall re-disinfect the well for as many times as is necessary to obtain a satisfactory report.

3.2 WELL CAPACITY TEST:

A. The pumping equipment installer will be required to perform a well capacity test utilizing a temporary test pump of suitable size. The test shall be conducted in accordance with ADEM Administrative Code 335-7-5. The approximate design capacity will be determined as part of the well drilling project. The maximum test capacity shall be 150% of the design capacity.

B. The capacity test shall be run at design capacity until the water level in the water supply well has stabilized (+/- 1.0 foot) and shall then be continued for a period of 24 hours with water level readings collected at regular intervals (the test shall be run for 21 hours after the drawdown has shown to remain constant for three consecutive hourly readings). The pumping rate shall then be increased to the maximum test capacity and shall continue to run until the water level is stabilized (+/- 1.0 foot) and shall then continue to run for a period of six (6) hours with water level readings collected at regular intervals. Immediately upon pump shut-down a full recovery test shall be performed. The conduction of the well capacity test shall meet the requirements of the Measurement section below.

C. Measurements:

1. The pumping test shall be conducted to determine the aquifer storage coefficient and transmissivity. Accurate drawdown readings shall be taken in both the production well and observation well simultaneously. Water levels shall be recorded three times within one day prior to the start of the capacity test and within five (5) minutes of the start of the test to provide background water level information. Drawdown readings shall be taken at two-minute intervals the first hour of the test; at five-minute intervals the second hour; at ten-minute intervals for the next two hours; thirty-minute intervals for the next two hours; and hourly thereafter to the end of the test. Drawdown data collected during the period of the test shall be corrected for changes in barometric pressure and tidal oscillations.

2. Immediately upon pump shut-down a full recovery test shall be performed. Water level recordings shall be made no less than one-minute intervals the first ten minutes; two-minute intervals the next ten minutes; five-minute intervals the next thirty minutes; and ten-minute intervals until practical recovery

3.3 WATER QUALITY:

A. During the testing of the water supply well capacity (pumping test) periodic water samples shall be taken during the pumping test and analyzed for turbidity. Complete analysis shall be performed for Primary and Secondary drinking water containments per chapters 335-7-2 and 335-7-3 of the ADEM Administrative Code. All other samples shall be stored in clean glass containers for future analysis if needed. A complete chemical analysis to include inorganic, radiological and VOC (regulated and unregulated) analysis shall be performed. The analyses must be performed by a laboratory certified by the Alabama Department of Environmental Management. Levels of primary and secondary contaminants shall be reported along with pH, total alkalinity, carbon dioxide, calcium, magnesium, hardness, sodium, and specific conductance

3.4 WELL PUMP:

A. Well Pump:

1. The well pump shall be furnished, set, aligned and made fully operational by the licensed well driller. The Contractor shall employ a factory-trained engineer to supervise the installation and alignment of all items of mechanical and electrical equipment. He shall see that all items of equipment are installed, piped and wired in accordance with the manufacturer's recommendations, and shall place all equipment in satisfactory operation and demonstrate such to the satisfaction of the Owner/Engineer. The Contractor shall guarantee the satisfactory operation of all apparatus and machinery against defects in workmanship, materials and installation for a period of one (1) year.

B. Pump Foundation:

1. After the well has been completed and the Contractor, Engineer and Owner have reviewed all results from the Well Completion Report and after the Contractor has been given the authorization to proceed, the Contractor may begin construction of the pump foundation and pumping equipment. The foundation shall consist of Class A concrete and be formed in a workmanlike manner with chamfered edges on the sides and top. All unsuitable soils around the casing pipe shall be removed and approved fill material places as specified elsewhere.

2. The top of the foundation shall be set approximately 12-inches above ground. The bottom of the foundation shall be carried to a firm bearing capacity of 2,500 psf and not less than 2-feet below the surface. The concrete foundation shall be at least 2-feet square and the exposed surfaces shall be rubbed with a carborundum stone to remove form marks.

3. The Contractor shall provide a schematic drawing to the Engineer for approval of the pump foundation which shows the dimensions of the foundation, base plate design, details of the base plate-to-casing connection, airline and electric cable penetration, discharge elbow or tee, connections for pump removal, etc.

4. The Casing shall project a minimum of 12-inches above the finished concrete slab around the well.

3.5 FIELD QUALITY CONTROL:

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.

C. Preoperational Check: Before operating system or components, perform following:

1. Check pump and motor alignment.
2. Check for proper motor rotation.
3. Check pump and drive units for proper lubrication.

D. Startup and Performance Testing:

1. Operate the pump at the design point for a minimum continuous period of thirty (30) minutes, under supervision of manufacturer's representative and in presence of Engineer’s Field Representative.

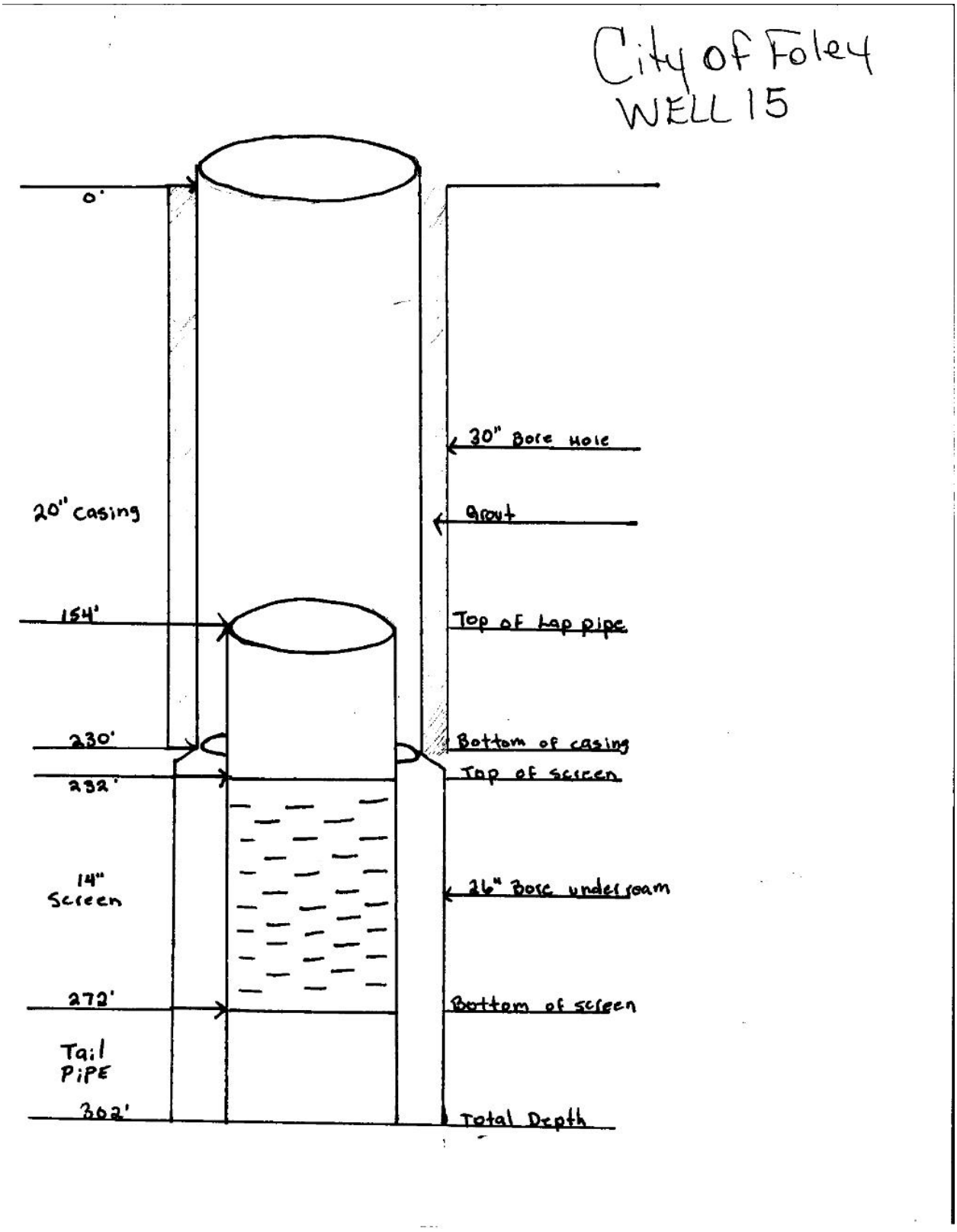
E. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than two (2) eight-hour days on Site for installation, inspection, startup, field testing, and instructing Owner's personnel in maintenance of equipment.

F. Check pump and motor for excessive vibration according to manufacturer instructions. Check for motor overload by taking ampere readings.

G. Equipment Acceptance:

1. Adjust, repair, modify, or replace system components that fail to perform as specified and rerun tests.
2. Make final adjustments to equipment under direction of manufacturer's representative.

END OF SECTION 33 11 13


City of Foley
WELL 15
0'
30" Bore Hole
20" casing
Grout
154'
Top of Lap pipe
230'
Bottom of casing
232'
Top of screen
14"
Screen
26" Bore underream
272'
Bottom of screen
Tail
PIPE
302'
Total Depth

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SECTION 43 23 13 – VERTICAL TURBINE PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Vertical turbine pumps for high service pump station.

B. Related Requirements:

1. Section 09 96 00 – High-Performance Coatings
2. Section 26 05 93 – Common Motor Requirements for Process Equipment

1.2 REFERENCE STANDARDS

A. American Bearing Manufacturers Association:

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. ASME International:

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.

C. ASTM International:

1. ASTM A29 - Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought.
2. ASTM A536 - Standard Specification for Ductile Iron Castings.
3. ASTM A744 - Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service.

D. ANSI/HI Standards

1. ANSI/HI 2.1-2.2 - Rotodynamic Vertical Pumps of Radial, Mixed, & Axial Flow Types for Nomenclature & Definitions
2. ANSI/HI 2.3 – Rotodynamic Vertical Pumps of Radial, Mixed, & Axial Flow Types for Design and Application
3. ANSI/HI 2.4 – Rotodynamic Vertical Pumps for Manuals Describing Installation, Operation and Maintenance
4. ANSI/HI 9 – Rotodynamic Pumps
5. ANSI/HI 14.6 – Rotodynamic Pumps for Hydraulic Acceptance Tests
6. ANSI/HI 20.3 – Rotodynamic (Centrifugal and Vertical) Pump Efficiency Prediction

1.3 COORDINATION

A. Section 01 31 00 – Project Management and Coordination: Requirements for coordination.
B. Coordinate installation and startup of Work of this Section with Owner and plant operations.

1.4 SCHEDULING

A. Section 01 31 00 – Project Management and Coordination: Requirements for scheduling.
B. Schedule Work of this Section to install pumps prior to connecting piping work.

1.5 QUALITY ASSURANCE

A. All materials and appurtenances in contact with potable water shall be NSF 61 certified.
B. Equipment specified in the section shall be the product of a single manufacturer.
C. The manufacturer shall be solely and fully responsible for the warranty and mechanical design adequacy of all the provided components under this section.
D. The pump manufacturer shall be certified to the ISO 9001 standard for the design and manufacturer of vertical turbine pumps.
E. Pressure containing fabrications shall be welded only by those whom are qualified on ASME code Section IX.

1.6 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
B. Product Data: Submit manufacturer information for materials of construction and fabrication.
C. Shop Drawings:

1. Submit detailed dimensions for materials and equipment, including wiring and control diagrams, performance charts and curves, installation and anchoring requirements, fasteners, and other details.
2. Include manufacturer's specified displacement tolerances for vibration at operational speed specified for pumps.

D. Critical speed calculations and analysis.
E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures, anchoring, and layout.
G. Source Quality-Control Submittals: Indicate results of shop/factory tests and inspections.

H. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
I. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.

1.7 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

1.8 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
B. The Manufacturer and Contractor shall furnish a warranty extending twelve (12) months after the product is put into operation.

PART 2 - PRODUCTS

2.1 VERTICAL TURBINE PUMPS

A. Manufacturers:

1. The vertical turbine pumps shall be manufactured by:

a. Xylem-Goulds Water Technology
b. American Marsh (Wilo)
c. Peerless
d. Or approved equal.

B. Description: Vertical multi-stage type, consisting of a fabricated steel discharge head, vertical hollow shaft motor, discharge column and shafting, bowl assembly and electric motor.

C. Pump Designation:

1. P6210.
2. P6220.
3. P6230.

D. Performance and Design Criteria:

1. Design Flow Rate: 1,750 gpm.
2. Design Flow Total Dynamic Head: 210 feet.
3. Minimum Efficiency at Design Flow Rate: 80%.
4. Maximum Pump Speed: 1800 rpm.
5. Motor Horsepower: 125 HP
6. Minimum Column Diameter: 10 inches
7. Pump Discharge Diameter: 10 inches
8. Minimum lineshaft diameter: 1.5 inches

E. Bowl Assembly:

1. Suction Bell: Shall be constructed of cast iron and machined for bolting to the bowls. The suction bell shall be a smooth bell-shaped entrance as a waterway to the impellers, and shall incorporate an integrally cast suction manifold bearing housing. The housing shall have an ASTM B584 lead-free bronze bearing and a cast iron suction manifold plug. Bowl inlet shall include a Type 316L stainless steel inlet strainer.
2. Pump Bowls: Shall be constructed of ASTM A48 Class 30 close grained cast iron with integrally cast diffusion vanes. The bottom bowl shall be machined to bolt to the suction bell. Each bowl shall be equipped with an ASTM B584 lead-free bronze bearing. Each bowl interior shall be enameled to provide smooth passage of water and increase efficiency.
3. Impellers: Shall be enclosed type, constructed of Type 316 stainless steel or aluminum bronze, dynamically and statically balanced. The impeller vanes shall be machined to match the contours of the suction bell, and also the contour of the series case. Impeller shall be secured by means of ASTM A582 Type 416 stainless steel taper lock collet to the bowl shaft. The impeller shaft shall be of 416 stainless steel. The total hydraulic down-thrust for pump shall be minimized. Up-thrust developed upon starting shall be acceptable, but pumps that operate in continuous up thrust shall not be acceptable. Verification of thrust values shall be provided and documented with standard manufacturers published information. Failure to verify thrust calculations shall be basis for rejection of equipment.

F. Column Assembly:

1. The Column Assembly: The pump shall be of open lineshaft construction designed for lubrication by the pumped media. Column pipe shall be flanged or threaded and shall be fabricated of ASTM A53 Grade B, carbon steel. Column assembly shall have ductile iron bearing retainers that are clamped between registers machined into adjoining column pipe flanges. Each guide shall contain a water lubricated cutless bearing designed for open line shaft, vertical turbine service. Maximum length of one column section shall be 10 feet. Column sections located directly below the discharge head and directly above the pump bowl assembly shall not generally exceed 5’-0” in length. Column sections shall be secured by means of ASTM F593-Gr. CW1 stainless bolts and ASTM F594-Gr.CW1 stainless steel nuts.
2. Line Shafting: Shall be of ASTM A582-88a Type 416 stainless steel, ground and polished. Shafting shall be connected by means of stainless steel couplings. All shaft journals shall be provided with ASTM A269 304 S.S. sleeves at the location of each shaft

bearing. Shafting size shall be determined from the thrust characteristics of the particular pump bowl under consideration, but shall in no case be less than one (1) inch in diameter, and shall be adequate size to transmit the full motor horsepower without failure. Undersized shafting shall be basis for rejection of the pump. Pump supplier shall submit manufacturer's published data to verify shafting selection. Failure to verify shaft sizing shall be basis for rejection of the equipment.

3. A flanged non-spacer coupling shall be furnished to facilitate removal of the motor. The flanged coupling shall be a Type CPAT design with flanged ends and a threaded pump coupling to facilitate field adjustment. The coupling shall be dynamically balanced for smooth operation. Threaded and coupled shafting is not acceptable. The top shaft and the line shaft shall be of ASTM A582-95b Type 416 stainless steel and of adequate size for the HP to be transmitted.

G. Discharge Head

1. The pump discharge head shall be fabricated steel type. The head shall be suitable for floor mounting and shall be furnished with a steel sole plate to facilitate future removal. Sole plate mounting surface shall be fully machined to provide a perfectly flat base for accurate leveling of the discharge head, and the sole plate shall be accurately leveled to the tolerances specified by the manufacturer prior to installation of the pump. The discharge head base shall be machined to accept the sole plate and shall include a Class 150 integral discharge flange. The head shall have provisions for the mounting and securing of a vertical hollow-shaft motor. The motor mounting flange shall be machined for a perfect fit and angular misalignment shall not be allowed.
2. Lifting lugs shall be integrally cast on the discharge head and shall be capable of supporting the entire weight of the pump. A 1-inch NPT drain connection, 1/2-inch NPT pre-lube connection, and a 1/4-inch NPT gauge connection shall be provided. The pump discharge flange shall be provided. The pump discharge flange shall conform to CL 150 ANSI standard drilling for pipe flanges. The pump shall be sealed at the discharge head by means of graphited packing. An ASTM B584-00 C90300 bronze bushing, an ASTM A744-00 Type 316 stainless steel packing washer, and an ASTM A744 Type 316 stainless steel two-piece packing gland shall secure the packing and allow for adjustment for lubrication. A removable coupling guard fabricated from stainless steel shall be provided to protect operating personnel from accidental contact with the shaft or flanged coupling during operation.
3. Discharge head shall include a tap on the packing gland for connection to external water lubrication source.
4. The pump discharge head shall be provided with shaft critical speed calculations, and a structural natural frequency analysis shall be performed on the discharge head and motor combination to ensure low-vibration operation.

H. Motor

1. Each turbine pump shall be driven by a hollow shaft motor suitable for 460 volts, 3 phase, 60 hertz. The motor shall be an integral part of the pumping unit, and shall be suitable for mounting as shown on the plans. All motors shall be sized so that they will not be overloaded at their rated capacity at any point on the pump performance curves. Motors shall be TEFC with Class F insulation and shall have a minimum service factor of 1.15.
2. Each motor shall have thrust bearing(s) capable of carrying the dead weight of all rotating parts of the pump plus the hydraulic thrust incurred during operation.

3. Motor shall be vertical hollow shaft, squirrel cage induction type and shall conform to AIEE standards. Each motor shall be equipped with a non-reverse coupling. A coupling at the top of the motor shall facilitate vertical adjustment of the impellers of the pump. The motor shall also be furnished with a protective cap. All bearings shall be oil or grease lubricated, with proper provisions made to guard against the escape of lubricant.
4. Motors shall be “inverter duty rated” and shall conform to the NEMA “High” standard for premium efficiency. The nameplate on the motor shall also indicate the motor is “inverter duty rated” to the NEMA “High” standard for premium efficiency. A 120v space heater shall be supplied with the motor.
5. Thermostats shall be provided in the windings of each phase to afford protection of the motor against excessive operating temperature. Thermostats shall be normally closed, suitable for operations on 120 VAC, with leads from the same routed to an accessory conduit box for connections separate from the power wiring. One thermostat shall be provided for each phase of the motor windings.
6. Space heaters and thermostat leads shall be directed to a separate junction box, for field wiring by the contractor. These leads shall not be routed through the primary junction box.
7. Shaft grounding rings shall be provided for each motor.
8. Motor bearings shall be oil lubricated and shall be rated for a minimum AMBA 9, L-10 life of 10,000 hours.

I. Miscellaneous

1. Data Plates: Each pump shall be equipped with a data plate securely fastened to the pump that contains the manufacturer's name, pump size and type, serial number, pump speed, impeller data, capacity and head rating, and any other pertinent information.
2. A fabricated steel sole plate shall be provided with each pump to facilitate installation and future removal. The plate shall be provided with min. 1" diameter holes for anchor bolts and tapped holes corresponding to drilling of the pump discharge head base bolting. A suitably-sized hole shall be accurately cut in the center of the plate to allow passage of the pump, and the top surface shall be accurately machined to provide a perfectly flat surface for mounting the discharge head. Raw or mill finished steel plate is not considered acceptable. The base plate shall be grouted in place by the Contractor, in the position as indicated on the Plans. Anchor bolts shall be provided by the Contractor, and shall be fabricated of 304 stainless steel. Sole plate shall be minimum of 25” square x 1” thick.
3. Testing: The pump shall be performance tested prior to shipment to confirm pump performance. Test shall comply with ANSI/HI 14.6 Grade 1U requirements, and shall include, but not be limited to, checking the unit at its rated speed, capacity, head, efficiency, and brake horsepower at such conditions of head and capacity so as to properly establish the actual performance curve. Certified copies of the test reports shall be submitted for review prior to shipment. The Standards of the Hydraulic Institute shall govern the procedures and calculations for the prescribed testing.
4. Painting: All equipment comprising each pumping unit shall be painted with a potable epoxy finish by the pump manufacturer prior to shipment. Epoxy shall be Tnemec Series 21, and shall be applied to the discharge head ID/OD, column pipe ID/OD, and bowl OD. All finish coating shall be provided as specified in Section 09 96 00. Coatings shall be NSF 61 certified.
5. All pumps shall be completely assembled, less motors, at the manufacturer’s facility prior to shipment, and shall be shipped in one (1) piece. Onsite assembly of pumps will not be permitted.

J. Operation:

1. Electrical Characteristics: As specified in Division 26 – Electrical and the following:

a. Voltage: 460/480V, 3 Phase, 60 Hz.

2. Control Panel: VFD/SCADA panel.
3. Operation Sequences:

a. The purpose of the vertical turbine pumps is to pump finished water from wetwell to the water distribution system and its associated elevated tanks. The pumps are vertical turbine type, and all are on variable speed drives (VFDs).
b. The pumps are designed with two (2) duty and one (1) standby. The pumps shall be set to alternate operation when the pumps are shut off such that the run times of the pumps are equalized throughout its lifecycle.

K. Fabrication:

1. Shaft Guard: Enclose shaft and universal joint with enclosed-type metal shaft guard complying with OSHA standards. Also, install a reverse ratchet to prevent the impeller from loosening if the motor turns in reverse.
2. Pump and Drive Mating Surfaces: Machine finished.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install pumps where indicated on Drawings and according to manufacturer instructions.
B. Provide and connect piping, power and control conduit, and wiring to make system operational and ready for startup.
C. Flush piping with clean water.

3.2 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
C. Preoperational Check: Before operating system or components, perform following:

1. Check pump and motor alignment.
2. Check for proper motor rotation.
3. Check pump and drive units for proper lubrication.

D. Startup and Performance Testing:

1. Operate each pump on clear water at design point for continuous period of two (2) hours, under supervision of manufacturer's representative and in presence of Engineer.

E. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than two (2) eight (8)-hour days on site for installation, inspection, startup, field testing, and instructing Owner's personnel in maintenance of equipment

F. Verify pump performance by performing time-fill test.

G. Check pump and motor for excessive vibration according to manufacturer instructions. Check for motor overload by taking ampere readings.

H. Equipment Acceptance:

1. Adjust, repair, modify, or replace system components that fail to perform as specified and rerun tests.
2. Make final adjustments to equipment under direction of manufacturer's representative.

I. Provide Operations & Maintenance Manuals per Section 01 78 23.

J. Provide Training per Section 01 79 00.

END OF SECTION 43 23 13

SECTION 26 24 13 - SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Surge protection devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.
7. Identification.
8. Mimic bus.

1.3 ACTION SUBMITTALS

A. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.

1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Detail utility company's metering provisions with indication of approval by utility company.
7. Include evidence of NRTL listing for series rating of installed devices.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
10. Include diagram and details of proposed mimic bus.
11. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Samples: Representative portion of mimic bus with specified material and finish, for color selection.

D. Delegated Design Submittal:

1. For arc-flash hazard study.
2. For arc-flash labels.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Seismic Qualification Data: Certificates, for switchboards, overcurrent protective devices, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

a. Routine maintenance requirements for switchboards and all installed components.
b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.6 MAINTENANCE MATERIAL SUBMITTALS

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

1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type but no fewer than two of each size and type.
2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type but no less than one of each size and type.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards and connect factory-installed space heaters to temporary electrical service to prevent condensation.

C. Handle and prepare switchboards for installation according to NECA 400.

1.9 FIELD CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

   a. Ambient Temperature: Not exceeding 104 deg F.
   b. Altitude: Not exceeding 6600 feet.

C. Unusual Service Conditions: NEMA PB 2, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Construction Manager's written permission.
4. Comply with NFPA 70E.

1.10 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

B. Manufacturer's Warranty: Manufacturer's agrees to repair or replace surge protection devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Shake-table testing shall comply with ICC-ES AC156.
2. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 SWITCHBOARDS

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

1. Square D; by Schneider Electric.
2. SIEMENS Industry, Inc.; Energy Management Division.
3. EATON.
4. Or Approved Equal.

B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 2.

F. Comply with NFPA 70.

G. Comply with UL 891.

H. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Panel mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

I. Front- and Side-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.

2. Branch Devices: Panel mounted.
3. Section Alignment: Front aligned.

J. Front- and Rear-Accessible Switchboards:

1. Main Devices: Drawout mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

K. Nominal System Voltage: 480Y/277 V.

L. Main-Bus Continuous: As shown on the plans.

M. Surge Protection: As shown on the plans.

N. Seismic Requirements: Fabricate and test switchboards according to IEEE 344.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Shake-table testing shall comply with ICC-ES AC156.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

O. Indoor Enclosures: Steel, NEMA 250, Type 12.

P. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

Q. Outdoor Enclosures: Type 3R or 4X as shown on the plans.

1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating.
2. Enclosure: Downward, rearward sloping roof; bolt-on rear covers for each section, with provisions for padlocking.
3. Doors: Personnel door at each end of aisle, minimum width of 30 inches; opening outwards; with panic hardware and provisions for padlocking. At least one door shall be sized to permit the largest single switchboard section to pass through without disassembling doors, hinges, or switchboard section.
4. Accessories: Fluorescent lighting fixtures, ceiling mounted; wired to a three-way light switch at each end of aisle; ground-fault circuit interrupter (GFCI) duplex receptacle; emergency battery pack lighting fixture installed on wall of aisle midway between personnel doors.
5. Walk-in Aisle Heating and Ventilating:

a. Factory-installed electric unit heater(s), wall or ceiling mounted, with integral thermostat and disconnect and with capacities to maintain switchboard interior temperature of 40 deg F with outside design temperature of 0 deg F.

b. Factory-installed exhaust fan with capacities to maintain switchboard interior temperature of 100 deg F with outside design temperature of 90 deg F.
c. Ventilating openings.
d. Thermostat: Single stage; wired to control heat and exhaust fan.

6. Power for Space Heaters, Ventilation, Lighting, and Receptacle: Include a control-power transformer, with spare capacity of 25 percent, within the switchboard. Supply voltage shall be 120 V ac.
7. Power for space heaters, ventilation, lighting, and receptacle provided by a remote source.

R. Barriers: Between adjacent switchboard sections.

S. Insulation and isolation for main and vertical buses of feeder sections.

T. Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.

1. Space-Heater Control: Thermostats to maintain temperature of each section above expected dew point.
2. Space-Heater Power Source: Transformer, factory installed in switchboard.

U. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain from one to six service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.

V. Utility Metering Compartment: Barrier compartment and section complying with utility company's requirements; hinged sealable door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.

W. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

X. Removable, Hinged Rear Doors and Compartment Covers: Secured by standard bolts, for access to rear interior of switchboard.

Y. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

Z. Pull Box on Top of Switchboard:

1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
2. Set back from front to clear circuit-breaker removal mechanism.
3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

AA. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity.
3. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
4. Copper feeder circuit-breaker line connections.
5. Tin-plated aluminum feeder circuit-breaker line connections.
6. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
7. Ground Bus: 1/4-by-2-inch-hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
8. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
9. Disconnect Links:

    a. Isolate neutral bus from incoming neutral conductors.
    b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.

10. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
11. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

BB. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

CC. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

DD. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

a. Instantaneous trip.
b. Long- and short-time pickup levels.
c. Long and short time adjustments.
d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
6. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
8. MCCB Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
h. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
i. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

B. Insulated-Case Circuit Breaker (ICCB): 80 percent rated, unless otherwise noted, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.

1. Fixed circuit-breaker mounting.
2. Two-step, stored-energy closing.
3. Full-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:

a. Instantaneous trip.
b. Time adjustments for long- and short-time pickup.
c. Ground-fault pickup level, time delay, and I^2t response.

4. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

5. Remote trip indication and control.
6. Communication Capability: Web enabled integral Ethernet communication module and embedded Web server with factory-configured Web pages (HTML file format). Provide functions and features compatible with power monitoring and control system specified in Section 26 09 13 "Electrical Power Monitoring and Control."
7. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
8. Control Voltage: 120-V ac.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

D. Fuses are specified in Section 26 28 13 "Fuses."

2.4 CONTROL POWER

A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.

B. Electrically Interlocked Main and Tie Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to the primary side of each control-power transformer at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.

C. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

D. Provide redundant, self-contained, UPS power supply for all 120VAC control circuits within the switchboard.

E. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.5 PLC AUTOMATIC TRANSFER/GENERATOR PARALLELING SCHEME

A. Main-Gen-Gen Transfer System

1. Generator controls shall be controlled by Woodward Easygen 3500XT-P1. Each generator controls shall be controlled by an independent controller (total of 2 units).
   a. Mounted on switchboard control cabinet door.
   b. Connection to metering PT/VT within switchboard instrument compartment.
   c. Connection to metering CT within switchboard instrument compartment.
2. Breaker control shall be controlled by LS6 breaker control units with Woodward LS-612XT-P1 with remote displays.
3. Controls shall be interfaced with SCADA system via SEL-2440 DPAC automation controller.
4. Sel-751 utility protection.
5. Generator Communication to Generator controller (CAT EMCPII+(CDL)).

6. Additional Required Equipment
   a. Line Reference PT: 2x for each N1, G1, G2
   b. Bus Reference PT
7. Controller shall be capable of closed transition, generator paralleling, and load exporting.

B. Normal Operation

1. The normal main breaker is closed and emergency breaker(s) open.
2. Open/closed mode switch is controlled via control page of HMI.

C. Loss of Normal Source

1. When the normal source drops below the threshold settings of the source monitoring relays, the system will delay transfer to emergency for (5 sec) adjustable (TDVF) in order to override any momentary source outages. If after (5sec) adjustable, the normal source is still not available then the system will initiate a generator start request. Once the emergency system becomes available (at 90% rated voltage and frequency as indicated by the emergency source available light). The normal main breaker will open and after timer TDOX (3sec) expires the emergency breaker will close.

B. Return of Normal Source

1. Closed Transition Mode (Retransfer from Emergency to Normal) Upon return of normal source 1, the system will monitor the source to ensure stability for (5 min) adjustable (TDVA). After time has expired the system will initiate a closed transition retransfer, (if, the phase, voltage and frequency at generator are in synchronization with that of utility) the normal main breaker will close after timer TDOL (100msec) expires the emergency breaker will open. Once retransfer has occurred, the generator start request will be removed and cool down timer will begin timing (15 minutes).

C. No Load Test

1. Push no load test pushbutton on HMI screen. The system will initiate a generator start request. To stop test, push the no load test pushbutton on HMI screen.

D. Load Test – Closed Transition Mode

1. Push load test pushbutton on HMI screen. The system will initiate a closed transition retransfer, (if, the phase, voltage and frequency at generator are in synchronization with that of utility) the emergency breaker will close after timer TDOL (100msec) expires the normal main breaker will open.

E. Closed Transition Transfer

1. Provide intertie protection with the utility.

   a. Sensitive directional three phase power relay with trip direction towards utility that can be set to detect a percentage of power rating of the utility service transformer. Confirm percentage with local utility.
   b. Timing relay to supervise sensitive directional three phase power relay.
   c. Manual reset, lockout relay.

d. Relays must be utility grade and are required for each intertie breaker. each relay must be wired to trip the circuit breaker directly and block the breaker from closing.
e. When the lockout relay trips the breaker, the customer shall not reset the lockout relay until instructed to do so by the local utility. Each lockout relay must be clearly labeled.
f. All intertie requirements shall be coordinated with the local utility provider.

F. Return from Load Test – Closed Transition Mode (Retransfer from Emergency to Normal)

1. Push load test off pushbutton on the HMI screen. The system will initiate a closed transition retransfer, (if, the phase, voltage and frequency at generator are in synchronization with that of utility) the normal main breaker will close after timer TDOL (100msec) expires the emergency breaker will open. Once retransfer has occurred, the generator start request will be removed and cool down timer will begin timing (5 minutes).

G. Load Test – Open Transition Mode

1. Push load test pushbutton on HMI screen. The system will initiate a generator start request. Once the emergency system becomes available (at 90% rated voltage and frequency as indicated by the emergency source available light). The normal main breaker will open after timer TDOX (3sec) expires the emergency breaker will close.

H. Return from Load Test – Open Transition Mode (Retransfer from Emergency to Normal)

1. Push load test off pushbutton on the HMI screen. The system will initiate an open transition retransfer, the emergency main breaker will open and after timer TDOX(3sec) expires the normal main breaker will close. Once retransfer has occurred, the generator start request will be removed and cool down timer will begin timing (5 minutes).

I. Load Test (Exerciser On) – Closed Transition Mode

1. Per the time and day set points on the HMI touch screen. The Exerciser will turn on and be on for the duration set point on the HMI screen. The system will initiate a closed transition retransfer, (if, the phase, voltage and frequency at generator are in synchronization with that of utility) the emergency breaker will close after timer TDOL (100msec) expires the normal main breaker will open.

J. Return from Load Test – Closed Transition Mode (Exerciser Off)

1. Per the time and day set points on the HMI touch screen. The Exerciser will turn off after the duration time set point has expired. The system will initiate a closed transition retransfer, (if, the phase, voltage and frequency at generator are in synchronization with that of utility) the normal main breaker will close after timer TDOL (100msec) expires the emergency breaker will open. Once retransfer has occurred, the generator start request will be removed and cool down timer will begin timing (5 minutes).

K. Load Test (Exerciser On) – Open Transition Mode

1. Per the time and day set points on the HMI touch screen. The Exerciser will turn on and be on for the duration set point on the HMI screen. The system will initiate a generator start request. Once the emergency system becomes available (at 90% rated voltage and

frequency as indicated by the emergency source available light). The normal main breaker will open after timer TDOX (3sec) expires the emergency breaker will close.

L. Return from Load Test – Open Transition Mode (Retransfer from Emergency to Normal)

1. Per the time and day set points on the HMI touch screen. The Exerciser will turn off after the duration time set point has expired. The system will initiate an open transition retransfer, the emergency main breaker will open and after timer TDOX (3sec) expires the normal main breaker will close. Once retransfer has occurred, the generator start request will be removed and cool down timer will begin timing (5 minutes).

M. No Load Test (Exerciser On)

1. Per the time and day set points on the HMI touch screen. The Exerciser will turn on and be on for the duration set point on the HMI screen. A start signal will be sent to the generator. Return from No Load Test (Exerciser Off) Per the time and day set points on the HMI touch screen. The Exerciser will turn off after the duration time set point has expired. The generator start request will be removed and cool down timer will begin timing (5 minutes).

N. Retransfer Inhibit (Maintain Emergency)

1. To inhibit retransfer, push the inhibit pushbutton on the control screen of HMI. The home and control screen will indicate retransfer is inhibited. The system will remain on emergency system until the bypass pushbutton on HMI is pressed or until retransfer mode is put back into auto by pressing auto pushbutton on control screen of HMI.

O. Notes:

1. No transfers will be allowed if one of the mains trips on overcurrent. All such trips must be reset before operations can commence.
2. All interlocking of breakers are hardwired in the breaker close circuitry and programmed in a PLC to prevent paralleling of unsynchronized sources. All automatic and manual mode commands are subject to the boundaries set forth in the interlocking.
3. Manual operations are performed by placing the selector switch in Manual mode and via the use of the breaker control switches. No automatic operations are able to be performed while in the manual mode. The manual mode light will illuminate to alert the operator that the system is in manual mode.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Overhead Circuit-Breaker Lifting Device: Mounted at top front of switchboard, with hoist and lifting yokes matching each drawout circuit breaker.

C. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

D. Mounting Accessories: For anchors, mounting channels, bolts, washers, and other mounting accessories, comply with requirements in Section 26 05 48.16 "Seismic Controls for Electrical Systems" or manufacturer's instructions.

E. Coordinate with Power Factor Correction/Harmonic Mitigation equipment supplier for the installation of 3rd party current transformers required to be installed in switchboard. These CTs shall be shown on submittals in shop drawings and wiring diagrams.

2.7 IDENTIFICATION

A. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on a photoengraved nameplate.

1. Nameplate: At least 0.032-inch-thick anodized aluminum, located at eye level on front cover of the switchboard incoming service section.

B. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on an engraved laminated-plastic (Gravoply) nameplate.

1. Nameplate: At least 0.0625-inch-thick laminated plastic (Gravoply), located at eye level on front cover of the switchboard incoming service section.

C. Mimic Bus: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram.

D. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.

E. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.

F. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NECA 400.

1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
3. Protect from moisture, dust, dirt, and debris during storage and installation.
4. Install temporary heating during storage per manufacturer's instructions.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect the performance of the equipment.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switchboards and accessories according to NECA 400.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete."

1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2 inches above concrete base after switchboard is anchored in place.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to switchboards.
6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.

D. Comply with mounting and anchoring requirements specified in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

F. Install filler plates in unused spaces of panel-mounted sections.

G. Install overcurrent protective devices, surge protection devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

H. Install spare-fuse cabinet.

I. Comply with NECA 1.

3.3 CONNECTIONS

A. Comply with requirements for terminating feeder bus specified in Section 26 25 00 "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.

B. Comply with requirements for terminating cable trays specified in Section 26 05 36 "Cable Trays for Electrical Systems." Drawings indicate general arrangement of cable trays, fittings, and specialties.

C. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.

D. Support and secure conductors within the switchboard according to NFPA 70.

E. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Acceptance Testing:

a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
b. Test continuity of each circuit.

2. Test ground-fault protection of equipment for service equipment per NFPA 70.
3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
5. Perform the following infrared scan tests and inspections, and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front and rear panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
    c. Instruments and Equipment:

        1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Switchboard will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION 26 24 13

SECTION 26 43 13 – SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 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.

1.3 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

I. Devices (SPDs) for Use on the Load Side of the Service Equipment in Low Voltage (1000 Volts and less) AC Power Circuits

J. 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

1.4 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 SPD's 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:

1. Surge Suppression Incorporated (Advantage Series) / 256-797-5097 / surgesuppressionrep@gmail.com
2. Schneider Electric
3. Liebert Corporation (ASCO) (560xx16 & 570xx17 Series) / 614-888-0246
4. Current Technology (SL3-150 Series) / 800-238-5000 or pre-approved manufacturers.

1.5 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 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).
5. Letter from manufacturer stating products are in strict compliance 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).

6. Statement of manufacturer's warranty duration and replacement policy.

1.6 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

2.1 GENERAL

A. Surge Protective Devices (SPDs) shall be installed on all Motor Control Centers (MCCs), Switchboards, Low-Voltage Switch Gear, Mini-Powers Zones, 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 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 available upon request.

F. Service entrance SPD's shall have a Nominal Discharge Current (In) of 20 kA. All other SPDs shall have a Nominal Discharge Current (In) 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. The fusing mechanisms employed must effectively coordinate their performance in conjunction with the high current abnormal over-voltage testing under ANSI/UL 1449.
4. 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. As an option, the Engineer may specify surge protection devices with a Frequency Responsive Circuitry (FRC) (or Sinewave Tracking Capability). NOTE TO SPECIFIER: THE FRC OPTION SHOULD NOT BE SELECTED WHEN THE SPD IS CONNECTED TO THE SAME POINT OF COMMON COUPLING WITH ACTIVE POWER CONDITIONING EQUIPMENT INJECTING CAPACITANCE AND/OR INDUCTANCE INTO THE ELECTRICAL NETWORK. Branch circuit panelboards; MCC's; LV Switchgear; and Switchboards 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. The FRC is used in conjunction with the Voltage Responsive Circuitry (VRC) which is included in every model and mitigates the impact of larger, impulse-type surges by activating at a preset voltage above the normal power frequency voltage. 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. For those applications not serving sensitive electronic equipment, utilize SPDs that are of Voltage Responsive Circuitry (VRC) design (responds to a change in voltage only rather than to a change in frequency).

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 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 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.

2.2 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	66V	114V
L-G	65V	81V	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.

2.3 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	600 V
	L-G	600 V
	N-G	700 V
	L-L	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

PART 3 - EXECUTION

3.1 INSTALLATION

A. For proper performance, the SPD shall be installed with the leads short and straight as 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.

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

C. 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.

D. 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.

E. The breaker, the neutral buss, 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 buss, as appropriate, with no sharp bends in the wire.

F. The ground wire should be connected to the panel ground buss 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 buss if the AHJ requires this connection.

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

H. Install the SPD 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. The remote light kit cannot be ordered to add to the SPD as an in-the-field modification.

I. 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.

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

K. 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.

L. 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 buss. 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.

M. If any SPD lead lengths are required to be longer than 18”, the Contractor responsible for installation must contact the Electrical Engineer and the surge protective device manufacturer or distributor (256-797-5097) for installation assistance.

N. The Electrical Contractor shall verify the proper application of the SPD (i.e., voltage, phases, etc.). The Electrical Contractor shall ensure all neutral conductors are bonded to the system ground at the service entrance. The electrical contractor shall ensure that neutral-to-ground bonds do not exist at locations that are not service entrances or separately derived power sources.

O. The Electrical Contractor shall furnish all labor, materials, equipment, and services necessary for and incidental to the installation of the SPD system components as specified herein.

P. 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.

Q. 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 26 43 13

SECTION 26 43 20 – SURGE PROTECTION FOR CONTROLS & COMMUNICATION CIRCUITS

PART 1 - GENERAL

1.1 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 120V, 120/208V, 277V, 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

1.2 REFERENCED 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 1449-2006 Listed (UL 1449 Third Edition), 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

J. UL 1283, Standard for Safety Electromagnetic Interference Filters

1.3 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 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 (FRC): A term used to describe the circuitry of a low-pass filter designed to attenuate “switching” or “ring wave” transients/surges.

1.4 SUBMITTALS

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

1. Complete data for all SPDs indicating part numbers, conductor sizes, etc.
2. Dimensioned drawing of each suppressor type indicating mounting arrangement.
3. Manufacturer’s UL 1283 listing classification page and listing number(s).
4. Certified test 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).

5. 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).
6. Statement of manufacturer's warranty duration and replacement policy.

1.5 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 (25) 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

2.1 MANUFACTURER QUALIFICATIONS

A. All surge protective devices (SPD) 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 SPD manufacturer shall provide unlimited free replacement of the entire SPD for all inoperable SPD units during the warranty period.

C. 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

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 specific models listed below only:

1. Surge Suppression Incorporated or ECS International LLC (Contact ITD of Huntsville, LLC at 256-797-5097 or surgesuppressionrep@gmail.com)
2. Schneider Electric or pre-approved manufacturers.

3. 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.
4. 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.
5. 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.
6. Incomplete submittal packages will not be reviewed.

2.2 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
   B. P-N: ≤ 25 volts
   C. P-G: ≤ 100 volts
   D. 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 (ECS International 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. L-L < 40 volts
    b. L-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: 15 Years Unlimited Free Replacement

C. Dedicated 480 Volt Single Phase (L, L, G) AC Site Pole Lighting Circuit Protection (Surge Suppression LLC 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
    b. L-L ≤ 75 volts
    c. L-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 240- or 277-Volt Single Phase (P, N, G) AC Site Pole Lighting Circuit Protection (Surge Suppression LLC 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
    b. L-N ≤ 25 volts
    c. L-G ≤ 100 volts
    d. 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 LLC 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
    b. L-N ≤ 25 volts
    c. L-G ≤ 100 volts
    d. 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 (ECS International Model DRJ45##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: 5 to 140 Volts.
3. Maximum Continuous Operating Current: 500 mA
4. Series Resistance: Zero Ohms per wire for 100 Mbps
5. Data Rates: Up to 100 Mbps
6. SPD circuitry shall include only solid-state clamping components. Device shall be bi-directional.
7. Protection Modes: Data transmission pairs shall be protected Line-to- Line and Line-to-Ground.
8. Each data carrying conductor shall have no internal series resistance per wire and no internal series resistance on the ground conductor.
9. Each conductor must have a peak surge current rating of 1,500 Watts 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: 25 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.

G. Discrete control circuits – (ECS International Model PCMF##DCDIN-21) (## equals voltage; i.e. DC 5, 12, 24, or 48 volts)

1. SPD devices shall be rated for the class of service necessary for the application.
2. Operating Voltage: 12 to 48 Volts, other voltages available upon request.
3. Maximum Continuous Operating Current: 20 Amps
4. Series Resistance: Zero Ohms per wire.
5. SPD circuitry shall include only solid-state clamping and frequency response components. Device shall be bi-directional.
6. Protection Modes: Circuit shall be protected Line-to-Neutral, Line-to-Ground and Neutral-to-Ground or Line-to-Line and Line-to-Ground where applicable.
7. Each conductor shall have no internal series resistance per wire and no internal series resistance on the ground conductor.
8. The device must be designed to be series connected and mounted internally to control panels for protection of equipment connected to data lines.
9. 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. Enclosure shall be designed for Panel Mount DIN Rail Mount compatible without any modification to the device or requirement of an alternative model number.
10. Warranty: 25 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

3.1 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 a 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 devices mounted in valve or metering pits. All related surge devices mounted exterior to a building shall be rated and listed as NEMA 4X, water-proof. All surge devices mounted in corrosive areas within a building shall be rated for such environments and listed as corrosive resistant and NEMA 4X.

D. Provide low voltage surge products on BOTH ends of ALL copper Ethernet circuits leaving a building or ALL copper Ethernet circuits exceeding 200 feet in length. Provide DIN rail mounted surge products installed within control cabinets. All related surge devices mounted exterior to a building shall be rated and listed as NEMA 4X, water-proof. All surge devices mounted in corrosive areas within a building shall be rated for such environments and listed as corrosive resistant and NEMA 4X.

E. Provide low voltage surge products on BOTH ends of ALL proprietary network circuits leaving a building or ALL copper Ethernet circuits exceeding 200 feet in length. Provide DIN rail mounted surge products installed within control cabinets. All related surge devices mounted exterior to a building shall be rated and listed as NEMA 4X, water-proof. All surge devices mounted in corrosive areas within a building shall be rated for such environments and listed as corrosive resistant and NEMA 4X.

F. Provide low voltage surge products on BOTH ends of discrete low-voltage control circuits leaving a building or ALL discrete low-voltage control circuits exceeding 300 feet in length. Provide DIN rail mounted surge products installed within control cabinets. All related surge devices mounted exterior to a building shall be rated and listed as NEMA 4X, water-proof. All surge devices mounted in corrosive areas within a building shall be rated for such environments and listed as corrosive resistant and NEMA 4X.

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

END OF SECTION 26 43 20