



Dos Rios WRC Electrical System Improvements Project Phase 1
Solicitation Number: CO-00084
Job No.: 14-6504

ADDENDUM 4
September 28, 2016

To Bidder of Record:

This addendum, applicable to work referenced above, is an amendment to the proposal, plans and specifications and as such will be a part of and included in the Contract Documents. Acknowledge receipt of this addendum by entering the Addendum number and issue date on the space provided in submitted copies of the bid proposal.

Addendum No. 4 consists of the items as outlined in the following pages. In addition to these items Addendum No. 4 includes two (2) reissued specifications, one (1) re-issued drawing and one (1) new drawing.

QUESTIONS/REQUESTS

1. Due to the complexity of the project we as a potential general contractor would like a two week extension for questions and the final bid dates as advertised. This 2 week extension will allow us to be more cost competitive at bid time. The questions deadline extension will allow us to address any further scope clarification reducing potential RFIs and change orders. Also there are a lot of other projects that are bidding in the next couple of weeks.

Response: The bid opening has been extended. Please see Addendum #3 issued September 26, 2016.

2. Would SAWS consider extending the bid date for this project due to the size and scope of work?

Response: See response to Question #1.

3. Taking into consideration the importance and complexity of this project and involvement of different disciplines, we kindly request for you to extend the deadline for submission to a different date and time in order to give sufficient time for our suppliers to define their technical solution and prepare their competitive offers.

Response: See response to Question #1.

4. I am reaching out to you to see if we could possibly get a two week extension on this project as we are having troubles getting a firm date on when we can expect our steel numbers and a few other hard numbers.

Response: See response to Question #1.

5. Is there a maximum % that can be subcontracted out on this project?

Response: Yes, please reference page SS-1, Supplemental Conditions. The maximum is 60%.

6. Documents required for bid submittal missing from contract documents:

- a. TWDB Form WRD 225
- b. TWDB Form TWDB- 0459

Response: These documents can be found within the TWDB Supplemental Conditions section of the specifications. WRD 255 (not 225) can be found on page 191 of the pdf itself. TWDB-0459 can be found on page 192 of the pdf itself.

7. In which Bid Line Item Number on the Solicitation Quotes Table (following the Bid Proposal in the specifications) should bidders include the cost for the 15kV Ductbank, Manholes, Cable & Appurtenances shown on Sheets E-1 through E-4 between the New Electrical Switchgear Building and the First Stage Aeration Area?

Response: Contractor shall include the cost of these items in Line Item No. 2: 13.2kV Feed.

8. I would like to request adding "Aksa Generators" to the list of approved generator manufacturers.

Response: Refer to Schedule of Manufacturers and Suppliers (SCH-1) provided in Addendum No 1 for Manufacturers the Contract Documents are based upon. Alternates will not be approved during the bidding process.

9. This project calls for a field quality control test for the waterproofing (EFVM). It states in spec section 07141FL-5 (3.06) and 07141FL-6 that the owner will engage a qualified testing agency. I would like to submit a proposal for that scope.

Response: This requirement is being removed from the specifications.

SPECIFICATIONS

10. In Specification 02050, Page 02050-7, Remove Paragraph 3.06.B.1. and replace with the following:

1. Contractor shall salvage existing generators and associated paralleling switchgear. SAWS will retain ownership and possession of these items. Contractor shall relocate this equipment to a location within the Dos Rios WRC that will be selected by SAWS at the time this equipment is being salvaged.
2. Contractor will have salvage rights to all other equipment being removed as part of this project with exception of the existing generators and associated paralleling switchgear.

11. In Specification 01312, Page 01312-3, Paragraph 1.04.C. replace PROLOG with CPMS.

12. In Specification 07141FL, Page 07141FL-5, Paragraph 3.06.B: Delete this paragraph in its entirety.

13. Specification 16232- Generator Paralleling Gear Systems: Remove this specification in its entirety and replace with attached revised Specification 16232- Generator Paralleling Gear Systems dated September 28, 2016.

14. SCH-1 Schedule of Manufacturers and Suppliers: Remove this specification in its entirety and replace with attached revised SCH-1 Schedule of Manufacturers and Suppliers dated September 28, 2016.

15. Special Conditions, page SC-2, insert the following:

SC11 Bidder's submitting a bid for this project, shall have the following experience:

- (1) Extensive electrical power systems renovation experience and a minimum of five (5) years of experience working in water production facilities and/or wastewater treatment plants with close and careful coordination with the Owner. And, if the experience is an existing plant, should include continuous coordination of power system outages and system down time with the Owner and provision of means to maintain load energization, including such loads as control systems, security systems, process equipment, and lighting systems, to ensuring the Owner's continuous use and operation of the plant per the Owner's requirements. The power systems renovation experience shall include furnishing and installation of:

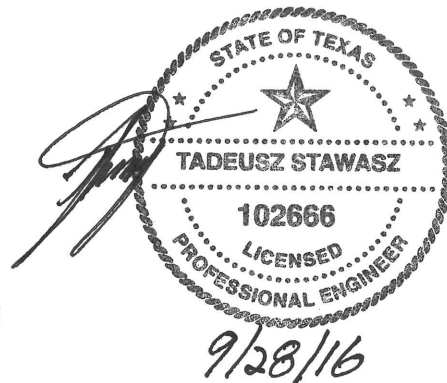
1. building construction and associated civil, structural, mechanical components,
 2. 15kV rated electrical equipment including power circuit breakers and breaker controls, appurtenances and associated equipment and instruments,
 3. 15kV rated electrical feeds,
 4. conduit and ductbanks,
 5. 480V generators, medium voltage rated transformers,
 6. Remote I/O (RIO) including integration of such equipment into the existing plant control systems, -
 7. large plant electrical shutdowns, and,
 8. service switchovers with voltages of at least 15KV.
- (2) Close and careful coordination with an Electric Power Utility for demolition of existing and installation of new electric utility service feeders, and interconnection of new utility service.
- (3) Extensive demolition of existing underground electrical ductbank systems and furnishing and installation of extensive proposed and renovated electrical underground medium voltage (5KV class or 15KV class) duct bank and cabling systems and grounding systems within a water treatment plant or wastewater treatment plant (preferably an existing plant) with coordination with underground utility systems of other trades, and, if an existing plant, maintaining plant operation per requirements of owner.

The Bidder, will be required to describe this construction experience on the Statement of Bidder's Experience found within the specifications, which shall be submitted with the bid. Bidder's must include a minimum of three (3) successfully completed similar projects within the last seven (7) years, comparable in size, scope, and complexity to the Work described in this project and in the bid proposal. Bidders may only submit experience and representative projects in which the Bidder served as the Prime Contractor. Work performed by a subcontractor will not be considered. Comparability requirements may be spread among the three (3) projects per items submitted, e.g. one project may demonstrate comparable size, another may demonstrate comparable in scope and another may demonstrate comparable in complexity. Decisions on "comparability" are at the complete discretion of SAWS.

DRAWINGS

16. Drawing AB-C-1: Delete this drawing in its entirety and replace with the attached revised drawing AB-C-1.
17. Drawing AB-C-1A is attached and shall become part of the contract documents.


 Ted Stawasz
 CP&Y, Inc.



END OF ADDENDUM

SECTION 16232

600 VOLT EMERGENCY GENERATOR PARALLELING GEAR SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

- A. Provide nine 600 volt metal-enclosed circuit breakers, paralleling switchgear as per project drawing, and associated control systems for paralleling generators on an isolated bus and for distributing power in AC systems, a master controller, 120 volt distribution panel, 75 kVA transformer, ceiling mounted lights, and HVAC system. A walk-in enclosure to house the paralleling gear systems including two generator(s) breakers, master controller, backplane bus systems, nine 600 volt metal enclosed circuit breakers, 75 kVA transformer, 120 volt distribution panel, and lights. The enclosure will be fitted with a special HVAC system to suitable for corrosive environment.
- B. The new paralleling switchgear shall consist of a switchgear line-up divided into sections per drawing. One section of the switchgear line-up shall be the location of the PLC master controls for the entire line-up. Generator breaker for each generator got which the load side is connected to the backplane 480 volt isolated bus system. This section shall also be the connection point of a load bank that can be connected to the switchgear control scheme, temporarily, to periodically and sequentially load test the generators. Master Control system must be programmed such a way, in the event of loss of normal power, load bank breaker should be programed to open and emergency operation should be carried out as programmed.
- C. Related Sections include the following:
 - 1. Section 16010, "Electrical General Provisions", "Conductors 600 V and below", and "Cable trays" for identification of conductors, interconnecting wiring, equipment, devices, and components
 - 2. Section 16105, "Power System Study" for short- circuit rating of devices and for setting of overcurrent protective devices
 - 3. Section 16195, "Power Metering and Protective Relays" power metering requirements.
 - 4. The bid proposal for the paralleling switchgear being proposed shall include the following.

- a. Product brochure.
- b. Specification compliance check.
- c. Physical, dimensional plan and elevation layout of the switchgear.

1.03 DEFINITIONS

- A. DPM. Multifunction Digital Power Meter.
- B. EMI. Electromagnetic interference.
- C. GFEP. Ground-fault equipment protection.
- D. HMI. Human machine interface.
- E. RFI. Radio-frequency interference.
- F. RMS. Root mean square.
- G. SCADA. Supervisory Control and Data Acquisition.
- H. SPDT. Single pole, double throw.
- I. SPD. Surge protective device.
- J. OIP. Operator interface panel.

1.04 PERFORMANCE REQUIREMENTS

- A. Overcurrent Protective Device Coordination. All overcurrent protective devices proposed for inclusion in the Work shall be selected to be selectively coordinated with the overcurrent protective devices installed on their supply side such that an overcurrent event (overload, short-circuit, or ground-fault) occurring at the lowest level in the system (branch circuit) cannot cause the feeder protective device supplying the branch circuit panel board to open. This coordination shall be carried through each level of distribution for all branches of emergency power. Refer to Section 16195 "Protective Relay and Device Coordination" for additional requirements.
- B. Protective Relay Coordination. In conjunction with the vendor performing the aforementioned coordination study, the paralleling switchgear manufacturer shall provide services necessary to determine settings of all protective relays in the emergency generator paralleling switchgear.

1.05 SUBMITTALS

- A. Submit all relevant product data and all shop drawings.
- B. Product Data. For the initial submittal package, for each type of switchgear, overcurrent protection device, accessory, and related component, include the following.

1. Manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 2. Rated capacities, features, operating characteristics, furnished specialties, factory settings, accessories and time-current characteristic curves for individual relays and overcurrent protective devices.
 - a. Time-current curves for each type of overcurrent protection device. Include hardcopies of characteristic curve and TCC Number for use with Power Tools by SKM Systems Analysis, Inc. Indicate available setting points and selectable ranges for each type of adjustable overcurrent protection device.
 3. Hardcopy layout of each display screen in HMI and DPM.
 4. Power monitoring block diagram. Show devices monitored and interconnections between components specified in this Section and devices furnished under section 16195 "Power Status and Monitoring System". Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines. Illustrate coordination among related equipment and power monitoring and control.
 5. Manufacturer's written sequence of operation.
- C. Shop drawings. For the initial submittal package, for each switchgear and related equipment, include the following.
1. Dimensioned plans, elevations, and details, including required clearances and service space around equipment. Show method of field assembly and location and size of each field connection. Include the following.
 - a. Tabulation of installed devices with features and ratings.
 - b. Enclosure types and details.
 - c. Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
 - d. Bus configuration with size and number of conductors in each bus run, including phase, neutral, and ground conductors of main and branch buses.
 - e. One-line diagram.
 - f. Horizontal and vertical bus current and voltage ratings.
 - g. Short-circuit current rating of equipment assembly.
 - h. Feeder entry locations and lug configuration.
 - i. Floor plan drawing showing locations for anchor bolts and leveling channels.
 - j. Nameplate legends.

- D. Specification compliance certification. Submittal shall be in compliance with the requirements defined in Division 1 "General Provisions". In addition to the requirements of Division 1 comply with the following.
1. Prepare a line-by-line Specification Compliance Certification by marking up a copy of the Contract Document specification section in the left margin. Accompany the markup with a written report explaining all items that are not marked with "Compliance". Submit line-by-line markup, written report of deviations, alternates and a cover letter certified by Manufacturer or Installer that prepared the Specification Compliance Certification. Use the following key for preparing the line-by-line markup.
 - a. "C" for Compliance. By noting the term "compliance" or "C" in the margin, it shall be understood that the manufacturer is in full compliance with the item specified and will provide exactly the same with no deviations.
 - b. "D" for Deviation. By noting the term "deviation" or "D" in the margin, it shall be understood that the manufacturer prefers to provide a different component in lieu of that specified.
 - c. "A" for Alternate. By noting the term "alternate" or "A" in the margin, it shall be understood that the manufacturer proposes to provide the same operating function but prefers to do it in a different manner.
 - d. "N/A" for Not Applicable. By noting the term "not applicable" or "N/A" in the margin, it shall be understood that the specified item is not applicable to the project.
- E. Wiring Diagrams. For a second submittal package, for each type of switchgear and related equipment, include the following.
1. Power, signal, and control wiring.
 2. Three-line diagrams of current and future secondary circuits showing device terminal numbers and internal diagrams.
 3. Schematic control diagrams.
 4. Diagrams showing connections of component devices and equipment.
 5. Diagrams showing connections to remote component devices and equipment, including but not limited to, engine generators, annunciators and control panels.
 6. Schematic diagrams showing connections to remote devices.
- F. Coordination Drawings. Submit Coordination Drawings in accordance with section 16010 "General Electrical Provisions" for each location where switchgear is included in the Work.
- G. Switchgear installation manual.

- H. Source quality control.
 - 1. Factory test procedure script for Owner and Engineer review.
 - 2. Factory test reports and product certificates. For switchgear, signed by product manufacturer.
- I. Extended maintenance offer. Priced preventive maintenance contract for Owner's consideration specified in this Section
- J. Field quality control, test method and procedure. List procedures to be used during functional and operations sequence testing. Method of procedure shall include but not be limited to the following.
 - 1. Tabulation of testing equipment and PPE required for tests.
 - 2. Schedule of shutdowns required.
 - 3. Manufacturer's recommended pre-start checklists for the following.
 - a. Overcurrent protection devices.
 - b. Metering and monitoring equipment.
 - c. Paralleling switchgear.
 - d. Engine generator.
 - e. Automatic transfer switch.
 - 4. Step-by-step testing operations and criteria for tests listed in Part 3 Paragraph "Field quality control".
- K. Field quality control test reports shall include the following.
 - 1. Test results that comply with requirements.
 - 2. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- L. Updated mimic-bus diagram for as-built record reflecting field changes after final switchgear load connections have been made.
- M. Operation and maintenance data. For electrical equipment, accessories and components to be included in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 "General Provisions" including the following:
 - 1. Manufacturer's routine maintenance requirements for switchgear and all installed components.
 - 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

3. Time-current curves, including selectable ranges for each type of relay and overcurrent protective devices. Include directory listing each adjustable breaker included in the Work and their final set points per the coordination study.
4. Manufacturer's samples system checklists and log sheets.
5. Manufacturer's written instruction of operation.

N. Warranty: Special warranty specified in this Section.

1.06 QUALITY ASSURANCE

- A. Manufacturer qualifications. Maintain a service center available on a 24-hour a day, 365 days a year, on-call basis, via a toll-free call center, capable of providing training, parts, and emergency maintenance repairs within a response period of less than 8 hours from time of notification. Maintain records of each switchgear, by serial number, for service purposes.
- B. Source limitations. Obtain switchgear, overcurrent protective devices, components, and accessories through one source from a single manufacturer, unless otherwise indicated.
- C. Product options. Drawings indicate spatial allocation for switchgear, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum spatial allocation.
- D. Electrical components, devices, and accessories. Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Factory Acceptance Testing to be witnessed as specified in Section 01010.

1.07 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references.
 1. ANSI/NEMA C12.20 – Electricity Meters – 0.2 and 0.5 Accuracy Classes
 2. ANSI C37.13 - IEEE Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures.
 3. ANSI C37.16 - Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations.

4. ANSI C37.20 - Standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear.
5. ANSI C37.50 - Low-Voltage AC Power Circuit Breakers Used in Enclosures - Test Procedures.
6. ANSI C37.51 – Metal-Enclosed Low-Voltage AC Power-Circuit-Breaker Switchgear Assemblies - Conformance Test Procedures.
7. ANSI C57.13 - IEEE Standard Requirements for Instrument Transformers.
8. ANSI/IEEE C37.90 - IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus.
9. ANSI / NFPA 70 - National Electrical Code.
10. ANSI / NFPA 110 - Standard for Emergency and Standby Power Systems.
11. IEEE 466 - IEEE Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems.
12. NEMA EI 21.1 - Instrument Transformers For Revenue Metering
13. NEMA PB 2.2 - Application Guide for Ground-Fault Protective (GFP) Devices for Equipment.
14. UL 1558 Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear and other applicable UL standards.
15. NECA (National Electrical Contractors Association) 400 - Standard for Installing and Maintaining Switchboards.
16. NECA 405 - Recommended Practice for Installing and Commissioning Interconnected Generation Systems.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Prepare equipment for shipment.
 1. Provide suitable rating, blocking, and supports so equipment will withstand expected domestic shipping and handling shocks and vibration.
 2. Weatherproof equipment for shipment. Close connection openings to prevent entrance of foreign material during shipment and storage.
- B. Installation pathway: Coordinate delivery of equipment to allow movement into designated space.
 1. Deliver in shipping splits in sizes that can be moved past obstructions in delivery path.

2. Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving equipment into place.
- C. Store equipment indoors in clean dry space with uniform temperature in accordance with manufacturer's requirements to prevent condensation. Protect equipment from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- D. Handle equipment components according to manufacturer's written instructions. Use factory installed lifting provisions.
- E. Handle switchgear according to NECA 400.

1.09 PROJECT CONDITIONS

- A. Interruption of existing electric service. Comply with requirements defined in Section 16010 "Electrical General Provisions".
- B. Field measurements. Indicate field measurements on shop drawings where equipment is proposed for installation in existing spaces.
- C. Environmental limitation. Rate equipment for continuous operation at indicated ampere ratings for the following conditions.
 1. Ambient temperature for circuit breakers. Not less than 23 degrees F (minus 5 degrees C) and not exceeding 104 degrees F (40 degrees C).
 2. Altitude. Not exceeding 6600 feet (2000 m).

1.10 COORDINATION

- A. Coordinate layout and installation of switchgear and components with other construction that penetrates floors, ceilings or walls or are supported by them, including but not limited to conduit, piping, other electrical equipment, light fixtures, HVAC equipment, fire suppression system components and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Cast anchor bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 "Concrete".

1.11 WARRANTY

- A. Special warranty. Manufacturer's standard form in which manufacturer agrees to repair or replace components of switchgear and associated auxiliary components that fail in materials or workmanship within spec field warranty period.
 1. Warranty Period: Two years from date of substantial completion.

1.12 MAINTENANCE SERVICE

- A. Initial Maintenance Service. Beginning at substantial completion, provide full inspection and maintenance by skilled employees of manufacturer's designated service organization during the Warranty period, including any special warranty period specified.
1. Include routine preventive maintenance and adjusting as required for proper operation as recommended by manufacturer. Provide number of visits recommended by manufacture; but no less than semi-annual inspection service.
 2. Provide parts and supplies same as those used in the manufacture and installation of the original equipment.
 3. The contractor performing the contract services shall be qualified and listed to maintain ongoing certification and listing of the completed system.
- B. Extended maintenance service. Offer for the Owner's consideration and evaluation at the time of Product Data Submittal, a priced inspection, maintenance, testing, and repair contract in compliance with the manufacturer's recommended routine preventive maintenance program.
1. The services offered under this contract shall begin after the completion of the initial maintenance service and warranty Period.
 2. The Owner shall have the option of renewing for single or multiple years, up to five years, at the price quoted upon completion of the warranty period.
 3. The contractor performing the contract services shall be qualified and listed to maintain ongoing certification and listing of the completed system.

1.13 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Keys. Six spares for each type of switchgear cabinet lock.
 2. Touchup Paint. Three 0.5 pint (250 mL) containers of paint matching enclosure finish.
 3. Indicating lights. One for every ten of each type and rating installed. Furnish at least one of each type.
 4. Spare fuses for the following.
 - a. Potential transformer uses. One for every ten of each type and rating installed. Furnish at least one of each type.

- b. Control power fuses. One for every ten of each type and rating installed. Furnish at least one of each type.

PART 2 PRODUCTS

2.01 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. The equipment must meet the requirements for the emergency generator paralleling switchgear described in this section and shown on the drawings. Deviations or alternates to this specification shall be noted in the specification compliance check and will only be considered if a complete written description of the proposed changes is provided with the compliance check with the bid and the submittals for approval. Any variances not specifically enumerated prior to bidding shall be considered non-responsive. Contractor shall modify the building and/or interfacing equipment, which are affected as a result of the proposed changes at no additional cost to the Owner.

2.02 MANUFACTURERS

- A. Russelectric
- B. ASCO
- C. Caterpillar
- D. Cummins

2.03 GENERATOR PARALLELING MONITOR AND CONTROL SYSTEM

- A. Individual generator control and monitoring panel. Provide each generator with a control and monitoring panel that allows the operator to view status and control operation of respective generator. Provide panel with the following features and characteristics.
 - 1. Generator Metering. 1 percent accuracy class or better.
 - a. Ammeter, voltmeter, frequency meter, wattmeter, kilowatt-hour meter, and power factor meter.
 - (i) For three-phase four-wire systems, indicate line-to-line and line-to-neutral conditions on voltmeter.
 - (ii) Provide analog devices for voltmeter and frequency meters.
 - (iii) Provide switches or other provisions to allow reading of both generator and bus voltages and frequencies from this metering set.

- b. Synchroscope and "generator set synchronized" indication.
 - (i) Provide lamp or LED indication of synchronization.
 - (ii) Provide 360-degree analog movement synchroscope.
 - c. Engine run time meter, start counter, rpm meter, and battery voltage meter; may be emulated in system software.
 - d. Engine oil temperature gage and engine coolant temperature gage; may be emulated in system software.
2. Generator protective and control switches. Provide oil-tight, industrial grade rotary switch in generator control and monitoring panel.
- a. Four-position mode selector switch (Lockout/Off/Auto/Run).
 - (i) "Lockout/Stop/Reset" - In this position the generator is prevented from starting or running. If the generator was shut down due to the operation of a protective device, the shutdown malfunction shall be reset when the switch is moved to this position. If the generator is running when the switch is moved to this position, it shall immediately shutdown.
 - (ii) "Off/Cool Down" - In this position the generator is shut down after cool down period if running. If the generator is not running, it is then prevented from starting.
 - (iii) "Auto" - In this position the generator is allowed to start and function in full automatic mode on receipt of remote start signal.
 - (iv) "Run" - In this position the generator operates in conjunction with load/no-load test as follows.
 - (a) "On-Line" - In this position the generator starts and runs. Generator shall be connected to the bus. When returned to the "Auto" position, the generator shall shutdown after cool down period.
 - (b) "Off-Line" - In this position the generator starts and runs. Generator shall not be connected to the bus unless an external start signal is received from a transfer switch during test. When returned to the "Auto" position, the generator shall shutdown after cool down period.
 - b. Four-position synchronizing mode selector switch. Provide oil-tight, industrial grade rotary switch in generator control and monitoring panel.
 - (i) "Permissive" - In this position the governor controls are deactivated. However, the synchronizer can operate as a passive synch check relay and signal the closing of the generator breaker.

- (ii) "Check" - In this position, the synchronizer is fully operational except it cannot close the generator breaker. The phase-lock feature holds the generator output in synchronism with the bus.
 - (iii) "Off" - In this position the synchronizer is turned off to allow for manual paralleling at the master cubicle.
 - (iv) "Run" - In this position the synchronizer is in the fully operational, automatic mode.
 - c. Circuit breaker trip/close switch. Interlocked with system control so that circuit breaker closure is impossible unless the following occurs.
 - (i) Mode selection is in "Run / On-Line" position.
 - (ii) Generator set is synchronized with system bus.
 - d. Control/reset push button with flashing lamp to indicate generator is locked out due to fault condition.
 - e. Lamp test push button to simultaneously test all lamps on panel.
 - f. Control panel illumination. DC lamps to illuminate panel when lighting from surrounding environment is not available.
 - g. Emergency stop push button. Red regressed push button switch under clear protective plastic cover. Switch maintains its position until manually reset with key.
 - h. Voltage and frequency raise/lower switches.
 - (i) Allow plus/minus percent adjustment when generator set is operating but not paralleled.
3. Generator protective and control devices. Solid-state industrial relays, integrated microprocessor-based control devices, and other accessories and devices located in switchgear control section to provide the following features and functions.
- a. Provide GE Multilin SR489 microprocessor-based relay, or approved equal, for each generator control section.
 - b. Kilowatt load sharing control.
 - (i) Coordinate location of emergency generator vendor provided load share module, whether at the paralleling switchgear or at the generator.
 - (ii) Operates engine governors during synchronizing and provides isochronous load sharing when paralleled.
 - (iii) Allow generator set to ramp up to kilowatt load level signaled by system master controller.

- c. Load demand governing control.
 - (a) Causes generator set to ramp down to zero load when signaled to shut down in load demand mode.
 - (b) Causes generator set to ramp up to a proportional share of total bus load.
- d. Sync-check, paralleling monitor and control.
 - (i) Monitors and verifies that generator set has reached 90 percent of nominal voltage and frequency before closing to bus.
 - (ii) Prevents out-of-phase paralleling if two or more generator sets reach operating conditions simultaneously, by sending "inhibit" signal to sets not designated by system as "first to close to bus".
 - (iii) Recognizes failure of "first-to-close" generator set and signals system paralleling to continue.
 - (iv) Prevents out-of-phase closure to bus due to errant manual or automatic operation of synchronizer.
- e. Synchronize control.
 - (i) Adjusts engine governor to match voltage, frequency, and phase angle of paralleling bus.
 - (ii) Maintains generator set voltage within 1 percent of bus voltage, and phase angle within 20 electrical degrees of paralleling bus for 0.5 seconds before circuit-breaker closing.
 - (iii) Provides "fail-to-synchronize time delay" adjustable from 10 to 120 seconds; with field selectivity to either initiate alarm or shut down generator set on failure condition.
- f. Reverse power monitor and control.
 - (i) Prevents sustained reverse power flow in generator set.
 - (ii) Trips generator circuit breaker and initiates generator set shutdown when reverse power condition exceeds 10 percent of generator set kilowatt for three seconds.
- g. Phase rotation monitor and control.
 - (i) Verifies generator set and paralleling bus phase rotation match prior to closing paralleling circuit breaker.
- h. Electronic alternator overcurrent alarm and shutdown control.

- (i) Monitors current flow at generator set output terminals.
 - (ii) Initiates alarm when load current on generator set is more than 110 percent of rated current for more than 60 seconds.
 - (iii) Provides overcurrent shutdown function matched to thermal damage curve of alternator. Provide without instantaneous trip function.
- i. Electronic alternator short-circuit protection.
 - (i) Provides shutdown when load current is more than 175 percent of rated current and combined time/current approaches thermal damage curve of alternator. Provide without instantaneous trip function.
 - j. Loss of excitation monitor.
 - (i) Initiates alarm when sensing loss of excitation to alternator while paralleled to system bus.
 - k. Generator set start contact. Redundant system, 10 A at 32 V dc.
 - l. Cool-down time-delay control. Adjustable, 0 to 600 seconds.
 - m. Start time-delay control. Adjustable, 0 to 300 seconds.
 - n. Paralleling circuit breaker monitor and control.
 - (i) Monitors circuit breaker auxiliary contacts.
 - (ii) Initiates fault signal if circuit breaker fails to close within adjustable time-delay period (0.5 to 15 seconds).
 - (iii) Trips open and locks out paralleling circuit breaker upon paralleling circuit breaker failure to close, until manually reset.
4. Engine protection and local annunciation (via the OIP).
- a. Provide annunciation and shutdown control modules for alarms indicated.
 - b. Provide visual alarm status indicator and alarm horn with silence acknowledge push button on generator control and monitoring panel.
 - c. Annunciate the following conditions.
 - (i) Status, light only.
 - (a) Generator engine control switches not in auto (flashing red).
 - (b) Generator engine control switches in auto (green).
 - (c) Emergency mode (red).
 - (d) Generator circuit breaker closed (red).

- (e) Generator circuit breaker opens (green).
 - (f) Auto-start (white).
 - (g) Engine running (white).
 - (h) Engine stopped (green).
 - (i) Engine cool-down (amber).
- (ii) Pre-alarm, light and horn (non-latching).
 - (a) Pre-high coolant temperature (amber).
 - (b) Pre-low oil pressure (amber).
 - (c) Generator fails to synchronize (red).
- (iii) Alarm, Light and Horn (non-latching).
 - (a) Low coolant temperature (red).
 - (b) High battery voltage (red).
 - (c) Low batter voltage (red).
 - (d) Low cranking voltage (red).
 - (e) Battery charger AC failure (red).
 - (f) Engine low fuel (red).
 - (g) Generator overloads (red).
 - (h) Generator circuit breaker fails to close (red).
 - (i) Generator lockout (red).
 - (j) Engine controller failure (red).
 - (k) Control voltage failure (red).
 - (l) PLC failure (red).
 - (m) High fuel level (red).
 - (n) Low fuel day tank (red).
 - (o) Day tank fuel leak (red).
 - (iv) Shutdown alarm, light and horn (latching).
 - (a) Engine overcrank (red).

- (b) Engine overspeed (red).
- (c) Engine low oil pressure (red).
- (d) Engine high coolant temperature (red).
- (e) Engine low coolant level (red).
- (f) Engine remote emergency shutdown (red).
- (g) Generator circuit breaker tripped (red).
- (h) Generator loss of field (red).
- (i) Generator reverses power (red).
- (j) Generator undervoltage (red).
- (k) Generator overvoltage (red).
- (l) Generator underfrequency (red).
- (m) Generator overfrequency (red).

B. Master control system and monitoring equipment. Paralleling and monitoring equipment, components, and accessories for multiple generators with the following features and characteristics.

1. The system shall be controlled by a Allen-Bradley PLC (Programmable Logic Control), or owner approved equal, for redundant master control of the emergency generator paralleling switchgear. The PLCs shall be hot backup and networked to form one distributed control system.
2. Components and devices shall be mounted in the switchgear master control section of the switchgear lineup.
3. Paralleled system metering. 1 percent accuracy class or better to monitor total output of generator bus.
 - a. Ammeter, voltmeter, frequency meter, wattmeter, kilowatt-hour meter, power factor meter, kilovolt ampere, kilovolt ampere rating, and kilowatt demand meters.
 - (i) For three-phase/four-wire systems, indicate line-to-line and line-to-neutral conditions on voltmeter.
 - (ii) Display all functions on the HMI device.
4. Master control system manual controls. Provide oil-tight, industrial-grade switches in master control section for the following.

- a. Failure to synchronize reset switch. Provide a momentary push-button switch to reset the "Fail-to-Synchronize" alarm.
 - b. Alarm acknowledge button. Provide push-button to silence audible horn. Visual alarms to remain illuminated until malfunction is corrected and system is reset from HMI. Each subsequent malfunction alarm received after alarm is silenced shall re-sound alarm horn.
 - c. System test switch. Provide a system no-load test switch to initiate a complete automatic system operation by simulating the closure of the remote engine start signal. Mount this switch inside front cover of the master control section to limit access to authorized personnel only.
 - d. Manual paralleling controls. Provide manual paralleling interface controls and metering in a central location on the front of the master control section. This shall allow for multiple generators paralleling from one location within the switchgear.
 - (i) Generator selector switch. Provide selector switch to select any generator for manual paralleling operation. Switch to have positions for each generator connected to switchgear, including provisions for known future generators. Position of selector switch shall simultaneously connect the synch-check relay, synchroscope, and "manual paralleling" push-button to the selected generator.
 - (ii) Solid-state control. Provide a solid-state device, to function as a sync check relay, for manual paralleling to sense and compare the phase angle difference between the oncoming generator and the paralleling bus. This solid-state device shall lockout the manual paralleling push- button until the oncoming generator is within 15 degrees of synchronism.
 - (iii) Manual paralleling push button. Provide illuminated push button for initiation of manual paralleling function. Controls shall be arranged so that the operator shall depress and hold the manual paralleling push- button. When the relative phase angle reduces to 15 degrees and going towards zero degrees, the solid-state device output contact shall initiate the closing of the respective oncoming generator breaker.
5. Full color HMI device (OIP). Touchscreen with minimum viewing area of 144 square inches.
- a. Allows operator to monitor and control the complete system of paralleled generator sets by allowing access to PLC timers and set-points, engine sequencing, system status, system alarms, and master control functions. The HMI device shall also communicate with the engine-generator controllers, the ATS's, the generator protective relays, the circuit breaker trip units, and the power quality meter.
 - b. Screens shall include the following.

- (i) Main menu. Include date, time, and system status messages with screen push buttons to access one-line diagram, system controls, load controls, alarms, bus metering, and individual generator-set data.
- (ii) One-line diagram screen. Depicting system configuration and system status by screen animation, screen colors, text messages, or pop-up indicators. Indicate the following minimum system conditions.
 - (a) Generator sets, buses, and paralleling circuit breakers energized/de-energized.
 - (b) Generator-set mode (run/off/auto).
 - (c) Generator-set status (normal/warning/shutdown/load-demand stop).
 - (d) Paralleling circuit-breaker status (open/closed/tripped).
 - (e) Bus conditions (energized/de-energized).
 - (f) Provide access to other screens.
- (iii) AC metering screen. Displays the following minimum meter data for the paralleling bus.
 - (a) Phase volts and amperes, kilowatt, kilovolt ampere, kilovolt ampere rating, power factor, frequency, kilowatt-hour, and kilowatt demand.
 - (b) Real time trend chart for system kilowatts and volts updated on no less than one-second intervals.
 - (c) A minimum of one historical trend chart for total system loads with intervals no shorter than five minutes and a minimum duration of four hours.
- (iv) Generator-set control screen. Provides control over individual generator sets from master system control panel. Includes the following minimum functions.
 - (a) Generator manual start/stop control (functional only when generator-set mounted control switch is in "Auto" position).
 - (b) Generator-set alarm reset.
 - (c) Manually initiated, automatically effected paralleling and circuit breaker controls.
- (v) Generator-set data display screen. Provide the following minimum parameters.
 - (a) Engine speed, oil pressure and temperature, coolant temperature, and engine operating hours.

- (b) Three-phase voltage and current, kilowatt, power factor, and kilowatt hour.
 - (c) Generator control switch position and paralleling circuit-breaker position.
 - (d) All generator-set alarms.
 - (e) Transducers needed for the aforementioned parameters shall be provided by the emergency generator vendor. Coordinate exact details with the generator vendor.
- (vi) System control screen. Password protected and with the following minimum functions.
- (a) System test modes. Test with load/test without load/normal/retransfer time-delay override.
 - (b) Test with Load. Starts and synchronizes generator sets on paralleling bus; all loads are transferred to bus.
 - (c) Test without load. Starts and synchronizes generator sets on paralleling bus but does not transfer loads to bus.
 - (d) Time adjustments for retransfer time delay, transfer time delay, system time delay on stopping, and system time delay on starting.
- (vii) Load-demand control screen. Monitors total load on system bus and controls number of generator sets running so that capacity tracks load demand while ensuring against overloading the generators(s) and preventing the loss of critical loads.
- (a) Load-demand control. On/off.
 - (b) Load-demand pickup set point. Adjustable from 90 to 40 percent in percent increments.
 - (c) Load-demand dropout set point: Adjustable from 20 to 70 percent in percent increments.
- (viii) Manual load control screen: Allows operator to manually add or delete generator sets from paralleled system in response to system load parameters.
- (a) Indication of system available in kilowatts and amperes.
 - (b) Control functions allow manual addition/removal of generator sets on system, and activation of load-shed/load-restore functions.
- (ix) Load-add/load-shed sequence screen. Password protected and with the following minimum functions.

- (a) Assigns "load-add sequence priority" to each load control relay with designation for relay operation after a set number of generator sets are online.
 - (b) Assigns "load-shed sequence priority" to each load control relay with designation for relay operation depending on number of generator sets online.
 - (c) Adding of loads shall be prioritized from 1.00 to minimum 5.00 (refer to ATS schedule on the drawings) and sub-prioritized as priority 1 loads (1.00-1.99), then priority 2 loads next (2.00-2.99), and then priority loads 3.00 and higher.
 - (d) Loads shall be shed in opposite order as they are added.
- (x) Alarm summary and run report screen.
- (a) Lists most recent alarm conditions and status changes.
 - (b) Lists a minimum of the most recent 32 alarm conditions by name and time/date; acknowledges alarm conditions with time/date.
 - (c) For each start signal, lists start time and date, stop time and date, maximum kilowatt and ampere load on system during run time, and start and stop times of individual generator sets.

6. System status and annunciation (via the OIP).

- a. Provide visual alarm status indicator and alarm horn with silence/acknowledge push button.
- b. Annunciate the following conditions.
 - (i) Status light only.
 - (a) Running status. Display generator set number and "white" status light (Generator No. X Running).
 - (b) Priority load status: Display load number and "white" status light
 - Priority load group 1 (ATS-xx) connected
 - Priority load group 2 (ATS-xx) connected
 - Priority load group x (ATS-xx) connected
 - Priority load group 2 (ATS-xx) bypassed
 - Priority load group x (ATS-xx) bypassed
 - Priority load group 2 (ATS-xx) loads shed
 - Priority load group x (ATS-xx) load shed

- (c) System test (white)
 - (d) Remote system start (red)
 - (e) Normal source available (green)
 - (f) Connected to normal (green)
 - (g) Generator source available (green)
 - (h) Connected to generator source (green)
- (ii) Status light and alarm
- (a) Load-shed level status. Displays load number and red load-shed, status light.
 - (b) Generator trouble and alarm status. Displays generator number and red "Check Generator" status light. [Generator No. x Trouble (common) and Generator No. x Lockout]
 - (c) Priority load status. Display load number and "red" status light
 - Priority load group 1 (ATS-xx) loss of normal power
 - Priority load group 2 (ATS-xx) loss of normal power
 - Priority load group x (ATS-xx) loss of normal power
 - (d) Load demand mode (red – steady or flash)
 - System controller failure (steady)
 - Control voltage failure (steady)
 - Check station battery (steady)
 - Bus overload (steady)
 - Generator control switch not in auto (flash)
 - Paralleling controls not in auto (flash)
 - Primary PLC failure (flash)
 - Alternate PLC failure (flash)
 - Feeder circuit breaker trip (steady)
 - Feeder circuit breaker fails to close (steady)
 - Bus (load shed) under-frequency (steady)
 - Bus overfrequency (steady)
 - Bus undervoltage (steady)
 - Bus ground fault (steady)

C. Description of system operation.

1. Loss of normal power.
 - a. System receives "start" signal from any ATS; all generator sets on the paralleling bus automatically start and achieve rated voltage and frequency.
 - b. System closes the first generator set achieving 90 percent of rated voltage to paralleling bus.
 - c. "Priority loads" connect to the paralleling bus.
 - d. "Priority load add" controls prevent overloading of system.
 - e. Remaining generator sets switched to synchronizers that control and then allow closure of generator sets to paralleling bus.
 - f. On closure to paralleling bus, each generator set assumes its proportional share of total load.
 - g. Remaining loads connect to the paralleling bus.
2. Failure of a generator set to start or synchronize (with the standby generator set not available).
 - a. After expiration of overcrank time delay, generator set shuts down and alarm is initiated.
 - b. Priority controller prevents overload of system bus.
 - c. Manual override of priority controller at HMI allows addition of low-priority load to bus.
 - d. Bus overload monitor protects bus from manual overloading.
3. Bus Overload.
 - a. On bus overload, load shed control initiates load shedding.
 - b. If bus does not return to normal frequency within adjustable time period, additional load continue to be shed until bus returns to normal frequency.
 - c. Loads shed can be reconnected to bus only by manual reset at HMI.
4. Load demand mode.
 - a. With "load demand" function activated, controller continuously monitors total bus load.
 - b. If bus load is below preset limits for 15 minutes, demand controller shuts down generator sets in predetermined order until minimum number of sets are operating to accommodate load.

- c. On sensing available bus capacity is diminished to set point, controller starts and closes generator sets to bus to accommodate load.
- 5. Failure of a generator set to start, synchronize, or continue to operate (with the standby generator set available).
 - a. Due to the inability of generator set to start synchronize, or continue to operate, the generator set shuts down and alarm is initiated.
 - b. Load shed control is initiated until the standby generator is on line.
 - c. Standby generator set receives a start signal and synchronizes to the paralleling bus on the end of the switchgear that the failure has occurred.
 - d. Load add control is initiated.
- 6. Return to normal power.
 - a. Process starts on removal of start signals from system.
 - b. When no load remains on paralleling bus, all generator breakers open, go through cool-down period, and shut down.
 - c. If start signal is received during cool-down period, one generator set is reconnected to bus, and system operation follows that of "loss of normal power".
- 7. Load Bank Operation.
 - a. If the load bank is in operation, upon loss of the normal power system, the load bank breaker shall open automatically.

2.04 RATINGS

- A. Suitable for application in 3-phase, 60-Hz, solidly grounded neutral system, unless otherwise indicated.
- B. Nominal system voltage. As indicated on the Drawings.
- C. Main bus. Amperage as indicated on the Drawings. Provide continuous rating across entire length of main bus.
- D. Short time and short-circuit current. Match rating of highest rated overcurrent protective device in switchgear assembly.
 - 1. Available short-circuit current. As indicated on the Drawings. Refer to Section 16105 "Power System Study" for additional requirements.

2.05 MANUFACTURED UNIT FABRICATION

- A. Mounting height of breakers shall be in accordance with NFPA 70 requirements. Fabrication of equipment shall take housekeeping pad dimension into account in determining height of top breaker in all sections. Refer to project drawing for dimension of housekeeping pad.
- B. Generator, feeder, and tie breakers sections. Factory assembled and tested in complying with ANSI C37.20 and UL 1558.
- C. Front-and-rear accessible switchgear. Front and rear aligned, with features as follows.
 - 1. Main devices. Drawout mounted.
 - 2. Feeder devices: Individually compartmented and drawout mounted.
 - 3. Feeder circuit breaker load terminals. Silver plated copper bus extensions equipped with mechanical pressure connectors for outgoing circuit conductors.
 - 4. Extend section barriers between main and tie circuit-breaker compartments to rear of section.
 - 5. Arrange bus isolation barriers to isolate line bus from load bus at each main and tie circuit breaker.
- D. Buses and connections. Three phase, four wire, unless otherwise indicated.
 - 1. Phase and neutral bus material. Hard-drawn copper of 98 percent conductivity, silver plated, with copper feeder circuit breaker line connections.
 - a. Lugs. Mechanical pressure type suitable for quantity and size of conductor. UL 486A-486B listed, dual rated and marked for use with copper conductors to suit project conditions.
 - 2. Ground bus. 2-by-1/4-inch hard-drawn copper of 98 percent conductivity, equipped with mechanical pressure type connectors for feeder and branch circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
 - 3. Neutral buses. 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical pressure type connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
 - 4. Neutral disconnect link. Where switchgear is used as the service disconnecting means, provide bolted, uninsulated copper bus, arranged to connect neutral bus to ground bus. Provide bussed link sized in accordance with NFPA 70.
 - 5. Vertical section bus size. Comply with IEEE C37.20.1 or UL 1558 as required by listing of section, including allowance for spare circuit breakers and spaces for future circuit breakers. Include bus to extend the full length of vertical sections.

6. Provide bus bar connections between vertical sections and compartments. Cable connections are not permitted.
 7. Support and brace buses for indicated short-circuit currents.
 8. Main phase buses and equipment ground buses. Uniform capacity for entire length of switchgear's main and distribution sections.
 9. Provide for future extensions from either end of main phase, neutral, and ground bus by means of predrilled bolt-holes and connecting links.
 10. Load terminals. Insulated, rigidly braced, silver plated, copper runback bus extensions equipped with pressure connectors for outgoing circuit conductors. Provide load terminals for future circuit breaker positions at full ampere rating of circuit breaker position.
- E. Fully equipped future device provisions. Equip compartments with unused space with mounting brackets, supports, bus connections, and necessary appurtenances at full rating of circuit breaker compartment.
- F. Auxiliary compartments. Match and align with basic switchgear assembly. Include the following where indicated.
1. Instrumentation compartment. Fabricated compartment or section as required to house meters, relays, controls, and auxiliary equipment.
- G. Indoor enclosure fabrication. Steel, rated for environmental conditions at installed location.
1. Indoor location rating: NEMA 250, Type 1.
 2. Finish. Factory applied finish in manufacturer's standard ANSI Gray enamel over corrosion-resistant treatment or rust-inhibiting primer coat.
 3. Hinged front panels. Allow access to control sections, metering, accessory, and blank compartment. Hinged panels must be arranged for minimum of 120-degree swing; standard 90 degrees swing is not acceptable.
 4. Access. Removable, hinged front and rear doors and compartment covers secured by keyed vault lock for access to interior of switchgear.
- 2.06 OVERCURRENT PROTECTIVE DEVICES
- A. Series rated devices are not permitted.
- B. B.Base of design product. Subject to compliance with requirements, provide breakout bid pricing in accordance with Division 01 for each of the following overcurrent protection device products.

1. Generator, feeder, and tie breakers. Low-voltage power circuit breakers.
 2. Manufacturers.
 - a. General Electric – Entelliguard series with Entelliguard TU trip units.
 - b. Schneider Electric, Square D – Masterpact NW series with Micrologic trip units.
- C. Low voltage power circuit breaker requirements. Comply with ANSI/IEEE C37.13; fully rated for continuous, interrupting, and short-time current capacity to meet available fault current.
1. Drawout circuit breaker mounting features. Circuit breaker mounting assembly equipped with a racking mechanism to position circuit breaker and hold it rigidly in connected, test, and disconnected positions. Include the following features.
 - a. Interlocks. Prevent movement of circuit breaker to or from connected position when it is closed, and prevent closure of circuit breaker unless it is in connected, test, or disconnected position.
 - b. Circuit breaker positioning. An open circuit breaker may be racked to or from connected, test, and disconnected positions only with the associated compartment door closed unless live parts are covered by a full dead-front shield. An open circuit breaker may be manually withdrawn to a position for removal from the structure with the door open. Status for connection devices for different positions includes the following.
 - (i) Test position. Primary disconnect devices disengaged, and secondary disconnect devices and ground contact engaged.
 - (ii) Disconnected position. Primary and secondary devices and ground contact disengaged.
 2. Operating mechanism. Mechanically and electrically trip free, stored energy.
 - a. Normal closing speed. Independent of both control and operator.
 - b. Slow closing speed. Optional with operator for inspection and adjustment.
 - c. Stored energy mechanism. Electrically charged, with optional manual charging.
 - d. Operation counter.
 3. Trip devices. Solid-state, overcurrent trip device system consisting of one or two current transformers or sensors per phase, a release mechanism, and the following features.
 - a. Functions. Long-time, short-time, and instantaneous trip functions, with ground fault protection per NFPA 70, independent of each other in both action and adjustment.

- b. Temperature compensation. Ensures accuracy and calibration stability from 23 to 104 degrees F.
 - c. Field adjustable, time-current characteristics.
 - d. Trip current adjustability. Dial settings and rating plugs on trip units, sensors on circuit breakers, or a combination of these methods.
 - e. Three bands, minimum, or long-time- and short-time-delay functions; marked "minimum," "intermediate," and "maximum".
 - f. Pickup points. Five minimum, for long-time- and short-time-trip functions. Equip short time trip function for switchable I²t operation.
 - g. Pickup points. Five minimum, for instantaneous-trip functions.
 - h. Trip Indication. Labeled, battery-powered lights or mechanical targets on trip device to indicate type of fault.
 - i. Power monitoring. The trip units shall have the following power monitoring features.
 - (i) Full function metering including.
 - (a) Current (Amps)
 - (b) Voltage (Ph-Ph; Ph-N)
 - (c) Energy (KWH)
 - (d) Real power (KW)
 - (e) Total power (KVA)
 - (f) Frequency (HZ)
 - (g) Demand (AVG KW)
 - (h) Peak demand
 - (ii) Ground fault alarm.
 - (iii) Modbus RTU (Remote Terminal Unit) communications.
4. Arc chutes. Readily removable from associated circuit breaker when it is in disconnected position, and arranged to permit inspection of contacts without removing circuit breaker from switchgear.
5. Control voltage. To match control power supply provided.

D. Circuit breaker features. Standard frame sizes, trip ratings, and number of poles. Provide the following features for all circuit breakers included in the work.

1. Lugs. Mechanical pressure type connectors, suitable for number, size, trip ratings, and conductor material; UL 486A-486B listed, dual rated and marked for use with copper or aluminum load side conductors.
 2. Communication capability. Communication module with functions and features compatible with power monitoring and control system specified in subsection of Instrumentation paragraph Part 2 - Product of this Section and in Section "Power Status and Monitoring System".
 3. Indicating lights: To indicate circuit breaker is open or closed.
 4. Auxiliary contacts: For interlocking or remote indication of circuit breaker position, with spare auxiliary switches and other auxiliary switches required for normal circuit breaker operation, quantity as indicated. Each consists of two Type "a" and two Type "b" stages (contacts) wired through secondary disconnect devices to a terminal block in stationary housing.
 5. Padlocking provisions. For installing at least three padlocks on each circuit breaker to secure its enclosure and prevent movement of drawout mechanism.
 6. Operating handle. One for each circuit breaker capable of manual operation.
 7. Electric close button. One for each electrically operated circuit breaker.
- E. Circuit breaker accessories. Standard frame sizes, trip ratings, and number of poles. Provide the following accessories where indicated or required.
1. Ground-fault protection and alarm indication. Where ground-fault protection is indicated on Drawings, provide an integrally, circuit breaker mounted relay and adjustable pickup and time-delay settings, push-to-test feature, and ground fault indicator alarm. Separation of ground-fault protection time-current characteristics shall conform to manufacturer's recommendations and per NFPA 70.
 2. Key interlock kit. To prohibit circuit breaker operation; key shall be removable only when circuit breaker is in off position.
 3. Under-voltage trip devices. Adjustable time delay and pickup voltage.
 4. Auxiliary switch. Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit breaker contacts.
 5. Shunt trip. Set to trip at 55 percent of rated voltage
 6. Remote trip indication and control.
- F. Relays. Comply with IEEE C37.90, integrated digital type; with test blocks and plugs.

2.07 INSTRUMENTATION

- A. Instrument transformers. The following are required, in addition to the requirement of NEMA EI 21.1, and IEEE C57.13.
 - 1. Potential transformers. Secondary voltage rating of 120V and ANSI/NEMA accuracy class of 0.3 with burdens of W, X, and Y.
 - 2. Current Transformers. Ratios with accuracy class and burden suitable for connected relays, meters, and instruments.
- B. Analog instruments. Rectangular, 4½-inch square, accurate within 1 percent, semi-flush mounting, with anti-parallax 250-degree scale and external zero adjustment, complying with ANSI C39.1.
 - 1. Voltmeters. Cover an expanded scale range of normal voltage plus 10 percent.
 - 2. Voltmeter selector switch. Rotary type with off position to provide readings of phase-to-phase and phase-to-neutral voltages.
 - 3. Ammeters. Cover an expanded scale range of bus rating plus 10 percent.
 - 4. Ammeter selector switch. Permits current reading in each phase and keeps current transformer secondary circuits closed in off position.
 - 5. Locate meter and selector switch on each generator circuit breaker compartment door.
- C. Power quality monitor. Provide monitoring and metering equipment according to Section 16195 "Power Metering and Protective Relays".

2.08 CONTROL POWER

- A. Control wiring. SIS conductor factory installed, complete with bundling, lacing, and protection; and complying with the following.
 - 1. Flexible conductors for No.8 WG and smaller, for conductors across hinges and for conductors for interconnections between shipping units.
 - 2. Conductors sized according to NFPA 70 for duty required.
- B. Control battery system.
 - 1. Automatic 24V DC control voltage sensor system. Provide an automatic DC control sensor system in the master control section to select DC control voltage.
 - a. Through a best battery selector system obtain DC control voltage from the station battery system or anyone of the engine starting batteries. The sensor shall automatically select the best control voltage from the available batteries and insure a stable system control voltage, as long as any of the battery sources are available.

- b. In each generator control cubicle a DC overvoltage protection circuit and supply shall be provided to protect the system from an excessive overvoltage (110-percent of nominal) and undervoltage (50-percent of nominal) conditions, particularly during engine cranking. The protection shall extend to all circuits connected to the best battery selector.

C. Station battery system.

1. System requirements. Battery shall have number of cells and ampere-hour capacity based on an initial specific gravity of 1.210 at 25 degree C with electrolyte at normal level and minimum ambient temperature of 13 degree C. Cycle battery before shipment to guarantee rated capacity on installation. Arrange battery to operate ungrounded.
2. Battery. Lead-calcium type in sealed, clear plastic or glass containers, complete with electrolyte, fully charged, and arranged for shipment with electrolyte in cells. Limit weight of each container to not more than 70 lb and cells per container to not more than 3. System batteries shall be suitable for service at an ambient temperature ranging from minus 18 to 25 degree C. Limit variation of current output to 0.8 percent for each degree blow 25 degree C down to minus 8 degree C.
3. Rack. Two-step rack with electrical connections between battery cells and between rows of cells; include two flexible connectors with bolted type terminals for output leads.
4. Accessories.
 - a. Thermometers with specific gravity correction scales.
 - b. Hydrometer syringes.
 - c. Set of socket wrenches and other tools required for battery maintenance.
 - d. Wall mounted, nonmetallic storage rack fitted to store above items.
 - e. Set of cell numerals.
5. Charger. Static-type silicon rectifier equipped with automatic regulation and provision for manual and automatic adjustment of charging rate. Unit shall automatically maintain output voltage within 0.5 percent from no load to rated charger output current, with ac input voltage variation of plus or minus 10 percent and input frequency variation of plus or minus 3 Hz. Other features of charger include the following.
 - a. DC ammeter.
 - b. DC Voltmeter. Maximum error of 5 percent at full-charge voltage; operates with toggle switch to select between battery and charger voltages.

- c. Ground indication. Two appropriately labeled lights to indicate circuit ground, connected in series between negative and positive terminals, and with midpoint junction connected to ground by normally open push-button contact.
- d. Capacity. Sufficient to supply steady load, float charge battery between 2.20 and 2.25 V per cell and equalizing charge at 2.33 V per cell.
- e. Charging rate switch. Manually operated switch provides for transferring to higher charging rate. Charger operates automatically after switch operation until manually reset.
- f. AC power supply is 120 V, 60 Hz, subject to plus or minus 10 percent variation in voltage and plus or minus 3-Hz variation in frequency. After loss of ac power supply for any interval, charger automatically resumes charging battery. Charger regulates rate of charge to prevent damage due to overload and to prevent fuses or circuit breakers from opening.
- g. Protective feature. Current-limiting device or circuit, which limits output current to rating of charger but does not disconnect charger from either battery or ac supply; protects charger from damage due to overload, including short circuit on output terminals.
- h. Electrical filtering. Reduces charger's audible noise to less than 26 dB.

2.09 ACCESSORY COMPONENTS AND FEATURES

- A. Surge protective devices.
 - 1. Install in cable termination compartments and connect in each phase of circuit.
 - 2. Coordinate rating with circuit voltage.
- B. Circuit breaker accessories. Furnish tools and miscellaneous items required for circuit breaker and switchboard tests, inspections, maintenance, and operation.
 - 1. Racking handle to manually move circuit breaker between connected and disconnected positions.
 - 2. Portable test set for testing all functions of circuit breaker, solid state trip devices without removal from switchboard.
- C. Circuit breaker removal apparatus. Provide overhead circuit breaker lifting device, track mounted at top front of switchgear and complete with hoist and lifting yokes matching each size of drawout circuit breaker installed.
- D. Communication.
 - 1. Provide communication interfaces for Facility Management System communication with system PLC's, engine generator controllers, ATS's, generator protective relays, circuit breaker trip units, and power quality meters.

2. Communication interface. Provide communications interface for remote monitoring via open protocol through Ethernet and Modbus TCP/IP, capable of connecting to owner's IP network to communicate faults, alarms and send SMS messages.
 3. Connection to data link. A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data link transmission of indications to remote data terminals. Data system connections to terminals are covered in Section 16195 "Power Status and Monitoring System".
- E. Storage for manual. Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

2.10 IDENTIFICATION

- A. Main nameplate. Provide switchgear with a stainless steel main nameplate, prominently displayed on the front, indicating manufacturer's name, address and shop order number, year manufactured, and the following ratings.
1. Nominal, maximum design and BIL voltage rating.
 2. Main bus continuous current rating.
 3. Interrupting, momentary and fault closing 3-phase symmetrical short circuit current rating.
- B. Provide engraved laminated plastic nameplates to identify major components, vertical sections, circuit breakers, relays, switches, etc. Coordinate nameplate color and letter size with Identification section of the specifications. Attach nameplates with stainless steel screws.
- C. Caution signs. Provide caution signs in accordance with the NEC and OSHA requirements.
- D. Mimic bus. Continuously integrate mimic bus factory applied to front of switchgear. Arrange in one-line diagram format, using symbols and letter designations consistent with final mimic bus diagram. Coordinate mimic bus segments with devices in switchgear sections to which they are applied. Produce a concise visual presentation of principal switchgear components and connections.

2.11 SOURCE QUALITY CONTROL

- A. Before shipment of equipment, perform the following tests and prepare test reports. Report factory test results within 10 business days of completion of test.
1. Provide 14 days advance notice of tests and opportunity for observation of tests by Engineer and Owner's representative.
- B. Factory tests. Perform the following factory certified tests on switchgear.

1. Factory tests the emergency generator paralleling switchgear to simulate a complete and integrated system. Install the circuit breakers in their actual position and electrically and mechanically test.
2. Production tests on circuit breakers according to IEEE C37.20.
3. Production tests on completed switchgear assembly according to IEEE C37.20.
4. Assemble switchgear and equipment in manufacturer's plant and perform the following.
 - a. Functional tests of all relays, instruments, meters, and control devices by application of secondary three-phase voltage to voltage circuits and injection of current in current transformer secondary circuits.
 - b. Functional test of all control and trip circuits. Connect test devices into circuits to simulate operation of controlled remote equipment such as circuit breaker trip oils, close coils, and auxiliary contacts. Test proper operation of relay targets.
5. Perform the following separate tests on the switchgear.
 - a. Dielectric.
 - b. Mechanical.
 - c. Grounding of instrument transformer case.
 - d. Electrical operation and control wiring.
 - e. Control wiring insulation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine elements and surfaces where equipment will be installed for compliance with installation tolerances, required clearances, and other conditions affecting performance.
- B. Examine roughing-in of conduits to verify the following.
 1. Wiring entries comply with layout requirements.
 2. Entries are within conduit entry tolerances specified by manufacturer and no feeders will have to cross section barriers to reach load or line lugs.
- C. Verify that ground connections are in place and that requirements in Section 16195 "Grounding and Bonding" have been met.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.
- C. Comply with applicable portions of NECA 400 - Standard for Installing and Maintaining Switchboards.
- D. Comply with applicable portions in NECA 405 - Recommended Practice for Installing and Commissioning Interconnected Generation Systems.
- E. Temporary lifting provisions. Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from equipment and components once unit is secured in place.
- F. Install and anchor equipment level on concrete bases, 4-inch nominal thickness. Refer to project drawing for dimension of housekeeping pad.
 - 1. Install dowel rods to connect concrete base to concrete floor.
 - 2. Install epoxy-coated anchor bolts that extend into concrete base.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevation required for proper attachment to equipment.
- G. Install overcurrent protective devices, controllers, and instrumentation.
- H. Install filler plates in unused spaces.
- I. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- J. Close unused conduit opening or other unused holes in sides of box with proper mating blank-off plates.

3.03 IDENTIFICATION

- A. Identify field installed conductors, interconnecting wiring, components and provide warning signs as specified in section 16012.
- B. Equipment identification nameplate. Refer to 2.10 IDENTIFICATION of this Section for requirement.
- C. Feeder overcurrent protective device labels. Label each protective device with nameplate that indicates the device it feeds using engraved Equipment Identification Label as specified in Section 16010 "Electrical General Provisions".

- D. Switchgear directory. Create a directory to indicate name/descriptions of installed circuit loads. Use a computer or typewriter to create neatly typed circuit directory printed on 80 weight paper. Obtain approval before installing within clear plastic pocket on outside of switchgear assembly.
- E. Diagram and instructions.
 - 1. Frame and mount the following items in clear acrylic plastic holder on the front of switchgear.
 - a. Operating instructions. Printed basic instructions for switchgear, including control and key-interlock sequences and emergency procedures where applicable.
 - b. System power riser diagrams provided in accordance with Part 2 of this section. Fold large format drawings neatly and place with instructions.
 - 2. Storage for maintenance manual. Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

3.04 CONNECTIONS

- A. Tighten bus joints, electrical connectors, and terminals according to manufacturer's published torque tightening values.
- B. Ground equipment according to Section 16662 "Grounding and Bonding System".
- C. Connect wiring according to Section 16120 "Conductors 600V and below".
- D. Wiring to remote components. Match type and number of cables and conductors to control and communication requirements of switchgear as recommended by manufacturer. Coordinate raceway size that is required by manufacturer and provide raceway as necessary to accommodate required wiring.
- E. Provide connection from TCP/IP card to Owner's IP network.
- F. Provide connection from terminal block to Facility Management System.
- G. Connect control wiring for the automatic transfer switches; Use the existing control cables that are connected to existing automatic transfer switches and coordinate with plant staff and additional requirements. Control wiring includes but is not limited to.
 - 1. Start signal.
 - 2. Load test circuit.
 - 3. Load control (Add/Shed) circuit, where required.
 - 4. ATS status indicator circuits.
 - a. Normal (primary) source available.

- b. On normal (primary) source.
- c. Emergency (secondary) source available.
- d. On emergency (secondary) source.

3.05 TESTING

- A. Testing and commissioning shall be per 01650 Facility Start Up and Commissioning Requirements. Coordinate with the testing agency, manufacturer's field service representative, and commissioning agent for field tests and commissioning of the complete emergency power system, including and in association with the operation of Engine Generators, Automatic Transfer Switches, Power Status and Monitoring System, and Emergency Generator Paralleling Switchgear provided under this section. Overcurrent protective device trip settings shall be set and tested in accordance with the short circuit and device coordination study provided. Protective relay settings shall be set as a part of the services of the provision of the switchgear provided under this section.
- B. Notify the Engineer and the Owner's Representative 14 working days in advance of the various test dates so that tests can be properly witnessed, as required.
- C. Prepare for acceptance tests as follows.
 - 1. Test insulation resistance for each switchgear bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
 - 3. Assist in field testing of equipment including pre-testing and adjusting of equipment and components.
- D. Perform the following field tests, inspections and prepare test reports.
 - 1. Impact mounting and anchorage devices.
 - 2. Inspect switchgear installation including wiring, components, connections, and equipment. Test and adjust components and equipment.
 - 3. Verify that electrical control wiring installation complies with manufacturer's submittal by means of point-to-point continuity testing. Verify that wiring installation complies with requirements in Sections 16120.
- E. Testing agency (testing company, or contractor). Engage a qualified independent testing and inspecting agency as defined in Section 16010 "Electrical General Provisions" to perform the following field tests and inspections and prepare certified test reports.
 - 1. After installing switchgear but before equipment is energized, verify that grounding system at switchgear tests to specified value or better.

2. Perform each electrical test, visual, and mechanical inspection stated in ANSI/NETA - Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems. Certify compliance with test parameters. Perform NETA tests and inspections for each of the following NETA categories.
 - a. Section 7.1 for Switchgear & Switchboard Assemblies.
 - b. Section 7.3 for Cables.
 - c. Section 7.4 for Metal Enclosed Busways.
 - d. Section 7.6 for Circuit Breakers.
 - e. Section 7.9 for Protective Relays.
 - f. Section 7.10 for Instrument Transformers.
 - g. Section 7.11 for Metering Devices.
 - h. Section 7.13 for Grounding Systems.
 - i. Section 7.14 for Ground-Fault Protection Systems, Low-Voltage.
 - j. Section 7.18 for Direct-Current System, Batteries.
 - k. Section 7.19 for Surge Arresters.
 - l. Section 7.22 for Emergency Systems, Engine Generator.
 3. Infrared scanning. Perform thermographic survey in accordance with NETA ATS, Section 9.
 - a. Initial infrared scanning. Perform an infrared scan of each switchgear assembly within 60 days after switchgear is energized. Open or remove doors and covers so connections are accessible to portable scanner.
 - b. Follow up infrared scanning. Perform an additional follow up infrared scan of each switchgear assembly 11 months after date of switchgear is energized.
 - c. Instruments, equipment.
 - (i) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- F. Manufacturer's field service. Engage a factory authorized service representative to perform the following field tests and inspections and prepare certified test reports.
1. Complete installation and startup checks according to manufacturer's written instructions.

2. Perform functional and operational sequence testing according to approved method or procedure. Test shall include, but not necessarily be limited to, the following.
 - a. Load sharing /paralleling test.
 - b. Automatic operation test.
 - c. Failure to synchronize test.
 - d. Voltage/frequency alarm failure test.
 - e. Manual operating test.
 - f. Switching from manual to automatic test.
 - g. Under-frequency load shedding test.
 - h. Manually dropping nonessential load shedding test.
 - i. Overload load shedding test.
 - j. Load re-add test.
 - k. Single engine failure test.
3. At a minimum the manufacturer's field service representative shall provide the following separate visits to the site.
 - a. Pre-installation coordination meeting with an engine generator representative, the design team, contractor, and Owner to coordinate the pre-installation and interconnection of the engine generator control switchgear with the engine generator equipment.
 - b. Installation coordination meeting with an engine generator representative, the design team and Owner to coordinate the installation and interconnection of the engine generator control switchgear with the engine generator equipment.
 - c. Post-installation startup and initial testing, prior to final system acceptance, and initial instruction and training period for operating personnel. Include service required to check out the emergency system and demonstrate the operation for final acceptance by the Owner.
 - d. Post-installation commissioning and final system acceptance. Assist commissioning agent as required during commissioning process.
 - e. After system acceptance, provide instruction for operating personnel on complete operation and maintenance program. Time and duration commensurate with the complexity of the system per Division 01 specification, and location of training visit as designated by Owner.

G. Correct deficiencies, retest and report.

1. Correct unsatisfactory conditions, and retest to demonstrate compliance; replace conductors, units, and devices as required to bring system into compliance.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 3. Prepare a report, certified by testing agency that identifies switchgear, units, conductors and devices checked and describes results. Include notation of deficiencies detected, remedial action taken, and observations and test results after remedial action.
- H. Test labeling. On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.06 ADJUSTING

- A. Set field-adjustable overcurrent protective device trip characteristics according to settings provided by the engineer reviewed third party Overcurrent Protective Device Coordination study.
1. Settings will be provided after the submittal process and review of report required by Section 16195 "Power Metering and Protective Relays" are completed.

3.07 CLEANING

- A. Clean components according to manufacturer's written instructions.
- B. Prior to installation of front trim and over plates inspect interior surfaces and perform the following.
1. Remove paint splatters and other spots.
 2. Vacuum dirt and debris; do not use compressed air to assist in cleaning.
- C. On completion of front trim and cove installation, inspect exterior surfaces and perform the following.
1. Remove paint splatters and other spots.
 2. Remove all temporary marking and labels.
 3. Vacuum dirt and debris; do not use compressed air to assist in cleaning.
 4. Repair exposed surfaces to match original finish.

3.08 PROTECTION

- A. Temporary heating. Maintain a clean dry space with uniform temperature in accordance with manufacturer's requirements to prevent condensation. Apply temporary heating as required.

- B. Protect equipment from exposure to dirt, fumes, water, corrosive substances, and physical damage.

3.09 TRAINING

- A. Engage a factory authorized service representative to train Owner's personnel to adjust, operate, and maintain switchgear, overcurrent protective devices, instrumentation, and accessories. Refer to Division 01 specification pertaining to testing and commissioning.

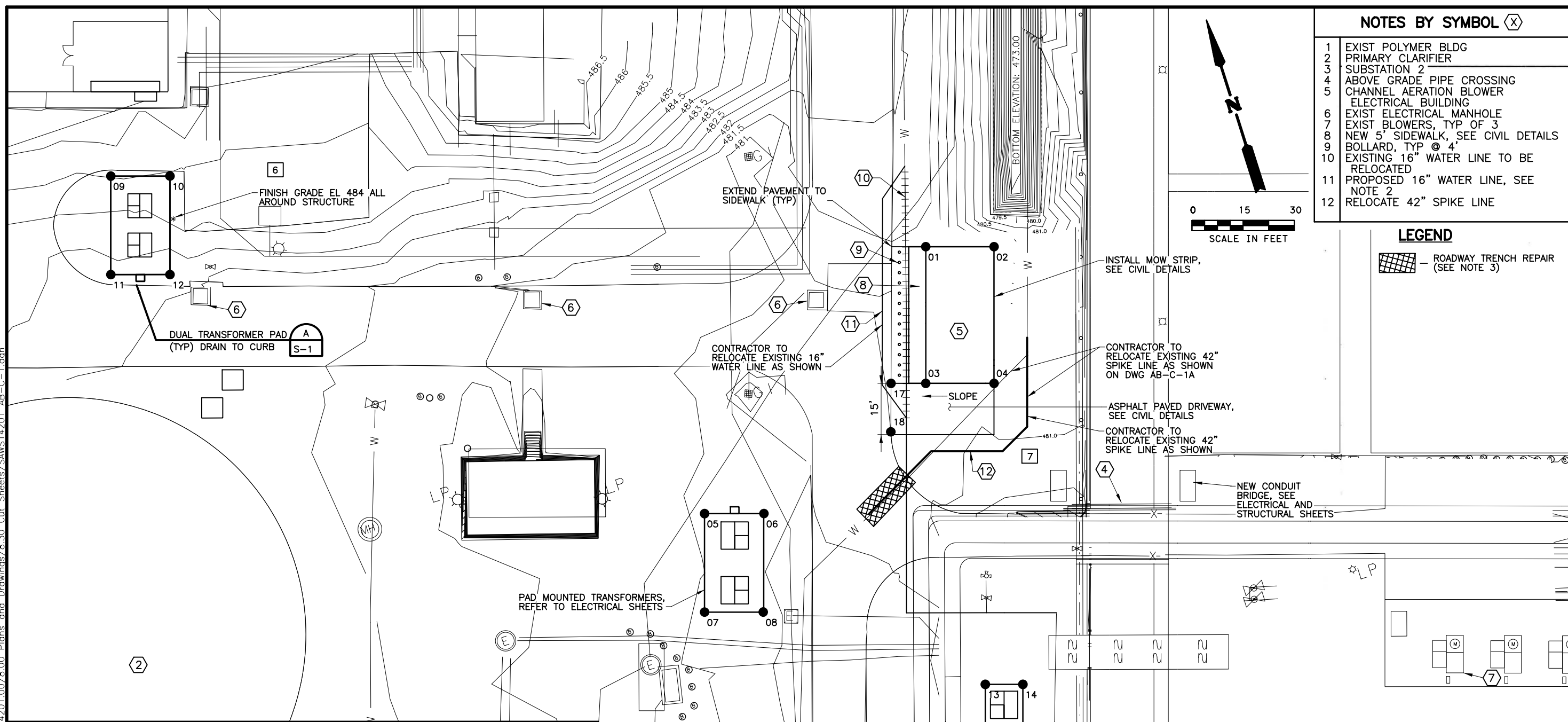
END OF SECTION

Schedule of Manufacturers and Suppliers

The Contract Documents are based upon the equipment or products available for the manufacturers/suppliers denoted as "a", "b", etc., below. Bidder must indicate in the Bid which manufacturer/supplier the bid was based upon and which bid is intended for use for each item of equipment, listed below by circling one of the listed suppliers/manufacturers. If the Bidder circles more than one listed supplier, he must use the first supplier circled (unless an alternate is approved).

Specification Number	Equipment	Manufacturer or Supplier
11149 2.01	Sump Pumps	a. Flowserve b. Flygt Corporation c. KSB, Inc. d. Ebara e. Owner Approved equal
16231 2.01	Packaged Engine Generator Systems	a. Caterpillar b. Cummins
16232 2.02	Emergency Generator Paralleling Gear Systems	a. Russelectric b. ASCO c. Caterpillar d. Cummins
16345 2.01	Medium Voltage Metal-Clad Switchgear	a. Eaton Cutler-Hammer b. Siemens c. Square D
16346 2.01	Medium Voltage Sealed Deadfront Distribution Switchgear	a. S & C Electric b. G & W Electric
17400 2.01	Control Panels	a. Hoffman Engineering Company b. Rittal

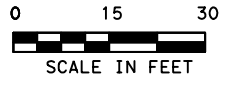
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- NOTES BY SYMBOL** (X)
- EXIST POLYMER BLDG
 - PRIMARY CLARIFIER
 - SUBSTATION 2
 - ABOVE GRADE PIPE CROSSING
 - CHANNEL AERATION BLOWER
 - ELECTRICAL BUILDING
 - EXIST ELECTRICAL MANHOLE
 - EXIST BLOWERS, TYP OF 3
 - NEW 5' SIDEWALK, SEE CIVIL DETAILS
 - BOLLARD, TYP @ 4'
 - EXISTING 16" WATER LINE TO BE RELOCATED
 - PROPOSED 16" WATER LINE, SEE NOTE 2
 - RELOCATE 42" SPIKE LINE

LEGEND

[Symbol] - ROADWAY TRENCH REPAIR (SEE NOTE 3)



POINTS

POINT NUMBER	NORTHING	EASTING	ELEVATION	DESCRIPTION
1	13637184.78	2152759.36	481.50	OUTSIDE CORNER, TOP OF SLAB
2	13637178.73	2152778.42	481.50	OUTSIDE CORNER, TOP OF SLAB
3	13637146.66	2152747.25	481.50	OUTSIDE CORNER, TOP OF SLAB
4	13637140.60	2152766.31	481.50	OUTSIDE CORNER, TOP OF SLAB
5	13637129.95	2152673.97	482.25	OUTSIDE CORNER, TOP OF CONCRETE CONTAINMENT CURB
6	13637124.71	2152690.49	482.25	OUTSIDE CORNER, TOP OF CONCRETE CONTAINMENT CURB
7	13637102.48	2152665.24	482.25	OUTSIDE CORNER, TOP OF CONCRETE CONTAINMENT CURB
8	13637097.23	2152681.75	482.25	OUTSIDE CORNER, TOP OF CONCRETE CONTAINMENT CURB
9	13637276.77	2152538.18	484.75	OUTSIDE CORNER, TOP OF CONCRETE CONTAINMENT CURB
10	13637271.52	2152554.69	484.75	OUTSIDE CORNER, TOP OF CONCRETE CONTAINMENT CURB
11	13637249.29	2152529.44	484.75	OUTSIDE CORNER, TOP OF CONCRETE CONTAINMENT CURB
12	13637244.05	2152545.96	484.75	OUTSIDE CORNER, TOP OF CONCRETE CONTAINMENT CURB
13	13637057.42	2152737.19	481.25	OUTSIDE CORNER, TOP OF SWITCH PAD
14	13637054.09	2152747.68	481.25	OUTSIDE CORNER, TOP OF SWITCH PAD
15	13637036.46	2152730.53	481.25	OUTSIDE CORNER, TOP OF SWITCH PAD
16	13637033.13	2152741.01	481.25	OUTSIDE CORNER, TOP OF SWITCH PAD
17	13637149.74	2152737.56	481.1	EXISTING GRADE
18	13637135.41	2152733.01	481.2	EXISTING GRADE

BENCHMARKS AND BORE DATA (X)

POINT NUMBER	NORTHING	EASTING	ELEVATION	DESCRIPTION
BM6	13637263.58	2152584.83	483.78	BENCHMARK 6
BM7	13637117.08	2152769.75	481.25	BENCHMARK 7

- SHEET NOTES:** (A)
- PRIOR TO CONSTRUCTION, CONTRACTOR SHALL CONFIRM CLEARANCE OF CONSTRUCTION EQUIPMENT, MATERIALS, AND BUILDING COMPONENTS.
 - SEE DRAWING AB-C-1A FOR RELOCATION OF 42" SPIKE LINE.
 - SEE DRAWING AB-C-1A FOR TRENCH REPLACEMENT IN ROAD.

SAWS JOB NO. 14-6504

CP&Y
12500 SAN PEDRO AVE.
SAN ANTONIO, TX 78216
SAN ANTONIO, TX 78216
TYPE REGISTRATION # 1741
TBAE REGISTRATION # BR 2019

SA SAN ANTONIO WATER SYSTEM

STATE OF TEXAS
WADE A. BROOKS
MADE A. BROOKS
66206
LICENSED PROFESSIONAL ENGINEER

DATE: SEPTEMBER 2016
Designed: RLJ
Drawn: GWM
Reviewed: TJS
CP&Y Proj. No. SAWS14201

SAN ANTONIO WATER SYSTEM
DOS RIOS WRC ELECTRICAL SYSTEM
IMPROVEMENTS - PHASE 1

EXISTING & PROPOSED TRANSFORMER AREA
SITE PLAN AND DIMENSIONAL CONTROL

SHEET AB-C-1
SHEET 122 OF 166

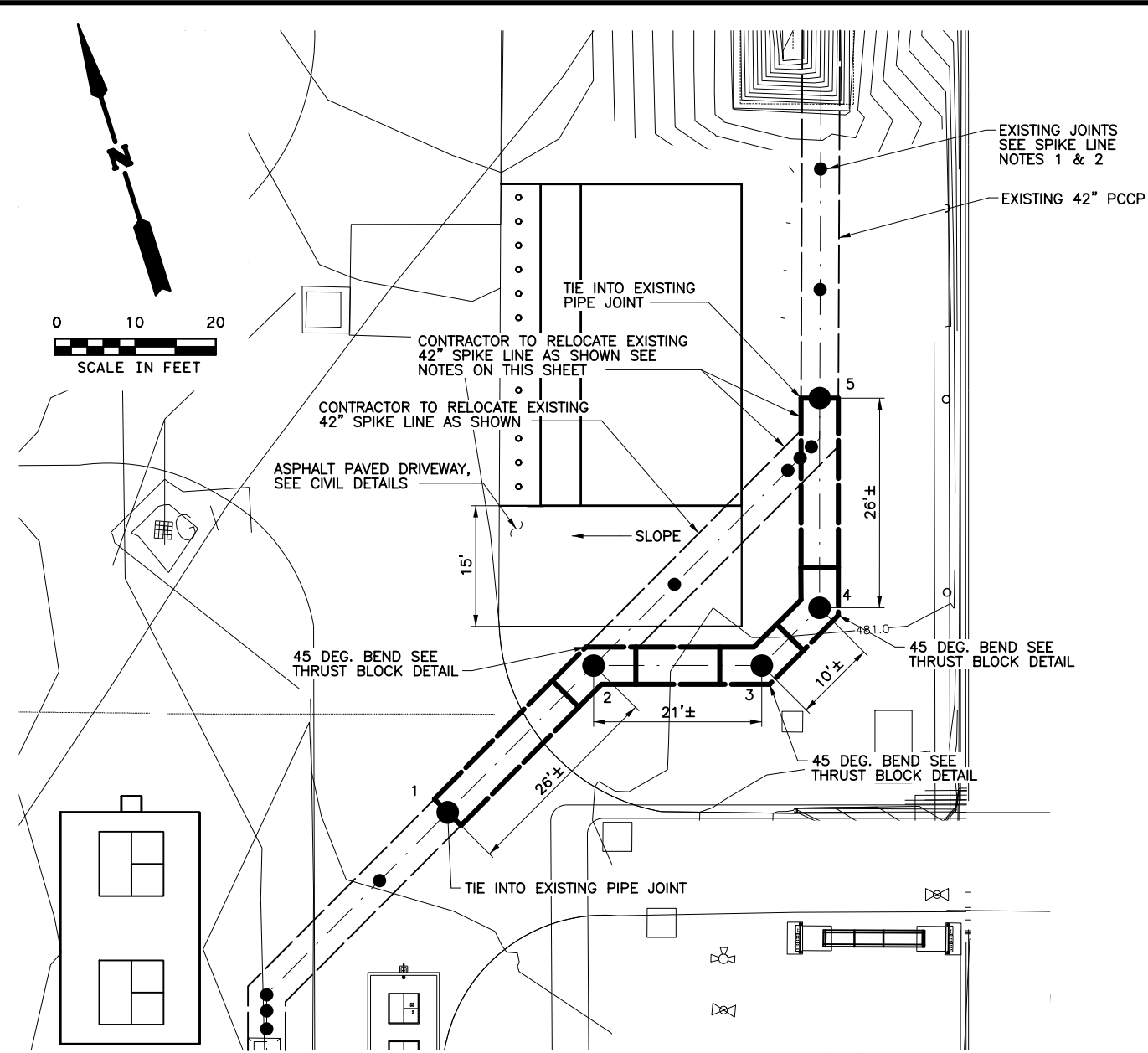
NO.	REVISION	DATE	BY
1	ADDENDUM NO. 4	WB 9/27/16	WB

DATE IS ONE INCH ON ORIGINAL ON THIS SHEET. ADJUST SCALE.

SAN ANTONIO WATER SYSTEM
DOS RIOS WRC ELECTRICAL SYSTEM
IMPROVEMENTS - PHASE 1
EXISTING & PROPOSED TRANSFORMER AREA
SITE PLAN 42" WATERLINE RELOCATION

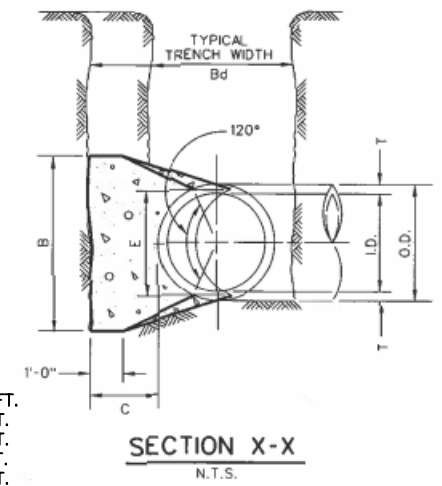
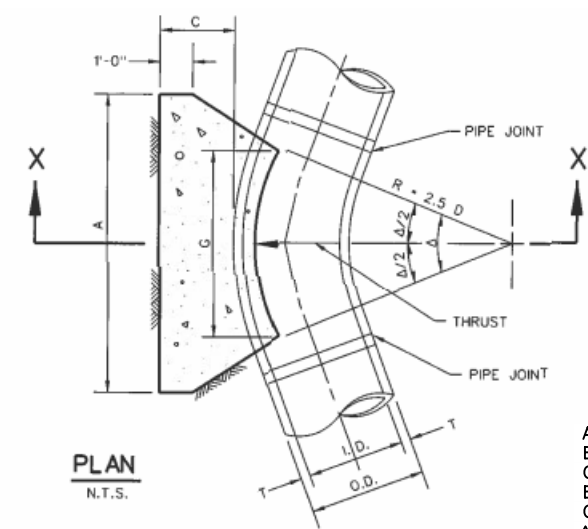
Date:	SEPTEMBER 2016
Designed:	WB
Drawn:	DJM
Reviewed:	TJS
CP&Y Proj. No.	SAWS14201

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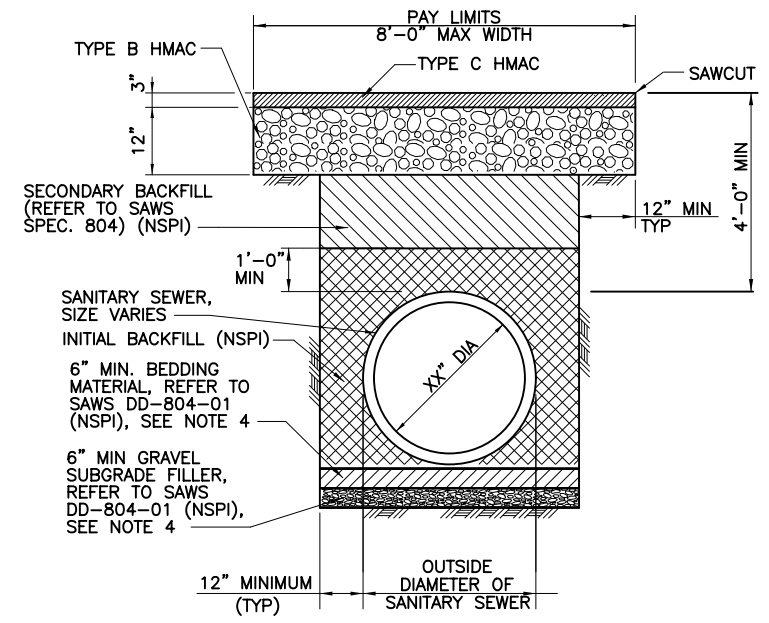
POINTS				
POINT NUMBER	NORTHING	EASTING	ELEVATION	DESCRIPTION
1	13637115.36	2152719.89	UNKNOWN	EXISTING PIPE JOINT
2	13637127.24	2152742.73	UNKNOWN	APPROXIMATE LOCATON OF 45 DEG. BEND
3	13637120.91	2152762.67	UNKNOWN	APPROXIMATE LOCATON OF 45 DEG. BEND
4	13637125.58	2152771.71	UNKNOWN	APPROXIMATE LOCATON OF 45 DEG. BEND
5	13637150.43	2152779.63	UNKNOWN	EXISTING PIPE JOINT

- SPIKE LINE NOTES:**
- THE LOCATION, DEPTH AND PIPE JOINT LOCATIONS OF THE EXISTING SPIKE LINE SHOWN ON THE DRAWING ARE APPROXIMATE, BASED ON AVAILABLE INFORMATION, AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE ENGINEER, THE OWNER OR THE OWNER'S REPRESENTATIVE.
 - THE CONTRACTOR SHALL FIELD VERIFY THE LOCATION OF THE EXISTING LINE TO INCLUDE LOCATION OF PIPE JOINTS AT THE TIE-IN POINTS SHOWN ON THE DRAWING PRIOR TO ORDERING ANY MATERIAL. THE CONTRACTOR SHALL NOTIFY THE ENGINEER AND SAWS INSPECTOR OF EXACT PIPE JOINT LOCATIONS AND CLEARLY SHOW EXACT TIE-IN LOCATIONS AND PIPE LENGTHS ON THE PIPE SUBMITTALS/SHOP DRAWINGS.
 - EXISTING PIPE MATERIAL IS PCCP BURIED AT A DEPTH OF APPROXIMATELY 10'-0".
 - THE SPIKE LINE IS ACTIVE. THE CONTRACTOR SHALL CONSTRUCT AS MUCH OF THE LINE AS POSSIBLE AND COORDINATE WITH SAWS ON SHUTDOWN OF THIS LINE DURING TIE-IN.
 - THE CONTRACTOR SHALL MAKE PROVISIONS FOR CAPTURING STATIC WATER IN THE LINE AND DISPOSING OF THIS WATER BACK TO THE HEADWORKS OF THE PLANT.
 - RELOCATED PIPE AND BENDS SHALL BE NEW 42" DIAMETER PCCP PIPE.
 - ALL BENDS AND PIPE JOINTS SHALL BE INSTALLED WITH THRUST BLOCK.
 - NEW PIPE AND PIPE INSTALLATION SHALL BE IN ACCORDANCE WITH SAWS STANDARD SPECIFICATIONS 820 AND 840.
 - CONTRACTOR SHALL REMOVE AND DISPOSE OFF-SITE THE EXISTING SECTION OF PIPE COMPLETELY.
 - CONTRACTOR SHALL BACKFILL THE TRENCH OF THE REMOVED SECTION OF PIPE IN ACCORDANCE WITH SAWS STANDARD SPECIFICATION 804.
 - CONTRACTOR SHALL REMOVE AND DISPOSE OFF-SITE THE SECTIONS OF THE EXISTING SPIKE LINE THAT ARE BEING RELOCATED. NO PORTION OF THE EXISTING LINE SHALL BE ABANDONED IN-PLACE.



- A = 11.5 FT.
- B = 8.0 FT.
- C = 3.0 FT.
- E = 4.0 FT.
- G = 7.5 FT.
- Δ = 45°
- O.D. = 47 1/4"
- I.D. = 42"
- T = 3.125"

HORIZONTAL THRUST BLOCK AT PIPE BEND △



- TRENCH REPLACEMENT NOTES:**
- THE EXISTING PAVING SURFACE SHALL BE SAW CUT IN A STRAIGHT LINE A MINIMUM OF 12" WIDER UNDISTURBED SIDES OF THE TRENCH SYMMETRICAL ABOUT THE CENTER LINE OF THE EXCAVATION.
 - ANY CONCRETE PAVING SHALL BE SAW CUT 6" WIDER THAN UNDISTURBED SIDES OF EXCAVATION.
 - IF EXCAVATION AREA IS OPEN FOR TEMPORARY PUBLIC USE THE SURFACE SHALL BE MAINTAINED LEVEL WITH ADJACENT RIDING SURFACE WITH COLD MIX AC OR TEMPORARY AC.
 - DEPTH OF GRAVEL SUBGRADE FILLER TO BE DETERMINED IN FIELD BY SAWS FIELD REPRESENTATIVE IN CONDITIONS WHERE BOTTOM IS UNSTABLE.
 - DAMAGED PAVEMENT OUTSIDE THE TRENCH CUT SHALL BE REMOVED AND REPLACED WITH A BASE THICKNESS OF 12" OR A THICKNESS MATCHING EXISTING, WHICHEVER IS GREATER.