



GUAM POWER AUTHORITY
HAGATNA, GUAM

PREPARED BY THE ENGINEERING DEPARTMENT

SPECIFICATION E-029

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March 25, 2013

REV. 3

GUAM POWER AUTHORITY
P.O. BOX 2977
HAGATNA, GUAM 96910

TRANSMISSION & DISTRIBUTION SPECIFICATION
Specification No. E-029

FOR

13.8 KV SWITCHGEAR

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1.0 SCOPE

- 1.1. This specification describes the requirements for the design, manufacture, factory testing and delivery of 15kV indoor metal-clad switchgear, as well as associated control and accessory equipment. The switchgear shall be an ANSI C37.20.7 Type 2C arc-resistant, providing compartmental protection. The switchgear shall meet the indoor requirements of ANSI C37. This general specification along with the detailed specification establishes the minimum requirements for this equipment. If there is a discrepancy between the single line diagram(s) and the detailed specifications, the detailed specifications shall take precedence. The entire switchgear shall consist of the following equipment:

- Main power circuit breaker equipment
- Bus tie circuit breaker equipment
- Spring bus with removable links and a tap section for the mobile substation
- Feeder power vacuum circuit breaker equipment
- Primary bus system
- Ground bus system
- Protective relaying
- Control devices
- Connection provisions for primary, ground and control circuits
- Auxiliary compartments and transformers
- Accessories and material

- 1.2. The switchgear shall perform satisfactorily under a non-air conditioned environment and be suitably designed for satisfactory operation under the hot tropical climate conditions and shall be dust and vermin proof. All the parts and surface, which are subject to corrosion, shall either be made of such material or shall be provided with such protective finish, which provided suitable protection to them from any injurious effect of excessive humidity.
- 1.3. The equipment shall be suitable for satisfactory continuous operation under the following tropical conditions:
- a. Maximum ambient temperature : 45 °C
 - b. Relative Humidity : 10 to 99 %(condensing)
 - c. Seismic level (Horizontal acceleration) : International Building Code Zone-4
- 1.4. Any special design or installation considerations to assure compliance with this requirement shall be thoroughly documented on the Supplier drawings.

2.0 CONFORMANCE TO STANDARDS AND SPECIFICATIONS

- 2.1. The metal-clad switchgear shall be designed, manufactured and tested in accordance with the latest editions of the applicable, National Electrical Code (NEC), National Electrical Safety Code (NESC), EEMAC, ANSI, IEEE and NEMA standards including:
- 2.1.1. American National Standards Institute, Inc. (ANSI)
- C37.04 IEEE Standard Rating Structure for AC High-Voltage Circuit Breakers
 - C37.06 IEEE Standard for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis - Preferred Ratings and Related Required Capabilities for Voltages Above 1000 V
 - C37.09 IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis

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- C37.010 IEEE Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
- C37.011 IEEE Guide for the Application of Transient Recovery Voltage for AC High-Voltage Circuit Breakers
- C37.11 IEEE Standard Requirements for Electrical Control for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
- C37.20.2 IEEE Standard for Metal-Clad Switchgear
- C37.55 Conformance Testing Procedure of Metal-Clad Switchgear
- C57.10 Requirements for Instrument Transformers
- C57.13 Requirements for Instrument Transformers
- 47 Guide for Surge Withstand Capability Tests
- 2.1.2. National Electrical Manufacturer's Association (NEMA)
 - CC1 Electrical Power Connectors
 - SG2 High Voltage Fuses
 - SG4 AC High-Voltage Circuit Breakers
 - SG5 Power Switchgear Assemblies
 - SG6 Power Switching Equipment
- 2.1.3. National Electric Code (NEC) / National Fire Protection Association (NFPA)
 - 70E Standard for Electrical Safety in the Workplace
- 2.1.4. American National Standards Institute (ANSI) C2, 2012 National Electric Safety Code (NEC) Part 1 Rules for the Installation and Maintenance of Electric Supply Stations and Equipment
 - Section 18 Switchgear and Metal Enclosed Bus
- 2.1.5. International Building Code – 2009
- 2.1.6. International Electrotechnical Commission (IEC)
 - IEC 61850 Substation Automation
- 2.1.7. U.S. Department of Defense – Military Specifications
 - Mil-1-46058C Insulating Compound, Electrical (For Coating Printed Circuit Assemblies)
- 2.1.8. IPC
 - IPC-CC-830 Qualification and Performance of Electrical Insulating Compound for Printed Wiring Assemblies
- 2.1.9. Underwriters Laboratories (UL)
 - UL 746E Polymeric Materials - Industrial Laminates, Filament Wound Tubing, Vulcanized Fibre, and Materials Used In Printed-Wiring Boards
- 2.1.10. International Engineering Consortium (IEC)

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IEC 60664-3 Insulation Coordination for Equipment within Low-Voltage Systems - Part 3:
Use of Coating, Potting or Moulding for Protection Against Pollution

2.2. Deviations And Non-Conformance Requirements

2.2.1. Deviations from this specification or changes in materials or design after the Purchase Order has been placed must be approved by the GPA Engineering Department and acknowledged by a Purchase Order Amendment.

2.2.2. Units received with deviations or non-conformances which are not acknowledged as specified in Sub-Paragraph 2.2.1 are subject to rejection. The Supplier is responsible for any corrective action including but not limited to materials, labor and transportation necessary to dispose of, or make the units conform to the specification.

2.2.3. Notification of defects discovered before or after installation that are believed to be inherent to manufacturing problems or workmanship shall be made and forwarded to the Supplier. The description of the item, documentation of the problem and the described information, disposition and/or follow-up (as appropriate) that GPA expects from the Supplier will be specified. The Supplier's response shall be made within thirty (30) days unless an extension is acknowledged and approved in writing by the GPA Manager of Engineering.

2.2.4. GPA shall be allowed two (2) weeks to review and approve drawings without affecting the shipping date. Delays in delivery due to drawings which are not approved during this review period are the responsibility of the Supplier.

2.3. Warranty

2.3.1. The Supplier shall warrant the satisfactory and successful operation of the apparatus furnished under this specification at the rating, under the conditions, and for the service specified for a period of not less than one (1) year. The Supplier shall further warrant the apparatus against defects of design, material and workmanship.

3.0 SUBMITTALS

3.1. Equipment outline drawings shall be submitted for approval within 30 days after Notice to Proceed. The remaining Shop Drawings shall be submitted within 60 days after Notice to Proceed. GPA will provide the successful bidder samples for three-line and DC Schematics and preferred format for inter-connection diagrams as a guide.

3.2. Shop Drawings and data shall include the following:

- a. General arrangement, floor plan, elevations and sections, anchor bolt details, overall dimensions and weights.
- b. Interior structural drawings, elevations and sections of main bus, sparing bus, breakers and potential transformers.
- c. A complete set of ac and dc schematic diagrams, one for each piece of equipment, including, but not necessarily limited to the following:
 - (1) Protection and controls
 - (2) Breaker controls
 - (3) Auxiliary equipment controls
- d. Current transformer data, including excitation and ratio correction factor curves and mechanical and thermal short-term ratings.
- e. Nameplate data.

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- f. Wiring diagrams with terminal block and device connections for each panel and cubicle. Tabular format is not acceptable.
 - g. Interconnection diagrams.
 - h. Potential transformer data.
 - i. Notes and symbols.
 - j. Bill of material.
 - k. Three-line diagram.
 - l. One-line diagram.
 - m. Panel layout drawing.
 - n. Other drawings, diagrams, and instructions required for installation, operation and maintenance of the equipment.
- 3.3. Instructions for installation shall be submitted within 90 days after Notice to Proceed.
- 3.4. Operations and maintenance manuals with a section on troubleshooting shall be submitted 30 days prior to shipment.
- 3.5. Number of Copies
- a. Submit five (5) copies of each shop drawing, pre-printed manufacturers' data, brochures and suppliers' information for review and approval.
 - b. After approval and manufacturing of equipment, submit one (1) reproducible transparency and five (5) prints of each shop drawing which has been specifically prepared for the Work. Indicate on the drawings that the drawings reflect the as-built condition of the equipment.
 - c. Submit two (2) paper copies and two (2) electronic copies of operations and maintenance manuals with a section on trouble shooting and instructions for installation. The electronic copies shall be in Portable Document Format (PDF) files in CD format.
 - d. Submit one (1) copy of the shop drawings in AUTOCAD 2005 format on a CD.

4.0 QUALIFICATIONS

- 4.1. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of ten (10) years. An acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement with the bid submittal.
- 4.2. For all equipment specified herein, the manufacturer shall have a quality system that is ISO 9001 certified.

5.0 QUALITY ASSURANCE

- 5.1. The manufacturer shall have a formal Quality Assurance Program. The manufacturer's Quality Assurance Manual shall consist of systematic procedures that provide confidence that the work is in accordance with the manufacture's standard design, codes and standards referenced above, and these specifications for controlling activities affecting quality, such as welding, heat treating, and nondestructive examination. Formal training of individuals

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performing the work shall be an element of the Quality Assurance Program. Inspections and audits shall be conducted to insure that the Quality Assurance Program is being followed.

- 5.1.1. The manufacturer's Quality Assurance Manual shall be available at GPA's request and shall include descriptive information and details of the program, including program organization, documentation requirements, and quality control procedures.
- 5.1.2. The Quality Assurance Program shall include testing procedures, acceptance criteria, repair methods and the quality control requirements of these specifications.

5.2. Factory Tests

5.2.1. General

Not less than 30 days prior to factory tests, a factory test plan shall be submitted to the Owner for approval. Each item of electrical equipment and similar equipment supplied as spare parts, shall be given the manufacturer's routine factory tests and also other tests as specified, to ensure successful operation of parts of the assemblies. The factory test equipment and the test methods used shall conform to the applicable requirements of ANSI, IEEE and NEMA standards. Five (5) certified copies of the reports of production tests, including complete test data shall be submitted to the Owner. Factory tests will be witnessed by two GPA representatives. Supplier shall cover the cost of airfare, rooms, meals and car rental for the GPA representatives to witness the FAT testing.

5.2.2. Assembly Tests

Units of the switchgear shall be assembled at the factory and checked for alignment and fit. Each circuit breaker to be supplied with the switchgear assembly shall be installed in the assigned unit after the switchgear has been fully assembled. Checks shall include correct operation of shutters, interlocks, auxiliary contacts, racking mechanisms and for ease of installation and withdrawal of circuit breakers. Wiring shall be given point-to-point circuit continuity tests and shall be subjected to dielectric tests in accordance with requirements of ANSI Standard C37.20. The control switches shall be checked for proper contact operation. Device marking, nameplate markings, conductor identification and the scale of meters and instruments shall be checked.

5.2.3. Functional Tests


Current and potential tests shall be made on relays, instruments, meters and transducers for proper operation, direction and calibration. Operational tests shall be performed to verify the functional controls.

5.3. Factory Test Reports

Four (4) copies of certified test results shall be provided to the Owner within 30 days after performance of factory tests.

6.0 RATING

6.1. Description

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- 6.1.1. The switchgear shall be designed to be operated on a 15kV maximum rated voltage system and shall be suitable for operation on a solidly-grounded system rated 13.8 kV, 3-phase, 4-wire, 60Hz. The main bus shall be rated for 2,000 Amperes, continuous. Basic insulation level shall be 110 kV.
- 6.1.2. Equipment and materials shall be the products of manufacturers regularly engaged in the production of such equipment and materials.
- 6.1.3. The switchgear arrangement and dimensions shall be as specified in the design drawings.

6.2. Circuit Breakers

- 6.2.1. Unless otherwise specified or approved by GPA Engineering Department, all circuit breakers shall be GE PowerVac® circuit breakers.
- 6.2.2. The 15 kV circuit breakers shall have vacuum interrupters, and be 3-pole, single throw, trip free, draw-out type, rated on the symmetrical current basis. Each breaker shall have its characteristics based on a 15 second close-open duty cycle, and shall be capable of interrupting its rating in 5 cycles or less from the time the trip coil is energized until the arc is extinguished.
- 6.2.3. The circuit breaker closing shall be operated by a stored energy mechanism, which is normally charged by an electric motor, but which can also be charged by a manual handle for emergency manual closing or test. The power supply for the stored energy mechanism shall be 125 VDC.
- 6.2.4. The circuit breaker control voltage shall be 125 VDC. GPA will provide the 125 VDC station control power.
- 6.2.5. Each circuit breaker shall be designed specifically for installation in the breaker compartment, and breakers of like ratings shall be completely interchangeable. Circuit breakers of 1200A ratings shall not be interchangeable in a 2000A compartment. Each breaker shall be self-contained, equipped with self-coupling primary and secondary disconnect contacts, and with either fixed and swivel casters or fixed casters and a fifth wheel accessory, or a maintenance and handling device to permit easy mobility. Provisions shall be made and accessory materials and equipment furnished to permit complete disconnection of the breaker from the line and bus and testing of the breaker within the switchgear compartment. Breakers shall be mechanically interlocked to ensure that the breaker is tripped before being withdrawn from or inserted into the connected position.
- 6.2.6. The breakers shall have the following features:
 - a. Sturdy, self-aligning, silver-plated, primary disconnect contacts with high contact pressure. The circuit breaker element, primary disconnect shall be an integral part of the element.
 - b. Auxiliary switch contacts connected to the mechanism of each breaker shall be provided. A minimum of 10 "a" and 10 "b" contacts for the Owner's use shall be supplied and shall be wired to terminal blocks. Contacts shall be field changeable from "a" to "b" and vice versa.
 - c. An easy-to-read position indicator located on the front of the equipment which can be read without opening the compartment door.

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- d. A manual means for tripping.
 - e. Trip free and non-pumping operation.
 - f. An operations counter which can be read without opening the compartment door.
- 6.2.7. The circuit breakers shall meet their ratings as listed in ANSI C37.06. Principal breaker ratings shall be as follows:
- a. Rated maximum voltage, kV 15
 - b. Withstand test voltages –
 - Low frequency RMS, kV 36
 - Impulse crest, kV 95
 - c. Rated continuous current, Amperes:
 - Feeder 1,200
 - Main 2,000
 - Bus Tie 2,000
 - d. Rated short-circuit current at rated maximum voltage, symmetrical Amperes, RMS 18,000
 - e. Maximum symmetrical interrupting capability, Amperes RMS 23,000
 - f. Rated Short Time Current: Three second Amperes 23,000

6.3. Enclosure

- 6.3.1. The switchgear assembly shall consist of metal-clad, free-standing, vertical, deadfront steel structures containing circuit breaker compartments and circuit breakers, primary bus system, ground bus system, auxiliary compartments and transformers, protection and control devices, control bus, and connection provisions for primary, ground and control circuits. Devices shall be arranged as shown on the contract drawings. The basic structure will be of modular construction and fabricated mainly of painted hot-dipped galvanized steel. The switchgear enclosure will be double wall construction with an air gap between sheets, so that in the event of a fault the second layer will be insulated by the air gap. The original vendor shall be the manufacturer of the enclosure and the final assembler.
- 6.3.2. The switchgear shall have a suitable framework of structural steel to provide self-supporting rigid and stable structures. Channel base members shall be provided as part of the frames for proper alignment. The panel and structure shall be sufficiently rigid to support the equipment without vibration and shall be sized as shown on the Contact Drawings. Each shipping group shall be provided with a welded base frame, so when assembled in the field it provides a completed structural metal-clad switchgear line-up assembly.
- 6.3.3. The panels and enclosure shall consist of selected sheets of smooth sheet steel. The panels shall be all the same size for front, rear and top alignment. Sheet steel shall not be less than No. 11 US Standard Gauge A-60 galvanneal steel, forming structural shapes or having bent angle or channel edges, with corner seams welded and ground smooth. Stiffeners shall be provided as required. The

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exposed exterior surfaces shall not be drilled or welded for attaching wires or devices if holes or fastenings will be visible after installation. Vertical wiring trough shall be provided on both sides of panels. Doors to each enclosure shall be the same material and thickness as the housing sheets. Doors shall be braced or constructed so as to hang true and prevent warping. Doors shall have a 1 inch allowance from the floor. Hinges shall be the concealed, loose-pin type which will permit the panels or doors to swing out not less than 105°. Doors shall be provided with 3-point latches. Ventilated openings shall be grill or louver type and provided with corrosion-resistant screens to prevent entrance of insects and rodents. Lights shall be provided within each enclosure.

- 6.3.4. The switchgear will be constructed with two (2) circuit breaker compartments stacked in a single vertical section with an indoor frame size of 36 inches wide x 95 inches high x 85 inches deep.
- 6.3.5. The enclosure shall be provided with 304L stainless steel ground pads with 304L stainless steel 1/2" - 13 UNC, 7/16" deep threaded nuts welded to the ground pads. The ground pad shall be welded to the walls and shall be free of paint.

6.4. Buses

6.4.1. Main Bus

The main bus shall be copper, rated 2,000 Amperes, silver-plated at joints and tap points, installed in separate compartment from other wiring by a minimum 11 gauge steel barrier which fully encloses the bus, and insulated its entire length with a high dielectric strength, flame-retarding, self-extinguishing, moisture resistant epoxy coating applied using a fluidized bed process. Use of extruded sleeves or heat shrink insulation is not acceptable. Suitable insulation covers shall be provided for bus joints. The bus supports between units shall be cycloaliphatic epoxy resin or wet process porcelain insulators for 15kV class. Use of glass-filled polyester, dry process porcelain, ceramic or non-cycloaliphatic epoxy formulations for bus supports is not acceptable. All bus supports must have the same BIL rating as the switchgear. Bracing shall be provided as required for the bus to withstand short circuit current equal to the momentary rating of the breakers furnished with the switchgear. The main bus shall comply with ANSI/IEEE temperature rise requirement.

6.4.2. High Voltage Connections

High voltage connections between the main buses, and circuit breaker disconnecting devices, current transformers, and potheads shall be furnished with material installed. Connections shall be made of copper bar insulated between terminals with insulation comparable to that required for the main bus bars. The cross-section of bars and joints shall be uniform and smooth to permit a flow of current equal to the full load rating of the breaker without excessive temperature rise. Joints shall be silver-plated and bolted. Joints shall be relieved of voltage stress by metallic gauze, or other suitable conducting material, and insulated with tape and glyptal to provide insulation levels equal to or better than those of the main insulated buses. High voltage connections between the main bus or breaker load terminals and fixed studs of potential transformer assemblies shall be made with high voltage cable having insulation coordinated with basic impulse levels required for the switchgear. Supports,



bushings, terminal lugs and joint insulation shall be furnished as required, and the leads installed to form a complete installation.

6.4.3. Ground Bus

Copper ground bus shall be 1/4-inch by 2-inches solidly connected to each switchgear unit and extended into the power cable entrance compartment of each unit. Ground bus shall be equipped with a clamp connector for #4/0 AWG – 500 kcmil copper cable. Provisions for external ground connections shall be provided at each end of the bus. Materials for interconnecting the ground bus on adjacent shipping groups shall be provided, as required. Bars of the various sections shall be bolted together to form an integral ground for the entire switchgear. At least three (3) studs shall be provided on the bar for connection of the external station ground.

6.4.4. Access

Removable panels shall be provided for access to the bus compartment.

6.5. Instrument Transformers

6.5.1. Voltage transformers shall be rated for 110 kV BIL with ANSI accuracy classification of 0.3 at burdens W, X, Y and Z. Potential transformers shall be dry-type draw-out or tilt-out mounted and equipped with high interrupting capacity current limiting fuses. The ratio shall be 70:1.

6.5.2. Current transformers shall be the toroidal type, suitable for metering or relaying as required. Metering current transformers shall have an accuracy rating equal to or better than 0.3B-0.1, 0.3B-0.2, 0.3B-0.5, 0.3B-1 and 0.3B-2. Multi-ratio current transformer for relaying and metering shall be of C400 relaying accuracy.

6.6. Surge Arresters

6.6.1. Surge arresters shall be station class, metal-oxide-varistor (MOV), mounted in the switchgear enclosure and connected to each circuit conductor on the line side of the associated circuit breaker. The arresters shall have a nominal 12 kVrms rating and a MCOV 10.2kV rms rating.

6.6.2. The following characteristics are typical of these arresters:

40 kV maximum crest voltage for a 10 kA impulse, which results in a discharge voltage cresting in 0.5 microseconds. The maximum discharge voltage (crest kV) at indicated impulse currents of 8x20 microseconds:

- 30 kV at 1.5 kA
- 32 kV at 5.0 kA
- 35 kV at 10.0 kA
- 40 kV at 20.0 kA

6.7. Wiring and Accessories

6.7.1. The metal-clad switchgear shall be completely wired at the factory, ready for installation and connection by others. Inter-panel wiring required between shipping groups shall be brought to terminal blocks on adjacent panels necessitating only on-site reconnections of factory-supplied jumpers. Terminal blocks and jumper cables shall be properly identified for assembly. Unused terminals on relays and auxiliary contacts shall be brought to conveniently



located terminal blocks. Feeder and main transformer power cables and all control and meter connections will enter from the bottom. The incoming cables for the main breaker will consist of three (3) 750 kcmil cables per phase. The manufacturer shall ensure that sufficient vertical and horizontal clearances are provided for training and terminating these cables in the cable compartment without requiring excessive bending or the use of special adapter plates furnished by the cable installer. Rubber insulators shall be provided at the terminations of power cables. In addition, bracket supports for the cables shall be provided.

- 6.7.2. Unless otherwise specified, secondary and control wiring or connections shall be made with a minimum wire size of No. 12 AWG stranded, tinned copper switchboard wire, NEC type SIS, and rated for 600 Volts. Minimum wire size for CT wiring shall be No. 10 AWG. Insulation jacket shall be gray in color. Splices will not be permitted. Wires shall run in conduits, raceways or trays. Suitable, extra flexible wiring shall be provided over door hinges or other locations where leads may be subjected to flexing.
- 6.7.3. Ring-tongue terminals shall be used for secondary wiring. Spade, slotted spade, flanged spade, and hook terminals are not acceptable. The strength of the terminals shall be such that the terminals will not break during vibration of the equipment in which the terminals are installed. Ring-tongue terminals shall be Thomas & Betts Stakon.
- 6.7.4. Terminals shall have insulated ferrules. To assure positive electrical connections, and to avoid damage to the ferrule, it is mandatory that the crimping tool be used in accordance with manufacturer's instructions, and that the proper terminal and crimping tool be used for each wire size. Crimps shall be made with the crimp indentation opposite to the connector seam.
- 6.7.5. Miscellaneous accessories, such as resistors, fuses, fuse blocks, and capacitors not shown on the Contract Drawings but required for proper operation of the switchgear shall be furnished.
- 6.7.6. Terminal blocks for current transformer leads shall be 6-point and shall be provided with short-circuiting devices to permit removing or testing of wiring without opening the current transformer circuits. Leads from multi-ratio current transformers shall be brought out to the terminal blocks. Terminal blocks shall be Marathon Series 1600, or as approved by the Owner. Terminal blocks shall be provided for all wires leaving switchboard panels and shall have marking strips for Owner's 6-digit number identification system. Terminal blocks shall have washer head binding screw terminals, barriers between terminals, high flame retarding properties, mechanical toughness and high electrical strength. At least 20% spare terminals shall be provided on each panel. Each wire shall be identified at both ends with a permanently machine-embossed black identification on white plastic, heat-shrinkable, tubular slip-on marker.
- 6.7.7. Terminal blocks for grouping of SCADA wiring shall be thermo-plastic insulation type, rated 300 Volts, with test socket screws, knife switch contacts and shall be mounted on rails. The marking system shall be Dekafix consecutive vertical numbering system and Peso white blanks for Owner's marking. Terminal blocks shall be furnished complete with mounting rails, end brackets, end plates, partitions and test equipment. Wiring to the SCADA terminal blocks shall be made with No. 18 wire minimum.

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- 6.7.8. Wiring for transducer output circuits shall be No. 18, twisted pair shielded conductor. Meter pulse circuit wiring shall be No. 18, 3-conductor shielded cable.
- 6.7.9. Wiring Format
- 6.7.10. All terminals shall be numbered, and the numbers shall correspond to the numbers on the wiring diagram.
- 6.7.11. All wires shall be identified at their termination points with the opposite end designation identification by labeled plastic sleeves or equal. Identification shall correspond to the lettered device, numbered terminal format of the wiring diagrams.
- 6.7.12. System Phase Rotation. The system phase rotation for the island-wide system is GPA C-B-A or NEMA 1-2-3 and all equipment purchased under this contract shall be wired and connected NEMA 1-2-3. All phase markings shall be NEMA 1-2-3. Instrument and relay arrangement shall be 1-2-3 left to right with neutral relays underneath phase grouping. GPA will make the external connections of the incoming and outgoing lines such that GPA C-B-A is connected to NEMA 1-2-3. Phase markings C-B-A shall be reserved for GPA's use.


6.8. Nameplates

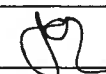
Nameplates shall be furnished and installed for panels, switches, relays and devices, including those internally mounted, and shall be of laminated plastic or formica with white letters on black background and shall be sized for easy reading. Nameplates shall be securely fastened to the panel with stainless steel panhead screws to prevent detachment and loss. Nameplate data shall be submitted for Owner's approval. Designations shall be machine engraved in upper case letters and shall be centered on the nameplates. Each metal-clad switchgear unit shall be provided with a circuit identifying nameplate, letters approximately 3/4-inch high, and mounted at the top of the switchgear.

6.9. Instrument and Control Switches

- 6.9.1. Instrument and control switches shall be the rotary, cam-operated type with silver contacts and a positive means for maintaining contact position. Contact requirements shall be as shown on the Contract Drawings or as specified. Switch contacts shall be totally enclosed to prevent the accumulation of dust, grit, and foreign matter on the contact surface. The switches shall be GE type SB-1, Westinghouse type W-2, Electroschwitch Series 24, or equal, and shall have operating handles as follows:
 - a. Large red pistol-grip handles for power circuit breaker control switches.
 - b. Black oval handles with arrow for transfer, and auxiliary switches.
- 6.9.2. Control switches for circuit breakers shall be momentary contact, spring-return type for both trip and close operation. Operation indicators showing the last operation shall be provided.
- 6.9.3. The switches shall have escutcheon plates marked as specified with standard circuit designation, except where otherwise specified, and shall be as follows:
 - a. Escutcheon plate for circuit breaker control switches, 52CS, shall

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read "TRIP-CLOSE".

- b. Escutcheon plate for supervisory selector switch, 43R/L shall be "REMOTE-LOCAL".
- c. Escutcheon plate for recloser cutout switch, 79CO, shall be "CUTIN-CUTOUT".

6.10. Indicating Lamps

Schweitzer SEL-2652 Trip Coil Monitors with an external red LED shall be mounted on the switchgear, suitable for operation on 125 VDC or 120 VAC, as required for the specific circuit (SEL Part Number 2652A1XX-Red).

6.11. Meter

Each feeder position shall have a multi-function, poly-phase, switchboard type (draw-out case) meter with electronic registers, displays, and input and output pulse contacts. The meter shall be a Schweitzer SEL-735 power quality and revenue meter, 0.2% accuracy, Form 9, Current Class CL 10/20, load profiling, with 3 element Watt and Var inputs. The display shall include digital kV, kA, kWh, kVarh, kW-demand, kVar-demand, and power factor. The meter shall provide kWh and kVarh pulse outputs for interface to a SCADA system (SEL Part Number 0735VX10944CXXXXXX2610XX).

6.12. Protective Relays

6.12.1. General

Protective relays shall be semi-flush mounting-type with test facilities that automatically short current circuits and open potential and trip circuits when the relay is withdrawn from the case.

If the relay is not equipped with built-in test facilities, external test blocks shall be furnished. Output contacts shall be rated for tripping or closing of the circuit breaker. Output contacts shall be dry type. SCR outputs are not acceptable. Relays shall have targets to indicate which elements caused the operation.

Control voltage shall be 125 VDC.

Relays shall pass the ANSI surge withstand tests.

All printed circuit boards are to be covered with a Conformal Coating meeting the specification indicated in Section 2.1 and operate within a temperature range of -40°C to +75°C (-40°F to +160°F) and a relative humidity range between 0% and 100%.

Communication protocols shall include DNP3 and TCP/IP, fully compliant with IEC 61850.

6.12.2. 13.8 kV Feeder Relays – Device 50/51/79/50G/51G/50PAF/50NAF

- a. Overcurrent relays shall be selectable curve type with a time overcurrent range of 0.5 to 15 Amperes and an instantaneous range of 0.5 to 100 Amperes.
- b. Overcurrent ground relays shall be selectable curve type with a time overcurrent range of 0.5 to 15 Amperes and an instantaneous range of 10

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to 0.5 to 100 Amperes.

- c. Feeder reclosing relays shall be multi-shot, 4 adjustable reclosers with facilities for blocking of instantaneous overcurrent relays after the first trip.
- d. Arc-flash detection shall be accomplished with fiber-optic, arc-flash light sensors strategically placed within the metal-clad switchgear, connected to the relay to send a fast trip signal to the circuit breaker.
- e. All of the above functions shall be provided by the Schweitzer solid-state relay type SEL-751A (Part number 751A11AB0X74850000) with a SEL Fiber Optic cable (Part number C80430XXXXX). SEL C273A cable for connection to SEL-2032 integration relay shall also be provided. Spare relay contacts shall be wired to terminal blocks.

6.12.3. 13.8-kV Feeder Backup Relays – Device 50/51/50G/51G/50PAF/50NAF

- a. Overcurrent relays shall be selectable curve type with a time overcurrent range of 0.5 to 15 Amperes and an instantaneous range of 10 to 80 Amperes.
- b. Overcurrent ground relays shall be selectable curve type with a time overcurrent range of 0.5 to 15 Amperes and an instantaneous range of 0.5 to 100 Amperes.
- c. Arc-flash detection shall be accomplished with fiber-optic, arc-flash light sensors strategically placed within the metal-clad switchgear, connected to the relay to send a fast trip signal to the circuit breaker.
- d. All of the above functions shall be provided by the Schweitzer solid-state relay type SEL-751A (Part number 751A61ACA1A74850230) with a SEL c804 Fiber Optic Point Sensors (Part number C80430XXXXX). SEL C273A cable for connection to SEL-2032 integration relay shall also be provided. Spare relay contacts shall be wired to terminal blocks.

6.12.4. 13.8 kV Bus Relays – Device 51B, 51GB

- a. Each bus section shall be protected by overcurrent relays with CT inputs connected to selectively trip the faulted bus section. The relays shall have selectable type characteristics with a time overcurrent range of 0.25 to 16 Amperes. The overcurrent relays shall be SEL 351-6.
- b. Each bus section shall also be provided with a ground overcurrent relay having selectable type characteristics with a time current range of 0.25 to 16 Amperes. The ground overcurrent relays shall be SEL 351-6.

6.12.5. Synchronism Check Relays – Device 25

Each 13.8 kV feeder connected to a power plant shall be provided with a synchronism check relay with provisions for dead line and/or dead bus checks. The synchronism check relays shall be Basler or SEL.

6.12.6. Auxiliary Relays

- a. Auxiliary relays shall be multi-contact type, with shunting or series

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resistors if necessary, suitable for operation on 125 VDC, as indicated on the Contract Drawings or required for the circuits. Panel-mounted relays shall be semi-flush window type. Surface-mounted relays on back of panels or on side walls shall be front-connected type with molded or window-type covers. Auxiliary relays shall be GE type HGA and HFA.

b. Spare contacts shall be wired to terminal blocks

6.13. Display

Each SEL meter and relay shall have a built in LCD to display analog metered values and targets, Trip Circuit Monitor

The trip circuit monitor shall be SEL-2652. See section 6.10.

6.14. Test Switches and Devices

Current and potential test switches and test plugs shall be provided with the test switches semi-flush mounted on the switchboard. Test switches shall be connected to the appropriate circuits to permit checking and calibrating of meters or instruments against portable standards connected in series with the instruments undergoing tests, under service conditions, or by means of a phantom load. Switches and plugs shall permit "in-service testing" as well as calibration and checking of instruments, meters and relays from separate sources of power. Provisions shall also be included for connecting current measuring devices in series with the current circuits of the switches. Switch blades shall be separated by insulated barriers and each switch and handle shall be provided with a recessed section for inserting circuit identification cards. Switches shall automatically short circuit current transformer circuits so they cannot be opened inadvertently. Meter test switches shall be unit base, front-connected with current elements and potential elements and a solid cover. Current type switches shall be ABB type FT-1.

6.15. Painting

The switchgear enclosure shall be thoroughly cleaned of rust, welding scale and grease using a non-acidic and non-abrasive cleaner, and shall be treated to effect a bond between the metal and paint which will prevent the formation of rust under the paint. A zinc-oxide zinc-chromate anticorrosion priming coat shall be applied immediately after the bonding treatment. A final finish shall consist of not less than one coat for concealed surfaces and two coats for exterior surfaces. Final finish shall be light gray, ANSI Color No. 70. The interior shall be painted with 2 coats of white enamel. A computerized paint system shall be utilized to apply a uniform thickness and coverage of paint to all surfaces.

6.16. Control AC Power Supply

The 50 kVA single phase dry type transformer shall be provided in the switchgear. The switchgear shall have provisions for connecting these transformers to the bus. If required, a separate station service for the power plant will be provided by the power plant supplier.

7.0 CONSTRUCTION

7.1. Installation

Installation will be provided by others.

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7.2. Accessories and Spare Parts

Accessories, special tools and spare parts required for proper maintenance and testing of the equipment, circuit breakers and devices shall be provided with the switchgear and shall include the following:

Breaker test cabinet, to facilitate operation of a circuit breaker out of its cubicle for test purposes.

One trip coil for every four power circuit breakers provided.

Twenty spare fuses for each rating of fuse provided in switchgear.

Test jumper for testing the breaker when removed from the cubicle.

Blank nameplates of each size used.

Gallons of touchup paint in one quart cans.

Closing lever for manual operation.

Levering device for breaker positioning.

Set test plugs for relays and meters.

Turning dolly for handling breaker, if required.

Transport truck for handling breaker outside the cubicle, if required.

Crank for manually charging the stored energy closing mechanism.

Spare fuses for potential transformers.

1,200-Ampere grounding and test device with provisions for independently locking each access door with a padlock without remote control, if applicable.

Special tools required for proper maintenance, testing and inspection of the equipment.

Spare vacuum bottle, if applicable.

8.0 PACKING AND SHIPPING REQUIREMENTS

- 8.1. Because of severe transportation conditions, the Supplier shall pay particular attention to the proper packaging and bracing of the apparatus to assure its safe arrival.
- 8.2. The Supplier shall prepare all materials and equipment for shipment in such a manner as to protect from damage in transit. All small parts and unit components shall be separately boxed or bundled to prevent galling due to rubbing of one part against another. Each item, box or bundle shall be plainly and individually identifiable for content according to item number, GPA P.O. Number, and Supplier's Identifying Number.
- 8.3. Complete itemized Bill of Lading, which clearly identifies and inventories each assembly, sub-assembly, carton, package, envelope, etc., shall be furnished and enclosed with each item or items at the time of shipment.
- 8.4. The switchgear shall be shipped in crates containing not more than two units each.

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