



GUAM POWER AUTHORITY
HAGATNA, GUAM

PREPARED BY THE ENGINEERING DEPARTMENT

SPECIFICATION E-030

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REV. 4

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

TRANSMISSION & DISTRIBUTION SPECIFICATION

Specification No. E-030

FOR

34.5 KV SWITCHGEAR

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34.5 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 38kV 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:

- Line circuit breaker equipment
- Bus tie circuit breaker equipment
- Sparing bus with removable links and a tap section for the mobile substation
- Provisions for connection of a future line breaker to the main bus
- Transformer circuit breaker equipment
- Primary bus system
- Ground bus system
- Protective relaying equipment and devices
- Control and status 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:

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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
- 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 (NESC) 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

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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)

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.

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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, sparring 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
 - (4) Communications and Scada
 - d. Current transformer data, including excitation and ratio correction factor curves and mechanical and thermal short-term ratings.
 - e. Nameplate data.
 - f. Wiring diagrams with terminal block and device connections for each panel and cubicle. Tabular format is not acceptable.
 - g. Interconnection diagrams for panels and for external devices and field equipment.
 - h. Potential transformer data.
 - i. Notes and symbols.
 - j. Bill of materials and manufacturers catalog sheets clearly marked.
 - 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,

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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 2013 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 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

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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, NETA, 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 (2) GPA representatives for a minimum of three (3) days or days required to perform a comprehensive Factory Acceptance Testing. 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 injection tests shall be made on relays, instruments, meters and transducers for proper operation, direction, phasing, and calibration. Operational tests shall be performed to verify the functional controls of all devices and equipment.

5.3. Factory Test Reports

Five (5) 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


6.1.1. The switchgear shall be designed to be operated on a 38kV maximum rated voltage system and shall be suitable for operation on a solidly-grounded system rated 34.5 kV, 3-phase, 4-wire, 60Hz. The main bus shall be rated for 2,500 amperes-continuous for bulk power transfer substations and 2,000 amperes-continuous for regular/normal substations. Basic insulation level shall be 150 kV.

6.1.2. Equipment and materials shall be the products of manufacturers regularly engaged in the production of such equipment and materials.

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- 6.1.3. The switchgear arrangement and dimensions shall be as specified in the design drawings.
- 6.1.4. Switchgear manufacturer shall provide lifting mechanism for breakers and VT drawout.
- 6.1.5. The preferred manufacturer is “Myers Power Products Inc”.

6.2. Circuit Breakers

- 6.2.1. Unless otherwise specified or approved by GPA Engineering Department, all circuit breakers shall be “Siemens” circuit breakers.
- 6.2.2. The 34.5 kV circuit breakers shall have **vacuum interrupters, oil-less type, 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 testing. The power supply for the stored energy mechanism shall be 125 VDC.
- 6.2.4. The circuit breaker control voltage shall be **125 VDC** supplied by the substation 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 rating shall not be interchangeable in a 2000A compartment as well as a 2000A rating breaker shall not be interchangeable with a 2500A 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"

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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.
- 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** **38**
- b. **Withstand test voltages –**
 - Low frequency RMS, kV** **80**
 - Impulse crest, kV** **150**
- c. **Rated continuous current, Amperes:**
 - Bulk Power Transfer Station**
 - Line** **2,000**
 - Transformer** **2,000**
 - Bus Tie** **2,500**
 - Regular/Normal Substation**
 - Line** **2,000**
 - Transformer** **1,200**
 - Bus Tie** **2,500**
- d. **Rated short-circuit current at rated maximum voltage, symmetrical Amperes, RMS** **40,000**
- e. **Maximum symmetrical interrupting capability, Amperes RMS** **64,000**
- f. **Rated Short Time Current: Three second Amperes** **40,000**
- g. **Minimum number of trip coils per breaker** **2 each**

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

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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 Contract 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 galvanized 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 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 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

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The main bus shall be copper, rated 2,500 amperes for bulk power transfer substations and 2,000 amperes for regular/normal substations. The bus shall be 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 38kV 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 rated at a minimum equivalent of #4/0 AWG copper wire and 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

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least three (3) studs shall be provided on the bar for connection of the external station ground.

6.4.4. Sparring Bus

The sparring bus shall be same as the main bus.

6.4.5. 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 **200 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 epoxy construction and equipped with high interrupting capacity current limiting fuses. The voltage transformers shall be **dual-ratio rated at 20,125 primary voltage (L-G), 67.08/115 secondary voltage and 300/175:1 ratio**. One set of **3-phase** voltage transformers shall be provided for **each bus section** of the switchgear. If design drawings require synching voltage transformers, one (1) each VT shall be provided on line side of incoming lines and connected on Ø1 GPA C.

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 **C800** relaying accuracy or as determined by CT saturation calculations. **Four (4)** current transformers shall be provided for **each breaker** and placed **2 on each side** of the breaker. Current transformer **polarity shall be away** from breaker contacts and **secondary currents shall be 5 amperes**.

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 **30 kVrms** rating, **MCOV of 24.4kV rms**, and meet or exceed **33 inches of leakage distance**.

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

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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 line breaker will consist of two (2) 1000 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, all **secondary and control wiring** or connections shall be made with a minimum wire size of **No. 12 AWG, CT wiring** shall be **No. 10 AWG**, and **SCADA wiring** shall be **No. 18 AWG**. Switchboard wire shall be stranded, tinned copper, NEC type SIS, and rated for 600 Volts. 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

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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.
- 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.

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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. Mimic Bus and Devices

Mimic bus shall be 3/8-inch in width and shall be anodized aluminum, approximately 1/16-inch thick, fastened to the panels with adhesive backing or blind metal fasteners. Mimic devices shall be made of the same materials as the bus, and shall indicate the required symbol. The Contractor shall obtain the colors for the mimic bus from the Owner.

Yellow	13.8 KV
Red	34.5 KV
Cyan	115 KV

6.10. Instrument and Control Switches

6.10.1. 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, Electros witch 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.

6.10.2. 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.

6.10.3. 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 read "TRIP-CLOSE".
- b. Escutcheon plate for supervisory selector switch, 43R/L shall be "REMOTE-LOCAL".

6.11. Indicating Lamps

Indicating lights shall be the manufacturer's standard transformer type units **125-volt DC** input utilizing low-voltage **LEDs with red color indicating breaker closed and LED off when breaker open**. Provide indicating lights that are capable of being re-lamped from the switchgear

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front. Indicating lights utilizing resistors in series with the lamps are not permitted, except in direct-current control circuits. For all breaker control switches and hand reset lockout relays, use Trip Coil Monitors in lieu of standard indicating lights.

6.12. Substation Metering

Power delivery measurement of each power transformer and 13.8 kV feeders shall be made via Schweitzer Engineering Laboratories' SEL-735 or latest device. The **SEL-735 power quality and revenue meter** shall have intermediate PQ and recording, 256 MB memory, Form 9, vertical panel mount, ANSI optical port, 125/250 VDC/VAC power supply, 125 VDC/VAC control input voltage, 2 inputs, 3 contact outputs, 2 EIA 232 ports, one 10/100 Base T Ethernet port, IRIG, current Class CL 10/20, 60 Hz frequency, DNP 3, LAN/WAN, MV90 Translation, Synchrophasor, ANSI labeling, Accelerator Quickset compatible, and conformal coating. **Provide meter part number for review and approval.**

6.13. 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 the checking and calibrating of meters, instruments or relays individually against portable standards connected in series with the instruments or relay undergoing tests, under service conditions or by means of a phantom load. The 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 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. Current test switches shall be ABB type FT-1.**

6.14. Trip Coil Monitor

The Trip Coil Monitor shall be Schweitzer Engineering Laboratories **SEL-2652** with an external red LED mounted on the switchgear. It shall be suitable for operation on 125 VDC or 120 VAC, as required for the specific circuit. The SEL-2652 shall have breaker status indicator function, **red LED color, 200 ms time delay**, and conformal coating. **Trip Coil Monitors shall be installed to monitor loss of DC for each circuit breaker and lock-out relay. Trip Coil Monitor alarm contacts will be wired to GPA SCADA RTU for TCM status.**

6.15. Protective Relays

6.15.1. General

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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.

6.15.2. Power Transformer Relays

a. Transformer Differential Relays – 87T

Primary transformer differential relays shall be a percentage differential type and shall have harmonic restraint. They shall be Schweitzer type **SEL-787 Primary Relay** or latest device. The SEL-787 transformer protection relay shall have two winding current differential or more based on drawing design. The relay shall have vertical chassis, front panel LCD display, 125 VDC/VAC power supply, 60 Hz, 125 VDC/VAC digital input, fast high-current interrupting digital output, EIA-232 port, 10/100 Base-T Ethernet, IRIG B, DNP3, IEC 61850, C37.118 Synchrophasor, Accelerator Quickset, 5 amp current winding inputs, and conformal coating. **Provide relay part number for review and approval.**

b. Transformer Time Overcurrent and Breaker Failure Relay – 51/51N/50BF

Backup transformer relay shall be Schweitzer type SEL-751 protection relay for overcurrent and breaker failure or latest device. The **SEL-751 Backup Relay** shall have standard overcurrent firmware, 125 VDC/VAC power supply, 60 Hz, 125 VDC/VAC digital input, fast high-current interrupting digital output, 4 pushbutton controls, EIA-232 port, 10/100 Base-T Ethernet, IRIG B, DNP3, IEC 61850, Accelerator Quickset, 3-phase AC voltage input, 3-phase AC current 5 amps input, neutral AC current 5 amp input, and conformal coating. **Provide relay**

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part number for review and approval.

6.15.3. Transmission Line Relays

- a. Transmission Line Differential, Line Distance, Residual Time Overcurrent, Direction Ground, and Breaker Failure – 87L/21/50/51/67/50BF

Primary transmission line relays shall be advanced line differential and distance protection. They shall be Schweitzer type **SEL-411L Primary Relay** or latest device. The SEL-411L relay shall have line differential, distance elements, traveling wave fault location, horizontal mount, 125 VDC/ VAC power supply, 60 Hz, 125 VDC/VAC digital input, high speed high current interrupting digital output, connectorized type, 300 V secondary voltage inputs, 5 amp current inputs, 1300 nm IEEE C37.94 Fiber communications for Channel 1 and Channel 2, EIA-232 port, 10/100 Base-T Ethernet, IRIG B, DNP3, IEC 61850, C37.118 Synchrophasor, Accelerator Quickset, and conformal coating. **Include 100’ fiber optic cables for connections to Channels 1 and 2. Provide relay part number for review and approval.**

- b. Transmission Line Differential, Line Distance, Residual Time Overcurrent, Direction Ground, and Breaker Failure – 87L/21/50/51/67/50BF

Backup transmission line relays shall be line differential and distance protection. They shall be Schweitzer type **SEL-311L Backup Relay** or latest device. The SEL-311L relay shall have line differential, distance elements, horizontal mount, 125 VDC/VAC power supply, 60 Hz, 125 VDC/VAC digital input, standard output, 150 VAC maximum wye connected voltage inputs, 5 amp current inputs, 1300 nm IEEE C37.94 Fiber communications for Channel X and Channel Y, EIA-232 port, 10/100 Base-T Ethernet, IRIG B, DNP3, IEC 61850, Accelerator Quickset, and conformal coating. **Include 100’ fiber optic cables for connections to Channels X and Y. Provide relay part number for review and approval.**

6.15.4. Bus Relays

- a. Bus Differential Relays and Breaker Failure– 87B/50BF

Primary and backup bus differential relays shall be a percentage differential type and shall have harmonic restraint. They shall be Schweitzer type **SEL-787 Primary and Backup Relays** or latest device. The SEL-787 transformer protection relay shall have four winding current differential. The relay shall have vertical chassis,

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front panel LCD display, 125 VDC/VAC power supply, 60 Hz, 125 VDC/VAC digital input, fast high-current interrupting digital output, EIA-232 port, 10/100 Base-T Ethernet, IRIG B, DNP3, IEC 61850, C37.118 Synchrophasor, Accelerator Quickset, 5 amp current winding inputs, and conformal coating. **Provide relay part number for review and approval.**

6.15.5. Bus Tie Relays

- a. Bus Tie Time Overcurrent and Breaker Failure Relay – 51/51N/50BF

Primary and backup bus tie relays shall be Schweitzer type SEL-751 protection relay for overcurrent and breaker failure or latest device. The **SEL-751 Primary and Backup Relays** shall have standard overcurrent firmware, 125 VDC/VAC power supply, 60 Hz, 125 VDC/VAC digital input, fast high-current interrupting digital output, 4 pushbutton controls, EIA-232 port, 10/100 Base-T Ethernet, IRIG B, DNP3, IEC 61850, Accelerator Quickset, 3-phase AC voltage input, 3-phase AC current 5 amps input, neutral AC current 5 amp input, and conformal coating. **Provide relay part number for review and approval.**

6.15.6. Zigzag Grounding Transformer Relays

- a. Zigzag Grounding Transformer Overcurrent and Breaker Failure Relay – 51/51N/50BF

Primary and backup zigzag grounding transformer relays shall be Schweitzer type SEL-751 protection relay for overcurrent and breaker failure or latest device. The **SEL-751 Primary and Backup Relays** shall have standard overcurrent firmware, 125 VDC/VAC power supply, 60 Hz, 125 VDC/VAC digital input, fast high-current interrupting digital output, 4 pushbutton controls, EIA-232 port, 10/100 Base-T Ethernet, IRIG B, DNP3, IEC 61850, Accelerator Quickset, 3-phase AC voltage input, 3-phase AC current 5 amps input, neutral AC current 5 amp input, and conformal coating. **Provide relay part number for review and approval.**


6.15.7. Lockout Relays

- a. Lockout Relays – 86

Lockout relays shall be electrical trip, hand-reset, 125 VDC auxiliary lockout relay type. Relays shall be multi-contact and shall be **Electroswitch Series 24**. **Spare contacts of 25%** shall be provided for all lockout relays.

6.16. Display

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Each meter and relay shall have a built in LCD to display analog metered values and targets.

6.17. Communication Processor

The communication processor shall be Schweitzer type SEL-3530 capable of communicating with different microprocessor based devices. The **SEL-3530** shall be horizontal mount, 125 VDC/VAC power supply, 60 Hz, 125 VDC/VAC digital inputs, standard outputs, 16 EIA-232 ports, 10/100 Base-T Ethernet, IRIG B, DNP3, IEC 61850, C37.118 Synchrophasor, Accelerator RTAC, and conformal coating. **Provide part number for review and approval.**

6.18. GPS Satellite Clock

To synchronize relays and other devices, a GPS satellite clock shall be provided. The GPS satellite clock shall be Schweitzer **SEL-2407** and have 125 VDC/VAC power supply, modulated/demodulated IRIG B BNC outputs, ± 100 ns average time accuracy, LED time display, and conformal coating. Include GPS antenna, 50 ohm resistor, and 75 feet of antenna cable. **Provide part number for review and approval.**

6.19. 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.

6.20. Power Supply

The switchgear power supply shall be **120/240 VAC or 120/208 VAC**, based on available station power, and **125 VDC** control power supply.

6.21. Space Heaters

6.21.1. **Equip each section of the switchgear assembly with externally energized space heaters** to provide approximately 4 watts per square foot of outer surface area and designed for operation at 120/240 VAC or 120/208 VAC. Locate heaters at the lowest portion of each space to be heated. Cover terminals. **Use thermostats to regulate the temperature.**

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7.0 CONSTRUCTION

7.1. Installation


Installation will be based on construction scope requirements.

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 be **turned over to GPA upon completion of the project**. Accessories and spare parts shall include the following:

- Ten switchboard indicating lamps or LEDs.
- One color cap for indicating lamps for each ten or less of each color and type used.
- Indicating lamp pullers.
- Color caps of each color for indicating lamps.
- Resistors and lamp sockets for indicating lamps.
- 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 control 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.
- Lifting truck for inserting and removing breaker and voltage transformer from the switchgear compartment.
- 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.

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

Spare vacuum bottles, if applicable.

7.3. Disconnect Switches (If Required)

7.3.1. **Disconnect switches (if required)** shall be provided as an integral part of the switchgear lineup as shown on the drawings.

7.3.2. Disconnect switches shall be rated for **38 kV, 2000A, 3-pole, no-load break, non-fused, manual operation**, and shall include a handle interlocked with operating mechanism, viewing window, and auxiliary contacts for future remote indication.

8.0 PACKING AND SHIPPING REQUIREMENTS

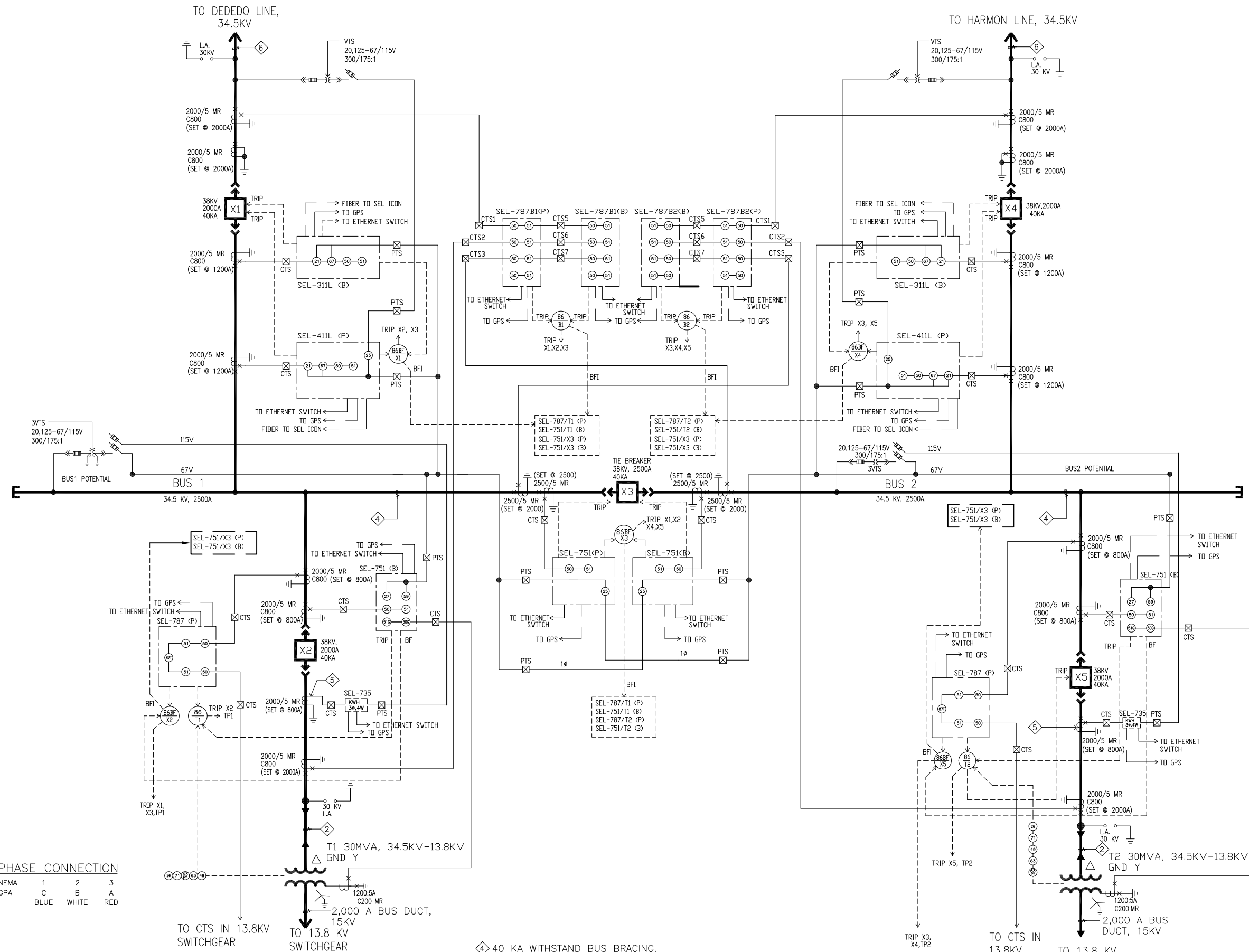
8.1. Because of severe transportation conditions, the Supplier shall pay particular attention to the proper packaging and bracing of the apparatus to assure its safe arrival.

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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PHASE CONNECTION

NEMA	1	2	3
GPA	C	B	A
	BLUE	WHITE	RED

NOTES:

- ① SPACE FOR FUTURE CIRCUIT BREAKER.
- ② 2 SETS, 156mm (6"), 3-600 KCMIL ALUMINUM, 35KV, 133% INSULATION XLP 1#4/0 GROUND. 1-156mm(6") SPARE.
- ③ 1-156mm(6"), 3-500 KCMIL ALUM, 35KV, 133% INSULATION XLP, 1-156mm(6") SPARE, 1#4/0 GND.



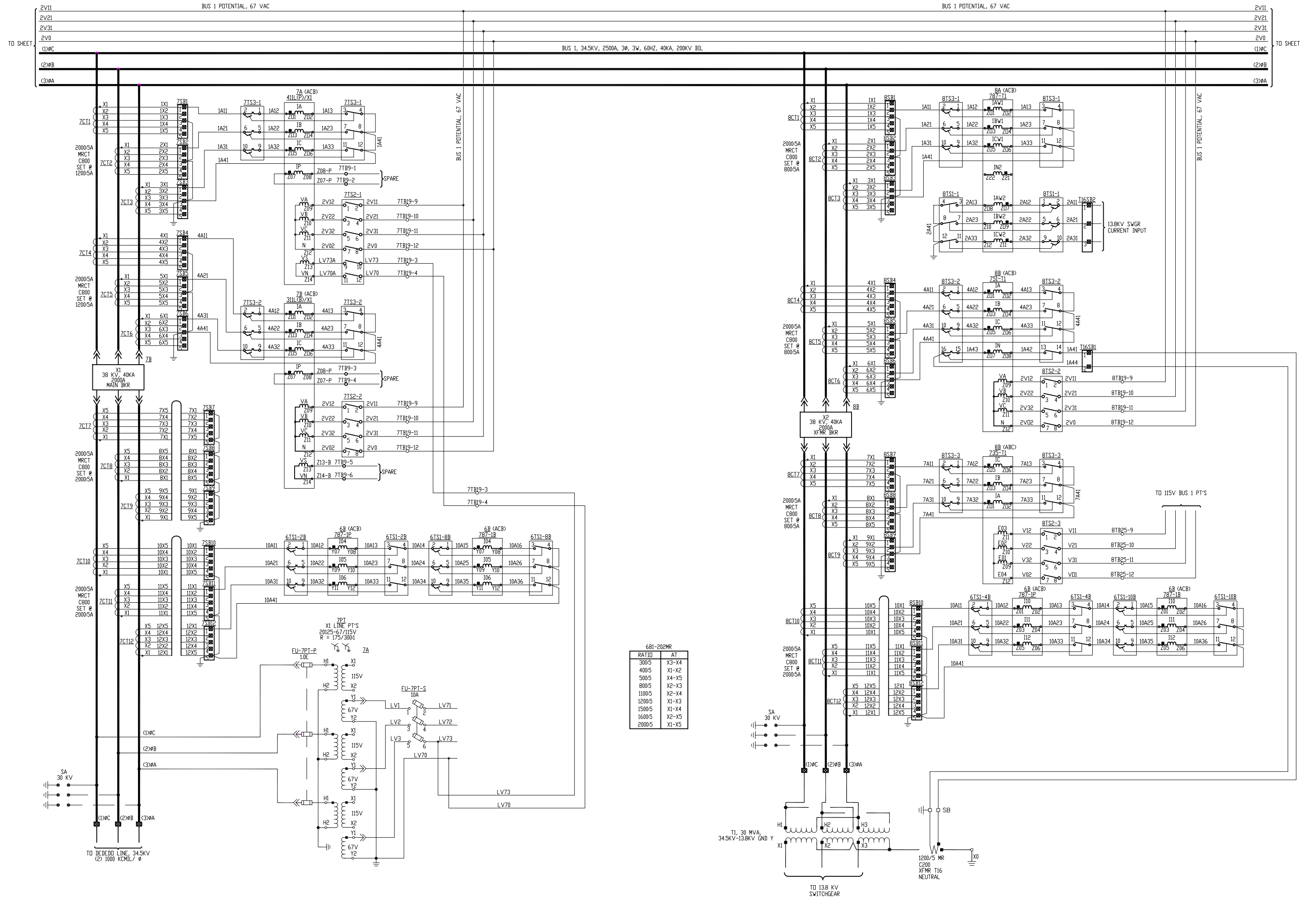
NEW SUBSTATION 34.5KV ONE LINE DIAGRAM

NOT TO SCALE

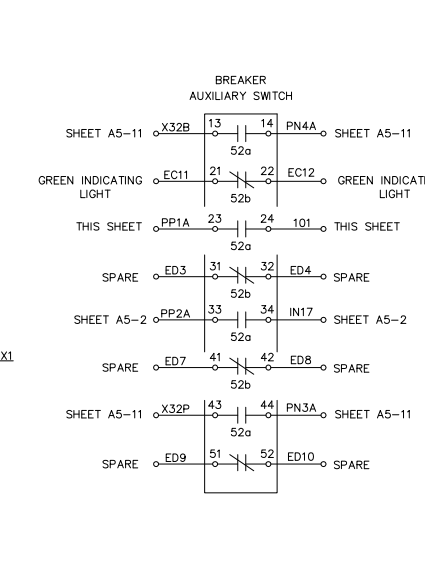
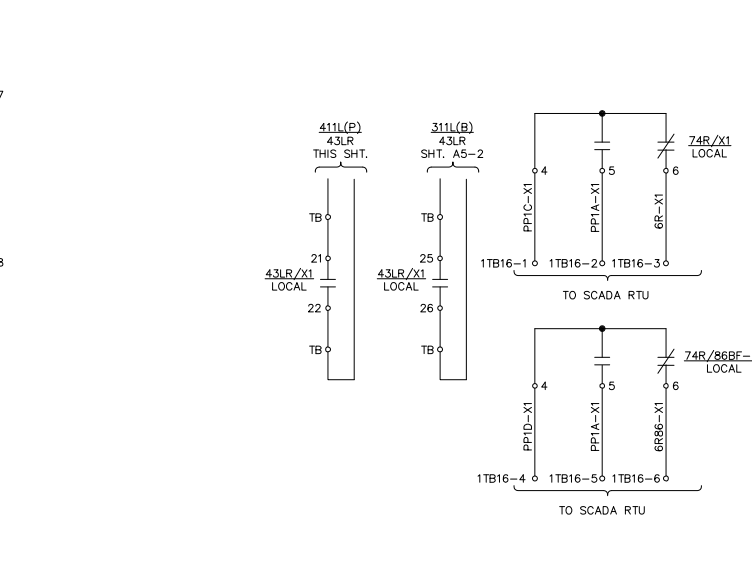
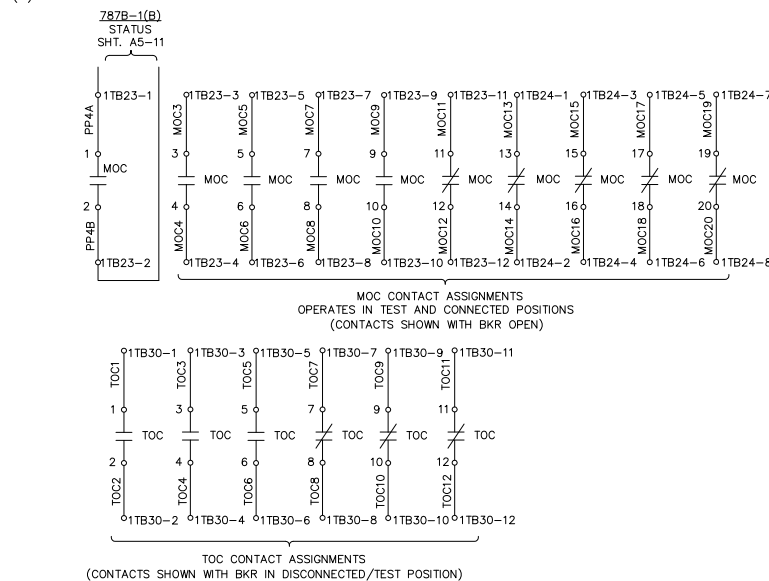
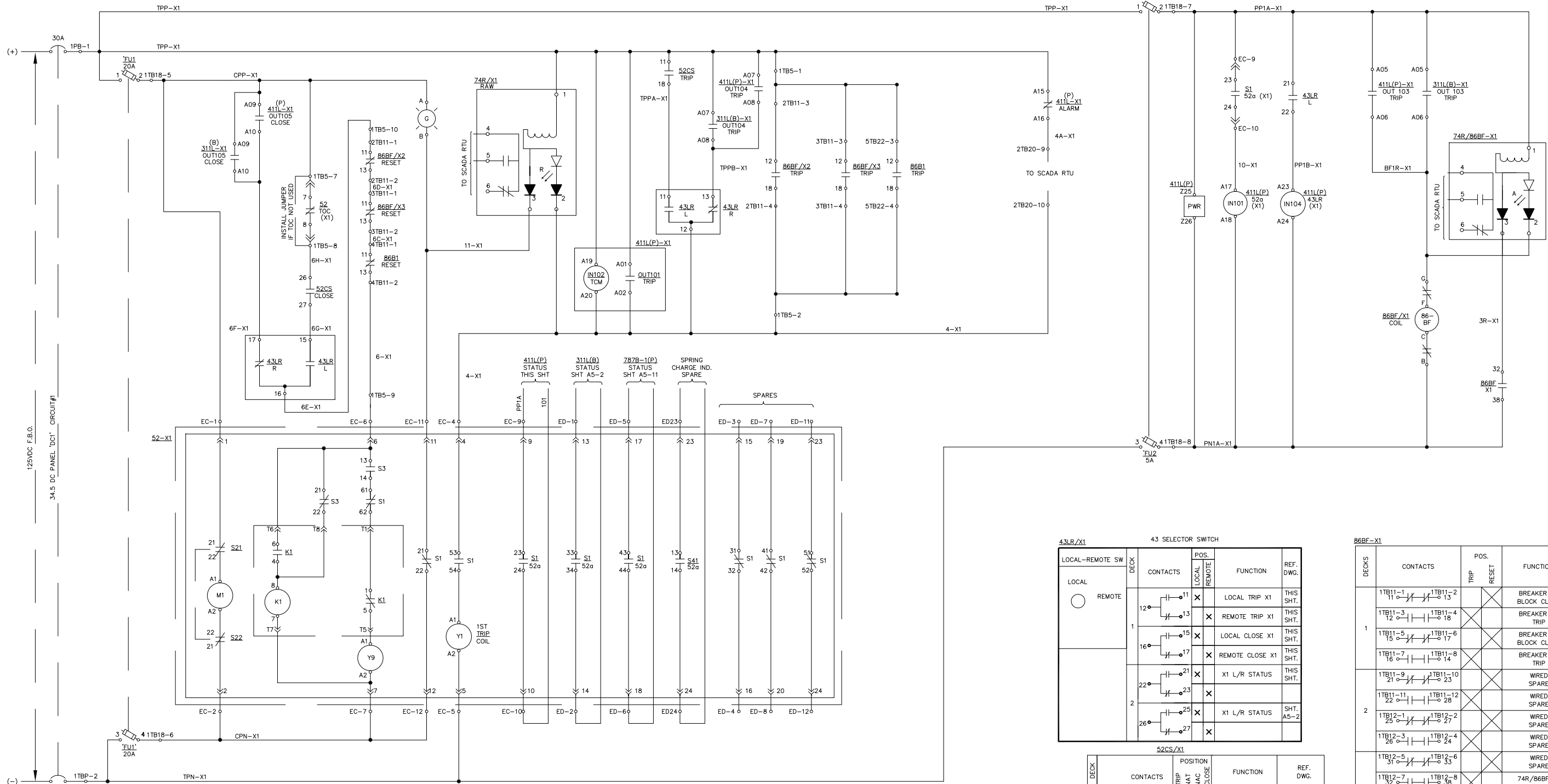
④ 40 KA WITHSTAND BUS BRACING.

⑤ METERING CT: 2000:5 MR SET AT 800:5 0.3B0.1, 0.3B0.2, 0.3B0.5, 0.3B-1, AND 0.3B-2 OR BETTER.

- ⑥ 3 SETS, 156mm (6"), 2-1000 KCMIL ALUMINUM, 35KV, 133% INSULATION XLP, 1#4/0 GND. 1-156mm (6") SPARE (PROVIDE PULLWIRE).
- ⑦ 103mm (4")Ø CONDUIT STUB-OUT. PROVIDE PULLWIRE.



RATID	AT
3005	X3-X4
4005	X1-X2
5005	X4-X5
8005	X2-X3
11005	X2-X4
12005	X1-X3
15005	X1-X4
16005	X2-X5
20005	X1-X5



43 SELECTOR SWITCH

LOCAL-REMOTE SW	DECK	CONTACTS	POS.		FUNCTION	REF. DWG.
			LOCAL	REMOTE		
LOCAL	1	11-13	X		LOCAL TRIP X1	THIS SHT.
		12-13		X	REMOTE TRIP X1	THIS SHT.
REMOTE	1	15-17		X	LOCAL CLOSE X1	THIS SHT.
		16-17		X	REMOTE CLOSE X1	THIS SHT.
	2	21-23	X		X1 L/R STATUS	THIS SHT.
		22-23		X		
	2	25-27	X		X1 L/R STATUS	SHT. A5-2
		26-27		X		

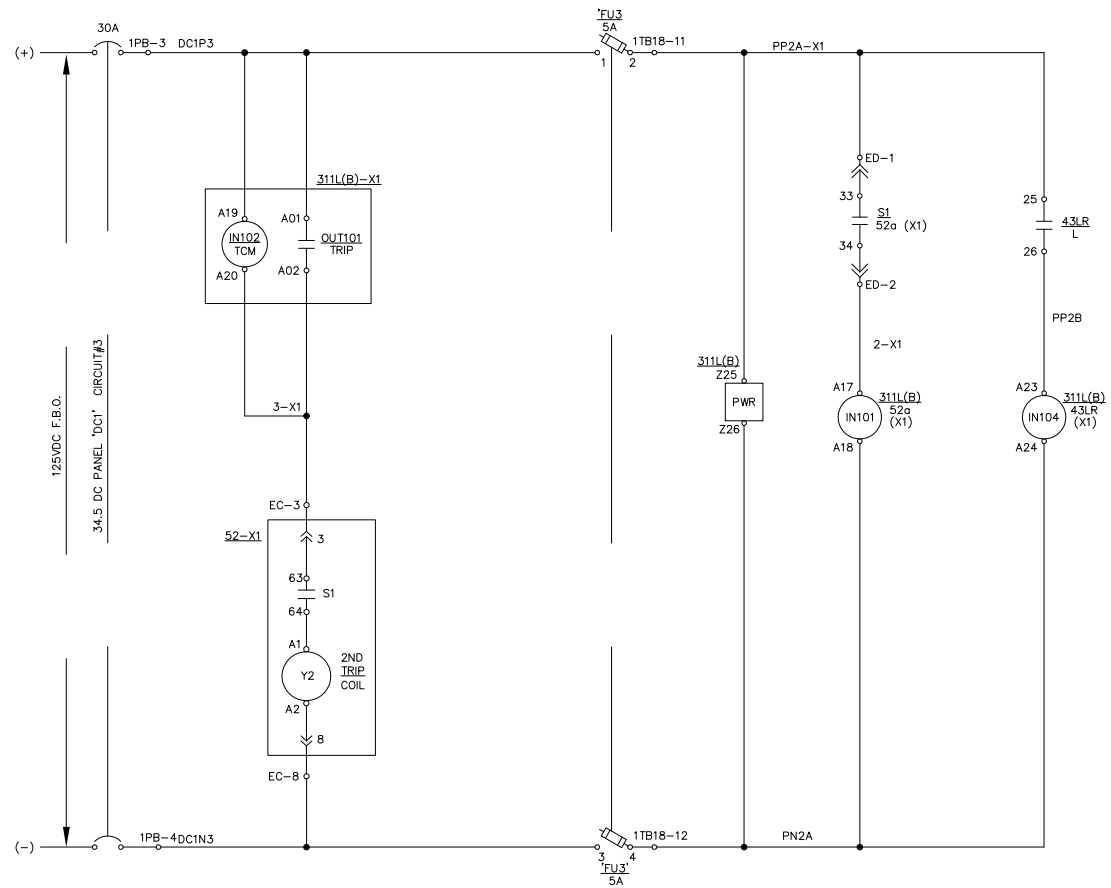
52CS-X1

DECK	CONTACTS	POSITION			FUNCTION	REF. DWG.
		TRIP	NAT	CLOSE		
1	11-18	X			BKR TRIP X1	THIS SHEET
	14-15		X		WIRED SPARE	
2	21-22	X	X		WIRED SPARE	
	26-27			X	BKR CLOSE X1	THIS SHEET
3	32-33	X	X		WIRED SPARE	
	36-37	X	X		WIRED SPARE	
4	42-43	X	X		WIRED SPARE	
	46-47	X	X		WIRED SPARE	

86BF-X1

DECKS	CONTACTS	POS.	FUNCTION	REF. DWG.
1	11-13	X	BREAKER X2 BLOCK CLOSE	SHT. A5-3
	12-18	X	BREAKER X2 TRIP	SHT. A5-3
	15-17	X	BREAKER X3 BLOCK CLOSE	SHT. A5-5
	16-14	X	BREAKER X3 TRIP	SHT. A5-5
	21-23	X	WIRED SPARE	
2	22-28	X	WIRED SPARE	
	25-27	X	WIRED SPARE	
3	31-33	X	WIRED SPARE	
	32-38	X	74R/86BF-X1	THIS SHT.
4	41-43	X	WIRED SPARE	
	42-48	X	WIRED SPARE	
5	51-53	X	WIRED SPARE	
	52-58	X	SEL-751(T1)	SHT. A5-4
6	61-63	X	WIRED SPARE	
	62-68	X	SEL-751(B)/X3	SHT. A5-10
6	65-67	X	WIRED SPARE	
	66-64	X	WIRED SPARE	

LEGEND:
 K1 = ANTI PUMPING RELAY
 M1 = MOTOR
 R1 = RESISTOR
 S1 = AUXILIARY SWITCH
 S3 = LIMIT SWITCH
 S41 = POSITION SWITCH
 S21, S22 = LIMIT SWITCH
 X0 = PLUG CONNECTOR (SECONDARY CONNECTION)
 Y1 = TRIPPING SOLENOID (TRIP COIL)
 Y2 = TRIPPING SOLENOID (2NDTRIP COIL)
 Y9 = CLOSING SOLENOID
 MOC = MECHANISM OPERATED CELL
 TOC = TRUCK OPERATED CELL
 X TB X - X = INTERCONNECTION TERMINAL POINT & SPARES
 ———— = TERMINAL NUMBER
 ———— = TERMINAL BLOCK NUMBER
 ———— = UNIT #



411L(P)/X1	FUNCTIONS	REF. DWG.
OUT101 1TB1-1 A01	BREAKER X1 TRIP COIL 1	SHEET A5-1
OUT102 1TB1-3 A03	Wired Spare	
OUT103 1TB1-5 A05	86BF/X1 TRIP	SHEET A5-1
OUT104 1TB1-7 A07	BREAKER X1 SCADA TRIP	SHEET A5-1
OUT105 1TB1-9 A09	BREAKER X1 SCADA CLOSE	SHEET A5-1
OUT106 1TB1-11 A11	Wired Spare	
OUT107 1TB2-1 A13	Wired Spare	
ALARM 1TB2-3 A15	SCADA RTU X1 ALARM	SHEET A5-1
1TB2-5 A17	BREAKER X1 S1/52a	SHEET A5-1
1TB2-7 A19	BREAKER X1 TCM 1	SHEET A5-1
1TB2-9 A21	Wired Spare	
1TB2-11 A23	43LR STATUS SCADA	SHEET A5-1
1TB3-1 A25	Wired Spare	
1TB3-3 A27	Wired Spare	
OUT201 1TB3-5 B01	Wired Spare	
OUT202 1TB3-8 B04	Wired Spare	
OUT203 1TB3-11 B07	Wired Spare	
OUT204 1TB4-1 B09	Wired Spare	
OUT205 1TB4-4 B12	Wired Spare	
OUT206 1TB4-7 B15	Wired Spare	

311L(B)/X1	FUNCTIONS	REF. DWG.
OUT101 1TB6-1 A01	BREAKER X1 TRIP COIL 2	THIS SHEET
OUT102 1TB6-3 A03	Wired Spare	
OUT103 1TB6-5 A05	86BF/X1 TRIP	SHEET A5-1
OUT104 1TB6-7 A07	BREAKER X1 SCADA TRIP	SHEET A5-1
OUT105 1TB6-9 A09	BREAKER X1 SCADA CLOSE	SHEET A5-1
OUT106 1TB6-11 A11	Wired Spare	
OUT107 1TB7-1 A13	Wired Spare	
ALARM 1TB7-3 A15	Wired Spare	
1TB7-5 A17	BREAKER X1 S1/52a	THIS SHEET
1TB7-7 A19	BREAKER X1 TCM 2	THIS SHEET
1TB7-9 A21	Wired Spare	
1TB7-11 A23	43LR STATUS SCADA	THIS SHEET
1TB8-1 A25	Wired Spare	
1TB8-3 A27	Wired Spare	
OUT201 1TB8-5 B01	Wired Spare	
OUT202 1TB8-8 B04	Wired Spare	
OUT203 1TB8-11 B07	Wired Spare	
OUT204 1TB9-1 B09	Wired Spare	
OUT205 1TB9-4 B12	Wired Spare	
OUT206 1TB9-7 B15	Wired Spare	