

**CITY OF AUSTIN ELECTRIC UTILITY DEPARTMENT**

**PURCHASE SPECIFICATION**

**FOR**

**SWITCHGEAR, NTWK, 3PH, 34.5KV, METAL CLAD**

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09/1/16 – Changed title DIST to NTWK.	

This specification, until rescinded, shall apply to each future purchase and contract for the commodity described herein.  
Retain for future reference.

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### ATTACHMENTS:

- Attachment I 34.5 kV Switchgear Relay One-Line Diagram, Rev.: 2/28/97
- Attachment II City of Austin Power Delivery - Substations Design Reference Manual - Taping Procedures, Rev.: 5/29/97
- Attachment III Typical AC Control Schematic
- Attachment IV Typical DC Control Schematic

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### PURCHASE SPECIFICATION

#### FOR

#### SWITCHGEAR, DIST, 3PH, 34.5KV, METAL CLAD

### 1.0 SCOPE AND CLASSIFICATION

#### 1.1 Scope

This specification sets forth the minimum requirements for operating characteristics and safety features of a 34.5 kV metal-clad switchgear.

#### 1.2 Classification

1.2.1 This specification covers outdoor, three phase, four wire, 34,500 Volts wye, resistance grounded (eight (8) Ohms), metal-clad switchgear and circuit breakers.

1.2.2 The switchgear will be cable connected to a 34.5 kV ring bus and will be used to distribute the power of the ring bus connected transformers into three (3) distribution circuits.

1.2.3 The switchgear will be installed in an outdoor electric utility substation below an altitude of 1,000 meters and subjected to an annual ambient temperature variance of  $-25^{\circ}\text{C}$  to  $+40^{\circ}\text{C}$  at 100% humidity. The average temperature for any twenty-four hour period will not exceed  $30^{\circ}\text{C}$ . The manufacturer shall design the switchgear to withstand the solar radiation (see ANSI/IEEE C37.24-1987 (Reaff 1991)) and the ambient conditions without reduction in the required ratings.

### 2.0 APPLICABLE STANDARDS

The switchgear furnished under this specification shall conform to the latest NEMA, NEC, NESC, IEEE, ANSI/IEEE, ANSI, and ASTM standards applicable to metal-clad power switchgear, power circuit breakers, instrument transformers, surge arresters, and other equipment covered by this specification. In the case of a conflict between any of the standards mentioned in this specification and the contents of this document, the Austin Electric Utility (AEU) Specification shall govern. The applicable standards include, but are not limited to, the following:

- 2.1 ANSI/IEEE C37.04-1979 (Reaff 1988) Standard Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis (Includes Supplement C37.04c-1985)
- 2.2 ANSI/IEEE C37.04f-1990 Supplement to ANSI/IEEE C37.04-1979
- 2.3 ANSI/IEEE C37.04g-1986 Supplement to ANSI/IEEE C37.04-1979
- 2.4 ANSI/IEEE C37.06-1987 Standard for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis-Preferred Ratings and Related Capabilities
- 2.5 ANSI/IEEE C37.09-1979 (Reaff 1988) Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
- 2.6 ANSI/IEEE C37.09a-1991 Supplement to ANSI/IEEE C37.09-1979
- 2.7 ANSI/IEEE C37.09c-1984 Supplement to ANSI/IEEE C37.09-1979
- 2.8 ANSI/IEEE C37.09e-1985 Supplement to ANSI/IEEE C37.09-1979
- 2.9 ANSI/IEEE C37.09g-1991 Supplement to ANSI/IEEE C37.09-1979
- 2.10 ANSI/IEEE C37.1-1987 Standard Definition, Specification, and Analysis of Systems Used for Supervisory Control, Data Acquisition, and Automatic Control

- 2.11 ANSI/IEEE C37.2-1991 Draft Standard Electrical Power System Device Function Numbers
- 2.12 ANSI/IEEE C37.20.2-1987 Standard for Metal-Clad and Station- Type Cubicle Switchgear
- 2.13 ANSI/IEEE C37.21-1985 Standard for Control Switchboards
- 2.14 ANSI/IEEE C37.23-1987 Standard for Metal-Enclosed Bus and Calculating Losses in Isolated-Phase Bus
- 2.15 ANSI/IEEE C37.24-1987 Guide for Evaluating the Effect of Solar Radiation on Outdoor Metal-Enclosed Switchgear
- 2.16 ANSI/IEEE C37.90-1987 Standard for Relays and Relay Systems Associated with Electric Power Systems
- 2.17 ANSI/IEEE C37.90.1-1989 Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems
- 2.18 ANSI/IEEE C37.100-1981 (Reaff 1989) Standard Definitions for Power Switchgear
- 2.19 ANSI/IEEE C37.100b-1986 Supplement to ANSI/IEEE C37.100-1981
- 2.20 ANSI/IEEE C37.100d-1990 Draft Supplement to ANSI/IEEE C37.100-1981
- 2.21 ANSI/IEEE C57.12.01-1989 Standard General Requirements for Dry-Type Distribution and Power Transformers Including Those With Solid Cast and/or Resin-Encapsulated Windings
- 2.22 ANSI/IEEE C57.12.50-1981 (Reaff 1989) Requirements for Ventilated Dry-Type Distribution Transformers, 1 to 500 kVA, Single Phase, and 15 to 500 kVA, Three Phase, with High-Voltage 601 to 34,500 Volts, Low-Voltage 120 to 600 Volts
- 2.23 ANSI/IEEE C57.12.70-1978 (Reaff 1987) Terminal Markings and Connections for Distribution and Power Transformers
- 2.24 ANSI/IEEE C57.12.80-1978 (Reaff 1986) Standard Terminology for Power and Distribution Transformers
- 2.25 IEEE C57.12.91-1979 Test Code for Dry-Type Distribution and Power Transformers
- 2.26 ANSI/IEEE C57.13-1978 (Reaff 1986) Standard Requirements for Instrument Transformers
- 2.27 ANSI/IEEE C57.13.1-1981 (Reaff 1986) IEEE Guide for Field Testing Relaying Current Transformers
- 2.28 ANSI/IEEE C57.13.3-1983 (Reaff 1990) Guide for the Grounding of Instrument Transformer Secondary Circuits and Cases
- 2.29 ANSI/IEEE C62.11-1987 Standard for Metal-Oxide Surge Arresters for AC Power Circuits
- 2.30 ANSI/IEEE Std 100-1984 IEEE Standard Dictionary for Electrical and Electronic Terms
- 2.31 ANSI/NFPA 70-1987 National Electrical Code
- 2.32 ANSI C2-1993 American National Standard National Electric Safety Code.
- 2.33 ANSI Z55.1-1967 (Reaff 1973) American National Standard Gray Finishes for Industrial Apparatus and Equipment
- 2.34 ANSI/IEEE Std 1-1986 Standard General Principles for Temperature Limits in the Rating of Electric Equipment and for the Evaluation of Electrical Insulation
- 2.35 ANSI/IEEE Std 4-1978 Standard Techniques for High-Voltage Testing
- 2.36 Federal Standard Number 595-A
- 2.37 ASTM F855-83 Specification for Temporary Grounding Systems to be used on De-energized Electric Power Lines and Equipment
- 2.38 NEC Article 300-1993 Wiring Methods

### **3.0 FUNCTIONAL REQUIREMENTS**

The switchgear will be used to provide three (3) 34,500 Volt wye, 4 wire, resistance grounded (eight (8) Ohms), three (3) phase electric distribution circuits supplied from a 34,500 V ring bus. The functions that the switchgear shall perform shall include, but not be limited to, the following:

- 3.1 Independent on and off switching of each distribution circuit
- 3.2 Fault protection for each distribution circuit, for the ring bus, and for the switchgear
- 3.3 Metering for each circuit

## 4.0 PERFORMANCE REQUIREMENTS

### 4.1 General

- 4.1.1 The switchgear shall be designed, constructed, and tested in accordance with ANSI/IEEE C37.20.2-1987 and other applicable standards. The switchgear shall meet the minimum requirements for Metal-Enclosed and Metal-Clad class switchgears.
- 4.1.2 All bus-connected equipment shall meet the following minimum requirements:
- a. Nominal voltage class, rms: 34.5 kV
  - b. Maximum operating voltage, rms: 38 kV
  - c. 60 Hz withstand, rms: 80 kV
  - d. Impulse withstand, peak: 150 kV
  - e. Momentary current, symmetrical peak: 95 kA
- 4.1.3 All equipment connected to the main bus shall have, as a minimum, a continuous current rating at 60 Hz of 2000 Amps. All equipment connected to the feeder buses shall have, as a minimum, a continuous current rating at 60 Hz of 1200 Amps.

### 4.2 Bus

All bus shall be of a non-segregated design. All bus shall be designed, constructed, and tested in accordance with ANSI/IEEE C37.23-1987 and other applicable standards. All bus and bus duct shall be rated as follows:

- 4.2.1 Maximum operating voltage, rms: 38 kV
- 4.2.2 60 Hz withstand, rms: 80 kV
- 4.2.3 Impulse withstand, peak: 150 kV
- 4.2.4 Continuous current at 60 Hz, rms: 2000 Amps
- 4.2.5 Momentary current, symmetrical peak: 95 kA

### 4.3 Power Circuit Breakers

All circuit breakers shall be designed, constructed, and tested in accordance with ANSI/IEEE C37.04-1979 (including Supplements), ANSI/IEEE C37.06-1987, ANSI/IEEE C37.09-1979 (including Supplements), ANSI/IEEE C37.20.2-1987, ANSI/IEEE C37.54-1987, and other applicable standards. The 34.5 kV power circuit breakers shall be three phase, vacuum type, and shall have the following ratings:

- 4.3.1 Nominal voltage class, rms: 34.5 kV
- 4.3.2 Maximum operating voltage, rms: 38 kV
- 4.3.3 Voltage range factor, K: 1.65
- 4.3.4 60 Hz withstand, rms: 80 kV
- 4.3.5 Impulse withstand, peak: 150 kV
- 4.3.6 Continuous current at 60 Hz, rms, bus tie breakers: 2000 Amps
- 4.3.7 Continuous current at 60 Hz, rms, feeder breakers: 1200 Amps
- 4.3.8 Maximum short circuit current at maximum voltage, symmetrical rms: 21 kA
- 4.3.9 Interrupting time: 5 cycles
- 4.3.10 Permissible tripping delay, Y: 2 seconds
- 4.3.11 Minimum voltage, rms: 23 kV
- 4.3.12 Maximum short circuit current at minimum voltage, symmetrical rms: 35 kA
- 4.3.13 3-second short-time current carrying capability, symmetrical rms: 35 kA
- 4.3.14 Closing and latching capability, symmetrical rms: 95 kA

#### 4.4 Power Source

This switchgear will be connected to a 34.5 kV ring bus with two (2) transformers rated as follows:

4.4.1	Capacity:	42/56/70 MVA
4.4.2	Impedance:	10.0 % on 42 MVA base
4.4.3	Primary Voltage	138 kV delta
4.4.4	Secondary Voltage:	34.5/19.9 kV wye with OLTC and 8 Ohm grounding resistor
4.4.5	Primary BIL:	550 kV
4.4.6	Secondary BIL:	200 kV

The wye secondary neutral will be grounded through an eight (8) Ohm grounding resistor. For calculation purposes, an infinite primary bus should be used. The phase rotation at the transformer terminals is X3-X2-X1. Phase A of the switchgear will connect to X1, Phase B will connect to X2, and Phase C will connect to X3.

### 5.0 MATERIAL REQUIREMENTS

#### 5.1 Arrangement

5.1.1 The switchgear shall be arranged as a single line-up of metal-clad cubicles with an enclosed aisle in a weatherproof enclosure. The switchgear line-up shall include the following positions in the order listed.

- a. Incoming cable from ring bus to switchgear (first bus tie breaker) cubicle 01
- b. Station service cubicle 02
- c. Potential transformer cubicle 03
- d. Outgoing feeder breaker cubicle 04
- e. Outgoing feeder breaker cubicle 05
- f. Outgoing feeder breaker cubicle 06
- g. Outgoing cable from switchgear to ring bus (second bus tie breaker) cubicle 07

The connections between this line-up and the existing ring bus will be made with cable, supplied by, and installed by the AEU.

#### 5.2 Enclosure

The enclosure shall be an enclosed aisle (walk-in) type. The enclosure shall be designed, constructed, and tested as a Category A Enclosure in accordance with ANSI/IEEE C37.20.2- Appendix A.

**5.2.1 The following footprint shall be maintained: 17 feet wide (outside wall to outside wall) and 26 feet long (outside wall to outside wall). Deviations outside of this footprint are not acceptable and will be grounds for rejection of the manufacturer's bid. The drawout aisle shall be a minimum of 72 inches wide.**

#### 5.2.2 Aisle Access Doors

- a. The enclosure shall have an access door located at each end of the aisle which open outwards.
- b. The doors shall have a drip shield, doorstops, three (3) point latch wind latch, and a "Panic Exit Device."
- c. The doors shall have provisions for outside pad locking but shall be arranged so that they can be opened from inside even when locked from outside.
- d. The door hinges shall be mounted such that the doors can not be removed unless the door is open. Captive fasteners shall not be used.
- e. The door openings shall be 3 feet and 5 feet wide, respectively. The doors for these openings shall swing fully open to a minimum of 135° with a restriction of 3 feet and 5 feet from the exterior wall of the switchgear to an adjacent wall.

- 5.2.3 A minimum of three 48-inch industrial type, rapid start two (2) tube, mechanically protected fluorescent lights shall be provided. They shall be mounted parallel to the length of the aisle. Two (2) three-way light switches shall be installed in the drawout aisle, one near each door. The lighting shall be pre-wired to an independent circuit off the station service bus.
- 5.2.4 Two (2) industrial grade forced ventilation fans with blade guards, damper louvers, and insect screens. The fans should be set to exhaust outwards and shall be mounted over (or adjacent but mounted at a high location) to the two access doors. The fans shall be controlled by an adjustable industrial grade thermostat. The fans shall also be controlled by one (1) manual on/automatic/off switch installed in the drawout aisle near the door. The fans shall be pre-wired to an independent circuit off the station service bus.
- 5.2.5 Two (2) 120 V AC weatherproof convenience outlets, three (3) wire grounding type, with a Ground Fault Current Interrupting (GFCI) device shall be provided. One outlet shall be mounted on the first tie breaker cubicle door facing outward. The second outlet shall be mounted in the second tie breaker cubicle door facing outward. Each outlet shall be pre-wired to an independent circuit off the station service bus.
- 5.2.6 The enclosure floor shall consist of steel plates of adequate strength to support the weight of any item of drawout equipment plus 350 pounds with a maximum deflection of 0.125 inches.
- 5.2.7 The enclosure shall have adequate aisle space for easy withdrawal and insertion of all drawout equipment. The draw out aisle shall be a minimum of 72" wide.
- 5.2.8 The enclosure shall be constructed of 11 MSG or thicker steel and shall be weatherproof in accordance with ANSI/IEEE C37.20.2-1987 (Reaff 1992).
- 5.2.9 The enclosure shall be designed for a slab type foundation.
- 5.2.10 The underside of the enclosure shall be undercoated with an asphalt base material to prevent rusting.
- 5.2.11 All 34.5 kV voltages in the switchgear, except for the station service transformer, shall be separated from all lower voltages by a steel barrier.
- 5.2.12 Protected vents shall be appropriately located to provide adequate air circulation. These vents shall have replaceable filters that will prevent the entrance of dust, insects, rodents, etc. The filter frame shall be secured by one (1) bolt for ease of replacement of the filters. The vents shall be durable, maintenance free, and designed to prevent entry of water and insects. The manufacturer shall supply three (3) sets of spare filters per switchgear.
- 5.2.13 Rear Doors
- a. The rear panels of switchgear cubicles are to be hinged (to form doors) rather than bolted. The doors shall be fabricated as a single piece (double doors will not be allowed) and shall extend from the top to the bottom of the cubicle opening. No bracing shall be allowed in the door opening.
  - b. The door hinges shall be mounted such that the doors can not be removed unless the door is open. Captive fasteners shall not be used.
  - c. The doors shall have drip shields, doorstops, and wind latches.
  - d. The rear cubicle doors shall be equipped with "L"-latches that can be locked with an ordinary padlock. Bolts, screw knobs, and sliding latches are not acceptable.
  - e. The doors shall be sufficiently rigid to prevent warping of the doors and to insure positive operation of the doors and latches.
- 5.2.14 All exterior switchgear and door hardware shall be non-rust stainless steel. All non-conducting nuts, bolts, washers, and screws used on or in the switchgear shall be non-rust stainless steel or AEU Engineer approved equivalent.

- 5.2.15 In addition to the rear doors on the bus tie breaker compartments, the manufacturer shall also supply one (1) side door to give further access to each bus tie breaker cable compartment. The side door shall be located on the exterior short side wall and be arranged as described in Section 5.2.13.
- 5.2.16 All wire fasteners, ties, and holders shall be non-rust stainless steel or AEU Engineer approved equivalent. Plastic wire ties and holders are not acceptable except for control wiring.
- 5.2.17 Open-cell foam rubber and RTV silicone rubber are not acceptable as gasket material for the purpose of weatherproofing.
- 5.2.18 The switchgear and bus dust, including the base, shall be designed such that, after installation, there will be no permanent deformation caused by shipping or handling.
- 5.2.19 Cubicle Doors
- a. Devices mounted on the cubicle doors facing the draw out aisle shall be labeled with 4"x1" engraved plastic nameplates. Nameplates shall have a black surface with a white core, and shall be secured to the doors and panels with self-tapping, non-rusting, stainless steel screws.
  - b. Cubicle doors facing the draw out aisle shall have a "T"-handle for opening and closing rather than bolts, screw knobs, or sliding latches.
  - c. Cubicle doors shall have doorstops and wind latches. If multiple doors are used in same cubicle, the wind latch of the inner door shall attach to the outer door.
- 5.2.20 The manufacturer shall supply a grounding bus mounted on the interior wall in the draw out aisle opposite from the circuit breakers. The grounding bus shall extend the full length of the switchgear less 3 feet on each end. The grounding bus shall be mounted 3 feet up from the interior floor and shall extend 6 inches from the interior wall. The grounding bus shall be braced to handle 21 kA of fault current and shall consist of silver plated 2 inch IPS copper pipe. Both ends of the ground bus shall be solidly grounded to the exterior ground pads specified in Section 5.4.8 D.
- 5.2.21 The manufacturer shall provide access plates into all bus compartments. The plates shall be located to provide easy access to all bolted joints and insulators. The access openings shall be large enough so that insulators can be replaced and the joints re-taped, if necessary.
- 5.2.22 The manufacturer shall provide one (1) 120 V, 200 W, mechanically protected incandescent outdoor light equipped with an outdoor fixture mounted outside over each access door. Two (2) three-way light switches shall be installed in the drawout aisle, one near each door. The lighting shall be pre-wired to an independent circuit off the station service bus.
- 5.2.23 The manufacturer shall provide one (1) 120 V, 100 W, mechanically protected incandescent outdoor light equipped with an outdoor fixture mounted in the rear of each cubicle in a high position. The lights shall be controlled by outdoor door operated switches. The lighting shall be pre-wired to an independent circuit off the station service bus.
- 5.3 Paint Requirements
- 5.3.1 The switchgear shall be painted inside and outside. Painting of non-rust stainless steel and hot dipped galvanized steel surfaces are not required.
- As mentioned above, painting of non-rust stainless steel and hot dipped galvanized steel surfaces are not required. However, the manufacturer must achieve a consistent color and finish over the entire switchgear. If the manufacturer proposes to use of non-rust stainless steel or hot dipped galvanized steel surfaces, the manufacturer shall indicate this in the bid and shall provide a written guarantee that these surfaces will be consistent in color and finish.
- 5.3.2 The finish coat shall be ANSI No. 70 light gray, except as noted in Section 5.3.3, in accordance with ANSI Z55.1-1967.



- 5.3.3 The back of the relay panels shall be finished with a Federal Std. No. 595-A White No. 7875 paint. The aisle ceiling shall also be finished with a Federal Std. No. 595-A White No. 7875 paint.
  - 5.3.4 The exterior total finish shall be at least five (5) mils in thickness and the interior total finish shall be at least three (3) mils in thickness.
  - 5.3.5 All primer and paint shall be lead free.
  - 5.3.6 The manufacturer shall provide a separate non-prorated warranty on the finish for a five (5) year period. The warranty shall cover rust, rust bleed-through, flakes, paint fading, and paint chipping. The AEU will exercise reasonable care in ensuring that the finish is protected during installation and will follow the manufacturer's receiving instructions on paint touchup. The manufacturer shall also provide a five (5) year non-prorated warranty on all cast aluminum, non-rust stainless steel, and hot dipped galvanized steel surfaces.
  - 5.3.7 The manufacturer shall supply five (5) spray cans of touchup paint for each switchgear ordered.
- 5.4 Bus
- 5.4.1 All bus shall be supported with porcelain insulating material or AEU Engineer approved equivalent.
  - 5.4.2 All phase bus shall be covered with 38 kV non-tracking, flame retarding insulation. All bolted bus bar connections shall be insulated with tape, which shall be applied as per the Taping Procedures supplied in Attachment 3. Other equivalent joint insulating methods may be accepted by the AEU. Equivalency will be solely determined by the AEU Engineer.
  - 5.4.3 The manufacturer may be required to perform appropriate temperature rise tests if the manufacturer can not demonstrate to the AEU Engineer that the tests are unnecessary. The AEU Engineer shall make the final determination if the temperature rise tests are necessary.
  - 5.4.4 Plastic or other types of insulating boots, which do not completely seal the connection, will not be allowed.
  - 5.4.5 All phase bus bar connections shall be bolted with a minimum of four (4) bolts equipped with stainless steel bolts (of the same length), nuts, washers, and bevel washers. Welding of bus bar connections is not allowed.
  - 5.4.6 All phase bus bar used in the switchgear and the bus duct shall be copper and shall have silver plated joints for high conductivity. Aluminum bus bars shall not be used. All edges shall be rounded. Sharp edges are not allowed.
  - 5.4.7 The phase bus in all outgoing feeder compartments shall be provided with a NEMA 4 hole copper pad for connection by the AEU of the outgoing feeder cable with a vertical clearance of 60 inches minimum for separately furnished terminators.

Switchgear shall be equipped with special hardware for electrically grounding the 34.5 kV buses. This hardware shall be used to provide for personnel safety when performing maintenance. Test reports shall be submitted to verify that this hardware, when installed, meets the requirements of ASTM Specification No. F855-83. Hardware to be mounted by the manufacturer shall include one (1) right-angled stud, J-Ro Tool P/N 87002, or AEU Engineer-approved equal, on each of the three buses connecting the 34.5 kV power circuit breakers. In addition, one (1) straight stud J-Ro Tool P/N 87003, or AEU Engineer-approved equal, shall be mounted on an extension of the ground bus in each circuit breaker cubicle. These studs shall be mounted to provide a clear and unobstructed path to the rear of the cubicle. The manufacturer shall exercise care in the placement of these studs and shall make allowances for adequate clearances to potential live parts when field personnel are attempting to attach their safety grounds.

#### 5.4.8 Neutral and Ground Bus in Switchgear

- a. A 1/4" x 2" copper bus bar shall be installed in the switchgear to be used as a combined neutral and grounding bus. It will connect to the neutral bus wire from the ring bus and shall be continuous (without interruption) through all of the switchgear cubicles. This neutral/ground bus shall be located low at a position close to the incoming cable neutral wires.
- b. A copper bus bar shall be provided for grounding each circuit breaker chassis. These bars also shall be continuous, connecting the chassis directly to the neutral/ground bus without interruption.
- c. The neutral/ground bus in all outgoing feeder compartments shall be provided with a copper clamp type terminal (2 hole NEMA pad) for 4/0 stranded copper to be used for connection of feeder circuit neutral.
- d. The ground bus shall be provided with a 2 hole NEMA pad on the outside of switchgear at each end. Each pad shall have two (2) holes horizontally spaced on 1 3/4 inch centers and drilled and tapped for 1/2 - 13 UNC thread to minimum depth of 1/2 inch. The ground bus shall be continuous to these terminals. The manufacturer shall exercise care in assuring the waterproof integrity of the enclosure is maintained.
- e. The switchgear enclosure shall be electrically connected to the ground bus in each cubicle.
- f. Sections of copper bar may be connected to form the neutral/ground bus. The term continuous means the bus shall be all copper and not have some other material, such as a steel cubicle wall, connected between two sections of copper bus bar.
- g. All ground bus connections shall be bolted with a minimum of two (2) bolts equipped with stainless steel bolts (of the same length), nuts, washers, and bevel washers. Welding of bus bar connections is not allowed.

#### 5.5 Control Power

- 5.5.1 The AEU will provide a 125 V DC, 2-wire power source necessary to operate the control circuits, alarm circuits, and closing and tripping control power for breakers.
- 5.5.2 The closing and tripping control power for the breakers shall be supplied from the 125 V DC. 125 V DC shall be from AEU's station service batteries. Batteries are not to be furnished under this specification. Stored energy devices utilizing DC motors are permitted under this specification.
- 5.5.3 The alarm circuits and other DC control equipment shall operate from 125 V DC.
- 5.5.4 125 V DC loads shall be supplied by molded-case circuit breakers properly sized for the loads. Molded-case circuit breakers shall be dual-rated at 240 V AC/250 V DC. Molded-case circuit breakers are to be used exclusively. **Knife switches and fuses are not allowed.** All molded-case circuit breakers shall have a DC interrupting rating of 10 kA.
- 5.5.5 The manufacturer shall provide one (1) 125 Volt DC service main circuit breaker to which the AEU will connect the switchgear DC service cable. This breaker shall be a 2 pole, 240-Volt AC/250 Volt DC, 100 Amp continuous, 10 kA DC interrupting circuit breaker. The manufacturer shall determine the adequacy of the size of this breaker and shall notify the AEU if a different size is required. The manufacturer shall provide one (1) switchgear DC distribution panel supplied by the DC service main circuit breaker with provisions for, but not be limited to, the following loads:
  - a. One (1) DC circuit breaker per 34.5 kV breaker for DC trip (20 A)
  - b. One (1) DC circuit breaker per 34.5 kV breaker for DC close (10 A)
  - c. One (1) DC circuit breaker for bus differential relay circuit (20A)
  - d. One (1) DC circuit breaker per 34.5 kV breaker for breaker failure relay (20A)
  - e. Breaker positioning equipment
  - f. Other 125 Volt DC switchgear accessories
  - g. A minimum of five (5) spare DC circuit breakers (20 A)

## 5.6 120/240 Volt Station Service

- 5.6.1 One (1) single phase station service transformer with 50 kVA capacity shall be provided and connected to the bus in cubicle 02.
- 5.6.2 The station service transformer shall be 19.92 kV-120/240 V with two (2) 2-1/2% taps above and below rated high side voltage. The transformer shall be a dry-type and shall have 150 kV BIL insulation.
- 5.6.3 The primary side of the station service transformer shall be connected to phase B of the 34.5 kV bus.
- 5.6.4 The station service transformer shall be fused with a current limiting fuse arranged on a drawout mounting. One (1) spare fuse shall be furnished by the manufacturer.
- 5.6.5 Single-phase 120/240 V AC loads shall be supplied by molded-case circuit breakers properly sized for the loads. Molded-case circuit breakers shall be rated at 240 V AC/250 V DC. Molded-case circuit breakers are to be used exclusively. **Knife switches and fuses are not allowed.** All molded-case circuit breakers shall have an AC interrupting rating of 22 kA.
- 5.6.6 The manufacturer shall provide one (1) 120/240 Volt AC service main circuit breaker to which the secondary side of the station service transformer shall be connected. This breaker shall be a 2 pole, 240 Volt AC/250 Volt DC, 250 Amp continuous, 22 kA AC interrupting circuit breaker. The manufacturer shall label this circuit breaker "120/240 V Service Main Circuit Breaker."

The manufacturer shall provide parallel connections from the low side of the main circuit breaker to an AC distribution panel and to a house supply circuit breaker.

The manufacturer shall provide one (1) 120/240 Volt AC house supply circuit breaker to which the outgoing service to the substation control house will be connected by the AEU. This breaker shall be a 2 pole, 240 Volt AC/250 Volt DC, 200 Amp continuous, 22 kA AC interrupting circuit breaker. The manufacturer shall label this circuit breaker "120/240 V Control House Supply Circuit Breaker."

The manufacturer shall provide one (1) switchgear AC distribution panel supplied by the AC service main circuit breaker with provisions for, but not be limited to, the following loads:

- a. Switchgear cubicle heaters
- b. Aisle lights
- c. Outside lights
- d. Cubicle lights
- e. Convenience outlets
- f. Ventilation fans
- g. Other 120/240 Volt AC switchgear accessories
- h. Ammeter/voltmeter power supply
- i. A minimum of five (5) spare AC circuit breakers (30 A)

The AC distribution panel shall be rated at 120/240 Volt AC and 200 Amp continuous.

- 5.6.7 One (1) AC failure alarm relay (74ACF) shall be provided and wired to the cubicle heater circuit with an alarm contact wired to a terminal board for AEU access. This relay shall be a General Electric Type HGA, Style Number 12HGA11J71, or an ABB Type SG, Style Number 293B254A28.

## 5.7 34.5 kV Power Circuit Breakers

- 5.7.1 The operating mechanisms for the 2000 Amp continuous, 34.5 kV tie circuit breakers and 1200 Amp continuous, 34.5 kV feeder circuit breakers shall be identical.

- 5.7.2 The 34.5 kV circuit breakers shall have an interrupting medium of vacuum. SF<sub>6</sub> circuit breakers (where the SF<sub>6</sub> is either used as an insulating medium and/or an interrupting medium) are not allowed.
- 5.7.3 The 34.5 kV circuit breakers shall be drawout type and mounted on a frame that can be easily rolled in and out of the switchgear cubicles. The 34.5 kV circuit breaker racking mechanism shall permit closed-door racking in and out of the circuit breaker.
- 5.7.4 The 34.5 kV distribution feeder circuit breakers shall be identical and interchangeable with each other. The 34.5 kV bus tie breakers shall be identical and interchangeable with each other. The 34.5 kV bus tie breakers shall also be capable of replacing the 34.5 kV distribution feeder circuit breakers. A mechanical interlock shall be provided to prevent insertion of the 34.5 kV feeder breakers into the bus tie breaker cubicles.
- 5.7.5 Vertical stacking of circuit breakers is not acceptable.
- 5.7.6 The 34.5 kV breakers shall be electric solenoid or stored energy spring operated. Hydraulic type will not be accepted. If spring operated type is furnished, spring winding motor shall be 125 Volts DC operated.
- 5.7.7 The 34.5 kV breakers shall be automatically tripped and discharged mechanically and electrically when withdrawn from the cubicle. The breaker must not be allowed to be inserted while closed.
- 5.7.8 Circuit breakers shall be designed and constructed to prevent pumping.
- 5.7.9 With the breakers in the test position, it shall be possible to perform all operating functions of an "in service position" breaker. This includes operation by control switch or by feeder protective relays. The breaker auxiliary switches shall operate correctly to indicate breaker status in the test position.
- 5.7.10 The 34.5 kV breakers shall be provided with a latch check switch and dual independent trip coils.
- 5.7.11 Two (2) extra "a" and two (2) extra "b" MOC contacts shall be provided with each breaker and shall be connected to a AEU accessible terminal strip. Auxiliary switches shall be field changeable.
- 5.7.12 The breakers shall be wired to permit remote supervisory control and indication. This wiring shall be brought to terminal blocks for connection to the remote supervisory equipment (not to be furnished under this specification). Leads from an auxiliary type "a" switch shall be brought to this terminal block for indication of breaker position. Trip and close interposing relays shall be installed and wired to accept supervisory trip and close signals. The trip and close interposing relay shall be installed and wired in the cubicle and shall be a GE Type HGA Style Number 12HGA11J52G or an ABB Type SG Style Number 293B254A20.
- 5.7.13 Each breaker shall have a breaker failure overcurrent fault detector relay (50/62BF). This relay shall be a four (4) element (three phase and ground) instantaneous overcurrent relay with time delay function. Schweitzer Engineering Labs Type 501, Style Number 0501003X561XXC or AEU Engineer approved equal.
- 5.7.14 Operation counter, to register only the opening stroke of the circuit breaker operating rod.
- 5.7.15 Visual open/close indicator located on the circuit breaker front panel.
- 5.7.16 Visual spring charged/discharged indicator located on the circuit breaker front panel.
- 5.7.17 All circuit breakers shall be supplied with interlocks that will disable the DC supply to the circuit breaker except when the circuit breaker is fully racked in or when the circuit breaker is in the test position.

5.8 First Bus Tie Breaker Position Cubicle 01

The manufacturer shall provide the following equipment mounted and wired in this position:

- 5.8.1 One (1) 34.5 kV power circuit breaker as specified in Sections 4.3 and 5.7 including provisions for supervisory control and breaker failure relaying.
- 5.8.2 Three (3) 36.5 kV MCOV class, single pole, station class, polymer-housed, metal oxide surge arresters to protect the incoming cable from the ring bus. All surge arrester ground wire shall be #6 Copper or larger. All surge arresters shall be placed in the cubicle such that the arrester may be removed and reinserted without removal of any other equipment. The manufacturer shall mount the surge arrester in such a manner as to limit dust collection. The surge arrester shall be chosen from the following list:

<u>Surge Arrester Manufacturer</u>	<u>Rating (MCOV) kV</u>
General Electric	36.5
Ohio Brass	36.5
ABB	36.5
Joslyn	36.5

The manufacturer shall use the same arrester throughout the switchgear. The manufacturer shall exercise care in assuring that the arresters installed in the switchgear are designed, constructed, and tested in accordance with ANSI/IEEE C62.11-1987.

- 5.8.3 One (1) circuit breaker control switch, GE Type SB1, Style #16SB1B14 or ElectroSwitch Series 24, Style #2444D.
- 5.8.4 Red, amber, green, and white indicating lights with the red light to monitor trip coil 1 only, and the amber light to monitor trip coil 2 only, the green light wired through an auxiliary "b" contact to indicate an open breaker, and the white light to monitor breaker charging motor. These indicating lights shall be GE Type ET-16 or ABB Type Minalite. Tripping diodes shall be provided with the indicating lights to monitor the trip coils separately while allowing the trip coils to operate in parallel. The tripping diodes shall be rated for 30 A continuous current, GE Type 102L218G8 or ABB TRB-2.
- 5.8.5 Three (3) relaying accuracy class, 2000/5 Ampere, single-ratio current transformers, ANSI Class 10C400, located on the incoming cable side of the circuit breaker with all six (6) connections brought out to a terminal block accessible from the front of the cubicle and equipped with shorting bars, GE Type EB-27 or AEU Engineer-approved equivalent, wired to the bus differential relay
- 5.8.6 Three (3) relaying accuracy class, 2000/5 Ampere, single-ratio current transformers, ANSI Class 10C800, located on the bus side of the circuit breaker with all six (6) connections brought out to a terminal block accessible from the front of the cubicle and equipped with shorting bars, GE Type EB-27 or AEU Engineer-approved equivalent, wired to the transformer differential relays provided by AEU.
- 5.8.7 Three (3) relaying accuracy class, 1200/5 Ampere, single-ratio current transformers, ANSI Class 10C400, located on the incoming cable side of the circuit breaker for local breaker failure relaying, instrumentation, and remote metering, wired to a terminal block accessible from the front of the cubicle and equipped with shorting bars, GE Type EB-27 or AEU Engineer-approved equivalent.
- 5.8.8 Three (3) metering accuracy class, 1200/5 Ampere, single-ratio current transformers, ANSI Class 0.3B1.8 RF 1.0, located on the bus side of the circuit breaker for local and remote transformer metering, wired to a terminal block accessible from the front of the cubicle and equipped with shorting bars, GE Type EB-27 or AEU Engineer-approved equivalent.

- 5.8.9 One (1) Scientific Columbus JEM10 electronic meter, Model #JEM10\_23109R121511. The meter shall have 3KYZ pulse outputs, a CommRepeater, Analog Output, DNP 3.0 Communication protocol, and an internal recorder.

The meter shall be wired considering that the AEU phase rotation is C-B-A.

- 5.8.10 One (1) Superior Switchboard and Devices Company test switch with CT and PT connections utilizing the CT designated for instrumentation in this position. This switch shall be a four wire, three-phase back connected flush type, switchboard test switch with a glass insert metal cover, 10 pole, consisting of Superior Switchboard and Devices Company assemblies arranged as follows: 2-11-7-1-7-2-11-7-1-7-2-11-7-1-7-6 reading from left to right, front view with the following colors: red, white, orange, black, white with black tracer, green, white, and blue as shown on AEU Drawing 7D 367.
- 5.8.11 One (1) ammeter, 3-phase, 0-1200 Ampere scale  
Bitronics, Style #ATAIE1 with MOV protection  
Calibration : CT Ratio 1200/5  
Power Supply : 115 V AC  
Faceplate label: Tie Breaker #1 Total Amperes
- 5.8.12 One (1) Superior Switchboard and Devices Company test switch. This switch shall be used for isolating metering currents from the breaker failure currents. This switch shall be a four wire, three-phase back connected flush type, switchboard test switch with a glass insert metal cover, 10 pole, consisting of Superior Switchboard and Devices Company assemblies arranged as follows: 2-11-7-1-7-2-11-7-1-7-2-11-7-1-7-6 reading from left to right, front view with the following colors: red, white, orange, black, white, white/black, green, white, and blue as shown on AEU Drawing 7D 367.
- 5.8.13 The breaker shall be tripped and locked out by the transformer differential lockout relay (not to be provided under this specification), the bus differential lockout relay, and the bus breaker failure lockout relay. Connection points shall be wired to a terminal board for AEU cable connection to connect the remote transformer differential lockout relay trip and lockout contacts to the breaker.
- 5.8.14 One (1) breaker failure relay as described in Section 5.7.13. This relay shall trip the bus tie breaker failure lockout relay as described in Section 5.8.13.
- 5.8.15 One (1) bus tie breaker failure lockout relay (86BF1) tripped by the breaker failure relay. This lockout relay shall trip and lock out all breakers on the 34.5 kV bus. This lockout relay shall also trip and lockout three (3) circuit breakers external to this switchgear. Spare contacts from this lockout relay shall be brought out to a terminal board for AEU access. This relay shall be an ElectroSwitch Style Number 7810D.
- 5.8.16 One (1) circuit breaker DC failure alarm relay (74DCF) with output contacts wired to a terminal block for AEU access. The 74DCF relay shall be an Allen-Bradley Style Number 700-HA32Z01-4.
- 5.8.17 Three (3) bus differential relays for the 34.5 kV bus. These relays shall be a GE Type PVD, Style Number 12PVD21D1A or an ABB Type KAB, Style Number 6668D37A22.

- 5.8.18 One (1) bus differential lockout relay for the 34.5 kV bus (86B1) tripped by the bus differential. This lockout relay shall trip and lock out the five 34.5 kV breakers and also short circuit the bus differential relays to prevent damage to the relays during faults. This lockout relay shall be a GE Type HEA, Style Number 12HEA61C240, or an ElectroSwitch Style Number 7805D. Spare contacts for the bus differential lockout relay shall be brought out to a terminal board for AEU access.
- 5.8.19 One (1) red indicating light (GE Type ET-16 or ABB Type Minalite) to monitor the bus differential lockout relay trip coil. One (1) white indicating light, GE Type ET-16, or ABB Type Minalite, to indicate the bus differential lockout relay has tripped.
- 5.8.20 One (1) red indicating light (GE Type ET-16 or ABB Type Minalite) to monitor the bus tie breaker failure lockout relay trip coil. One (1) white indicating light, GE Type ET-16, or ABB Type Minalite, to indicate the breaker failure lockout relay has tripped.
- 5.8.21 One (1) bus differential lockout relay test switch (ABB Type FT-1, Style Number 129A539G01 or AEU Engineer-approved equal). Each lockout relay trip output shall be wired through one of the FT-1 test switches.
- 5.8.22 One (1) bus tie breaker failure lockout relay test switch (ABB Type FT-1, Style Number 129A539G01 or AEU Engineer-approved equal). Each lockout relay trip output shall be wired through one of the FT-1 test switches.
- 5.8.23 One (1) bus differential scheme DC failure alarm relay (74B1), with output contacts wired to a terminal block for AEU access. The 74B1 relay shall be an Allen-Bradley Style Number 700-HA32Z01-4.
- 5.8.24 One (1) bus tie breaker failure scheme DC failure alarm relay (74BF1), with output contacts wired to a terminal block for AEU access. The 74B1 relay shall be an Allen-Bradley Style Number 700-HA32Z01-4.
- 5.8.25 One (1) breaker failure lockout relay for the 34.5 kV bus (86BF2), tripped by the three feeder breaker failure timer relays (Cubicles 03, 04, and 05). This lockout relay shall trip and lock out all breakers on the 34.5 kV bus. This lockout relay shall be a GE Type HEA, Style Number 12HEA61C240 or a ElectroSwitch Style Number 7805D. Spare contacts for the bus breaker failure lockout relay shall be brought out to a terminal board for AEU access.
- 5.8.26 One (1) red indicating light, GE Type ET-16 or ABB Type Minalite, to monitor the breaker failure lockout relay trip coil. One (1) white indicating light, GE Type ET-16, or ABB Type Minalite, to indicate the breaker failure lockout relay has tripped.
- 5.8.27 One (1) breaker failure lockout relay test switch, ABB Type FT-1, Style Number 129A539G01 or AEU Engineer-approved equivalent. Each lockout relay trip output shall be wired through one of the FT-1 test switches.
- 5.8.28 One (1) breaker failure scheme DC failure alarm relay (74BF2) with output contacts wired to a terminal block for AEU access. The 74BF1 relay shall be an Allen-Bradley Style Number 700-HA32Z01-4.
- 5.8.29 Terminal boards for connection by AEU control and current cables (Section 5.13)
- 5.8.30 Six (6) breaker auxiliary "a" MOC contacts and six (6) breaker "b" MOC contacts wired to AEU accessible terminal blocks for OLTC paralleling control schemes. The "a" and "b" contacts shall indicate the breaker is open when the breaker is withdrawn from the cubicle.
- 5.8.31 An uncut, non-magnetic bottom entrance plate large enough to accept (4) 2" rigid steel control conduits on 3 3/8" centers in the bottom of the cubicle with a clear and accessible path provided between the conduit location and the terminal boards

- 5.8.32 Switchgear bus terminated with a NEMA 4 hole copper pad for connection by the AEU of the incoming cable from the ring bus with a vertical clearance of 60 inches minimum for separately furnished terminators. NEMA pads shall be provided to terminate up to eight (8) 350 MCM cables per phase.
- 5.8.33 A 14"x22" minimum size, uncut, non-magnetic metallic bottom entrance plate for exit of the incoming cable from the ring bus and transformer.

#### 5.9 Station Service Cubicle 02

The manufacturer will not be allowed to combine the installation of the PTs and the station service transformer into one cubicle to meet the requirements of this Section and Section 5.10. The manufacturer shall ensure that the foot print requirements of the specification are met. The manufacturer shall also ensure that the when meeting the requirements of this Section and Section 5.10 that all code clearances are maintained and that the equipment is easily maintainable.

The manufacturer shall provide the following equipment mounted and wired in this position:

- 5.9.1 Station service transformation as covered in Section 5.6.
- 5.9.2 One (1) Basic Measuring Instruments (BMI) PQNODE Model 9010-4 power disturbance analyzer shall be provided to monitor the power quality for the load served by the switchgear. The PQNODE shall be connected into the metering current of the three feeders and potential circuits. The currents from each feeder should be brought out to a terminal block accessible from the PQNODE enclosure and equipped with shorting bars, GE Type EB-27 or AEU Engineer approved. Branch circuits from the PT secondary shall be fused with a minimum of 3 Amp current limiting fuses accessible from the PQNODE enclosure. The PQNODE will be connected into a telephone circuit. The telephone circuit shall be terminated to a Citel B08/E280T protection block accessible from the PQNODE enclosure. The PQNODE shall be equipped with the following options:
  - PQNODE Model 9010 4V/12I
  - 3 phase 4 wire configuration
  - 4 voltage channels
  - 12 current channels
  - Eight (8) hour backup battery
  - NEMA 12 indoor enclosure
  - Internal 14.4 KBPS modem
  - Internal RAM 16 MBPE Software
  - Interconnection cables as required
- 5.9.3 One (1) Citel B08/E280T or equivalent 8-pair protector with gas arresters mounted inside the cubicle for connection of AEU's communication cable. This terminal block shall accept #18-26 AWG wire sizes. The telephone cable from the PQNODE shall be terminated on the first pair of the station protector. This protector needs to be field accessible from the PQNODE while the switchgear is energized.
- 5.9.4 Terminal boards shall be provided for the connection of AEU's control cables and wires (Section 5.13). The AEU will be responsible for the connection of these control cables and wires.

#### 5.10 Potential Transformer Cubicle 03

The manufacturer will not be allowed to combine the installation of the PTs and the station service transformer into one cubicle to meet the requirements of this Section and Section 5.9. The manufacturer shall ensure that the foot print requirements of the specification are met. The manufacturer shall also ensure that the when meeting the requirements of this Section and Section 5.9 that all code clearances are maintained and that the equipment is easily maintainable.



The manufacturer shall provide the following equipment mounted and wired in this position:

- 5.10.1 Three (3) 200 volt-ampere, 19.92 kV to 120 V potential transformers (PTs) connected wye-wye to the main bus. These PTs shall be 0.3% accuracy class and have 150 kV BIL insulation. The PTs shall have butyl-rubber case design.
- 5.10.2 Each potential transformer shall be fused with a current limiting fuse and mounted on a common drawout assembly. The drawout tray shall have a flexible grounding conductor to connect the tray to the ground bus. One (1) spare set of fuses for each set of PTs shall be provided.
- 5.10.3 The 120 V secondary of the PTs shall be fused with current limiting fuses rated for 30 A. Branch circuits from the PT secondary shall be fused with a minimum of 3 A current limiting fuses.
- 5.10.4 The three phase potential shall be bussed to each test switch in the circuit breaker positions in the line-up.
- 5.10.5 One (1) voltmeter, 3-phase, 0-38 kV scale  
 Bitronics, Style #VTAIE1 with MOV protection  
 Calibration : PT Ratio 166/1  
 Power Supply : 115 V AC  
 Faceplate label: Phase-Neutral Bus Voltage
- 5.10.6 Terminal boards shall be provided for the connection of AEU's control cables and wires (Section 5.13). The AEU will be responsible for the connection of these control cables and wires.

5.11 Second Bus Tie Breaker Position Cubicle 07

The manufacturer shall provide the following equipment mounted and wired in this position:

- 5.11.1 One (1) 34.5 kV power circuit breaker as specified in Sections 4.3 and 5.7 including provisions for supervisory control and breaker failure relaying.
- 5.11.2 Three (3) 36.5 kV MCOV class, single pole, station class, polymer-housed, metal oxide surge arresters to protect the incoming cable from the ring bus. All surge arrester ground wire shall be #6 Copper or larger. All surge arresters shall be placed in the cubicle such that the arrester may be removed and reinserted without removal of any other equipment. The manufacturer shall mount the surge arrester in such a manner as to limit dust collection. The surge arrester shall be chosen from the following list:

<u>Surge Arrester Manufacturer</u>	<u>Rating (MCOV) kV</u>
General Electric	36.5
Ohio Brass	36.5
ABB	36.5
Joslyn	36.5

The manufacturer shall use the same type arrester throughout the switchgear. The manufacturer shall exercise care in assuring that the arresters installed in the switchgear are designed, constructed, and tested in accordance with ANSI/IEEE C62.11-1987.

- 5.11.3 One (1) circuit breaker control switch, GE Type SB1, Style #16SB1B14 or ElectroSwitch Series 24, Style #2444D.

- 5.11.4 Red, amber, green, and white indicating lights with the red light to monitor trip coil 1 only, and the amber light to monitor trip coil 2 only, the green light wired through an auxiliary "b" contact to indicate an open breaker, and the white light to monitor breaker charging motor. These indicating lights shall be GE Type ET-16 or ABB Type Minalite. Tripping diodes shall be provided with the indicating lights to monitor the trip coils separately while allowing the trip coils to operate in parallel. The tripping diodes shall be rated for 30 A continuous current, GE Type 102L218G8 or ABB TRB-2.
- 5.11.5 Three (3) relaying accuracy class, 2000/5 Ampere, single-ratio current transformers, ANSI Class 10C400, located on the incoming cable side of the circuit breaker with all six (6) connections brought out to a terminal block accessible from the front of the cubicle and equipped with shorting bars, GE Type EB-27 or AEU Engineer-approved equivalent, wired to the bus differential relay.
- 5.11.6 Three (3) relaying accuracy class, 2000/5 Ampere, single-ratio current transformers, ANSI Class 10C800, located on the bus side of the circuit breaker with all six (6) connections brought out to a terminal block accessible from the front of the cubicle and equipped with shorting bars, GE Type EB-27 or AEU Engineer-approved equivalent, wired to the transformer differential relays provided by AEU.
- 5.11.7 Three (3) relaying accuracy class, 1200/5 Ampere, single-ratio current transformers, ANSI Class 10C400, located on the incoming cable side of the circuit breaker for local breaker failure relaying, instrumentation, and remote metering, wired to a terminal block accessible from the front of the cubicle and equipped with shorting bars, GE Type EB-27 or AEU Engineer-approved equivalent.
- 5.11.8 Three (3) metering accuracy class, 1200/5 Ampere, single-ratio current transformers, ANSI Class 0.3B1.8 RF 1.0, located on the bus side of the circuit breaker for local and remote transformer metering, wired to a terminal block accessible from the front of the cubicle and equipped with shorting bars, GE Type EB-27 or AEU Engineer-approved equivalent.
- 5.11.9 One (1) Scientific Columbus JEM10 electronic meter, Model #JEM10\_23109R121511. The meter shall have 3KYZ pulse outputs, a CommRepeater, Analog Output, DNP 3.0 Communication protocol, and an internal recorder.
- The meter shall be wired considering that the AEU phase rotation is C-B-A.
- 5.11.10 One (1) Superior Switchboard and Devices Company test switch with CT and PT connections utilizing the CT designated for instrumentation in this position. This switch shall be a four wire, three-phase back connected flush type, switchboard test switch with a glass insert metal cover, 10 pole, consisting of Superior Switchboard and Devices Company assemblies arranged as follows: 2-11-7-1-7-2-11-7-1-7-2-11-7-1-7-6 reading from left to right, front view with the following colors: red, white, orange, black, white with black tracer, green, white, and blue as shown on AEU Drawing 7D 367.
- 5.11.11 One (1) ammeter, 3-phase, 0-1200 Ampere scale  
Bitronics, Style #ATAIE1 with MOV protection  
Calibration : CT Ratio 1200/5  
Power Supply : 115 V AC  
Faceplate label: Tie Breaker #1 Total Amperes
- 5.11.12 One (1) Superior Switchboard and Devices Company test switch as described in Section 5.8.12.
- 5.11.13 The breaker shall be tripped and locked out by the transformer differential lockout relay (not to be provided under this specification), the 34.5 kV bus differential lockout relay, and the 34.5 kV bus breaker failure lockout relay. Connection points shall be wired to a terminal board for AEU cable connection to connect the remote transformer differential lockout relay trip and lockout contacts to the breaker.

- 5.11.14 One (1) breaker failure relay as described in Section 5.7.13. This relay shall trip the bus tie breaker failure lockout relay as described in Section 5.10.13.
  - 5.11.15 One (1) bus tie breaker failure lockout relay (86BF3) tripped by the breaker failure relay. This lockout relay shall trip and lock out all breakers on the 34.5 kV bus. This lockout relay shall also trip and lockout three (3) circuit breakers external to this switchgear. Spare contacts from this lockout relay shall be brought out to a terminal board for AEU access. This relay shall be an ElectroSwitch Style Number 7810D.
  - 5.11.16 One (1) red indicating light (GE Type ET-16 or ABB Type Minalite) to monitor the bus tie breaker failure lockout relay trip coil. One (1) white indicating light, GE Type ET-16, or ABB Type Minalite, to indicate the breaker failure lockout relay has tripped.
  - 5.11.17 One (1) bus tie breaker failure lockout relay test switch, ABB Type FT-1, Style Number 129A539G01 or AEU Engineer-approved equivalent. Each lockout relay trip output shall be wired through one of the FT-1 test switches.
  - 5.11.18 One (1) circuit breaker DC failure alarm relay (74DCF) with output contacts wired to a terminal block for AEU access. The 74DCF relay shall be an Allen-Bradley Style Number 700-HA32Z01-4.
  - 5.11.19 One (1) bus tie breaker failure scheme DC failure alarm relay (74BF3) with output contacts wired to a terminal block for AEU access. The 74BF1 relay shall be an Allen-Bradley Style Number 700-HA32Z01-4.
  - 5.11.20 Terminal boards for connection by AEU control and current cables (Section 5.13)
  - 5.11.21 Six (6) breaker auxiliary "a" MOC contacts and six (6) breaker "b" MOC contacts wired to AEU accessible terminal blocks for LTC paralleling control schemes. The "a" and "b" contacts shall indicate the breaker is open when the breaker is withdrawn from the cubicle.
  - 5.11.22 An uncut, non-magnetic bottom entrance plate large enough to accept (4) 2" rigid steel control conduits on 3 3/8" centers in the bottom of the cubicle with a clear and accessible path provided between the conduit location and the terminal boards
  - 5.11.23 Switchgear bus terminated with a NEMA 4 hole copper pad for connection by the AEU of the incoming cable from the ring bus with a vertical clearance of 60 inches minimum for separately furnished terminators. NEMA pads shall be provided to terminate up to eight (8) 350 MCM cables per phase.
  - 5.11.24 A 14"x22" minimum size, uncut, non-magnetic metallic bottom entrance plate for exit of the incoming cable from the ring bus and transformer cabling.
- 5.12 Feeder Breaker Position Cubicles 04, 05, 06
- Three (3) outgoing feeder breaker positions with each being a 34,500 V, 3 phase, 4 wire wye, neutral grounded through an eight (8) Ohm grounding resistor, distribution feeder circuit that will enter the switchgear from the bottom shall be provided. The manufacturer shall provide the following equipment mounted and wired into each of these positions:
- 5.12.1 One 34.5 kV power circuit breaker as specified in Sections 4.3 and 5.7, including provisions for remote AEU close and trip contacts and breaker failure relaying.
  - 5.12.2 One (1) circuit breaker control switch, GE Type SB1, Style #16SB1B14 or ElectroSwitch Series 24, Style Number 2444D.

- 5.12.3 Red, amber, green, and white indicating lights with the red light to monitor trip coil 1 only, and the amber light to monitor trip coil 2 only, the green light wired through an auxiliary "b" contact to indicate an open breaker, and the white light to monitor breaker charging motor. These indicating lights shall be GE Type ET-16 or ABB Type Minalite. Tripping diodes shall be provided with the indicating lights to monitor the trip coils separately while allowing the trip coils to operate in parallel. The tripping diodes shall be rated for 30 A continuous current, GE Type 102L218G8 or ABB TRB-2.
- 5.12.4 Three (3) relaying accuracy class, 2000/5 Ampere, single-ratio current transformers, ANSI Class 10C400, located on the feeder side of the circuit breaker with all six (6) connections brought out to a terminal block accessible from the front of the cubicle and equipped with shorting bars, GE Type EB-27 or AEU Engineer-approved equivalent, wired to the appropriate bus differential relays
- 5.12.5 Three (3) relaying accuracy class, 600/5 Ampere, single-ratio current transformers, ANSI Class 10C400, located on the bus side of the circuit breaker with all six (6) connections brought out to a terminal block accessible from the front of the cubicle and equipped with shorting bars, GE Type EB-27 or AEU Engineer-approved equivalent, wired to the local breaker failure and feeder protection relaying.
- 5.12.6 Three (3) relaying accuracy class, 600/5 Ampere, single-ratio current transformers, ANSI Class 10C400, located on the feeder side of the circuit breaker for instrumentation and remote transducers, wired to a terminal block accessible from the front of the cubicle and equipped with shorting bars, GE Type EB-27 or AEU Engineer-approved equivalent.
- 5.12.7 One (1) ammeter/demand ammeter, 0-600 Ampere scale  
Bitronics, Style #AQADC2 with MOV protection  
Calibration : CT Ratio 600/5  
Power Supply : 115 V AC  
Faceplate label: Amperes/Demand
- 5.12.8 One (1) Superior Switchboard and Devices Company test switch as described in Section 5.8.10.
- 5.12.9 One (1) feeder protection relay with the following features:
- A. Performance Requirements.
1. Mounting Semi-flush mounting, drawout case
  2. Inputs: Nominal 5 A, 120 V, 60 Hz
  3. Maximum permissible inputs
    - a) Continuous 10 A
    - b) 1 second 400 A
    - c) 3 second 150 A
  4. Surge withstand ANSI C37.90.1-1989: Impulse test 5 kV peak, 1.2/50 microsec, joules
  5. Insulation Test: 2 kV, 50/60 Hz, 1 minute
  6. Contacts
    - 30 A tripping at 125 V DC
    - 5 A continuous
    - 1 A break resistive
    - 0.3 A break inductive
  7. Operating Temperature: -20° C to +55° C

8. Power Supply
  - a) Nominal 125 V DC
  - b) Range 100 to 140 V DC
9. CT Circuit Burden: less than 0.5 VA at 5 A

10. Setting Ranges:

The following time overcurrent curves shall be available: Inverse, Very Inverse, Extremely Inverse, and Definite-Time. Phase and ground time overcurrent curves shall be independently selectable.

Time overcurrent pickup setting range (both phase and ground):

1 to 12 A in 0.1 A steps (Phase)

0.5 to 2.5 A in 0.1 A steps (Ground)

Time dial setting range - 1 to 10 seconds in 0.1 steps

Instantaneous overcurrent pickup setting range (both phase and ground):

Multiples of Time pickup, adjustable from 1 to 20X in 1.0 A steps.

Both standard and inverse instantaneous characteristics shall be available.

B. Relays for this item are as follows:

Schweitzer Engineering Labs SEL-251, Style #0551003X561XXC or AEU Engineer approved equal.

- 5.12.10 One (1) ground overcurrent relay, very inverse time characteristic, ABB Type CO-9 Style No. 264C901A01 (0.5-2.5 A.T) or General Electric Type IAC53A Model No. I2IAC53A801A (0.5-4.0 A.T).
- 5.12.11 Terminal boards shall be provided for connection by AEU of AEU's control and CT cables (Section 5.13).
- 5.12.12 The breaker shall be tripped and locked out by the bus differential lockout relays, bus breaker failure lockout relay, and both bus tie breaker failure lockout relays.
- 5.12.13 The breaker failure timer relay shall trip the bus breaker failure lockout relay.
- 5.12.14 One (1) breaker failure scheme DC failure alarm relay (74DCF), with output contacts wired to a terminal block for AEU access. The 74DCF relay shall be an Allen-Bradley Style Number 700-HA32Z01-4.
- 5.12.15 An uncut, non-magnetic bottom entrance plate large enough to accept (4) 2" rigid steel control conduits on 3 3/8" centers in the bottom of each feeder cubicle with a clear and accessible path provided between the conduit location and the terminal boards
- 5.12.16 Switchgear bus shall be terminated with a NEMA 4 hole copper pad for connection by the AEU of the outgoing feeder cable with a vertical clearance of 60 inches minimum for separately furnished terminators.
- 5.12.17 A 14"x22" minimum size, uncut, non-magnetic metallic bottom entrance plate for exit of the outgoing feeder cable.
- 5.12.18 Where the manufacturer is allowed the option of furnishing either the ABB, General Electric, or other manufacturer devices, the switchgear manufacturer shall be consistent in his selection of device manufacturers.

### 5.13 Control Wiring Details

- 5.13.1 Current transformer circuits shall be wired to terminal strips equipped with shorting bars, General Electric Type EB-27 or AEU Engineer-approved equivalent. A white marking strip shall be furnished, marked, and attached so that terminal points can be identified.
- 5.13.2 All other control wiring shall be wired to #10-32 barrier type terminal strips properly sized to handle the loads, General Electric Type EB-25 or AEU Engineer-approved equivalent. Terminal boards for control wiring shall be solid molded blocks, rated 600 Volts and a minimum of 30 A per terminal and able to accommodate wire sizes up to and including #10 AWG wire size. Terminal board for terminating customer station service cable shall accept #2 AWG copper and be rated for 115 A. A white marking strip shall be furnished, marked, and attached so that terminal points can be identified.
- 5.13.3 One (1) spare twelve (12) point terminal board shall be provided in each cubicle for AEU use.
- 5.13.4 The use of "plug-in" terminal boards will not be allowed.
- 5.13.5 All wire terminals and exposed conducting parts shall be provided with barriers to prevent personnel injury.
- 5.13.6 All CT wiring shall be No. 10 AWG copper wire, 600 V insulation, NEC THW rated. All other switchgear auxiliary wiring shall be a minimum of No. 12 AWG copper wire, 600 V insulation, NEC THW rated.
- 5.13.7 All wiring shall be flame resistant, oil resistant, heat resistant, and moisture resistant. All wiring shall be complete and performed in a professional, workmanlike manner and bundled or contained.
- 5.13.8 Splices will not be allowed in factory wiring, including CT leads. However, terminal blocks are allowed for point-to-point connection.
- 5.13.9 Wiring shall be run in plastic wireway, Panduit or AEU Engineer approved equivalent, except for short open runs to component terminals.
- 5.13.10 Wiring between cubicles shall run from terminal board to terminal board in each compartment.
- 5.13.11 The auxiliary wiring shall be permanently captivity identified at both ends and routed to the switchgear in plastic wireway, Panduit, or AEU Engineer-approved equivalent. The method of permanently tagging the conductor ends shall be approved by the AEU Engineer. Wire ends shall be permanently fitted with compression type, ring lugs before attaching securely to terminal studs.
- 5.13.12 The manufacturer shall design the layout of the electrical wiring in the switchgear to segregate the manufacturer's wiring from the AEU's wiring. Terminal boards shall be wired with one side reserved for the manufacturer and one side reserved for the AEU. Factory wiring shall not be terminated on the side of the terminal boards reserved for AEU use.
- 5.13.13 All electrical control components shall be clearly and permanently identified with reference designation numbers and/or letters on or near them. These reference designations shall match the wiring and schematic diagrams. The label shall be placed on or near the device so as to be visible from the rear of the panel.

5.14 AEU Connection to External Equipment

- 5.14.1 All wiring leads for connection to external equipment shall be brought to clearly marked vertically mounted terminal boards (TB) in each service position in such a manner that the terminal boards and associated wiring are easily accessible (without the necessity for de-energizing a feeder). A steel barrier must separate the terminal block section of the cubicle and any 34.5 kV equipment. Terminal boards for control wiring shall be twelve (12) point solid molded blocks as outlined in Section 5.13.2.
- 5.14.2 All terminal blocks used for terminating AEU's external cables and wiring shall be totally clear of factory switchgear wiring on AEU's side of these terminal blocks. The only exceptions allowed are current transformer shorting jumpers.
- 5.14.3 Alarm contacts shall be wired so that contact closing indicates an alarm condition. All DC failure alarm contacts shall be paralleled together.
- 5.14.4 Other alarm and control functions normally furnished shall also be wired to AEU accessible terminal boards.
- 5.14.5 A minimum of twelve (12) consecutive spare terminal board points shall be provided in each cubicle accessible for AEU connection.
- 5.14.6 Terminal points requiring connection to external equipment include the following:

A. Cubicles 01 and 07

<u>Number of TB Points</u>	<u>Purpose</u>
* 12	Breaker failure lockout relay output to trip and lockout transformer high side breakers and other switchgear breakers
* 4	Transformer differential lockout relay trip and lockout contacts to breaker from other switchgear
* 2	Bus differential lockout relay contacts for AEU use
* 2	Bus breaker failure lockout relay contacts for AEU use
* 4	Metering currents to remote transducers
* 4	Metering currents from remote transducers
* 4	Transformer differential currents to other switchgear
* 4	Transformer metering currents to other switchgear
* 4	Bus potentials to other switchgear
* 6	Supervisory trip, close, and indication
* 6	DC failure alarms (breaker, bus differential, and breaker failure)
* 12	Auxiliary "a" contacts for OLTC paralleling control scheme
* 12	Auxiliary "b" contacts for OLTC paralleling control scheme
* 12	Spare terminals

Note: \* - Adjacent terminals

B. Cubicles 02

<u>Number of TB Points</u>	<u>Purpose</u>
* 3	120/240 V Station service to AEU (100 circuit)
* 2	Station service AC failure alarm

Note: \* - Adjacent terminals

C. Cubicles 04, 05, 06

<u>Number of TB Points</u>	<u>Purpose</u>
* 4	Metering currents to remote transducers
* 4	Metering currents from remote transducers
* 6	Supervisory trip, close, and indication
* 2	Breaker DC failure alarm
* 2	Feeder protection relay alarms
* 12	Spare terminals

Note: \* - Adjacent terminals

5.15 Accessories

Include all accessories normally furnished. Accessories shall include, but not be limited to, the following:

- 5.15.1 A 125 V DC breaker positioning motor or other tools required to move breakers in and out of operating position.
- 5.15.2 A test device for testing the operation of the drawout circuit breakers while they are fully withdrawn.
- 5.15.3 A ground and test device for use in any circuit breaker cubicle to permit testing or grounding the bus and line circuits. The device is to be mounted on a frame that can be easily rolled in and out of the circuit breaker cubicles by AEU personnel. One (1) ground and test device shall be furnished for each switchgear lineup.
- 5.15.4 One (1) or more 240 V AC non-thermostatically controlled bus duct strip heaters, cubicle strip heaters, and/or cubicle drawout heaters with personnel protective barriers shall be mounted in each cubicle and the bus duct. The heaters shall be rated for operation at 240 V AC but installed to operate at 120 V AC. The total power dissipated in each compartment shall be approximately equal to three (3) Watts per cubic foot of space contained therein. The heaters shall be wired to the station service breaker box through a terminal block mounted not less than six (6) inches away from each heater. The connection between the terminal block and heater shall be made with heat resistant wire approved by the AEU Engineer. The heaters shall be installed in such a manner as to be accessible at all times without requiring a bus and/or an equipment clearance.
- 5.15.5 A portable truck that will enable maintenance personnel to remove or insert the circuit breaker from the switchgear cubicle and place the circuit breaker into the circuit breaker drawout area. The circuit breaker drawout area is the aisle of the enclosure. One (1) portable truck shall be furnished for each line-up of switchgear.
- 5.15.6 As a minimum, the manufacturer shall supply one (1) set of the following spare parts for each switchgear lineup:
  - a. One (1) circuit breaker trip coil
  - b. One (1) circuit breaker close coil
  - c. One (1) circuit breaker spring charging motor
  - d. One (1) circuit breaker vacuum bottle
  - e. One (3) sets of vent filters (Section 5.2.12)
  - f. One (1) station service transformer primary fuse (Section 5.6.4)
  - g. Three (3) PT primary fuses (Section 5.10.3)
  - h. One (1) set of any special tools required to install or maintain the switchgear or circuit breakers (Section 7.7.7)

The manufacturer shall also supply one set per switchgear of the recommended spare parts.



#### 5.16 AEU Drawings and Construction Standards

The following AEU Master Drawings are included as part of this specification:

<u>Drawing Number</u>	<u>Title</u>
7E 723 A	34.5 kV Switchgear Relay One-Line Diagram
7D 367	City of Austin 34.5 kV Switchgear General Arrangement Superior Test Switch Detail Drawing

The following Power Delivery Construction Standard is also included as part of this specification:

<u>Date</u>	<u>Title</u>
05/29/97	Taping Procedure

#### 5.17 Nameplate

- 5.17.1 The manufacturer shall supply all nameplates as specified in the ANSI/IEEE C37.04-1979 (Reaff 1988). All nameplates shall be made from non-rust stainless steel and shall be permanently attached. The information contained on the nameplates shall be inscribed and painted black. All the information shall be in English and in standard non-metric units of measure.
- 5.17.2 The switchgear nameplate shall be mounted on the exterior of the switchgear and shall include, but not be limited to, the following data:
- Manufacturer's name and address
  - Manufacturer's switchgear type and switchgear designation
  - Switchgear serial number
  - AEU Purchase Order (P.O.) number and date of manufacture
  - Electrical characteristics to include:
    - Rated frequency
    - Voltage class
    - Phasing configuration
    - Insulation data
    - Feeder breaker manufacturer, serial numbers, and ratings (voltage class, continuous current, and interrupting capability)
- 5.17.3 The circuit breaker nameplate shall be mounted on the circuit breaker and shall include, but not be limited to, the following data:
- Manufacturer's name and address
  - Manufacturer's circuit breaker type and designation
  - Mechanism type and designation
  - Circuit breaker serial number
  - AEU Purchase Order (P.O.) number and date of manufacture
  - Electrical characteristics to include:
    - Rated frequency
    - Voltage class
    - Insulation data
    - Continuous current rating
    - Interrupting rating

#### 5.18 Material

- 5.18.1 The conductor for all current carrying parts shall be copper or silver-bearing copper.

- 5.18.2 All materials used in the switchgear shall be subject by the manufacturer to rigid quality assurance and control standards. The manufacturer shall have complete traceability on all materials from receiving until final installation in the switchgear. Material tracking and inspection reports shall be made available to the AEU inspector upon demand.
- 5.18.3 The manufacturer shall have conducted an initial vendor inspection and qualifying audit with ongoing spot checks on all materials used in the switchgear. Vendor inspection and audit reports shall be made available to the AEU inspector upon demand. Materials found by the AEU inspector to have not been properly qualified for use by the manufacturer shall, as a general rule, be unacceptable for use in the switchgear. Arrangements satisfactory to the AEU, up to and including the replacement of the non-qualified material, shall be made by the manufacturer.

## 6.0 TEST REQUIREMENTS

The AEU reserves the right to visit the manufacturing facility and to observe the switchgear while undergoing construction and testing. The manufacturer may not charge the AEU for its right to visit the facility during construction and testing. The AEU shall be notified at least three weeks (3) prior to the implementation of the required tests. If three (3) weeks notice is not given before the start of testing, the AEU reserves the right to have the manufacturer delay the testing until the first time in which the AEU inspector(s) assigned to this purchase are available. Furthermore, if the AEU inspector(s) arrives on site and the switchgear is not ready for testing within eight (8) hours, the AEU reserves the right to postpone the testing for up to three (3) weeks.

Delays caused by the AEU exercising its rights as per the above paragraph shall not relieve the manufacturer from meeting the required delivery dates.

- 6.1 The switchgear shall be tested in accordance with ANSI/IEEE C37.20.2-1987 (Reaff 1992). The following tests shall be performed:
  - 6.1.1 Low-Frequency Withstand Tests (Section 5.3.1)
  - 6.1.2 Mechanical Operation Tests (Section 5.3.2)
  - 6.1.3 Grounding of Instrument Transformer Case Tests (Section 5.3.2)
  - 6.1.4 Control Wiring Continuity Tests (Section 5.3.4.1)
  - 6.1.5 Control Wiring Insulation Tests (Section 5.3.4.2)
  - 6.1.6 Polarity Verification (Section 5.3.4.3)
  - 6.1.7 Sequence Tests (Section 5.3.4.4)
- 6.2 The following tests from ANSI/IEEE C37.23-1987 (Reaff 1991) Section 6.3 shall be performed on the bus:
  - 6.2.1 Low-Frequency Withstand Tests
  - 6.2.2 Polarity Verification
- 6.3 The following tests from ANSI/IEEE C37.09-1979 (Reaff 1988) Section 5.1 shall be performed on each circuit breaker:
  - 6.1.1 Nameplate Check (Section 5.6)
  - 6.1.2 Resistors, Heaters, and Coils Check Tests (Section 5.8)
  - 6.1.3 Control and Secondary Wiring Check Tests (Section 5.9)
  - 6.1.4 Clearance and Mechanical Adjustment Check Tests (Section 5.10)
  - 6.1.5 Mechanical Operation Tests (Section 5.11)
  - 6.1.6 Timing Tests (Section 5.12)
  - 6.1.7 Stored Energy System Tests (Section 5.13)
  - 6.1.8 Electrical Resistance of Current Path Tests (Section 5.14)
  - 6.1.9 Low-Frequency Withstand Voltage Tests on Major Insulation Components (Section 5.15)
  - 6.1.10 Low-Frequency Withstand Voltage Tests on Control and Secondary Wiring (Section 5.16)

6.4 The following tests from ANSI/IEEE C57.13-1978 (Reaff 1986) Section 8.0 shall be performed on each potential transformer:

- 6.4.1 Ratio and Phase Angle (Section 8.1)
- 6.4.2 Impedance and Excitation (Section 8.3)
- 6.4.3 Polarity (Section 8.4)
- 6.4.4 Resistance (Section 8.5)
- 6.4.5 Applied Potential (Section 8.8.3)
- 6.4.6 Induced Potential (Section 8.8.4)

6.5 The following tests from ANSI/IEEE C57.13-1978 (Reaff 1986) Section 8.0 shall be performed on each current transformer:

- 6.5.1 Ratio and Phase Angle (Section 8.1)
- 6.5.2 Impedance and Excitation (Section 8.3)
- 6.5.3 Polarity (Section 8.4)
- 6.5.4 Applied Potential (Section 8.8.3)
- 6.5.5 Induced Potential (Section 8.8.4)

6.6 The following tests from ANSI/IEEE C57.13.1-1981 (Reaff 1986) shall also be performed on each current transformer:

- 6.6.1 Insulation Resistance Test (Section 5.0)
- 6.6.2 Winding and Lead Resistance (Internal Impedance) (Section 8.0)

6.7 Control and Power Wiring Tests

Low frequency withstand voltage tests shall be performed on all control and secondary wiring. All low voltage wiring, including relaying, control, and indication wiring, shall be given full functional tests.

Quality control and assurance tests results shall be made available to the AEU inspector upon demand.

6.8 Reports

The manufacturer shall present evidence of quality control testing and proof that the switchgear has passed these tests. The AEU shall approve the switchgear quality control test results before the shipment of the switchgear. All reports shall be in English and in standard non-metric units of measure.

6.8.1 Five (5) sets of the certified test reports shall be provided. The test reports shall be certified by a licensed professional engineer. These reports shall be submitted to the AEU no later than one (1) week after the shipment of the switchgear. The manufacturer shall fax one (1) copy of these reports to the Supervisor, Apparatus Engineering (512 505-7104) no later than one (1) week prior to the shipment of the switchgear. All reports shall be in English and in standard non-metric units of measure.

6.8.2 The test report shall include photographic records of the manufacturing of the switchgear. Both prints (8 ½" x 11" or equivalent size) from 35 mm film and digital images taken by high resolution (600 DPI or higher) digital camera shall be submitted. The camera and associated equipment used to take the photographs shall be approved by the AEU Engineer. Prints shall be made from 35 mm color film with the photographic image taken from a high quality camera (Nikon SLR type or equivalent). Computer printouts from digital images taken from a digital camera shall not be considered as having met the requirements of this section due to poor resolution quality. Digital images shall be submitted in JPEG format on conventional PC FAT formatted 3.5" high density diskettes, IOMEGA Zip Drive compatible diskettes, or Compact Disk-Recordable 74 media.

As a minimum, the following photographs and shall be included:

- a. Photos of the major components including unracked circuit breaker
- b. Photos of the fully assembled switchgear
- c. Photos of the rear of the fully assembled cubicles with rear door open
- d. Photos of the front of the fully assembled cubicles with front door open and relay panel closed
- e. Photos of the front of the fully assembled cubicles with front door open and relay panel open

Photographs from identical units supplied on the same order may be duplicated and provided with each unit's test report.

## 11.0 OTHER REQUIREMENTS

### 11.1 Drawings and Instruction Books

- 11.1.1 Approval drawings and manuals shall be furnished within eight (8) weeks of the receipt of the contract and at least three (3) weeks prior to beginning construction of the switchgear.
- 11.1.2 The manufacturer shall furnish five (5) complete sets of drawings for approval. One (1) set of these drawings shall also be provided in AutoCAD (release 12 or later) .dwg format or .dxf format on 3 ½" diskettes. The manufacturer shall also provide three (3) copies of the operation and maintenance manuals for approval. Partial sets are not acceptable. All the information shall be in English and in standard non-metric units of measure. Each approval drawing set shall include, but not limited to, the following:
- a. Switchgear one-line diagrams
  - b. Switchgear three-line AC and DC schematics, including alarm contacts
  - c. Switchgear internal wiring diagrams, one for each compartment (Point-to-point method is required)
  - d. Bill of material
  - e. Internal schematics of each metering, relaying, and control device as well as internal schematic of the feeder breakers
  - f. Outline drawings including size and location of control and power conduit entrance plates
  - g. Base drawing, including weight and other information necessary for foundation design
  - h. Circuit breaker nameplate drawing
- 11.1.3 The AEU requires fifteen (15) working days after the receipt of approval drawings and manuals to review and return the approval drawings to the factory.
- 11.1.4 The manufacturer shall furnish three (3) sets of "Certified For Construction" electrical, control, and relay drawings. These drawings shall also be provided in AutoCAD (release 12 or later) .dwg format or .dxf format on 3 ½" diskettes. These drawings shall be submitted to AEU no later than one (1) month after review of the approval drawings. The manufacturer shall stamp "CERTIFIED FOR CONSTRUCTION" and the current date on these drawings. All the information shall be in English and in standard non-metric units of measure. The drawing sets shall include, but not limited to, the following:
- a. Switchgear one-line diagrams
  - b. Switchgear three-line AC and DC schematics, including alarm contacts
  - c. Switchgear internal wiring diagrams; one for each compartment (Point-to-point method is required)
  - d. Bill of material
  - e. Internal schematics of each metering, relaying and control device as well as internal schematic of the feeder breakers
  - f. Typical excitation and ratio correction factor curves for all current transformers
- 11.1.5 The manufacturer shall supply two (2) sets of the information and drawings in Sections 7.1.6, 7.1.7, and 7.1.8 on compact disk (CD) in addition to the hard copies listed in those sections. All text documents shall be in Microsoft Word 6.0 format. All drawings and diagrams shall be in a raster image or bit map (.bmp) format. The CD(s) shall be submitted to the AEU no later than two (2) weeks after the shipment of the switchgear.
- 11.1.6 Three (3) complete installation, operating, and maintenance instruction books for each of the switchgear components and each relay and control device. These materials shall be bound in 8 ½" x 11" light weight folders suitable for reference and filing with the particular model supplied clearly noted on documents that apply to more than one (1) type or model. Three (3) spare parts lists with prices and catalog numbers shall also be provided and shall be bound in 8 ½" x 11" light weight folders. The instruction books and spare parts lists shall be submitted to the AEU no later than one (1) month prior to the agreed delivery date of the switchgear. All the information shall be in English and in standard non-metric units of measure.

- 11.1.7 Three (3) complete nameplate drawings, plus one (1) 8½" x 11" copy, shall be submitted to the AEU no later than one (1) month prior to the agreed delivery date of the switchgear. All the information shall be in English and in standard non-metric units of measure.
- 11.1.8 In addition to the instruction books supplied in Section 7.1.6, one (1) set of instruction books, with a complete set of "as built" drawings, shall be packed with the switchgear when shipped. The manufacturer shall stamp "AS BUILT" and the current date on these drawings. The manufacturer shall ship this material in weatherproof packaging. If revisions to the "as built" drawings are necessary, the manufacturer shall pack the latest copy of the "as built" drawings with the switchgear and shall send the revised drawings within two (2) weeks of shipment of the switchgear. All the information shall be in English and in standard non-metric units of measure.
- 11.1.9 Three (3) complete sets of "as built" drawings shall be submitted to the AEU no later than two (2) weeks after the shipment. The manufacturer shall stamp "AS BUILT" and the current date on these drawings. All the information shall be in English and in standard non-metric units of measure.
- 11.1.10 One (1) AutoCAD diskette (in .dxf format or release 12 or later) containing a complete set of "as built" drawings on diskette. These drawings shall be provided in AutoCAD (release 12 or later) .dwg format or .dxf format on 3 ½" diskettes. These drawings shall be submitted to AEU no later than two (2) weeks after shipment of the switchgear. The AutoCAD drawings shall also include complete nameplate information with serial numbers. All the information shall be in English and in standard non-metric units of measure.

## 11.2 Correspondence

All correspondence, after award of contract, shall be directed to: Supervisor of Apparatus Engineering, Austin Electric Utility, Transmission Division, 2526 Kramer Lane, Bldg. "E," Austin, Texas 78758.

## 11.3 Prefabrication Meeting and Single Point of Contact Person

The AEU, at its own discretion, will conduct a prefabrication meeting within three (3) weeks after award of the contract. The manufacturer shall provide a single point of contact person who shall be responsible through out the design, fabrication, and shipment phases. The single point of contact person shall be a representative from the manufacturer's fabrication facility and shall be identified in the manufacturer's bid. This person shall attend the prefabrication meeting, which will be held at the manufacturer's fabrication facility.

## 11.4 Inspection

The AEU reserves the right to visit the manufacturing facility and observe the switchgear while undergoing construction. The manufacturer may not charge the AEU for its right to visit the facility during construction and testing.

The AEU will conduct an inspection after all joints are taped. At this inspection the AEU Inspector will randomly chose a joint and dissect the joint to ensure total compliance with the AEU Taping Procedure. If the joint fails inspection, the manufacturer shall be required to totally re-tape the entire switchgear. NO EXCEPTIONS. This inspection will be conducted for each switchgear on the order.

## 11.5 Shipping and Receiving

- 11.5.1 The switchgear furnished under this specification shall be shipped fully assembled and factory adjusted. All loose parts for each switchgear shall be packaged in the one crate and properly identified (including purchase order item number). Partial shipment of switchgear components is not acceptable.

- 11.5.2 Each crate shall bear a waterproof tag containing the following information:
- a. Purchaser
  - b. Purchase order number
  - c. Purchase order item number
  - d. Manufacturer
- 11.5.3 All crates shall be constructed of wood and shall be suitable for handling with a forklift, overhead crane, or other mechanical means without the need for a pallet. The crates shall be of sufficient strength to withstand stacking two (2) high for outdoor storage for one (1) year.
- 11.5.4 A packing list shall be furnished by the manufacturer including a description and the total number of each item in the crate.
- 11.5.5 The switchgear and all associated crates shall be shipped F.O.B. purchaser's warehouse at 2515 Brockton Drive, No. 101, Austin, Texas 78758, or other designated site within the AEU service area, with full freight allowed and prepaid as designated on the purchase order. The receiving point (purchaser's warehouse) shall be given both a forty-eight (48) hour and a twenty-four (24) hour advance notification of intended delivery. The warehouse phone numbers are (512) 505-7011 (office), (512) 613-3076 (pager), and (512) 505-7130 (fax). No deliveries will be accepted after normal working hours. If proper notice of intent to deliver is not received, then the shipment will be refused. Any additional charges due to the refusal of the shipment shall be the responsibility of the manufacturer.
- 11.5.6 The switchgear will be subject to inspection and acceptance tests before off loading is allowed. The manufacturer shall provide a representative to witness these inspections and acceptance tests. Failure to provide a representative will result in the removal of manufacturer from the qualified supplier's list.
- 11.5.7 A delivery ticket (bill of lading) shall be furnished by the carrier for each shipment showing the customer's purchase order number, the total number of packages in the shipment and the appropriate item number on the purchase order to which each package applies.

## 11.6 Warranty

The manufacturer shall provide a warranty for thirty-six (36) months from date of shipment or thirty (30) months from date of energization, whichever expires first, against all manufacturing and design defects in the equipment (five (5) year non-prorated warranty on the paint). During this period the warranty shall cover the costs of removal, any freight by common carrier in full, and reinstallation after repair. Costs of special, indirect, or consequential damages will be excluded.

## 11.7 Bid Requirements

- 11.7.1 The manufacturer shall furnish a complete bid including two (2) copies of the instruction manual for receiving, installing, testing, operating, and maintaining the switchgear and circuit breakers.

The manufacturer shall also supply two (2) complete copies of the ANSI/IEEE design certified design test reports on the switchgear and circuit breakers. The test reports for the circuit breakers shall be complete as per ANSI/IEEE C37.09-1979 (Reaff 1988). The test reports for the switchgear shall be complete as per ANSI/IEEE C37.20.2-1987 (Reaff 1992) and ANSI/IEEE C37.23-1987 (Reaff 1991).

The manufacturer shall state clearly in the bid what circuit breaker (by manufacturer, type, and model number) the manufacturer will use to meet the requirements of this specification. The circuit breaker must be a certified ANSI design tested circuit breaker. Original Equipment Manufacturer (OEM) certification will be accepted, along with a copy of the ANSI design test report, by the AEU to meet this requirement. The manufacturer will not be allowed to change the manufacturer, type, and/or model number of the circuit breaker which will be used to meet the requirements of this specification after award of the purchase contract without prior written consent of the AEU.

The switchgear that the manufacturer will use to meet the requirements of this specification must have been ANSI design tested. OEM certification will not be accepted by the AEU to meet this requirement.

The circuit breaker that the manufacturer will use to meet the requirements of this specification must be the same circuit breaker with which the switchgear was design tested. The certified design test report for the switchgear must indicate which circuit breaker was in place at the time of the design test on the switchgear. Failure to supply this information may result in the rejection of the manufacturer's bid. The information requested in this section must be supplied with the bid. The manufacturer is not to assume that the AEU has any of this information in its files and the AEU, at its option, may or may not request supplemental information from the manufacturer while evaluating the bids.

- 11.7.2 The manufacturer shall furnish with the bid a firm shipping date after receipt of an order for the switchgear quoted. Failure to comply with the mandatory dates as stipulated on the AEU Bid Sheet may be grounds for rejection of the bid.
- 11.7.3 The manufacturer shall furnish a complete bid including descriptive literature. The type of construction to be used, features of the design, and important accessories shall be described. Catalog numbers or other means of identification shall be furnished. A schematic diagram of the switchgear system shall be provided.
- 11.7.4 The manufacturer shall specify all equipment and material, which is of foreign (non-USA) supply or manufacture in the bid. The manufacturer shall also provide information regarding the availability of spare parts and service for each item of foreign manufacture. General statements are not acceptable.
- 11.7.5 The manufacturer shall provide any special tools that are necessary to install the switchgear or circuit breakers and to perform routine maintenance.

#### 11.8 Handling Provision and Instructions

Manufacturer shall provide lifting eyes or other satisfactory arrangement along with instructions for assembling switchgear units as shipped. The switchgear shall be constructed in such a manner that construction crews will be able to lift and set the units in final position with a crane, without having to "skid" them into place after they are on the foundation.

#### 11.9 Manufacturer Requirements

The switchgear furnished under this specification shall be completely factory assembled, wired, and tested requiring only the connection of the external power source, external DC control voltage, and external control and CT cables to put the switchgear into service.

The manufacturer shall supply written guarantees that the manufacturer will support the switchgear and circuit breakers supplied to meet the requirements of this bid for a minimum of twenty years. The manufacturer shall also supply written guarantees spare parts shall be readily available for the switchgear and circuit breakers supplied to the meet the requirements of this bid for a minimum of twenty years. These guarantees shall be supplied with the manufacturer's bid submittal.

#### 11.10 Special Requirements

The manufacturer must be represented in the U.S.A. by a domestic entity, which shall assume all responsibility for the equipment and shall indicate financial resources for providing this responsibility. Furthermore, this entity shall provide permanent operating and maintenance staff and permanent service and repair facilities under its direct ownership in the mainland U.S.A. The manufacturer shall also maintain a complete and ready inventory of spare parts in the mainland U.S.A. The AEU reserves the right to visit and inspect these facilities prior to awarding a contract. Subcontracting for after installation service will not be acceptable.



Service Bulletins shall be provided to the AEU. The manufacturer shall be responsible for providing any and all service bulletins/advisories on the switchgear, circuit breakers, and protective relaying provided after delivery. This is to be an ongoing process provided by the manufacturer to keep the purchaser informed of any mechanical and/or electrical problems which may cause breakdown or failure of the equipment, or more importantly, jeopardize personnel working near the equipment. This service shall continue beyond the standard warranty period and any fee for this service shall be included in the purchase price of the switchgear. This correspondence shall be sent to the Supervisor of Apparatus Engineering, Austin Electric Utility, Transmission Division, North Service Center, 2526 Kramer Lane, Bldg. "E," Austin, Texas 78758.

#### 11.11 Manufacturer Qualification and Bid Award Process

The AEU will award the bid based upon low qualified evaluated bid meeting the requirements of Specification E-1271 and the Bid Sheet. The bids will be evaluated as per the requirements outlined in Specification E-1271. The apparent low evaluated bidder meeting the requirements of Specification E-1271 and the Bid Sheet will be further evaluated to ensure that the bidder meets the AEU's minimum standards for qualified bidders on this type of equipment. The evaluation of the apparent low bidder will take place at the bidder's manufacturing facility. The evaluation will be conducted by a team of AEU Engineers. The following criteria will be evaluated:

- 11.11.1 Technical Organization
- 11.11.2 Analytical Capability
- 11.11.3 Manufacturing Facilities and Personnel
- 11.11.4 Manufacturing Processes
- 11.11.5 Test Facilities and Personnel
- 11.11.6 Quality Control and Quality Assurance
- 11.11.7 Record of Performance
- 11.11.8 Field Service

If the apparent low bidder passes the evaluation, the bidder will be recommended for award of the contract. If the apparent low bidder does not meet the minimum acceptable requirements of the AEU, the next highest low evaluated bidder meeting the requirements of Specification E-1271 and the Bid Sheet will be further evaluated to ensure that that bidder meets the AEU's minimum standards for qualified bidders on this type of equipment. This process will continue until the low qualified evaluated bid is found by the AEU.

ATTACHMENT I

34.5 kV SWITCHGEAR RELAY ONE-LINE DIAGRAM

ATTACHMENT II

CITY OF AUSTIN POWER DELIVERY - SUBSTATIONS DESIGN REFERENCE MANUAL  
TAPING PROCEDURES  
REV.: 5/29/97

ATTACHMENT III

Typical AC Control Schematic

ATTACHMENT IV  
Typical DC Control Schematic