AUSTIN ENERGY ELECTRIC UTILITY DEPARTMENT

PURCHASE SPECIFICATION

FOR

SWITCHGEAR, NTWK, VAULT, 15KV, INDOOR, ARC-RESISTANT

Date	Prepared by	Issuance/ Revision	Department Approval Division Manager/Standards Manager
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This specification, until revised or rescinded, shall apply to each future purchase and contract for the service described herein.

CITY OF AUSTIN ELECTRIC UTILITY DEPARTMENT

PURCHASE SPECIFICATION

FOR

15 kV INDOOR, ARC-RESISTANT SWITCHGEAR

TABLE OF CONTENTS

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TABLE OF CONTENTS

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FOR

15 KV INDOOR ARC-RESISTANT SWITCHGEAR

1 SCOPE AND CLASSIFICATION

1.1 The City of Austin Electric Utility Department d/b/a Austin Energy (AE) sets forth this specification as the minimum requirements for operating characteristics and safety features for two (2) 15 kV metal-clad, arc-resistant Type 2 switchgear.

1.2 This specification covers indoor, 3 phase, 4-wire, 12,470 Volt wye, solidly grounded neutral arc-resistant switchgear, circuit breakers and bus duct. The switchgear shall include all control and protection wiring associated with the functions covered in this specification and attached drawings.

1.3 The switchgear will be installed in a weatherproof control room in an outdoor electric utility substation below an altitude of 1,000 meters and subjected to an annual ambient temperature variance of -25° C to +40° C at 100% humidity. The average temperature for any twenty-four hour period will not exceed 30° C. The contractor shall design the switchgear to withstand the solar radiation (see ANSI/IEEE C37.24) that the switchgear will be exposed to in the Austin, Texas area.

1.4 The first switchgear will be throat connected to a 12.47 kV transformer and will be used to distribute the power of the connected transformer into four (4) distinct circuits. The second switchgear will be cable connected to a 12.47 kV transformer and will be used to distribute the power of the connected transformer into four (4) distinct circuits. Each switchgear will be equipped with a main breaker at the entrance to the gear from the transformer and shall include a bus tie-breaker capable of tying the gear to other switchgear units. The power transformer is not covered under this specification.

1.5 The switchgear submitted in response to this specification shall have been successfully tested in accordance with ANSI C37.20.7.

2 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 specification, the AE Specification shall govern. The applicable standards include, but shall not be limited to the following:

2.1 Power Switchgear, Circuit Breakers and Fuses
ANSI/IEEE C37

2.2 Current Transformers, Voltage Transformers
ANSI C57

2.3 NEC Article 300 Wiring Methods

3 FUNCTIONAL REQUIREMENTS

The switchgear will be used to provide four 12,470 Volt wye, 4-wire, solidly grounded neutral, 3 phase electric utility distribution circuits from the 12,470 Volt secondary of a separate transformer. The functions that the switchgear shall perform include, but are not limited to, the following:

3.1 Independent on and off switching of each distribution circuit
3.2 Fault protection for each distribution circuit
3.3 Metering for each circuit and for the transformer
3.4 Fault protection for each bus in the switchgear
3.5 Fault protection for the power transformer feeding this switchgear.
3.6 Breaker Failure protection and control for all breakers
3.7 Breaker Failure protection and control for circuit switcher(circuit switcher not included)
3.8 Cable Differential protection for tie breaker circuits

4 PERFORMANCE REQUIREMENTS

4.1 General

The switchgear shall be designed, constructed, and tested in accordance with ANSI/IEEE C37.20.2 and other applicable standards. The switchgear shall meet the minimum requirements for metal-clad (MC) class switchgears.

4.2 Bus-connected equipment minimum requirements:

Nominal voltage class, rms:	13.8	kV
Maximum operating voltage, rms:	15	kV
Short time withstand, rms:	36	kV
Impulse withstand (BIL), peak:	95	kV
Momentary current, Asym rms:	58	kA
Continuous current at 60 Hz @40°C, rms:	2000	A

4.3 Bus and Bus Duct

All bus shall be of a non-segregated design. All bus and bus duct shall be rated as follows:

Maximum operating voltage, rms:	15	kV
Short time withstand, rms:	36	kV
Impulse withstand (BIL), peak:	95	kV
Momentary current, Asym rms:	58	kA
Main bus Continuous Current rating (60 Hz)	2000	A

4.4 Power Circuit Breakers-Main

The power circuit breakers shall have vacuum interrupters, be three-phase and shall have the following ratings as per C37.04, C37.06 and C37.09.

Nominal voltage class, rms:	13.8	kV
Maximum operating voltage, rms:	15	kV
Voltage range factor, K:	1.0	
Power Freq lightning frequency withstand, rms:	36	kV
Impulse withstand, peak:	95	kV

Continuous current at 60 Hz, rms:	2000	A
Interrupting time:	3/50	cycles/ms
Permissible tripping delay, Y:	2	seconds
Maximum symmetrical interrupting capability, rms:	36	kA
Short-time current carrying capability, rms:	36	kA
Closing and latching capability, crest:	97	kA pk
Back to back capacitor switching	1640	A

4.5 Power Circuit Breakers- Tie

The power circuit breakers shall have vacuum interrupters, are three-phase and shall have the following ratings as per C37.04, C37.06 and C37.09.

Nominal voltage class, rms:	13.8	kV
Maximum operating voltage, rms:	15	kV
Voltage range factor, K:	1.0	
Power Freq lightning frequency withstand, rms:	36	kV
Impulse withstand, peak:	95	kV
Continuous current at 60 Hz, rms:	2000	A
Interrupting time:	3/50	cycles/ms
Permissible tripping delay, Y:	2	seconds
Maximum symmetrical interrupting capability, rms:	36	kA
Short-time current carrying capability, rms:	36	kA
Closing and latching capability, crest:	97	kA pk
Back to back capacitor switching	1640	A

4.6 Power Circuit Breakers-Feeder

The power circuit breakers shall have vacuum interrupters, are three-phase and shall have the following ratings as per C37.04, C37.06 and C37.09.

Nominal voltage class, rms:	13.8	kV
Maximum operating voltage, rms:	15	kV
Voltage range factor, K:	1.0	
Power Freq lightning frequency withstand, rms:	36	kV
Impulse withstand, peak:	95	kV
Continuous current at 60 Hz, rms:	1200	A
Short circuit current at maximum voltage, rms:	36	kA
Interrupting time:	3/50	cycles/ms
Permissible tripping delay, Y:	2	seconds
Maximum symmetrical interrupting capability, rms:	36	kA
Short-time current carrying capability, rms:	36	kA
Closing and latching capability, crest:	67	kA

4.7 Power Source

This switchgear will be connected to a transformer rated as follows:

Capacity:	18/24/30 MVA
Impedance:	9.81 % on 30 MVA base
Primary Voltage	138 kV delta
Secondary Voltage:	12.47/7.2 kV wye with LTC
Primary BIL:	650 kV
Secondary BIL:	150 kV

The wye secondary neutral will be solidly grounded. For purposes of calculations, an infinite primary bus should be used.

5 MATERIAL REQUIREMENTS

5.1 Arrangement

The switchgear shall be arranged as a single line-up of metal-clad, Arc-Resistant Type 2 cubicles in a weatherproof enclosure in accordance with IEEE C37.20.7. The switchgear line-up shall include the following positions in the order listed starting with the cubicle adjacent to the transformer. See drawing E-1701-3.

a. Transformer Differential Relay Cubicle 01
b. Main transformer breaker Cubicle 02
c. Bus Tie breaker Cubicle 03
d. Instrumentation Cubicle 04
e. Outgoing feeder breaker Cubicle 05
f. Outgoing feeder breaker Cubicle 06
g. Outgoing feeder breaker Cubicle 07
h. Outgoing feeder breaker Cubicle 08

5.2 Control Room

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

5.2.2 The following provisions apply to the switchgear enclosure:

A. The enclosure shall have an access door located at each end of the aisle. The doors shall have doorstops, wind latch, and a "Panic Exit Device". The doors shall have provisions for outside locking but shall be arranged so that they can be opened from inside even when locked from outside. The doors shall be equipped with weather-stripping in order to keep insects and dust out and a constant temperature inside.

B. A minimum of three 48-inch industrial type, rapid start two (2) tube, fluorescent lights shall be provided. They shall be mounted parallel to the length of the aisle. Two three-way light switches shall be installed on the inside of the aisle, one (1) near each door. The lighting shall be pre-wired to an independent circuit off the station service bus. The contractor shall ensure that the enclosure is adequately lighted such that it complies with all applicable OSHA regulations.

C. Three (3) 120 Volt AC convenience outlets, three-wire grounding type, with a Ground Fault Current Interrupting (GFCI) device shall be provided. The outlets shall be placed on or near cubicle 1 transformer differential panel, on or near the last feeder cubicle, and on the instrumental panel 4. Each outlet shall be pre-wired to an independent circuit off the station service bus.

D. The enclosure floor shall consist of steel plates of adequate strength to support the weight of any item of draw-out equipment with a maximum deflection of 0.125 inches.

E. The enclosure shall have adequate aisle space for easy withdrawal and insertion of all draw-out equipment.

F. The enclosure shall be constructed of 14 ga or thicker galvanized steel and shall be weatherproof in accordance with ANSI/IEEE C37.20.2.

G. The enclosure shall be designed for concrete beam, pier, or slab type foundations.

H. The underside of the enclosure shall be undercoated with an asphaltic base material to prevent rusting.

I. The enclosure shall be weatherproof and insulated with a minimum insulation level of R-11.

J. Except for the station service transformer, all 12.47 kV voltages in the switchgear shall be separated from all lower voltages by a steel barrier.

K. The contractor shall provide a vertical, self-contained, wall mounted HVAC unit mounted on the inside wall of the control room. The unit shall be rated for 230 Vac, single phase 60 Hz. The unit shall have a minimum rating for 57k BTU/h, 110k w Heat with thermostat. The contractor shall inform Austin Energy if a larger unit is necessary to meet item 1.3 of this specification.

L. The outside front and rear compartment doors are to be hinged 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. The doors shall be capable of withstanding an internal arcing fault as proven by successful testing in accordance with ANSI C37.20.7.

M. The outside doors described in section 5.2.2 (L) shall provide direct access to the rear compartments without any intermediate doors or covers.

N. The door hinges shall be mounted such that the doors cannot be removed unless the door is open. Captive fasteners shall not be used.

O. The front and rear cubicle doors shall be equipped with provisions that can be locked.

P. The doors shall be sufficiently rigid to prevent warping of the doors and to insure positive operation of the doors and latches.

Q. Devices mounted on the inner cubicle doors shall be labeled with nameplates. Nameplates shall have a black surface with a white core, and shall be secured to the doors and panels. Nameplate schedule shall be supplied at design review meeting.

R. Inside cubicle doors shall have single point handles for opening and closing high voltage compartment doors rather than bolts or screw knobs. These handles shall be capable of meeting arc-resistant testing with no special hardware required to latch and secure.

S. All 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 AE engineer approved equivalent.

T. Open-cell foam rubber and RTV silicone rubber are not acceptable as gasket material for the purpose of weatherproofing.

U. The switchgear and bus duct, including the base, shall be designed such that, after installation, there will be no permanent deformation caused by shipping or handling.

V. One 24 port fiber wall box, fms Technologies model #PWLX1024/ST-62P, with 24 ST adapters and 24 pigtails.

W. Paint Requirements

1 The switchgear shall be painted inside and outside. Painting of non-rust stainless steel and hot dipped galvanized steel surfaces are not required. However, the contractor must achieve a consistent color and finish over the entire switchgear. If the contractor proposes to use of non-rust stainless steel or hot dipped galvanized steel surfaces, the contractor shall indicate this in the bid and shall provide a written guarantee that these surfaces will be consistent in color and finish.

2 The finish coat shall be ANSI No. 70 light gray.

3 The inside control cubicles shall be finished with a Federal Std. No. 595-A White No. 7875 paint. The aisle ceiling on the walk-in enclosures shall also be finished with a Federal Std. No. 595-A White No. 7875 paint.

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 All primer and paint shall be lead free.

6 The contractor 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. AE will exercise reasonable care in ensuring that the finish is protected during installation and will follow the contractor's receiving instructions on paint touchup. The contractor shall also provide a five (5) year non-prorated warranty on all cast aluminum, non-rust stainless steel, and hot dipped galvanized steel surfaces.

7 The contractor shall supply two (2) spray cans of touchup paint per switchgear.

5.3 Bus

5.3.1 All phase bus bar used in the switchgear 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.

5.3.2 All bus shall be supported with cycloaliphatic insulating material or AE engineer approved equivalent. All phase bus shall be covered with 15kV non-tracking, flame retarding insulation. All bolted bus bar connections shall be insulated. The contractor and AE engineer shall decide jointly if the temperature rise test is needed. No plastic or other type of insulating boots will be allowed which does not completely seal the connection.

5.3.3 All phase bus bar connections shall be bolted with a minimum of four (4) bolts equipped with stainless steel bolts, nuts, washers, and bevel washers.

5.3.4 The phase bus in all outgoing feeder compartments shall be provided with a NEMA 4 hole copper pad for connection by AE of the outgoing feeder cable with a vertical clearance of 60 inches minimum for separately furnished terminators.

5.3.5 Switchgear shall be equipped with special hardware for electrically grounding the 12.47 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 contractor shall include one (1) right-angled stud, J-Ro Tool P/N 87002, or AE approved equal, on each of the three buses connecting the 12.47 kV power circuit breakers. In addition, one (1) straight stud J-Ro Tool P/N 87003, or AE approved equal, shall be mounted on an extension of the ground bus, as specified in Section 5.3.6 A, in each circuit breaker cubicle. These studs shall be mounted to provide a clear and unobstructed path to the rear of the cubicle. The contractor 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.

5.3.6 Neutral/Ground Bus

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 bar from the power transformer and shall be continuous (without interruption) through all of the switchgear cubicles. This ground bus shall be located low at a position close to the exit cable ground and shall have a good electrical connection to the switchgear. The current carrying capacity of these connections shall be equal to the current carrying capacity of the neutral bus bar.

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 contractor 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. All ground bus connections shall be bolted with a minimum of two (2) bolts equipped with stainless steel bolts, nuts, washers, and bevel washers.

5.3.7 Transformer Connection (Bus Duct)

A. Bus duct shall be included to connect the switchgear main bus to the transformer secondary terminals. The bus duct shall include bolted flexible disconnect links in the phase and neutral bus and a removable covering to provide access to the disconnect links. The transformer switchgear connection shall be as shown on AE Drawing 7D 283-1 and R14.W1.

B. The bus duct enclosure shall be constructed of 14 MSG or thicker steel and shall be weatherproof in accordance with ANSI/IEEE C37.20.2 and ANSI/IEEE C37.23.

C. Bus duct neutral bus bar shall be a 1/4" x 2" copper bar and shall have a good electrical connection to the bus duct housing. The neutral bus bar shall extend through the throat and be bolted on bronze fittings which are permanently connected to the bus duct housing. The current carrying capacity of these connections shall be equal to the current carrying capacity of the neutral bus bar. A connection of this type is to be made as close as practical to each end of the bus duct and shall have a maximum distance of three (3) feet between connections along the length of the bus duct.

D. The contractor shall make a penetration of the bus duct housing with the neutral bus and shall attach the neutral bus to a NEMA two (2) hole copper-plated steel pad mounted on the exterior of the bus duct housing. The penetration and pad shall be located as close to the transformer as practically possible. The contractor shall exercise care in assuring the waterproof integrity of the bus duct is maintained. For grounding the neutral bushing, a path from the neutral bushing to a ground pad at the switchgear base shall be delineated. The contractor shall supply one (1) bolt connectors securely attached to the exterior of the bus duct and the switchgear enclosure, spaced at no more than five (5) foot intervals, and suitable for securing 500 MCM stranded copper cable from the externally mounted steel pad to the ground pad on the base of the switchgear.

5.4 DC Control Power

5.4.1 AE 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.

5.4.2 The closing and tripping control power for the breakers shall be supplied from the 125 V DC. 125 V DC shall be from AE’s station service batteries. Batteries are not to be furnished under this specification. Stored energy devices utilizing DC motors are permitted under this specification.

5.4.3 The alarm circuits and other DC control equipment shall operate from 125 V DC.

5.4.4 125 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 in the station service panel.** All molded circuit breakers shall have an interrupting rating of 10 kA.

5.4.5 The contractor shall provide a main circuit breaker to which AE will connect the switchgear DC station service cable. This breaker shall be a 2 pole, 250 Volt DC, 100 Amp continuous, 10 kA interrupting circuit breaker. The contractor shall determine the adequacy of the size of this breaker and shall notify the AE if a different size is required. The contractor shall provide the appropriate number of DC distribution panels supplied by the DC service main circuit breaker with provisions for, but not be limited to, the following loads:

A. Two (2) DC circuit breakers per 12.47 kV breaker for DC trip (20 A)
B. One (1) DC circuit breaker per 12.47 kV breaker for DC close (10 A)
C. One (1) DC circuit breaker per protective relay circuit.
D. One (1) DC circuit breaker per lockout relay.
E. One (1) DC circuit breaker for circuit switcher close
F. One (1) DC circuit breaker for circuit switcher trip #1
G. One (1) DC circuit breaker for circuit switcher trip #2
H. One (1) DC circuit breaker for transformer controls
I. Other 125 Volt DC switchgear accessories
J. One (1) DC circuit breaker for the DAQ RTU.
K. One (1) DC circuit breaker for the 12.47 breaker charging motor
L. A minimum of five (5) spare DC circuit breakers (20 A)

DC supplies for Circuit switcher trip and close shall be wired to a test switch per section 5.7.1 (I) in cubicle 1 for wiring by Austin Energy.

5.5 AC Control Power

5.5.1 Single-phase AC control power transformer with 50 kVA capacity shall be provided and connected to the incoming service bus.

5.5.2 The AC control power transformer shall be 7200-120/240 Volts with two (2) 2-1/2% taps above and below rated high side voltage. The transformer shall be a dry-type and shall have 95 kV BIL insulation.

5.5.3 The primary side of the AC control power transformer shall be connected to phase B (as defined in Section 5.8.1B) of the incoming 12.47 kV bus.

5.5.4 The AC control power transformer shall be fused with a current limiting fuse arranged on a drawout mounting. One (1) spare fuse shall be furnished by the contractor.

5.5.5 The AC control power transformer shall be connected to a 120/240V AC 200A NEMA I manual transfer switch. Provisions shall be made to allow AE to connect an alternate AC power source to the switch in case of failure of the internal transformer.

5.5.6 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 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 in the AC station service panel.** All molded circuit breakers shall have an interrupting rating of 10 kA.

5.5.7 The contractor shall provide AC service main circuit breaker to which the manual transfer switch shall be connected. This breaker shall be a 2 pole, 120/240 Volt AC, 200 Amp continuous, 10 kA interrupting circuit breaker. The contractor shall determine the adequacy of the size of this breaker and shall notify the AE if a different size is required. The contractor shall provide switchgear AC distribution panel(s) supplied by the AC service main circuit breaker through a manual transfer switch with provisions for, but not be limited to, the following loads:

A. Switchgear and bus duct heaters
B. Circuit breaker charging motor (6)
C. Aisle lights
D. Convenience outlets (3)
E. Other 120/240 Volt AC switchgear accessories
F. Main power transformer fans, pumps, LTC drive (2 pole, 240 Volt, 50 Amp circuit)
G. AE station service (2 pole, 240 Volt, 100 Amp circuit)
H. Circuit Switcher Charging Motor
I. A minimum of five (5) spare AC circuit breakers (30 A)

5.5.8 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 AE access. This relay shall be an Allen-Bradley HA-700 series relay or Austin Energy engineer approved substitute.

5.6 Power Circuit Breakers

5.6.1 The power circuit breakers shall have an interrupting medium of vacuum.

5.6.2 The power circuit breakers shall be drawout type and mounted on a frame that can be easily rolled in and out of the switchgear cubicles. The 12.47 kV circuit breaker racking mechanism shall permit closed-door racking in and out of the circuit breaker.

5.6.3 The power circuit breakers shall be identical and interchangeable with other power circuit breakers. The lower rated breaker shall not be able to be inserted into the higher rated cubicle.

5.6.4 Vertical stacking of power circuit breakers is not acceptable.

5.6.5 The power circuit breakers shall be spring operated. Hydraulic type or electric solenoid type will not be accepted.

5.6.6 The spring winding motor shall be a universal motor. The universal motor shall be rated 120 V AC and 125 V DC with an automatic transfer device. Primary feed for the universal motor shall be 120 V AC.

5.6.7 The power circuit breakers shall be automatically tripped and discharged mechanically and electrically when withdrawn from the cubicle. The breaker shall not be allowed to be inserted while closed.

5.6.8 The cubicle doors shall be equipped to open the breaker under emergency conditions while the doors remain closed.

5.6.9 Interlocks shall be included to prevent opening of cubicle doors while the breaker is in the connected position. Interlocks shall prevent racking a circuit breaker into a cubicle with the door in the open position.

5.6.10 Power circuit breakers shall be designed and constructed to prevent pumping.

5.6.11 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.

5.6.12 The power circuit breakers shall be provided with a latch check switch and dual independent trip coils.

5.6.13 Six extra "a" and six extra "b" MOC contacts shall be provided with each breaker and shall be connected to a AE accessible terminal strip. Contacts should be accessible without having to remove the breaker.

5.6.14 The power circuit breakers shall be wired to permit remote supervisory control and indication utilizing SEL relays and remote terminal unit. Auxiliary “a” and “b” switches shall be wired to the SEL relays to indicate breaker position.

5.6.15 All current transformers shall be connected such that the polarity markings are away from the breaker.

5.6.16 The power circuit breakers shall be wired to trip and prevent automatic reclosing from the lockout relay contacts in the switchgear.

5.6.17 Each power circuit breaker shall be wired to trip and prevent automatic reclosing from its under frequency relay.

5.6.18 The power transformer tap changer lockout control during breaker reclosing sequences shall be obtained by wiring a set of normally closed contacts from main breaker protection relay, in series with each other and connected to the wiring from the transformer tap changer control lockout brought into the totalizing cubicle. AE access to this wiring and these connections shall be provided.

5.6.19 Operation counter, to register only the opening stroke of the circuit breaker operating rod.

5.6.20 Visual open/close indicator located on the circuit breaker front panel.

5.6.21 Visual spring charged/discharged indicator located on the circuit breaker front panel.

5.6.22 Provisions shall be made such that the breaker cubicle doors must be closed in order to rack the breaker into the connected position. Racking the breaker in and out shall not be possible with the cubicle door open.

5.7 Transformer Differential/Circuit Switcher Relay Cubicle 01

5.7.1 One relay panel wired for transformer differential and circuit switcher protection and control per the one line schematic shown in 7BXXXXR2.X. Protective relays shall be mounted at heights reachable by AE technicians without the use of ladders or step stools. The following shall be included in this panel.

A. One (1) SEL 387 transformer differential relay, style #0387613x532x4x1 shall be installed to protect the transformer described in Section 4.5. The alarm contact shall be configured to be N.O. All relay inputs and outputs shall be wired as per DC schematics 7B XXXX R4A.X6**.**

B. One (1) Schweitzer Engineering Labs SEL-351S relay, Style #0351S713B355421 for high side O/C relay, circuit switcher fail, O/C inhibit for the circuit switcher. Tripping diodes type ABB TRB-1 shall be used to isolate supervisory and local control switch operations from breaker fail initiate circuitry. Alarm contact shall be configured to be N.O., OUT106 shall be Form B and OUT211 shall be Form B. All relay inputs and outputs shall be wired as per DC schematics 7B XXXX R4A.X3.

C. A SEL-2030 (Part No. 203033X344E1XX) shall be installed in totalizing cubicle. The SEL-2030 shall be powered from 125VDC source through fuses. All inputs and outputs shall be wired to test blocks. All SEL relays in Cubicle 1, 2, 3 shall have RS232 communication ports wired to the SEL-2030 via SEL-2810 transceivers.

D. One (1) SEL 2100 (Part No. SEL-2100XX3443) Protection Logic Processor , 38-200VDC OR 85-140 VAC, 16 inputs and 4 outputs I/O board, SVDC control power, 1 Alarm Contact, Horizontal mount.

E. One Electroswitch lockout relay, type 7810D (86T) to be tripped by the transformer differential relay described in 5.7.1A. N.O. contacts from the lockout relay shall be wired to an ABB type FT-1 or AVO equivalent potential test switch as per drawing 7B XXXX R4A.X5. Two spare N.O. contacts shall be wired to the test switch.

F. Red and amber indicating lights with the red light to monitor lockout coil only, the amber light to monitor lockout trip only. The indicating lights shall be GE Type ET-16 with LED bulbs.

G. One remote terminal unit with the following specifications:

1) Processor and motherboard with capacity to operate all listed below required and future I/O (DAQ# DXC15)
2) Dual Voltage fused power supply capable of accepting 120VAC and 125VDC
3) (4) External Communication Boards with Ethernet Port (DAQ# IoE2)
4) (4) Communication Termination Boards each with (4) DB9-M Serial Ports (DAQ# IoET1)
5) (1) Control Output Multiplexer Board (DAQ# IoC1)
6) (2) Control Output Termination Boards each with (4) latching Form C output points (DAQ# IoCT3)
7) (2) Control Output Termination Boards each with (4) momentary "On/Off" (2 N.O. independent contacts) output points (DAQ# IoCT3)
8) (1) Digital Input Multiplexer Board (DAQ# IoD1)
9) (2) Digital Input Termination Boards each with (8) digital input points (DAQ# IoDT1)
10) Provide space and connection ports for the following additional boards:
11) (1) External Communication Boards with Ethernet Port (DAQ# IoE2)

12) (1) Communication Termination Boards each with (4) DB9-M Serial Ports (DAQ# IoET1)
13) (1) Control Output Multiplexer Board (DAQ# IoC1)
14) (1) Control Output Termination Boards each with (4) latching Form C output points (DAQ# IoCT3)
15) (1) Control Output Termination Boards each with (4) momentary "On/Off" (2 N.O. independent contacts) output points (DAQ# IoCT3)
16) (1) Analog Input Multiplexer Board (DAQ# IoA1)
17) (1) Analog Input Termination Boards each with (8) digital analog points (DAQ# IoAT1)
18) (1) Digital Input Termination Boards each with (8) digital input points (DAQ# IoDT1)
19) All terminals shall be capable of terminating (2) #10 AWG conductors.
20) RTU shall be capable of communicating with the SEL relays directly using DNP and capable of passing critical analog, status, and alarm data to AE's SCADA System.
21) RTU will be used to provide the following hard-wired status and control signals:
22) Circuit Switcher, Main, Tie, and all Feeder Breaker Trip and Close Momentary Control
23) All Feeder Breaker Reclose and Ground Fault Protection Cut Out Latching Control
24) Status of Circuit Switcher High Priority, Low Priority, Annunciator DCF Alarms and Circuit Switcher Open/Close Indication
25) Sump Pump Alarm
26) Transformer LTC Auto/Remote Latching Control
27) Transformer LTC Local/Remote Indication
28) Transformer LTC Raise/Lower Momentary Control
29) Future Capability for Status of Transformer High Priority, Low Priority, Annunciator DCF Alarms

H. All SEL relays shall have ABB type FT-1 or AVO equivalent test switches installed to isolate voltages and currents. The test switch shall have clear covers which can be used with the switch in the open position.

I. The manufacturer shall include six (6) test switches, AVO style C3-212-A, for transformer and circuit switcher controls and alarms. The test switches shall be 12 pole potential type switches.

J. Screw type terminal boards for connection by Austin Energy of control and CT cables shall be provided.

5.8 Transformer Main Breaker Cubicle 02-2000A

5.8.1 One incoming service position to receive incoming 12.47 kV, 3 phase, 4 wire solidly ground service from the power transformer shall be included in the Transformer Main Breaker Cubicle. This cubicle shall also contain the following equipment mounted on the front door and wired according to the one line schematic 7B XXXX R2.X.

5.8.2 Wire tags shall be used for door wiring as well as cubicle wiring

5.8.3 Three (3) 8.4 kV MCOV class, single pole, station class, polymer-housed metal oxide surge Arresters to protect the transformer low-side and all bus-connected equipment. All surge arrester ground wire shall be 2/0 Copper or larger. All surge arresters shall be

mounted in the cubicle such that the arrester may be removed and re-installed without removal of other equipment. All surge arresters shall be mounted with the polymer skirts pointed downward to prevent excessive dust accumulation on the surge arrester.

The surge arrester shall be manufactured by Hubbel-Ohio Brass, Cooper, or ABB. The BIL of the external surge arrester housing shall have a 95 kV rating.

The contractor shall exercise care in assuring that the arresters installed in the switchgear are designed, constructed, and tested in accordance with ANSI/IEEE C62.11.

5.8.4 One 12.47 kV, 3000A power circuit breaker as specified in Sections 4.4 and 5.6, including provisions for remote supervisory control

5.8.5 Red, amber, green, and white indicating lights with the red light to monitor trip coil 1 only, 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. The indicating lights shall be GE Type ET-16 with LED bulbs. Tripping diodes shall be provided to monitor the relay manual pushbutton trip and close contacts.. The tripping diodes shall be ABB TRB-2 rated for 30 Amps continuous current.

5.8.6 Three (3) relaying accuracy class, 2000/5 Ampere, multi-ratio current transformers, ANSI Class 10C200, located on the transformer 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), for connection to bus differential relays inside this switchgear. CT’s shall be installed so that the polarity marks are away from the breaker.

5.8.7 Three (3) relaying accuracy class, 2000/5 Ampere, multi-ratio current transformers, ANSI Class 10C200 wired to terminal blocks accessible from the front of the cubicle and equipped with shorting bars (GE Type EB-27) 10C200, for transformer overcurrent relaying and breaker fail relaying located in this cubicle. Current transformers shall be located on the transformer side of the circuit breaker. CT’s shall be installed so that the polarity marks are away from the breaker.

5.8.8 Three (3) single-ratio metering class current transformers 2000/5 Ampere, , 0.3 % accuracy B1.0, wired to terminal blocks accessible from the front of the cubicle and equipped with shorting bars (GE Type EB-27) for metering. Current transformers shall be located on the bus side of the circuit breaker. CT’s shall be installed so that the polarity marks are away from the breaker.

5.8.9 Three (3) relay accuracy class, 2000/5 Ampere, single-ratio current transformers, ANSI Class 10C200, wired to terminal blocks accessible from the front of the cubicle and equipped with shorting bars (GE Type EB-27) on the transformer differential panel 01 for transformer differential relaying. Current transformers shall be located on the bus side of the circuit breaker. CT’s shall be installed so that the polarity marks are away from the breaker.

5.8.10 One (1) SEL 587Z bus differential relay, style 0587Z0X325312XX shall be installed and wired to protect the main bus of the switchgear as shown in Austin Energy drawing 7B XXXX R4A.X8.

5.8.11 One Electroswitch lockout relay, type 7810D (86B) to be tripped by the bus differential relay described in 5.8.10. N.O. contacts from the lockout relay shall be wired to an ABB

type FT-1 or AVO equivalent potential test switch as per drawing 7B XXXX R4A.X8. Two spare N.O. contacts shall be wired to the test switch.

5.8.12 Red and amber indicating lights with the red light to monitor lockout coil only, the amber light to monitor lockout trip only. The indicating lights shall be GE Type ET-16 with LED bulbs.

5.8.13 One (1) Schweitzer Engineering Labs SEL-351S relay, Style #0351S713B355421 for transformer low side breaker fail. Tripping diodes type ABB TRB-1 shall be used to isolate supervisory and local control switch operations from breaker fail initiate circuitry. All relay inputs and outputs shall be wired as per DC schematics 7B XXXX R4A.X13. Alarm contact shall be configured N.O. and OUT106 and OUT211 shall be configured Form B.

5.8.14 One (1) Schweitzer Engineering Labs SEL-421 relay, Style #04210615126553X for transformer high and low side O/C protection. All relay inputs and outputs shall be wired as per DC schematics 7B XXXX R4A.X7.

5.8.15 One Electroswitch lockout relay, type 7810D (86BF1) for circuit switcher/main breaker fail lockout relay. N.O contacts from the lockout relay shall be wired to an ABB type FT-1 or AVO equivalent potential test switch as per drawing 7B XXXX R4A.X9. Two spare N.O. contacts shall be wired to the above test switch.

5.8.16 Red and amber indicating lights with the red light to monitor lockout coil only, the amber light to monitor lockout trip only. The indicating lights shall be GE Type ET-16 with LED bulbs.

5.8.17 One Electroswitch lockout relay, type 7810D (86BF2) for bus tie/feeder breaker fail lockout. N.O. contacts from the lockout relay shall be wired to an ABB type FT-1 or AVO equivalent potential test switch as per drawing 7B XXXX R4A.X10. Two spare N.O. contacts should be wired out to the test switch.

5.8.18 Red and amber indicating lights with the red light to monitor lockout coil only, the amber light to monitor lockout trip only. The indicating lights shall be GE Type ET-16 with LED bulbs.

5.8.19 Terminal boards for connection by Austin Energy of control and CT cables shall be provided.

5.9 Bus Tie breaker Cubicle-2000A

5.9.1 One (1) bus-tie breaker position being a 12,470 Volt, 3 phase, 4-wire wye, solidly grounded neutral circuit that will enter the switchgear from the bottom shall be included. Each position shall contain the following equipment mounted on the front door and wired according to the one line schematic shown in 7BXXXXR2.

A. One 12.47 kV, 2000A power circuit breaker as specified in Sections 4.5 and 5.6, including provisions for remote supervisory control

B. Red, amber, green, and white indicating lights with the red light to monitor trip coil 1 only, 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 with LED

bulbs. Tripping diodes shall be provided to monitor the relay manual push button trip and close contacts. The tripping diodes shall be ABB type TRB-2 rated for 30 Amps continuous current.

C. Three (3) relaying accuracy class, 2000/5 Ampere, muti-ratio current transformers, ANSI Class 10C200, located on the switchgear 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), for connection to cable differential relays in this switchgear. CT's shall be installed so that the polarity marks are away from the breaker.

D. Three (3) relaying accuracy class, 2000/5 Ampere, multi-ratio current transformers, ANSI Class 10C200, for O/C relaying wired to terminal blocks accessible from the front of the cubicle and equipped with shorting bars (GE Type EB-27). Current transformers shall be located on the switchgear side of the circuit breaker. CT's shall be installed so that the polarity marks are away from the breaker.

E. Three (3) relaying accuracy class, 2000/5 Ampere, multi-ratio current transformers, ANSI Class 10C200, for breaker fail wired to terminal blocks accessible from the front of the cubicle and equipped with shorting bars (GE Type EB-27). Current transformers shall be located on the external bus side of the circuit breaker. CT's shall be installed so that the polarity marks are away from the breaker.

F. Three (3) relaying accuracy class, 2000/5 Ampere, multi-ratio current transformers, ANSI Class 10C200, for bus differential relaying wired to terminal blocks accessible from the front of the cubicle and equipped with shorting bars (GE Type EB-27). Current transformers shall be located on the external bus side of the circuit breaker. CT's shall be installed so that the polarity marks are away from the breaker.

G. One (1) Schweitzer Engineering Labs SEL-311L relay, Style #0311L03CC3254X1 to be used for cable differential relaying. All relay inputs and outputs shall be wired as per DC schematics 7B XXXX 4A.X19. Alarm contact shall be configured N.O.

H. One (1) Schweitzer Engineering Labs SEL-351S relay, Style #0351S713B355421 for O/C protection. All relay inputs and outputs shall be wired as per DC schematics 7B XXXX R4A.X16. Alarm contact shall be configured N.O. and OUT106 shall be configured Form B.

I. One (1) Schweitzer Engineering Labs SEL-351-6 relay, Style #035161335542x1 for breaker failure protection. Tripping diodes type ABB TRB-1 shall be used to isolate supervisory and local control switch operations from breaker fail initiate circuitry. All relay inputs and outputs shall be wired as per DC schematics 7B XXXX R4A.X17.

J. One Electroswitch lockout relay, type 7810D (86C) to be tripped by the cable differential relay described in 5.9.1G. N.O. contacts from the lockout relay shall be wired to an ABB type FT-1 or AVO equivalent potential test switch as per drawing 7B XXXX R4A.X18. Two spare N.O. contacts shall be wired to the test switch.

K. Red and amber indicating lights with the red light to monitor lockout coil only, the amber light to monitor lockout trip only. The indicating lights shall be GE Type ET-16 with LED bulbs.

L. Terminal boards for connection by Austin Energy of Austin Energy's control and CT cables shall be provided.

M. Switchgear bus terminated with a NEMA 4 hole copper pad for connection by the Austin Energy of the outgoing bus cable with a vertical clearance of 60 inches minimum for separately furnished terminators.

N. A 14"x22" minimum size, uncut, non-magnetic metallic bottom entrance plate or exit of the outgoing bus cable.

5.10 Instrumentation Panel 04

A. Three 400 Volt-Ampere, 7200 to 120 Volt potential transformers (PTs) connected Y-Y to the incoming service bus, fused with current limiting fuses and mounted on a drawout assembly with one (1) spare set of fuses for each set of transformers and with three phase potential bussed to each test switch in the positions in line-up. These PTs shall be 0.3% accuracy class.

B. Station service transformers as covered in Section 5.6.3.

C. Terminal boards shall be provided for the connection of AE's control cables and wires to and from the transformer control cabinet. AE will be responsible for the connection of these control cables and wires.

D. All P.T. circuits shall be separately fused and wired to terminal boards for AE use.

5.10.1 One (1) Power Measurements ION electronic meter, Model #P8500E9C0H6C1A0A and Power Measurements type P850EB1 I/O expander module utilizing 10baseT Ethernet with RJ45 connector and external power supply. The meter shall include but not be limited to the following: instantaneous volts, amps, Kw Kvar, KVA, PF, frequency and unbalance.

5.10.2 The meter shall be wired considering that the AE phase sequence is C-B-A. The meter shall be wired so that AE’s C phase (0°) is wired to the meter C phase.

5.10.3 One (1) Superior Switchboard and Devices Company test switch with CT and PT connections utilizing the CT designated for instrumentation in this position, 4 wire, 3 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 2-11-7-1-7-2-11-7-1-7-2-11-7-1-7-6 reading from left to right, front view with colors Red, White, Orange, Black, White, White with Black Tracer, Green, White, and Blue as shown on AE Drawing 7D-367.

5.10.4 One (1) 120 Volt AC weatherproof convenience outlet, three-wire grounding type, with a Ground Fault Current Interrupting (GFCI) device shall be provided per 5.2.2C. The outlet shall be pre-wired to an independent circuit off the station service bus.

5.10.5 Terminal blocks for connection by AE of AE's control and CT cables, including CT shorting blocks where appropriate, shall be provided.

5.11 Feeder Breaker Positions 05,06,07,08-1200A

5.11.1 Four (4) outgoing feeder breaker positions with each being a 12,470 Volt, 3 phase, 4-wire wye, solidly grounded neutral distribution feeder circuit that will enter the switchgear from the bottom shall be included. Each position shall contain the following equipment mounted on the front door and wired according to the one line schematic shown in 7BXXXXR2.X.

A. One 12.47 kV, 1200A power circuit breaker as specified in Sections 4.5 and 5.7, including provisions for remote supervisory control

B. Red, amber, green, and white indicating lights with the red light to monitor trip coil 1 only, 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 with LED bulbs. Tripping diodes shall be provided to monitor the relay manual push button trip and close contacts. The tripping diodes shall be ABB TRB-2 rated for 30 Amps continuous current.

C. Three (3) relaying accuracy class, 2000/5 Ampere, multi-ratio current transformers, ANSI Class 10C200, 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), for connection to bus differential relays in this switchgear. CT’s shall be installed so that the polarity marks are away from the breaker.

D. Three (3) relaying accuracy class, 1200/5 Ampere, multi -ratio current transformers, ANSI Class 10C200, for feeder O/C relaying wired to terminal blocks accessible from the front of the cubicle and equipped with shorting bars (GE Type EB-27). Current transformers shall be located on the bus side of the circuit breaker. CT’s shall be installed so that the polarity marks are away from the breaker.

E. Three (3) relaying accuracy class, 1200/5 Ampere, multi -ratio current transformers, ANSI Class 10C200, for breaker failure protection and metering wired to terminal blocks accessible from the front of the cubicle and equipped with shorting bars (GE Type EB-27). Current transformers shall be located on the bus side of the circuit breaker. CT’s shall be installed so that the polarity marks are away from the breaker.

F. A SEL-2030 (Part No. 203033X344XXXX) shall be installed in totalizing cubicle. The SEL-2030 shall be powered from DC through fuses. All inputs and outputs shall be wired to test blocks. All SEL relays in cubicle 4,5,6,7 shall have RS232 communication ports wired to the SEL-2030 via SEL 2810 fiber-optic transceivers.

G. One (1) Schweitzer Engineering Labs SEL-351S relay, Style #0351 S713B355421 for feeder breaker protection and reclosing. All relay inputs and outputs shall be wired as per DC schematics 7B XXXX R4A.X30. Alarm contact shall be configured N.O. and OUT106 shall be configured Form B.

H. One (1) Schweitzer Engineering Labs SEL-351-6 relay, Style #035161335542x1 for breaker fail relaying. Tripping diodes type ABB TRB-1 shall be used to isolate supervisory and local control switch operations from breaker fail initiate circuitry. All relay inputs and outputs shall be wired as per DC schematics 7B XXXX R4A.X31. Alarm contact shall be configured N.O.

I. Terminal boards for connection by Austin Energy of Austin Energy's control and CT cables shall be provided.

J. Switchgear bus terminated with a NEMA 4 hole copper pad for connection by the Austin Energy of the outgoing feeder cable with a vertical clearance of 60 inches minimum for separately furnished terminators

K. A 14"x22" minimum size, uncut, non-magnetic metallic bottom entrance plate or exit of the outgoing feeder cable

5.12 Control Wiring Details

5.12.1 Current transformer circuits originating in the switchgear shall be wired to terminal strips equipped with shorting bars (General Electric Type EB-27 or AE engineer approved equivalent). A white marking strip shall be furnished, marked, and attached so that terminal points can be identified.

5.12.2 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 AE engineer approved equivalent). Terminal boards for control wiring shall be solid molded blocks, rated 600 Volts and a minimum of 30 Amperes 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 4/0 AWG copper and be rated for 200 Amps. Terminal board points for terminating transformer AC supply for fans, pumps, LTC drive, etc. shall accept #6 AWG and shall be rated for 50 Amps. A white marking strip shall be furnished, marked, and attached so that terminal points can be identified. Typical terminal block arrangement is shown in E728-9.

5.12.3 One (1) spare twelve (12) point terminal board shall be provided in the control cabinet for AE use.

5.12.4 The use of “plug-in” terminal boards will not be allowed.

5.12.5 All wire terminals and exposed conducting parts shall be provided with barriers to prevent personnel injury.

5.12.6 All CT wiring shall be No. 10 AWG copper wire, 600 Volt insulation, NEC THW rated. All other switchgear auxiliary wiring shall be a minimum of No. 14 AWG copper wire, 600 V insulation, NEC THW rated.

5.12.7 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.

5.12.8 Splices will not be allowed in factory wiring, including CT leads. However, terminal blocks are allowed for point-to-point connection.

5.12.9 Wiring shall be run in plastic wireway (Panduit or AE Engineer approved equal) except for short open runs to component terminals.

5.12.10 Wiring between cubicles shall run from terminal board to terminal board in each compartment.

5.12.11 The auxiliary wiring shall be permanently identified at both ends and routed to the switchgear in plastic wireway (Panduit or AE Engineer-approved equal). The method of permanently tagging the conductor ends shall be approved by AE engineer. Wire ends shall be permanently fitted with compression type, ring lugs before attaching securely to terminal studs. Wiring between cubicles shall run from terminal board to terminal board in each compartment.

5.12.12 The contractor shall design the layout of the electrical wiring in the switchgear to segregate the contractor's wiring from AE's wiring. Terminal boards shall be wired with one side reserved for the contractor and one side reserved for AE. Factory wiring shall not be terminated on the side of the terminal boards reserved for AE use. Typical terminal block arrangement is shown in E728-9.

5.12.13 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.

5.12.14 Control wiring connection diagrams shall be point-to-point.

5.13 AE Connection to External Equipment

5.13.1 All wiring leads for connection to external equipment shall be brought to clearly marked vertically mounted terminal boards in Cubicle 1 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 12.47 kV equipment. Terminal boards for control wiring shall be twelve point solid molded blocks.

5.13.2 All terminal blocks used for terminating Austin Energy's external cables and wiring shall be totally clear of factory switchgear wiring on Austin Energy's side of these terminal blocks. The only exceptions allowed are current transformer shorting jumpers. Arrangement, identification, point designation, and connections of terminal blocks used for Austin Energy connections are shown in E-728-9. These drawings are provided for reference only.

5.13.3 Transformer and circuit switcher controls shall be terminated in Cubicle 1 on a 12-pole front-connected, potential test switch manufactured by AVO/States #C3-212A or approved equal.

5.13.4 Rear connected test switches used in relaying and control circuits shall be ABB FT-1, with clear cover as follows: 10 potential, C129A501G01,4 potential, 6 current C129A514G01,2 potential, 8 current, 2 potential C129A518G01 or approved equal.

5.13.5 Alarm contacts to RTU shall be wired so that contact closing indicates an alarm condition.

5.13.6 Other alarm and control functions normally furnished shall also be wired to AE accessible terminal boards.

5.13.7 One (1) spare twelve (12) point terminal board shall be provided in the control cabinet for AE use.

5.14 Accessories

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

5.14.1 A 125 Volt DC breaker positioning motor or other tools required to move breakers in and out of operating position

5.14.2 A test device for testing the operation of the drawout circuit breakers while they are fully withdrawn

5.14.3 One (1) or more 240 Volt 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 operated at 120 Volt AC and at rated 240 Volt current. The total power dissipated in the control cabinet 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 6 inches away from each heater. The connection between the terminal block and heater shall be made with heat resistant wire approved by the AE 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. The manufacturer shall supply AC failure alarms for all heater circuits as per section 5.5.8.

5.14.4 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. For an enclosed aisle unit, the circuit breaker drawout area is the aisle of the enclosure. One (1) portable truck shall be furnished for each line-up of switchgear.

5.14.5 Operation counter, to register only the opening stroke of the circuit breaker operating rod

5.15 Nameplate Requirements

5.15.1 The contractor shall supply all nameplates as specified in the ANSI/IEEE C37.04. All nameplates shall be made from non-rust stainless steel and shall be permanently attached to the exterior of the switchgear. 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. The nameplate shall include, but not be limited to, the following data:

A. Contractor's name and address
B. Contractor's switchgear type and switchgear designation
C. Switchgear serial number
D. AE Purchase Order (P.O.) number and date of manufacture
E. Electrical characteristics to include:
    1. Rated frequency
    2. Voltage class
    3. Phasing configuration
    4. Insulation data
    5. Feeder breaker contractor, serial numbers, and ratings (voltage class, continuous current, and interrupting capability)

5.15.2 The switchgear shall also be provided with an additional nameplate mounted on the control cabinet door that includes the following information:

A. AE Purchase Order (P. O.) Number
B. System Unique Number (SUN) (to be supplied by AE to the contractor within four (4) weeks after P. O. is issue

5.17 Material

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

5.17.2 All materials used in the switchgear shall be subject by the contractor to rigid quality assurance and control standards. The contractor 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 AE inspector upon demand.

5.17.3 The contractor 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 AE inspector upon demand. Materials found by AE inspector to have not been properly qualified for use by the contractor shall, as a general rule, be unacceptable for use in the circuit switcher. Arrangements satisfactory to AE, up to and including the replacement of the non-qualified material, shall be made by the contractor.

6 TEST REQUIREMENTS

Austin Energy reserves the right to visit the manufacturing facility and to observe the switchgear while undergoing construction and testing. The contractor may not charge AE for its right to visit the facility during construction and testing. AE 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, AE reserves the right to have the contractor delay the testing until the first time in which AE inspector(s) assigned to this purchase are available. Furthermore, if AE inspector(s) arrives on site and the switchgear is not ready for testing within eight (8) hours, AE reserves the right to postpone the testing for up to three (3) weeks.

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

6.1 The switchgear shall be tested in accordance with ANSI/IEEE C37.20.2. 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 arc resistant design testing shall be performed per the ANSI C37.20.7 using the maximum short circuit current available for the system or device rating as the perspective current available at the incoming bus terminals.

6.2.1 Test reports for design tests shall be submitted with the response to this specification at the time of the bid opening.

6.3 The following tests from ANSI/IEEE C37.23 Section 6.3 shall be performed on the bus:

6.3.1 Low-Frequency Withstand Tests
6.3.2 Polarity Verification

6.4 The following tests from ANSI/IEEE C37.09 Section 5.1 shall be performed on each circuit breaker:

6.4.1 Nameplate Check (Section 5.6)
6.4.2 Resistors, Heaters, and Coils Check Tests (Section 5.8)
6.4.3 Control and Secondary Wiring Check Tests (Section 5.9)
6.4.4 Clearance and Mechanical Adjustment Check Tests (Section 5.10)
6.4.5 Mechanical Operation Tests (Section 5.11)
6.4.6 Timing Tests (Section 5.12)
6.4.7 Stored Energy System Tests (Section 5.13)
6.4.8 Electrical Resistance of Current Path Tests (Section 5.14)
6.4.9 Low-Frequency Withstand Voltage Tests on Major Insulation Components (Section 5.15)
6.4.10 Low-Frequency Withstand Voltage Tests on Control and Secondary Wiring (Section 5.16)

6.5 The following tests from ANSI/IEEE C57.13 Section 8.0 shall be performed on each potential 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 Resistance (Section 8.5)
6.5.5 Applied Potential (Section 8.8.3)
6.5.6 Induced Potential (Section 8.8.4)

6.6 The following tests from ANSI/IEEE C57.13 Section 8.0 shall be performed on each current transformer:

6.6.1 Ratio and Phase Angle (Section 8.1)
6.6.2 Impedance and Excitation (Section 8.3)
6.6.3 Polarity (Section 8.4)
6.6.4 Applied Potential (Section 8.8.3)
6.6.5 Induced Potential (Section 8.8.4)

6.7 The following tests from ANSI/IEEE C57.13.1 shall also be performed on each current transformer:

6.7.1 Insulation Resistance Test (Section 5.0)
6.7.2 Winding and Lead Resistance (Internal Impedance) (Section 8.0)

6.8 Control and Power Wiring Tests

6.8.1 Low frequency withstand voltage tests shall be performed on all control and secondary wiring.
6.8.2 All control schematics shall be function tested for proper wiring by applying a jumper across the relay contacts and verifying test switch isolation. Functional testing shall include the proper tripping of associated lockout relays and circuit breakers.
6.8.3 Relay inputs shall be energized and test isolation verified using Hyperterminal or SEL-5010 program.
6.8.4 Relay settings shall not be provided by AE and need not be tested.
6.8.5 C.T. circuits shall be tested with primary current not lower than 100 amps. Secondary current magnitudes and phase angles shall be measured at all test switches, relays and meters to verify proper function. Equipment supplying the primary current shall be connected as to minimize neutral current.
6.8.6 Readings shall be taken on all bus differential circuits on two breakers to verify correct CT polarity and connection.

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

6.9 Reports

The contractor shall present evidence of quality control testing and proof that the switchgear has passed these tests. AE 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.

6.9.1 Three (3) 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 AE no later than one (1) week after the shipment of the switchgear. The contractor shall fax one (1) copy of these reports to the Supervisor, Engineering Support (512 505-7004) 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.

6.9.2 The test report, for the first test only, shall include a photographic record of the manufacturing of the switchgear. The contractor shall use a high quality 35 mm camera to take the photographs. AE engineer shall approve the camera and associated equipment used to take the photographs. As a minimum, the following photographs 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.

7 OTHER REQUIREMENTS

7.1 Drawings and Instruction Books

7.1.1 Approval drawings and manuals shall be furnished within 4 weeks of the receipt of the contract and at least three (3) weeks prior to beginning construction of the switchgear.

7.1.2 The contractor shall furnish three (3) complete sets of paper drawings for approval. The contractor shall also provide one (1) copy 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
I. Test switch nameplate drawing
J. RTU wiring diagram

7.1.3 AE requires fifteen (15) working days after the receipt of approval drawings and manuals to review and return the approval drawings to the factory.

7.1.4 The contractor shall furnish two (2) sets of “Certified For Construction” electrical, control, and relay paper drawings. These drawings shall be submitted to AE no later than one (1) month prior to the agreed delivery date of the circuit switcher. The contractor 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 materials
E. Internal schematics of each metering, relaying and control device as well as internal schematic of the feeder breakers
F. Excitation and ratio correction factor curves for all current transformers

7.1.5 Two (2) 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. Two (2) 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 AE 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.

7.1.6 Three (3) complete nameplate drawings, including one (1) 8½" x 11" copy, shall be submitted to AE 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.

7.1.7 In addition to the instruction books supplied in Section 7.1.5, one (1) set of instruction books, with one (1) complete set of "as built" drawings, shall be packed with the switchgear when shipped. The contractor shall stamp "AS BUILT" and the current date on these drawings. The contractor shall ship this material in weatherproof packaging. If revisions to the "as built" drawings are necessary, the contractor 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.

7.1.8 Two (2) complete sets of "as built" paper drawings shall be submitted to AE no later than two (2) weeks after the shipment. The contractor 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. These drawings shall also be provided in AutoCAD (release 14 or later) (.dwg format) or .dxf format on CD. 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.

ATTACHMENTS
Relay Schematics and Typical Wiring Diagrams (38)
Bus Duct Connection Diagrams (2)
Test Switch Assignment