

**Controlled Power, LLC**

**5kV, 15kV, and 27kV  
Metal Clad Switchgear**

**Guide Specification**

# 5kV - 15kV - 27kV METAL CLAD SWITCHGEAR WITH VACUUM CIRCUIT BREAKERS

## CONTENTS

1.0	QUALITY ASSURANCE PROGRAM .....	Page 2
2.0	QUALITY ASSURANCE PROGRAM, APPROVAL, & INSPECTION .....	2
3.0	SCOPE .....	2
4.0	STANDARDS.....	2
5.0	DRAWINGS .....	2
6.0	TEMPERATURE LIMITS (ANSI STANDARDS) .....	4
7.0	STRUCTURE .....	4
8.0	CIRCUIT BREAKER ELEMENTS .....	6
9.0	SHIPMENT OF CIRCUIT BREAKERS.....	8
10.0	INSTRUMENTS AND RELAYS .....	8
11.0	VOLTAGE TRANSFORMERS .....	8
12.0	CURRENT TRANSFORMERS .....	9
13.0	CONTROL AND INDICATING LIGHTS.....	9
14.0	CONTROL AND AUXILIARY SWITCHES .....	9
15.0	WIRING.....	10
16.0	BUS SYSTEMS.....	10
17.0	CERTIFIED TEST REPORTS .....	11
18.0	FACTORY PRODUCTION TESTS (ANSI/IEEE C37.20.2 - 1987).....	11
19.0	HEATERS.....	11
20.0	BUS SUPPORTS AND INSULATION .....	11
21.0	NAMEPLATES .....	12
22.0	FIELD SERVICE.....	12
23.0	MIMIC BUS .....	12
24.0	ACCESSORIES.....	12
25.0	FINISH.....	12
26.0	HARDWARE .....	12
27.0	HANDLING.....	12
28.0	SPARE PARTS LIST .....	12
29.0	SHIPPING.....	12
30.0	INSPECTION / WITNESS TEST .....	12

## APPENDIX:

"A"	TYPICAL DETAILED EQUIPMENT .....	15
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## **1.0 QUALITY ASSURANCE (QA) PROGRAM**

The Switchgear manufacturer shall be certified ISO 9001, or have an equivalent quality program in place prior to bidding this project. If the manufacturer is not ISO 9001, a copy of that company's quality program must be approved prior to bid date.

## **2.0 QA PROGRAM, APPROVAL, and INSPECTION**

An Engineer may visit the manufacturer's facility, to review the detailed program as outlined in manufacturer's Master Quality Control Manual. Please indicate in your proposal when your company received your ISO registration and the date of your last surveillance audit.

## **3.0 SCOPE**

The scope of the work included in this specification shall include furnishing the following material and service complete. Equipment to be furnished is shown on attached one-line drawings, data sheets and arrangement drawings, which form part of this specification. All work shall be done and completed in a thorough workmanlike manner and in accordance with the best modern practices in manufacturing and fabrication. All materials used in the construction of the apparatus shall be selected as the best available for the purpose for which used, considering strength, ductility, accuracy, insulation, and best engineering practice. Liberal factors of safety shall be used throughout the design.

## **4.0 STANDARDS**

All apparatus shall comply with currently applicable standards of the American National Standards Institute (ANSI), Institute of Electrical and Electronic Engineers (IEEE), the National Electric Manufacturers Association (NEMA) Switchgear specifications, and the National Fire Protection Association (NFPA).

## **5.0 DRAWINGS**

Seller shall furnish within 6 weeks after receipt of order \_\_\_\_\_ copies of each of the following drawings for Purchaser's examination and approval. Do no work without approved drawings and release for manufacture.

- 5.1 Complete dimensioned assembly drawings(s) showing plan, elevation, section views, and weights.
- 5.2 Plan showing exact location and details of channel sill, anchor bolts and terminations of power bus and control cables.
- 5.3 Elementary or schematic diagrams.
- 5.4 Section views, and detailed dimensioned drawings of the end unit for future additions.
- 5.5 Bill of Material shall be provided listing all the devices and accessories to be furnished. The Bill of Material shall include complete identification and description of all the devices.

Further information concerning Engineering information that is required as part of this contract is as follows:

- A. Equipment shall be shown on the cubicle Wiring Diagram with the same relative position as shown on the Front View Drawing. On the Wiring Diagram, the rear view shall be shown for all equipment mounted on the front of the panel where space is available on the front of the panel. Shipping splits shall be shown on drawings of cubicles affected, showing clearly all connections to be made by Purchaser when installing Switchgear.
- B. Terminal block drawings shall provide space to show the Purchaser's connections, if required, which will be added to the prints when they are checked and approved. The markings shall then be added to the manufacturer's tracings and "as built" and connection drawings re-submitted.
- C. All revisions to drawings shall be identified.
- D. Seller shall assure that drawings are correct at date of Switchgear shipment, and that "as built" drawings are included.
- E. Spare parts list.
- F. Seller shall furnish drawings for record via Auto-Cad drafting system on hard copy, 3½ floppy disks, or CD-ROM.
- G. One complete set of operating and maintenance instructions for each piece of equipment specified shall be furnished at shipment with the equipment and the balance of the operating and maintenance instructions two weeks after equipment has shipped. (Purchaser to specify number of sets required). One set of "as built" drawings shall be sent within 2 to 3 weeks after the equipment has been shipped.
- H. The work of assembly in the field by the Purchaser shall consist of unloading, setting, aligning, leveling, and fastening the stationary housing to the concrete floor, connecting bus work, cables at shipping splits, and attaching power and control cables to appropriate terminals.
- I. Equipment, apparatus and material furnished, shall be subject to ANSI factory production tests and inspection by the Purchaser's authorized representative. Inspection may be made during any stage of manufacture, and any equipment, apparatus, or material found unsatisfactory as to quality of workmanship will be rejected. Tests shall be in accord with applicable standards as noted above.

## **6.0 TEMPERATURE LIMITS (ANSI STANDARDS)**

- 6.1 The normal current carrying capacity rating of the circuit breakers and other equipment covered under this specification shall be based upon their temperature

rise, including connections, as enclosed, when carrying full rated current continuously.

- 6.2 The temperature rise of current carrying parts and apparatus shall not exceed 65°C over a maximum ambient temperature of 40° C inside the enclosure.
- 6.3 The temperature of non-current carrying parts of the structure shall not exceed 70° C.

## **7.0 STRUCTURE**

- 7.1 Switchgear will be a complete self-supporting structure of the required number of vertical sections bolted together to form a single line-up of metal-enclosed rigid equipment. Vertical section barriers, rear covers, and roofs will be 11-gauge epoxy powder coated steel. Equipment must be provided with lifting facilities.
- 7.2 Outdoor equipment will be enclosed in a weatherproof, gasketed steel housing. Access doors will have stops and provisions for padlocking. Interior lighting, receptacles, and convenience outlets will be furnished. Space heaters to retard condensation will be furnished.
- 7.3 All bus joints, taps, splices and outgoing connections shall be insulated. The manufacturer shall provide bolt-torquing instructions.
- 7.4 Each cubicle that has high voltage connections shall be effectively isolated from the others and from low voltage sections by 11-gauge metal barriers. All high voltage connections in these compartments shall be accessible through removable cover plates or doors. The voltage and current transformer secondary wiring runs in high voltage compartments shall be shielded or routed in metal conduit. Removable cover plates shall be provided for access to buses, voltage and current transformers, low voltage wires, etc. The relay panels or doors shall be isolated from the high voltage connections by grounded metal panels.
- 7.5 All doors shall be hinged with formed welded edges and provided, as required, with doorstops and louvers. For outdoor applications, doors with louvers shall include 1/8" mesh vermin screens. Doors shall have a minimum of 105° opening and be so designed that there will be no interference with devices when the circuit breakers are inserted or removed.
- 7.6 Provision shall be made in the appropriate Switchgear cubicles for the entrance of conduits containing the low voltage control and auxiliary power cables, and necessary connections to interposing relays, auxiliary transformers, and voltage regulating equipment, and other low voltage wiring. In outdoor cubicles, a floor plate shall be supplied with provision for the entrance of the cables and/or conduits.

- 7.7 The power cable compartment shall be located at the rear of the structure and shall provide adequate facilities for terminating cables. At least 30-inches of vertical space shall be provided to accommodate cable bending radius and stress cones. For outdoor applications, the rear compartment access doors shall be hinged and latched and shall have provisions for padlocking. Doorstops and stop catches shall also be furnished.

Incoming cables will be (top)(bottom) entry. Terminal connectors for cable connections will use NEMA 2- or 4-hole drilling and adapters where required, for multiple cables, and be silver-plated copper.

- 7.8 Grounded metal cable tunnels shall be provided in each unit to segregate cables between the upper and lower breaker units, where applicable (two-high design).

- 7.9 Each circuit breaker will be mounted in a steel framework cell equipped with a guide rail mechanism and self-coupling, self-aligning primary and secondary disconnecting devices (contacts). Circuit breakers requiring manual engagement of secondary disconnects, or that require the use of umbilical cords or manual plug and socket connection of secondary disconnects are not permitted. All breakers of the same type and rating, listed in the detail specification must be entirely interchangeable with each other.

- 7.10 Sturdy interlocks to prevent racking breaker into or from connected position with breaker closed must be included. A positive stop will prevent over-travel when in the connected position. The design of the mechanism will be such that the removable breaker will be self-aligning and will be held rigidly in the connected position without the necessity of locking bars or bolts. Removing a front cover access plate shall make maintenance access to the circuit breaker spring charge mechanism possible. Contact wear indicators shall be accessible without removing the breaker element from the breaker cell rails (for two-high applications).

- 7.11 Automatic grounded metal safety shutters will close the entrance to the stationary primary disconnecting devices when the breaker is in the test or withdrawn position.

- 7.11 All main bus supports subject to line-to-line or line-to-ground voltages in excess of 4160 volts shall be of high-grade wet process porcelain.

This equipment shall be shipped assembled to the maximum possible extent.

Two (2) high construction (is) (is not) permitted.

- 7.13 The primary disconnecting contacts shall be constructed of silver-plated copper. All moveable contact fingers and springs shall be mounted on the circuit breaker where they may be easily inspected.

- 7.13.1 The breaker is automatically tripped when moving the circuit breaker to the connected position before the primary shutters open.
- 7.13.2 The breaker is trip-free mechanically and electrically during racking.
- 7.13.3 The breaker can be racked in with the door open or closed.
- 7.13.4 The breaker closing spring is automatically discharged as the breaker is withdrawn from the cell.
- 7.13.5 A latch secures the breaker in the connected, disconnected, or test position with the door open or closed.
- 7.13.6 The circuit breaker is grounded throughout its' travel (first make - last break).
- 7.13.7 Positive indication of the breaker position shall be provided for connected, test, and disconnected positions. Physically separate connected, test, and disconnected positions are required.
- 7.14 Vent opening shall be provided with filters, accessible from exterior of equipment (outdoor only).
- 7.15 All floors shall be under-coated with bituminous mastic (outdoor only).
- 7.16 Manufacturer shall furnish all necessary power and control interconnections between cubicles.
- 7.17 All of the control cables shall enter as shown on the conduit drawings.
- 7.18 Cable troughs for wiring between the circuit breaker cubicles and the miscellaneous cubicles shall be located internal to the Switchgear.
- 7.19 The base for outdoor equipment shall be structural steel channel and angle, not formed 11-gauge steel.

## **8.0 CIRCUIT BREAKER ELEMENTS**

- 8.1 All of the circuit breakers shall be (5) (15) (27) kV class, 3-pole, single throw, automatic and electrically and mechanically trip free with a (250) (500) (750) (1000) (1500) MVA interrupting rating. Each circuit breaker position shall be equipped with \_\_\_ normally open and \_\_\_ normally closed auxiliary contacts in addition to the auxiliary switches required for normal circuit breaker control and

operation. The circuit breaker element shall be stored energy type, \_\_\_\_\_ V close V trip.

- 8.2 Protective front covers shall be provided on the circuit breaker element to prevent access to the operating mechanism or live parts when the circuit breaker is in the connected position.
- 8.3 All circuit breakers shall be vacuum interrupter, horizontal draw-out type, provided with self-aligning, line-side and load-side disconnecting devices. Each breaker shall be provided with a motor-charged spring, stored energy operating mechanism. The stored energy mechanism shall be charged normally by a universal electric motor and in emergency situations, by a manual handle.
- 8.4 The primary disconnecting fingers shall be silver-plated. The secondary disconnecting contact shall be a silver-plated, multiple contact, plug. The plugs shall automatically engage the housing sockets in the breaker operating positions. Manual plug and socket secondary disconnecting devices are not permitted.
- 8.5 Circuit breakers of the same ratings and control voltage shall be completely interchangeable.
- 8.6 The breaker front panel shall be a grounded steel barrier that effectively isolates the instrument and control compartments. The front panel shall have the following control and indication features.
  - 8.6.1 Breaker open-close indication.
  - 8.6.2 Closing springs charged-discharged indication.
  - 8.6.3 Operations counter.
  - 8.6.4 Manual trip-close push buttons.
- 8.7 Switchgear shutters are to be metal and shall be permanently marked to indicate the "Bus" or "Feeder" side primary stationary disconnects. Phase markings shall also be included.
- 8.8 The circuit breaker shall be mechanically interlocked as follows:
  - 8.8.1 It shall not be possible to insert or remove a circuit breaker element from the connected position while the interrupters are in the closed position. The stored energy mechanism shall be discharged automatically prior to the circuit breaker element being withdrawn from the cubicle.
- 8.9 Manual operating devices for racking the circuit breaker elements in and out of their cubicle shall be provided.

- 8.10 An extension jumper shall be provided for each Switchgear assembly so that the circuit breaker, and the circuit breaker's operation, may be checked with the element outside of the circuit breaker cubicle.
- 8.11 The circuit breaker's operating mechanism shall be fully accessible by removing the front metal panel from the breaker and without removing the circuit breaker from the guide-rail assembly.

## **9.0 SHIPMENT OF CIRCUIT BREAKERS**

Circuit breakers shall not be integrally shipped in their Switchgear enclosures. Breakers not being used by the Switchgear assembly plant shall be appropriately marked, boxed, and protected against shipping and handling damage and delivered to a designation point provided by the owner. Actual circuit breakers of each rating being provided (not dummy elements) will be inserted into the appropriate cubicles after each cell has been inspected and or tested for mechanical performance. They are not to be considered an integral part of the stationary structure, but together they shall perform as outlined in this specification and the appropriate standards.

## **10.0 INSTRUMENTS AND RELAYS**

- 10.1 Instruments, relays and other devices for mounting on the Switchgear panels shall be semi-flush mounted with cases of similar design and attractive in appearance. The accuracy of the instrument shall be one percent of full-scale values.
- 10.2 Protective relays, except as otherwise approved, shall be of the draw-out type with test devices incorporated in the relay unit. They shall have hand reset indicators. The latest applicable standards shall be applied to all protective relays.
- 10.3 One complete set of test plugs as required for testing draw-out relays or meters with suitable terminals and cables shall be supplied.
- 10.4 Main contacts of all switching devices shall be silver-plated or equivalent. The contact surfaces of secondary disconnecting devices and relays shall be silver-plated or equivalent.

## **11.0 VOLTAGE TRANSFORMERS (VT)**

- 11.1 Each set of voltage transformers and their primary fuses shall be mounted in separate steel compartments. Primary connections to the transformers shall be insulated and enter the compartment through porcelain bushings. Each set of voltage transformers and fuses shall be mounted on the draw-out steel carriage which will be capable of disconnecting the transformer fuses from their voltage source and removing them from the structure. This drawout mechanism shall be so arranged that full access to the transformers cannot be accomplished until the

fuses are disconnected from the structure. When moved to a full out position, the transformer fuses and VT windings shall be automatically grounded.

- 11.2 Control power transformers rated above 15 KVA shall be stationary mounted. Fuses shall be draw-out and key-locked with a secondary breaker to prevent access with secondary breaker closed.

## **12.0 CURRENT TRANSFORMERS (CT)**

Current transformers shall be dry type, insulated for \_\_\_\_\_ Kv as applicable, and rated as indicated on the drawings. They shall have sufficient thermal and mechanical capacity to withstand the maximum momentary current rating of the breakers. The secondary terminals shall be of the solder-less clamp type. All current transformers shall be properly identified for polarity with standard marking symbols. The minimum acceptable accuracy class for metering and relaying shall be in accordance with the latest edition of ANSI Standard C37.20. Window type CT's having an insulation rating of 600V, and having fully insulated bus centered in the transformer window opening, shall be acceptable when ionization and impulse tests prove a satisfactory arrangement. Phase CT's shall be mounted over stationary primary disconnects. Ground fault sensor CT's shall be mounted in cable compartment and sized to accommodate power cables. If multi-ratio CT's are shown on the specification drawings, all leads shall be wired out to shorting type terminal strips.

## **13.0 CONTROL AND INDICATING LIGHTS**

Indicating lights shall be of the series resistor type with color caps designed for maximum visibility, low wattage consumption of the lamps (maximum 2 watts) and long service life shall be provided. Green and red indicating lights shall show the open and closed positions of the circuit breaker. Light Emitting Diode (LED) lights may be substituted.

## **14.0 CONTROL AND AUXILIARY SWITCHES**

- 14.1 Control switches shall be rotary, multi-position, cam-operated, multi-stage type with dust cover and silver-to-silver contacts rated 600 volt and 20 amperes. Breaker control switches and selector switches shall have "pistol grip" handles. Meter switches shall all have "knurled knob" handles. Lockout switches shall have "oval" handles.
- 14.2 Each circuit breaker unit shall be provided with a breaker control switch and two indicating lights, red (breaker closed) and green (breaker open). Control switches shall be three-position (close-off-trip) with spring return to center. Pistol grip handles to be provided.
- 14.3 Each incoming line main circuit breaker, bus tie circuit breaker, and feeder circuit breaker unit shall be provided with a Truck Operated Cell (TOC) auxiliary switch. The TOC switch shall operate when the circuit breaker is racked into the connected position only. The Mechanism Operated Contact (MOC) auxiliary

switch shall operate when the breaker closes and in either the connected or test positions. The TOC switch shall have a minimum of two normally open and two normally closed contacts rated at 10 amperes and 125 VDC. The MOC auxiliary switch shall have a minimum of five normally open and five normally closed contacts rated 10 amperes. All auxiliary switches shall be wired to terminal blocks located in the breaker compartment.

## **15.0 WIRING**

- 15.1 Each switchgear line up shall be completely assembled, wired, and tested at the factory, including all buses, connections, insulators, terminals, and terminal blocks.
- 15.2 Secondary wiring shall be firmly laced and secured and terminated in approved molded-type terminal blocks conveniently located with respect to shipping splits and control conduit terminals.
- 15.3 Terminal blocks shall be mounted such that the wires to them can be grouped and laced together in a neat and workmanlike manner. A sufficient number of terminal connections including 15 percent of spare terminals shall be provided for all control and instrument wiring.
- 15.4 All secondary wiring shall be No. 14 AWG or larger, 90°C, 600 volt switchboard wire, type SIS, 41 strand, tinned copper and provided with a permanent wire marking system identifying the “from-to” wire designation.
- 15.5 All current transformers and associated circuitry control wiring shall be terminated with insulated ring-tongue or locking spade terminals.
- 15.6 Terminal blocks shall be Marathon series 1500 or approved equal.
- 15.8 Two-pole, pullout disconnecting fuse blocks (with fuses) to be provided for each breaker to protect trip and close circuits.

## **16.0 BUS SYSTEMS**

- 16.1 Bus bars will be electrical grade copper having the specified continuous current rating as limited by ANSI standards to temperature rise and documented by design tests. All joints will be silver-plated and have at least two bolts per joint using plated steel hardware (See 25.0 Hardware). All bus connections will be rated to carry the full frame size continuous current of the associated breaker. Bus bars will be braced to withstand the magnetic stresses developed by currents equal to the power circuit breaker momentary and interrupting ratings. Tapering of bus systems is not permitted.

- 16.2 All bus bars in Switchgear rated above 600 volts shall be insulated with cycloalaphatic epoxy. Due to corona and potential cracking problems, slip-on sleeve type insulation is not permitted.
- 16.3 A full length, bare ground copper bus shall be provided and installed near the bottom of the unit line-up. It shall be ¼ by 2 inches minimum in cross-section. In the feeder breaker units, provision shall be made for attachment of a NEMA 2-hole ground lug. The ground bus shall be securely bonded to the frame of each unit and shall have provision for grounding the entire assembly at each end of the line-up. Extension provisions similar to those of the power buses shall be provided.

## **17.0 CERTIFIED TEST REPORTS**

- 17.1 Certified Test Reports of design and / or conformance in accord with the latest applicable ANSI standards shall be provided prior to award of contract. These tests shall be made with the circuit breaker specified connected in the cubicle of the same design as being provided in accord with these specifications. Such tests shall be made in a nationally recognized U. S. laboratory.
- 17.2 The manufacturer shall provide five certified copies of test reports covering all factory tests made on the equipment and insulating materials.

## **18.0 FACTORY PRODUCTION TESTS (ANSI/IEEE C37.20.2)**

The manufacturer shall make factory tests at not less than standard NEMA, ANSI, or IEEE values and such additional factory tests required by the manufacturer's control organization to insure that this product will maintain its high quality standard of materials and reliability in operation. Tests on each unit of equipment shall include, but not be limited to:

- 18.1 Dielectric - (5.3.1)  
18.2 Sequence Test (Control Circuit Continuity) - (5.3.4.1/5.3.4.4)  
18.3 Functional Check  
18.4 Mechanical Operation Tests - (5.3.2)  
18.5 Polarity Verification - (5.3.4.3)

## **19.0 HEATERS**

Long life tubular heaters shall be supplied for each unit of outdoor Switchgear. Each shall be rated to deliver required watts at 240 volts. Each heater shall have a protective perforated metal cover. A 120/240V external source shall supply power to the heaters.

## **20.0 BUS SUPPORTS AND INSULATION**

All bus and live part supports shall be Glastic for 5 Kv or 15 Kv indoor applications and high-strength electrical grade wet process porcelain for 15 Kv outdoor applications. For all 38 Kv applications, cycloalaphatic epoxy shall be used. The bus support system shall have a BIL rating of (60) (95) (125) (150) Kv.

## **21.0 NAMEPLATES**

Each cubicle shall be provided with engraved laminated plastic nameplates, white with black lettering and with identification as specified and indicated on the plans. Size to be specified by purchaser. Each exterior device shall have an identification plate including fuse blocks, interior devices, etc.

## **22.0 FIELD SERVICE**

The Switchgear manufacturer shall supply field service technician(s) for installation and start up after equipment has been delivered. One man-day per breaker unit shall be included in the base price. This shall include all travel and living expenses. A separate price shall be quoted on a per man-day basis for any additional or lesser number of days needed by the buyer.

The field service technician shall be a qualified technician having a minimum of 5 years field experience in the installation, operation, and maintenance of Switchgear.

## **23.0 MIMIC BUS [Optional]**

1/8" x 1/2" (color selected by purchaser) acrylic mimic bus shall be supplied on each unit outlining the one-line diagram power circuits.

## **24.0 ACCESSORIES**

One complete set of manufacturer's standard accessories for test, inspection, and operation shall be furnished. Such accessories shall include at least the following, unless a particular item is not used with the selected design:

The following accessories, as a minimum, shall be supplied to facilitate handling, maintenance, and operation:

- 1 Control jumper for checking breakers outside the stationary structures.
- 1 Test cabinet.
- 1 Racking crank for breaker levering-in mechanism.
- 1 Set of rail clamps.
- 1 Set of extension rails as required.
- 1 Special wrench or tool(s) as needed for routine maintenance.
- 1 Transport dolly, lifter, or ramp as required and necessary to transfer breaker.

## **25.0 FINISH – Powder Coat**

All metal surfaces shall be painted with dry powder epoxy coating for a porcelain-type finish. The bare metal shall be prepared by running the material through a minimum five-stage automatic washing process using high-temperature, high pressure chemical solutions to thoroughly cleanse and etch the metal. The powder shall be applied by electrostatic process, and then be cured in a convention heating bake oven for a hard scratch resistant finish.

## **26.0 HARDWARE**

All bolting hardware to be high tensile strength zinc plated steel. Where high currents are encountered which create excessive joint heat, silicon bronze or stainless steel hardware shall be used.

## **27.0 HANDLING**

Switchgear will be provided with adequate lifting means. Provisions for anchoring on a level foundation must be provided by Purchaser.

## **28.0 SPARE PARTS LIST**

Spare parts list shall include the following:

28.1 Complete spare parts list.

28.2 List prices of parts that the Manufacturer recommends being available during start-up and the first two (2) years of operation.

## **29.0 OPERATION AND MAINTENANCE MANUAL**

Installation, operating, and maintenance instructions shall cover all the equipment furnished including all protective relays, power fuses, auxiliary relays, etc. and shall include characteristic curves for each different current transformer, protective relay, and power fuse.

## **29.0 SHIPPING**

Seller shall prepare and crate all equipment and materials to protect them against damage in transit. All apparatus or equipment not bolted to the housing structure and not forming a part thereof in shipment shall be packed in separate boxes. Circuit breakers shall also be packed in separate boxes. Detailed packing lists shall be provided.

## **30.0 INSPECTION / WITNESS TEST**

The purchaser reserves the right to inspect the equipment during manufacture and prior to shipment. Travel and living expenses for visits to the manufacturer's plant will be at the

purchaser's expense. The purchaser will not accept any charges for visiting the plant. The manufacturer shall notify purchaser in writing of the intended date for shipment and test.

After all ANSI Production Tests have been completed and any deficiencies and/or wiring errors have been corrected, the tests shall be repeated and made available for witness test by the purchaser, or his authorized representative. The manufacturer shall supply a qualified service technician for the length of time required to perform these tests. The service technician shall assist in testing each Switchgear metering, control, and protective relay circuit during checkout by the purchaser. Any additional costs for this service shall be included as part of the base bid.

## TYPICAL DETAILED EQUIPMENT

(Example Only)

### SCOPE

The equipment to be provided shall consist of indoor Metal-Clad Switchgear manufactured and tested as a minimum in accordance with ANSI Spec. C37.20.2 and these specifications. The following material is to be supplied.

<u>UNIT NO.</u>	<u>QUANTITY</u>	<u>DESCRIPTION</u>
03,05	2	Incoming Line Circuit Breaker Unit
04	1	Bus Tie Circuit Breaker Unit
01,02,06,07	4	Feeder Circuit Breaker Units
03,05	2	Control Power Transformer (CPT)
04	2	Voltage Transformer (VT)

### **Basic Circuit Breaker Unit**

- 1 \_\_\_\_\_ volt vacuum power circuit breaker, \_\_\_\_\_ amp. continuous, three pole, with electrically operated, stored energy mechanism, \_\_\_\_\_ MVA and breaker control power (user to specify)
- 1 Breaker draw-out structure
- 1 Provisions for power cable conductors terminations - cables entry from bottom / top.
- 1 Breaker closing fuse block, pullout type, two-pole.
- 1 Breaker tripping fuse block, pullout type, two-pole.
- 1 Circuit breaker control switch.
- 1 Indicating lamps, breaker open-close, red and green.

### **Unit No. - 01,02,06,07**

Feeder circuit breaker units, each consisting of:

- |   |                                      |               |
|---|--------------------------------------|---------------|
| 1 | Basic circuit breaker unit - 1200A   | Device #52    |
| 3 | Over-current relays                  | Device #50/51 |
| 1 | Ground sensor relay                  | Device #51GS  |
| 1 | Ammeter and switch                   | Abbr. AM, AS  |
| 3 | Current transformers - single ratio  | Abbr. CT      |
| 1 | Current transformers - ground sensor | Abbr. CT      |
| 1 | Main bus increase, 1200A to 2000A    |               |

### **Unit No. - 03,05**

Incoming line units, each consisting of:

- |   |  |               |
|---|--|---------------|
| 1 | Basic circuit breaker unit - 2000A   | Device #52    |
| 3 | Over-current relays  | Device #50/51 |
| 1 | Lockout relay  | Device #86    |
| 1 | Ammeter and switch   | Abbr. AM, AS  |
| 1 | Voltmeter and switch   | Abbr. VM, VS  |
| 1 | Automatic throw over (partial package):  |               |
| 1 | Voltage sensing relay  | Device #27/47 |
| 1 | Auxiliary relay (light duty)   | Device #27X   |
| 3 | Current transformers - single ratio  | Abbr. CT      |
| 1 | Control power equipment mounted on a draw-out carriage, 15kVA, _____-240/120V to be complete with current limiting fuses and interlocked with secondary breaker to prevent the CPT from being disconnected under load. |               |
| 1 | Key interlock  |               |
| 1 | Set of three (3) distribution class surge arresters.   |               |

**Unit No.** - 04

Bus tie unit consisting of:

- |   |  |                 |
|---|--|-----------------|
| 1 | Basic circuit breaker unit -2000A  |                 |
| 1 | Automatic throw over (partial package):  |                 |
| 2 | Auxiliary relays (heavy duty)  | Device #2X, 62X |
| 2 | Timers   | Device #2,62    |
| 1 | Manual-Automatic switch  | Device #43      |
| 2 | Draw-out voltage transformer units rated ___-120 volts<br>Each with 2 VT's fused connected open delta.<br>Transformer windings and fuses to be solidly grounded in the withdrawn position. | Abbr. VT        |
| 1 | Key interlock  |                 |