**External ABB document**

1VAL108004-SS

SafeGear® HD switchgear and breaker sample specification

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# Part 1 – General

## 1.1 Scope

A. The Seller shall furnish the switchgear lineup as specified herein and as shown on the drawings for medium voltage (5kV or 15kV), free-standing, metal-clad switchgear with vacuum circuit breakers.

B. The Seller shall develop interlocks as required to implement the controls strategy described and the protective relay philosophy indicated on the drawings.

C. Switchgear shall be located indoors.

## 1.2 References

A. The metal-clad switchgear and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of IEEE, ANSI and NEMA.

B. Applicable Codes and Standards

The applicable codes and standards listed below should be considered as part of this specification. The latest revision in effect at time of inquiry shall apply for all standards referenced.

ANSI/IEEE C37.04 Standard Rating Structure for AV HV Circuit Breakers

C37.06 Preferred Ratings for AC HV Circuit Breakers

C37.09 Standard Test Procedure for AC HV Circuit Breakers

C37.010 Application Guide for AC HV Circuit Breakers

C37.011 Application Guide for TRV for AC HV Circuit Breakers

C37.012 Application Guide for Capacitance Switching

C37.11 Requirements for Electrical Control

C37.20.7 IEEE Guide for Testing Metal-Enclosed Switchgear Rated Up to 38kV for Internal Arcing Faults

C37.20.2 Standard for Metal-Clad and Station Type Cubicle Switchgear

C37.55 Conformance Testing Procedure of Metal-Clad Switchgear

C57.13 Requirements for Instrument Transformers

NFPA 70E NEC Code 2009 Edition

CSA C22.2 Switchgear Assemblies

NEMA CC1 Electrical Power Connectors

SG-4 Standards for Power Circuit Breakers

SG-5 Power Switchgear Assemblies NEC/NFPA

250 Enclosures for Electrical Equipment

PIP ELESSG02 Medium Voltage Metal-Clad Switchgear

It shall be the manufacturer’s responsibility to be knowledgeable of these standards and codes.

## 1.3 Submittals

A. The following information shall be submitted to the Engineer during drawing approval process.

1. Front View Elevation

2. Floor Plan

3. Top View

4. Single Line

5. Schematic Diagram

6. Component List

7. Conduit Entry/Exit Locations

8. Assembly Ratings, including:

a. Short-circuit rating

b. Voltage

c. Continuous Current

d. Basic Impulse level for equipment over 600 volts

9. Major component ratings including:

a. Voltage

b. Continuous Current

c. Interrupting Ratings

10. Cable terminal sizes

11. Wiring Diagrams

12. AC Elementary Diagrams

B. Submit [\_] copies of the above information

## 1.4 Submittals After Order Completion

A. The following information shall be submitted for information purposes:

1. Final as-built drawing and information

2. Certified production test reports

3. Installation information including equipment anchorage provisions

4. Seismic Certification

B. Submit [\_] copies of the above information

## 1.5 Qualifications and Quality Assurance

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of X years.

C. The manufacturer of the switchgear must be the same manufacturer of the circuit breaker.

## 1.6 Delivery, Storage and Handling

A. Equipment shall be handled and stored in accordance with manufacturer’s instructions. One (1) copy of these instructions shall be included with the equipment at the time of shipment.

B. Shipping groups shall be designed to be shipped by truck. Indoor groups shall be bolted to skids. Breakers and accessories shall be packaged and shipped separately.

C. Switchgear being stored prior to installation shall be stored to maintain the equipment in a clean and dry condition.

## 1.7 Operation and Maintenance Data

A. [\_] copies of the equipment operation and maintenance manuals shall be provided. They seller shall also provide manual on a CD-ROM, which contains all manuals and drawings in PDF format.

B. Operation and maintenance manuals shall include the following information:

1. Instruction books and/or leaflets

2. Recommended Parts List

3. Drawings and Information

## 1.8 Extra Accessories and Spare Parts

A. Supply [\_] breaker accessory kit(s), including racking handle.

B. Supply breaker lift truck for the purpose of moving breakers from cell to cell.

C. Provide [\_] test cabinet(s).

D. Provide [\_] test jumper(s).

E. Provide ABB SmartRack remote racking device.

F. Provide ground and test device.

G. Supply [\_] breaker control fuses

H. Supply [\_] secondary potential transformer fuses and [\_] primary potential transformer fuses.

I. Supply [\_] spare indicating lights of each type used.

# Part 2 – Products

## 2.1 Metal-Clad Arc-Resistant Switchgear Assembly and Ratings

A. The metal-clad switchgear shall consist of an ABB [5,15kV] indoor SafeGear HD lineup including plenum.

B. The switchgear described in this specification shall be designed for operation on a [5,15]kV, three phase, 3-wire, 60Hz system.

C. The switchgear described in this specification shall contain factory assembled and operational tested circuit breakers and accessories and be self-supporting.

D. UL Labeled equipment shall be provided to the full extent that UL labels are applicable.

E. Each circuit breaker shall have the following ratings, with continuous current ratings as specified on single line drawing.

|  |  |  |
| --- | --- | --- |
| Maximum Voltage | [5] [15] | kV |
| BIL Rating | [60] [95] | kV |
| Short Circuit Current | 63 | kA |
| Closing and Latching Capability | 164 | kA rms |
| Short Time Rating | 63 | kA |
| Rated Interrupting Time | 3 | cycles |

F. Switchgear shall be certified for IBC Seismic Region D.

## 2.2 Construction

A. The switchgear assembly shall consist of individual vertical section housing various combinations of circuit breakers and auxiliaries, bolted to form a rigid metal-clad switchgear assembly. Two-high arrangements are allowed to maximize space savings. Metal side sheets shall provide grounded barriers between adjacent structures and solid removable metal barriers shall isolate major primary sections of each circuit. Refer to drawings for any size limitations.

B. The manufacturer shall provide minimum room dimensions and other guidelines related to the performance of the arc-resistant switchgear. The manufacturer shall provide a method of venting the arc fault byproducts out of the equipment room. The vent shall be covered such that it meets all specified environmental requirements.

C. The stationary primary contacts shall be silver-plated and recessed within insulating tubes. A metal or lexan shutter shall automatically cover the stationary primary disconnecting contacts when the breaker is in the disconnected or test position or out of the cell.

D. Cubicles designated as future on the one line drawing shall be furnished with bus, current transformers, metering and relaying as per one line diagram. The cubicle shall be equipped for a future breaker element.

E. All metal work shall be free from burrs and sharp edges, and all exterior walls and doors shall be hem bent for strength and safety.

F. Each front and rear compartment door shall be provided with a formed steel hinged door with hand operated door latches. Each door shall have provisions for padlocking. The door(s) shall be provided with provisions for padlocking and view window for observing the circuit breaker position. The door(s) shall be capable of withstanding the effects of an internal arcing fault as proven by successful testing per IEEE C37.20.7.

I. Instrument compartments shall have doors tested per IEEE C37.20.7 Type 2B Accessibility.

J. Cooling vents may be provided in the switchgear for ventilation or cooling purposes. The design must conform to the applicable IEEE standard construction and pass the requirements of IEEE C37.20.7 with respect to the emission of ionized gas. The design must be constructed so that material cannot become trapped within the louver assembly and thereby prevent the arc resistant features from functioning.

K. The switchgear shall be capable of extension from either end at a future date without modification to existing structural members.

L. The depth of the finished equipment shall be sufficient to allow for entrance, bending, and termination of power cables. Individual units shall be provided for top or bottom entrance as specified.

## 2.3 Plenums

A. Each arc resistant switchgear assembly shall include a plenum to direct fault gases and associated pressure wave, installed on top of the switchgear and extending over the entire length of the lineup.

B. The plenum shall be self-supporting and attach directly to the top of the switchgear.

C. In all cases, exhaust vents extending from the plenum to the outside shall be included with the switchgear assembly.

D. The plenum shall be shipped separately and installed in the field.

E. The plenum shall be constructed of heavy gauge steel in such a manner to assure integrity in the event of an arc fault.

## 2.4 Bus and Bus Supports

A. The main bus shall be copper and have flame-retardant and track-resistant cycloaliphatic epoxy insulation. The bus supports between units shall be flame-retardant, track-resistant, cycloaliphatic epoxy.

B. The switchgear shall be constructed so that all buses, bus supports and connections shall withstand stresses that would be produced by currents equal to the momentary ratings of the circuit breakers.

C. All bus joints shall be [silver] [tin] plated, bolted and insulated with epoxy molded boots secured with nylon fasteners.

D. The bus shall be braced to withstand fault currents equal to the close and latch rating of the breakers.

E. The temperature rise of the bus and connections shall be in accordance with ANSI standards and documented by design tests.

F. A ¼ x 2 inch [silver][tin] plated copper ground bus shall extend the entire length of the switchgear.

G. The main bus pass through insulators and main bus stand-off insulator supports shall be molded of cycloaliphatic epoxy.

H. Compression type cable lug shall be furnished in cable compartments as shown on the single line drawings.

## 2.5 Surge Arrestors

A. [Distribution]/[Intermediate]/[Station] class surge arrestors shall be provided as detailed on the single line diagram.

## 2.6 Wiring/Terminations

A. The switchgear manufacturer shall provide suitable terminal blocks for secondary wire terminations and a minimum of 20% spare terminal connections shall be provided. Switchgear secondary control wire shall be (minimum) #14 AWG (#12 for CT circuits) type SIS, 41 strand extra flexible, stranded copper or larger rated 600 volt, 90 degrees C, furnished with wire markers at each termination.

B. All control wiring shall be UL listed and have a VW-1 flame retardant rating. Wires shall terminate on terminal blocks with marker strips numbered in agreement with detailed connection diagrams.

C. Exposed wiring shall be suitable protected against contact with sharp edges. Throughout the assembly it must be neatly bundled and secured with nylon wire ties. Where control wiring passes from cubicle to door, it must be wrapped with suitable protection so as to prevent damage. Holes cut to allow control wires to pass from cubicle to cubicle will have a rubber grommet for protection.

D. Each control wire shall be marked at both terminations to agree with wiring diagrams. Plastic wire markers of either the slip on or heat shrink variety shall be provided.

E. Incoming line and feeder cable lugs of the type and size indicated on the single line drawings shall be furnished by the manufacturer.

## 2.7 Circuit Breakers

A. The circuit breakers shall be horizontal draw-out type, capable of being withdrawn. The breakers shall be operated by a motor-charged stored energy spring mechanism charged normally by a universal electric motor or a magnetic actuator mechanism. The primary disconnecting contacts shall be silver-plated copper.

B. Each circuit breaker shall contain three vacuum interrupters separately mounted in a self-contained, self-aligning pole unit. The breaker front panel shall be removable when the breaker is withdrawn for ease of inspection and maintenance.

C. The secondary contacts shall be silver plated and shall automatically engage in the breaker operating and test positions.

D. Interlocks shall be provided to prevent closing of a breaker between operating and test positions to trip breakers upon insertion or removal from the housing and to discharge stored energy mechanisms upon insertion or removal from the housing. The breaker shall be secured positively in the housing between and including the operating and test positions.

E. Circuit breaker close and trip circuits shall be electrically separate. Control voltages for each circuit shall be independently selectable from the full range of ANSI/IEEE preferred control voltages.

F. Each breaker shall be complete with controls witch and red and green indicating lights to indicate breaker contact position.

G. Close and trip circuits shall be separately fused or protected with a molded case circuit breaker. Fuse blocks shall be dead front, finger-safe type.

H. Each breaker shall have a minimum of 9 ‘a’ and 8 ‘b’ auxiliary contacts.

I. The continuous current capacity of each power circuit breaker shall be 1200A, 2000A, 3000A or 4000A as dictated on the single line drawing.

J. The breaker bushings shall be mono-block cycloaliphatic epoxy.

K. The circuit breakers shall have an interruption clearing time of 50ms (3-cycle).

L. Circuit breakers of the same type, rating and control circuits shall be electrically and mechanically interchangeable.

M. The breaker shall have the following ratings:

|  |  |  |
| --- | --- | --- |
| Maximum Voltage | [5] [15] | kV |
| BIL Rating | [60] [95] | kV |
| Short Circuit Current | 63 | kA |
| Momentary Current (peak, withstand only) | 164 | kA rms |
| Short Time Rating | 63 | kA |
| Rated Interrupting Time | 3 | Cycles |
| Power Frequency Withstand Voltage | 36 | kV |
| Voltage Range Factor K | 1.0 |  |

N. Manual provisions shall be provided for breaker closing and tripping. These provisions shall be mounted and easily accessible at the front of the breaker.

## 2.8 Protective Relays

A. The switchgear manufacturer shall furnish and install, in the metal-clad switchgear, the quantity, type and rating of protection relays as indicated on the drawings and described hereafter in this specification. Unless otherwise approved, protective relays shall be manufactured by ABB and be of the Relion family.

B. In general, microprocessor based, multi-function and solid state relays shall be provided.

C. Relays shall operate from the 5 ampere secondary output of current transformers.

D. The primary current transformer rating being used for phase and ground protection feeding the device shall be programmable for current transformers with primary current ratings from 5 through 5,000 amperes.

E. Current and potential test switches and plugs shall be ABB FT-1 type and shall be provided for all metering and protection circuits.

F. The seller shall provide all the potential and current transformer ratings.

## 2.9 Auxiliary Devices

A. Current transformers shall be furnished as indicated on the contract drawings. The thermal and mechanical ratings of the current transformers shall be coordinated with the circuit breakers. Their accuracy rating shall be equal to or higher than the ANSI standard requirements. The standard location for the current transformers on the bus side and line side of the breaker units shall be front accessible to permit adding or changing current transformers without removing high-voltage insulation connections. Shorting terminal blocks shall be provided on the secondary of all the current transformers.

B. Voltage and control power transformers of the quantity and ratings shown in the single line drawings shall be supplied. Voltage transformers shall be mounted on draw-out trucks with racking operations similar to breaker operation. The primary connections shall utilize solid bus bars or NATVAR. PT contacts shall use Delrin arc quenching technology in place of shutters.

C. A mechanical interlock shall be provided to require the secondary breaker to be open before the CPT truck or CPT primary fuse truck can be withdrawn.

## 2.10 Switchgear Enclosure

A. The switchgear shall consist of breaker and auxiliary units assembled to form a rigid, self-supporting, metal clad structure. In each unit, major circuit components shall be completely enclosed by grounded metal barriers, including a front barrier as part of the circuit breaker.

B. Each vertical section shall be provided with space heaters. Tubular type heaters operated at half voltage for long life shall be supplied.

C. Power for space heaters, lighting, receptacles, and breaker control power shall be supplied by the owner.

## 2.11 Nameplates

A. Engraved nameplates shall be furnished for all main and feeder assemblies as indicated on the drawings. Nameplates shall be laminated plastic and secured with screws.

B. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer’s wiring diagrams.

C. The manufacturer shall not remove, reuse, alter or replace original equipment nameplates or equipment tags associated with equipment or components supplied by the manufacturer’s suppliers and sub-suppliers.

## 2.12 Finish

A. All steel structure members shall be cleaned, rinsed and phosphatized prior to painting.

B. The switchgear shall be painted ANSI 61 gray.

## 2.13 Accessories

A. Provide the following accessories with switchgear proposal:

1. Breaker Lift Truck

2. Racking handle and special tools required for maintenance

3. Test plugs for ABB FT-1 test Switches

4. CB Test Jumper and Test Station

B. Provide a manual Ground and Test Device with the following characteristics:

1. The ground and test device is a manual type.

2. The G&T must feature the following:

a. Terminal Set Barriers designed to prevent access to the ungrounded terminal set. A padlocking provision must be provided as a secure means to prevent the barrier from being inadvertently moved and exposing the ungrounded terminal set

b. The device must be able to be inserted and withdrawn from the circuit breaker compartment using the same mechanism as the circuit breaker. This includes using the same lift truck and racking tools and being provided with a position indicator.

c. The device must be equipped with mechanical interlock that coordinates with the circuit breaker compartment. The device is blocked from being inserted into a circuit breaker compartment where the required ratings exceed those of the G&T device.

d. The device must feature two terminal sets. One set is intended for grounding of the line side and the other set for the load side. Only one set can be grounded at any time.

e. The device must feature a grounding connection system that operates with the use of grounding cables. The grounding cables and related hardware provided with the device satisfy the requirements of the design tests for the short time and momentary tests performed on the unit.

f. The device should not feature closing or interrupting or have a mechanism or interrupter.

g. The device must be fully tested to the most recent version of IEEE Std. C37.20.6 and a test certificate must be available on request.

h. Production tests must be performed in accordance with USA Standard C37.09.

i. Each ground and test device must be shipped with an instruction book.

# Part 3 – Execution

## 3.1 Factory Testing and Examination

A. The following standard factory tests shall be performed on the circuit breaker element provided by the manufacturer. All tests shall be in accordance with the latest IEEE/ ANSI standards.

1. Alignment test with master cell to verify all interfaces and interchangeability.

2. Circuit breakers operated over a range of minimum to maximum control voltage.

3. Factory setting of contact gap.

4. One-minute dielectric test per ANSI/ IEEE Standards.

5. Final inspections and quality checks.

B. The following production tests shall be performed on each breaker cubicle:

1. Alignment test with master breaker to verify interfaces

2. On-minute dielectric test per ANSI standards on primary and secondary circuits.

3. Operation of wiring, relays and other devices verified by an operational sequence test.

4. Final inspection and quality check.

C. The manufacturer shall supply [\_] certified copies of factory test reports.

## 3.2 Installation (by others)

A. The installation contractor shall install all equipment per manufacturer’s recommendations and contract drawings.