

External ABB document

**1VAL107002-SS**

**Advance 27 Switchgear and Breaker Sample Specification**

## Contents

Part 1 – General.....	1
1.1 Scope.....	1
1.2 References .....	1
1.3 Submittals .....	2
1.4 Submittals After Order Completion .....	2
1.5 Qualifications and Quality Assurance .....	2
1.6 Delivery, Storage and Handling.....	3
1.7 Operation and Maintenance Data.....	3
1.8 Extra Accessories and Spare Parts.....	3
Part 2 – Products .....	3
2.1 Metal-Clad Arc-Resistant Switchgear Assembly and Ratings .....	3
2.2 Construction .....	4
2.3 Plenums .....	<b>Error! Bookmark not defined.</b>
2.4 Bus and Bus Supports .....	5
2.5 Surge Arrestors .....	5
2.6 Wiring/Terminations .....	5
2.7 Circuit Breakers .....	6
2.8 Protective Relays .....	7
2.9 Auxiliary Devices .....	7
2.10 Switchgear Enclosure .....	8
2.11 Nameplates.....	8
2.12 Finish.....	8
2.13 Accessories .....	9
Part 3 – Execution.....	10
3.1 Factory Testing and Examination .....	10
3.2 Installation (by others) .....	10

## 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 27kV, 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
	C37.20.2	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
NEMA	CC1	Electrical Power Connectors
	SG-4	Standards for Power Circuit Breakers
	SG-5	Power Switchgear Assemblies NEC/NFPA
	250	Enclosures for Electrical Equipment

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 a 27kV indoor lineup.



- B. The switchgear described in this specification shall be designed for operation on a 27kV, three phase, 3-wire, 50 or 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. Switchgear shall have the following ratings, with continuous current ratings as specified on single line drawing.

Maximum Voltage	27	kV
BIL Rating	125	kV
Continuous Current	1200/2000	A
Short Circuit Current	16/25	kA
Momentary Current	42/65	kA
Short Time Rating	16/25	kA

- 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 stationary primary contacts shall be silver-plated and recessed within porcelain insulating tubes. A Lexan shutter shall automatically cover the stationary primary disconnecting contacts when the breaker is in the disconnected or test position and while removed from the cell.
- C. 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.
- D. 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.
- E. Each front and rear compartment door shall be provided with a formed steel hinged door with thumbscrews or 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.

- F. Instrument compartments shall be completely isolated from high voltage compartments.
- G. Cooling vents may be provided in the switchgear for ventilation or cooling purposes.
- H. The switchgear shall be capable of extension from either end at a future date without modification to existing structural members.
- I. 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 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 porcelain.
- 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 porcelain.
- H. Compression type cable lug shall be furnished in cable compartments as shown on the single line drawings.

### **2.4 Surge Arrestors**

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

### **2.5 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.

## **2.6 Circuit Breakers**

- A. The circuit breakers shall be horizontal draw-out type, capable of being withdrawn. The breakers shall be operated by 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. Control voltage shall be selected with a rated auxiliary voltage of 24-48 VDC or 125-250 VDC (120-240 VAC). Range in accordance with IEEE C37.06-2009
- F. Each breaker shall be complete with control switch and red and green indicating lights to indicate breaker contact position.
- G. Control voltage circuit shall be 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 or 2000A 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 83ms (5-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	27	kV
BIL Rating	125	kV
Continuous Current	1200/2000	A
Short Circuit Current	16/25	kA
Closing and Latching Capability	42/65	kA rms
Short Time Rating	16/25	kA
Rated Interrupting Time	5	cycles
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.

## 2.7 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.

## 2.8 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.

## **2.9 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.

## **2.10 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.

## **2.11 Finish**

- A. All module side, floor and roof sheets shall be galvanized.
- B. All mild steel parts and doors/end panel assemblies shall be cleaned, rinsed and phosphatized prior to painting.
- C. The switchgear shall be painted ANSI 61 gray.

## 2.12 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.