

## Specification for Air Circuit Breaker (ACB)

### 1. General

- 1.1 Air circuit breakers (ACB) shall comply with standards IS/IEC 60947-1 & 2.
- 1.2 The breakers shall be tested & certified reputed testing lab. Also complies with environmental directives like RoHS & WEEE. Air circuit breakers (ACB) shall comply with standards IS/IEC 60664-1, i.e Degree of pollution 4. ACB's shall be suitable to use in continuous conductivity (which occurs due to conductive dust, rain or other wet conditions).
- 1.3 All Air circuit breakers can be reverse fed without reduction in performance.
- 1.4 All Air circuit breakers shall have a rated operational voltage of 440V/690V AC (50/60Hz). The tests shall be carried out with a breaking performance during operation (Ics) and admissible short time withstand (Icw) equal to the ultimate breaking capacity (Icu). I.e.  $I_{cu} = I_{cs} = I_{cw} = 50\text{kA}$  for 1 Sec. as per system fault levels (refer SLD).
- 1.5 The rated insulation voltage shall be 1000V AC (50/60Hz).
- 1.6 Air circuit breakers shall have rated impulse voltage should be 12Kv to ensure proper insulation co-ordination in system.

### 2. Construction

#### 2.1 Environmental aspects

- 2.1.1 Production site organization shall be certified to comply with ISO 14001 standards.
- 2.1.2 Air circuit breakers shall be supplied in recyclable packing complying with European directives. The manufacturer shall implement non polluting production processes that do not make use of chlorofluorocarbons, chlorinated hydrocarbons, ink for cardboard markings, etc.
- 2.1.3 Environmental considerations and processing of materials at end of service life. The manufacturer shall provide instructions on the removal, dismantling and processing of Air circuit-breaker materials at the end of service life (material composition, weight, toxicity).

#### 2.2 General features

- 2.2.1 Air circuit breaker shall be designed in such a way that maintenance may be carried out as a function of their use. To reduce maintenance, electrical endurance (without maintenance) shall be greater than 6000 cycles up to 2000 A, 5 000 cycles for 2500A to 4000A.
- 2.2.2 All acb's shall have ready to close mechanism with indication (Mechanical +Remote). The breaker is allowed to close after all safety checks are ascertained. It checks for: **UV release energized, Shunt release de-energized, spring charged, Breaker is not "ON", breaker has not tripped on fault, it is not mechanically interlocked with other breaker and ACB is racked in completely.** The operating mechanism shall be of the stored-energy spring type. The closing time shall be less than or equal to 70 milliseconds, and of fast opening type with opening time of breaker should be <30ms.
- 2.2.3 Air circuit breakers main contact shall be encased in a reinforced polyester casing and offer double insulation for the operators on the breaker front face.

#### 2.3 Main contacts

- 2.3.1 The main contacts shall be designed such that no maintenance shall be required under normal conditions of use.
- 2.3.2 The main contacts shall be equipped with a visual wear indicator that may be accessed by removing the arc chutes, for immediate assessment of contact wear without requiring measurements or specific tools.

#### 2.4 Arc chutes

2.4.1 The arc chutes shall be removable on site.

2.4.2 Air circuit breakers shall be equipped with arc chute cover for better safety.

### 2.5 Drawout mechanism

The drawout operation shall be possible through a closed door.

Three positions of the moving part shall be possible:

- Connected position - all auxiliary and main circuits engaged.
- Test position - all auxiliary circuits engaged all main circuits disconnected.
- Isolated position - all circuits disconnected.

### 2.6 Safety requirements

2.6.1 A door interlock shall be provided so that it shall not be possible to open the door until the air circuit breaker moving part is in the disconnected position.

2.6.2 Insulated safety shutters shall be provided over the incoming and outgoing main circuits and over the auxiliary circuits. An interlocking shall be provided to prevent insertion of a circuit breaker having a rating higher than the current rating of the fixed part, into that fixed part.

2.6.3 The racking handle shall be stored on the air circuit breaker in such a manner as to be accessible without defeating the door interlocking.

### 2.7 Electrical auxiliaries

2.7.1 All electrical auxiliaries including the motor spring charging mechanism shall be field adaptable without adjustment or the necessity for any tool (except a screwdriver). They shall be fitted into a compartment which under normally loaded conditions has no metalwork energized from the main poles exposed with it. Any adaptation carried out thus shall not increase the breaker volume.

2.7.2 It shall be possible to connect all auxiliary wiring from the front face of the air circuit breaker, this wiring shall be taken through a set of disconnecting contacts, so that all auxiliary wiring is automatically disconnected in the isolated position.

2.7.3 Ready-to-close contact shall be provided for indicating that all safety parameters are checked & enabling closure of breaker, ensuring at-most safety for the user.

2.7.4 For Incomer Acb's delayed type under voltage release to be use to avoid nuisance tripping during voltage surges. ACB's shall have minimum 4 change-over auxiliary contacts rated at 10 A 240/380V volts 50 Hz and shall be wired on chassis/cradle. There should be facility to add one more set of 4 contacts as required.

### 2.8 Termination

All circuit breakers shall be fully tropicalized as standard & suitable for terminating copper or aluminum bus bars. Both fixed & draw-out circuit breakers shall have single pole-pitch. The ACB shall be provided with vertical terminal adapters for proper cable connections/bus duct connections. Terminal orientation for top and bottom side can be changed on site as per cable/bus duct entry.

## 3. Over current Protection (Microprocessor based Trip Unit)

### 3.1 General

The micro processor release should be self powered type without any auxiliary power supply during protection function. The circuit breaker trip unit shall measure the true r.m.s value of the current. All trip units are interchangeable & can be upgraded to higher version without modifications in the breaker. All trip units tested for EMC/ EMI. The sensors shall be non-magnetic or of the Rogowski type for accurate current measurements up to Ics value. The ACB trip unit shall comprise a thermal memory to store temperature-rise data in the event of repeated overloads or earth faults.

### 3.2 Protection

- 3.2.1 The ACB control unit shall offer the following protection functions as standard:
- 3.2.1.1 Long-time (LT) protection adjustable over load current ( $I_r$ ) settings from 40% to 100% of rating of ACB ( $I_n$ ). Over load trip time setting ( $t_r$ ) from 0.5s, 1s, 2s, 4s... 24s.
  - 3.2.1.2 Short-time (ST) protection short circuit setting ( $I_{sd}$ ) from 1.5 to 10 times of  $I_r$  setting, short circuit time delay adjustable from 0 to 400 msec.
  - 3.2.1.3 Instantaneous (Ii) protection with an adjustable pick-up from 2 to 15 times of  $I_n$  setting and an OFF position with fix time delay.
  - 3.2.1.4 Earth-fault protection ( $I_g$ ) with adjustable pick-up from 0.2 to 1.0 times of  $I_n$  with time delay settings from Ints. to 400ms.
  - 3.2.1.5 Individual fault trip LED indications shall be available on the trip unit. The fault indicating LED's are powered by an in-built battery.  $I^2t$  ON /  $I^2t$  OFF options shall be available for short-circuit & earth fault protections. The trip unit shall have integral test facility to verify the healthiness and to avoid external calibration. The release shall be self-diagnostic with separate indication in case of mal functioning. It shall be possible to change the protection settings on line and the circuit breaker need not be switched off while adjusting the setting.
  - 3.2.1.6 The Zone Selective Interlocking is must for all ACB's. The releases shall be suitable to communicate between incomer breakers and out going breakers enable zone selective interlocking. It shall provide intelligent discrimination between breakers in event of short circuit & ground fault condition. It shall help to reduce the thermal and dynamic stresses during fault conditions and thus minimizes the damage to the system. The manufacturer should supply all equipment like power supply, wiring connectors etc. to implement ZSI. Pre wired Fault trip contact should be provided with Release as standard.
  - 3.2.1.7 All 4 Pole ACBs shall have fully rated neutral equal to rating of the breaker & shall be protected against over-load faults with provisions for settings neutral unprotected, neutral protection at  $0.5I_n$  and neutral protection at  $1.0I_n$  to ensure precise neutral protection.

## **Specification for Module Case Circuit Breaker (MCCB)**

### **1. General**

- 1.1 Moulded-Case Circuit Breakers (MCCB) shall comply with IEC 60947-1 and 60947-2 standards or with the corresponding standards applicable in the member countries. They shall be of category A with a rated service breaking capacity ( $I_{cs}$ ) equal to the ultimate breaking capacity ( $I_{cu}$ ) - on all the operational voltage range for the ratings.
- 1.2 MCCBs shall be designed according to Eco-design complying with ISO 14062 especially MCCB's materials shall be of hallogen free type. They shall be supplied in recyclable packing complying with European Directives. The manufacturer shall implement none polluting production processes that do not make use of chlorofluorocarbons, chlorinated hydrocarbons, ink for cardboard markings, etc.
- 1.3 MCCBs shall be fixed type as well as in 3-pole and 4 Pole versions.
- 1.4 MCCBs shall be designed for both vertical and horizontal mounting, without any adverse effect on electrical performance. It shall be possible to supply power either from the upstream or downstream side.
- 1.5 MCCBs shall provide class II insulation (according to IEC 60664-1 standard) between the front and internal power circuits.

### **2. Construction, operation, environment**

- 2.1 Production site organization shall be certified to comply with ISO 14001 standards.
- 2.2 For maximum safety, the power contacts shall be insulated in an enclosure made of a thermosetting material from other functions such as the operating mechanism, the case, the trip unit and auxiliaries.
- 2.3 All poles shall operate simultaneously for circuit breaker opening, closing and tripping.
- 2.4 MCCBs shall be actuated by a toggle or handle that clearly indicates the three positions: ON, OFF and TRIPPED.
- 2.5 In order to ensure suitability for isolation complying with IEC 60947-2 § 7-27:
  - The operating mechanism shall be designed such that the toggle or handle can only be in OFF position (O) if the power contacts are all actually separated.
  - In OFF position, the toggle or handle shall indicate the isolation position.
 Isolation shall be provided by a double break on the main circuit.
- 2.6 MCCBs shall be able to receive a device for locking in the “isolated” position, with up to 3 padlocks.
- 2.7 MCCBs shall be equipped with a “push to trip” button in front to test operation and the Opening of the poles.
- 2.8 MCCB rating, “push to trip” button, performances and contact position indication must be clearly visible and accessible from the front, through the front panel or the door of the switchboard.

## **2.9 Current limitation, discrimination, durability**

- 2.9.1 MCCBs shall be capable of greatly limiting currents. For short-circuits, the maximum thermal stress  $I^2t$  shall be limited. The thermal stress ( $A^2s$ ), i.e. the energy dissipated by mccb during fault should as low as possible. Cable selection to be done as per Maximum permissible cable stresses for which manufacture should produce current limiting and energy limiting curves of MCCB's.
- 2.9.2 MCCBs shall be equipped with a tripping unit independent of the thermo-magnet or Electronic one. This unit will trip the circuit-breaker for high value short circuit currents. The breaking will be carried out in less than 10ms for short-circuit currents above  $25I_n$ .
- 2.9.3 MCCBs shall comprise a device, designed to trip the circuit-breaker in the event of high-value short-circuit currents. This device shall be independent of the thermal-magnetic or electronic trip unit.
- 2.9.4 The electrical durability of MCCBs, as defined by IEC 60947-2 standard, The electrical life of MCCBs shall be (12,000 operations up to 160A ,10,000 operations up to 250A, 4000 operations up to 630A and 2500 operations up to 800A ).
- 2.9.5 MCCBs shall be equipped with a self-test of the connection between the electronic trip unit, the current transformers and the actuator, that will not cause the circuit-breaker to trip. The self test will be of positive logic and visible through the flashing of a green LED in case the self-test occurred correctly and the extinction of the LED in case the self-test failed.
- 2.10 Auxiliaries and accessories
  - 2.10.1 It shall be possible to equip MCCBs with a motor mechanism for electrically controlled operation. An “auto/manual” switch in front shall, when set to the “manual” position, lock out electrical control; when set to “auto”, lock out the manual control; remote indication of “manual” or “auto” mode shall be possible. It shall also be possible to seal the access to the “auto” control. Closing shall take place in less than 80 ms.  
 Following tripping due to electrical faults (overload, short-circuit, earth fault), remote reset shall be inhibited. It shall however be possible if opening was initiated by a voltage release. The operating mechanism shall be of the stored-energy and communicating type only.

2.10.2 The addition of a motor mechanism or a rotary handle shall in no way affect circuit Breaker characteristics:

- Only three stable tripping mechanism positions (ON, OFF and TRIPPED) shall be possible with the motor mechanism,
- Suitability for isolation shall be provided by positive contact indication (ON and OFF) in front of the motor mechanism module.

2.10.3 MCCBs shall be designed to enable safe on-site installation of auxiliaries such as voltage releases (shunt and undervoltage releases) and indication switches as follows:

- they shall be separated from power circuits,
- all electrical auxiliaries shall be of the snap-in type and fitted with terminal blocks,
- the shunt and under voltages should be continuous rated type.

2.10.4 The addition of a motor mechanism module or a rotary handle, etc., shall not mask or Block device settings

2.10.5 It shall be possible to assemble earth leakage protection moulded-case circuit breakers by adding a residual current device (RCD) directly to the circuit breaker case. The resulting device shall:

- comply with appendix B of IEC 60947-2 standard,
- be immunized against nuisance tripping as per IEC 60255 and IEC 61000-4 standards,
- be capable of working normally down to -25 °C ambient temperature,
- operate without an auxiliary power supply, i.e. it shall be capable of operating normally on any phase or 3-phase power network with a voltage between 200 V and 440 V, and of tripping the circuit-breaker even in the event of voltage dips down to 80 V.

### 3. Protection functions

3.1 The thermal-magnetic trip units shall be adjustable and it shall be possible to fit lead seals to prevent unauthorized access to the settings. Protection settings shall apply to all circuit breaker poles. The trip units setting dial must be on front side. Adjustable thermal protection from 0.7 to 1.0 times the current rating.

### 3.2 Protection

The microprocessor release should be self powered type without any auxiliary power supply during normal operation of the breaker. The circuit breaker control unit shall measure the true r.m.s value of the current. All trip units are interchangeable & can be upgraded to higher version without modifications in the breaker. The MCCB control unit shall comprise a thermal memory to store temperature-rise data in the event of repeated overloads or earth faults.

3.2.1 The MCCB control unit shall offer the following protection functions as standard:

3.2.1.1 Long-time (LT) protection adjustable over load current ( $I_r$ ) settings from 50% to 100% of rating of MCCB ( $I_n$ ).

3.2.1.2 Short-time (ST) protection short circuit setting ( $I_{sd}$ ) from 2 to 10 times of  $I_r$  setting.

3.2.1.3 Instantaneous ( $I_i$ ) protection with pick-up 11 times of  $I_n$  setting.

3.2.1.4 Earth-fault protection ( $I_g$ ) with adjustable pick-up from 0.2 to .6 times of  $I_n$  with time delay settings from ints. to 3 sec.

3.2.1.5 The over current and earth fault trip indication shall be available. The release shall be self-diagnostic with separate indication in case of mal functioning. It shall be possible to change the protection settings on line and the circuit breaker need not be switched off while adjusting the setting.

3.2.1.6 All 4 Pole ACBs shall have fully rated neutral equal to rating of the breaker & shall be protected against over-load faults with provisions for settings neutral unprotected, neutral protection at  $0.5I_n$  and neutral protection at  $1.0 I_n$  to ensure precise neutral protection.