

CIRCUIT BREAKER**PART 1 – GENERAL****1.1 SCOPE**

- A. Circuit breaker including Air-circuit breaker (ACB), Moulded Case Circuit Breakers (MCCB), Miniature Circuit Breakers (MCB) and Residual Current Circuit Breakers (RCCB / RCD) shall be provided according to the specification.
- B. All breakers shall be capable of withstanding the electrical, mechanical and thermal stress of the prospective fault level experience. The prospective fault levels of the various breakers shall be verified according to result in short circuit/co-ordination study specified in specification Section 11002.
- C. The drawings, specification and BOQ compliment each other and which is shown or called for one shall be interpreted as being called for on both. Material, if any, which may not have been specified but fairly required to make a complete assembly of switch gear as shown on the drawing, specifications shall be construed as being required and no extra charges shall be payable on this account.

1.2 STANDARDS

- A. All equipment, material and components shall comply with the requirements of the latest editions of Indian Standards with updated amendments. Standards and Regulations applicable in the area where equipment is to be installed shall also be followed.
- B. The equipment offered complying with other standards, these standards shall be equal to or superior to those specified and full details of the differences shall be furnished along with the tender.
- C. The Panel boards shall be engineered and constructed in accordance with the latest revision of the following Indian and British standards:

1.IS/IEC: 60947-2	:	Air circuit breaker/molded case circuit breaker.
2.IS: 3156	:	Voltage transformers.
3.IS: 2705 Part-I, II & III	:	Current transformers for metering and protection with classification burden and insulation.
4.IS: 9224	:	Low voltage fuse and protection.
5.IS: 3231	:	Specification for electrical relays for power system protection.
6.IS:8623	:	Specification for factory built assemblies of switchgear and control gear for voltage upto and including 1000-V AC/1200 V-DC.
7.IS: 4237	:	General requirements for switch gear and control gear for voltage not exceeding gear.
8.IS: 2147	:	Degree of protection provided by enclosures for low voltage switch gear and control gear.
9.IS: 1018	:	Switchgear and control gear selection/installation and maintenance.
10.IS: 1248	:	Direct acting electrical indicating instruments.
11.IS: 375	:	Arrangement for switchgear, bus bars, main connections, auxiliary wiring and marking.
12.IS: 2959	:	AC contactors for voltage not exceeding 1000V.
13.IS: 5578	:	Guide for marking of insulated conductors.
14.IS: 11050	:	Guide for forming system of marking and identification of conductors & apparatus terminal.
15.IS: 1248	:	Direct acting indicating analogue electrical measuring

			instruments and testing accessories.
16.IS: 6005	:		Code of practice for phosphating of iron & steel.
1.BS EN 60898	IEC :		Circuit breakers for over current protection for household and similar installations.
898			
2.BS EN 60947-2	IEC :		Low-voltage switchgear and control gear, Part 2 circuit breakers.
947-2			
BS 54193.	:		Air-break switches, air-break disconnectors, and fuse combination units for voltage up to and including 1000V AC and 1200 VDC.
4.BS 5486	:		Low-voltage switchgear and control gear Part 1 assemblies. Part 1 requirement for type tested and partially type tested assemblies.
5.BS 4293	:		Residual Current Circuit Breaker

- D. BS/IEC or other National standards not mentioned above but are applicable to this installation shall also apply.

1.3 SUBMISSION

- A. A component list and catalogues.
- B. Preparation of bill of materials for Different Items as mentioned in Schedule of Quantities.
- C. Factory and site testing procedures and report formats shall also be included.
- D. Protection co-ordination drawings/tables for complete power system.
- E. Shop inspection and testing procedures.
- F. Field testing and commissioning procedures.
- G. General Arrangement drawing of the Switchboard, showing front view, plan, foundation plan, floor cutouts/trenches for external cables and elevations, transport sections and weights.
- H. Sectional drawings of the circuit breaker panels, showing general constructional features, mounting details of various devices, bus bars, current transformers, cable boxes, terminal boxes for control cables etc.
- I. Schematic and control wiring diagram for circuit breaker and protection including indicating devices, metering instruments, alarms, space heaters etc.
- J. Terminal plans showing terminal numbers, ferrules markings, device terminal numbers, function etc.
- K. Relay wiring diagrams.
- L. Equipment List.
- M. Vendor shall furnish required number of copies of above drawings for Purchaser's review, fabrication of switch boards shall start only after Purchaser's clearance for the same. After final review, required number of copies and reproducible shall be furnished as final certified drawings.
- N. The information furnished shall include the following:
 - a. Technical literature giving complete information of the equipment.

- b. Erection, Operation and Maintenance Manual complete with all relevant information, drawings and literature for auxiliary equipment and accessories, characteristics curves for relays etc.
- c. A comprehensive spare parts catalogue.

Any other work/activity which is not listed above; however is necessary for completeness of electrical system.

PART 2 – PRODUCTS

2.1 AIR CIRCUIT BREAKERS

- A. Air circuit breakers shall be metal clad, flush mounted, horizontal draw out isolation, air break type complying to IS/IEC 60947-2. Air circuit breakers shall have a rupturing capacity of not less than short circuit current experienced at location of installation for 1 second certified by ASTA or other recognized testing authorities.
- B. The breaker shall be provided with variable microprocessor based releases for over load, short circuit and earth fault protection (and shall be compatible with PC) and shall be in conformance with this specifications.
- C. All air circuit breakers (ACBs) shall be of draw-out type encased in metal clad housings. The manufacturing of the breaker shall be such that there is no compulsory safety clearance imposed around the breakers, in order to optimise the switchboard space requirement.
- D. The ACBs shall be so manufactured that they comprise of main and arcing contacts of adequate ratings and housed in reinforced polyester casings, offering double insulation from the front face and ensuring no possibility of “Flashover” between phases. The main contacts shall have double-actions in each pole and all contacts shall be silver-plated and replaceable.
- E. Arc chutes with stainless steel filters shall be provided on each pole of the breaker as an efficient means of arc control. The filters must be effective to minimize the diffusion of ionized gas outside the breaker when the contacts open on short circuits. This manufacturing detail must be effective at all levels of current for which the breaker is manufacture to operate. Any arc created as a result of the opening of the breaker’s contacts during fault conditions shall be completely contained in the chute without any possibility of a “Flashover” between poles or to adjacent earthed metallic parts.
- F. The draw out version of ACBs shall have three indicated positions as follows:
 - a. The breaker is fully racked-in with all the main & auxiliaries engaged.
 - b. Connected: The breaker is fully racked-in with all the main & auxiliaries engaged.
 - c. Tested: The breaker is racked out and with the main disconnected, but all auxiliaries are still connected.
 - d. Disconnected: The breaker is fully withdrawn and all circuits disconnected.
- G. A clear means of Positive Contact Indication (PCI) shall be provided by a mechanical flag marked “ON” or “OFF” to indicate the circuit breakers contact positions. The stored energy mechanism shall also have clear indications marked “CHARGE” or “DISCHARGE” to reflect its status.
- H. Safety shutters shall be provided to all draw out breakers in order to inhibit inadvertent access (degree of protection IP20) to the “live” clusters when the breakers are in the “Test” or “Disconnected” positions. It must be possible to padlock the safety shutters in the SHUT position.
- I. Auxiliary switches shall be equipped for each breaker for indication, alarm and control purposes. Auxiliary switches shall be robust, with double break-action, easily accessible for maintenance and having adequate current ratings to carry the connected load. Each breaker shall have provision for

extending the number of auxiliary switches to cover future alarm or signalling circuit requirements. All auxiliary circuitry wiring shall be connected on the front face of the breaker on a set of disconnecting terminals to facilitate the automatic disconnection of auxiliary circuits when the breaker is in the "Disconnected" position.

- J. Circuit breakers shall be manufactured for optimum performance with minimum maintenance. The mechanical endurance (C-O cycles) without maintenance shall be at least 12500 cycles for breakers up to 1600A, 10000 cycles for breakers from 2000A to 4000A and 5000 cycles for 5000A and 6300A breakers. The electrical endurance (C-O cycles) at 440V without maintenance shall be 10000 cycles for breakers up to 1600A, 8000 cycles for breakers of 2000A, 5000 cycles for breakers of 2500A to 4000A and 1500 cycles for 5000A and 6300A breakers.
- K. The circuit breakers shall be equipped with electrical motor operating mechanisms for automatic charging of the stored energy spring mechanism. However, this shall not prohibit the breakers to be operated manually, if required. Closing operations can be initiated either from the local push button on the front face of the circuit breaker or by remote control. The closing coils shall be rated at 230 v AC. After closing, the stored energy spring mechanism shall immediately be recharged automatically by the motor, so as to be ready for next closing operation when the breaker trips.
- L. Normal manual opening of the circuit breaker shall be accomplished either from the local push button on the front face of the circuit breaker or by means of a trip coil. The trip coil must be capable of carrying continuous rated current, i.e. being permanently energized, for electrical interlocking purposes. The tripping mechanism shall be robustly built and stable without possibility of being inadvertently operated by shock or jerk. The trip coil shall be manufactured such that the plunger operates immediately when activated, without having undue delay for the building up of the coil's magnetic field. Regardless of all circumstances, the speed of closing and opening shall be independent of the operator.
- M. The operating mechanism, carriage and hinged panel shall be so interlocked that it is not possible to withdraw the circuit breaker while it is in the closed position. Closing of circuit breaker in between service and disconnected position is also not possible and vice versa.
- N. Provision shall be made so that it is possible to operate the circuit breaker mechanism when it is in the disconnected position.
- O. The main circuit breakers for the incoming supply and the bus-tie (couple) breaker shall be mechanically and electrically interlocked such that only two of the three circuit breakers can be closed at any one time. The mechanical interlock shall be achieved by means of Ronis keys and electrical interlock by means of a permanently energized coil. The system shall be so arranged that the withdrawal of any one circuit breaker shall in no way effect the operation of the others.
- P. Pad locking facilities shall be provided for each breaker so that breaker operation can be locked in a particular position if so indicated.
- Q. The tests to verify the characteristics of circuit breaker shall include type tests, routine tests and special tests.
 - 1. Type test shall include:
 - a. Verification of temperature rise unit
 - b. Verification of dielectric properties
 - c. Verification of rated short-circuit making and breaker current
 - d. Verification of mechanical operation and endurance
 - 2. Routine test shall include:
 - a. Mechanical operation tests
 - b. Calibration of releases
 - c. Dielectric tests
- R. Other tests, which are to be carried out on request of the relevant authorities, shall be done on the Vendor's account. Vendors must submit type test certificates issued by ASEFA, ASTA or other

recognized testing authorities together with the Technical documents or upon request.

2.02 MOULDED CASE CIRCUIT BREAKERS (MCCB)

- A. The MCCB shall comply with IS/IEC 60947-2. The MCCB shall be provided with over current protection by means of thermal and magnetic tripping element.
- B. All MCCB tripping mechanism shall be ambient temperature compensated. MCCB of frame sizes greater than 150 amps shall be equipped with continuously adjustable magnetic pick up setting. MCCBs used for incoming main feeders shall in addition be provided with continuously adjustable rated current settings in the range of 50 to 100% rated current.
- C. The MCCBs shall have quick make and quick break mechanism independent of the operating speed. The tripping mechanism shall be mechanically "trip free" from the handle so that the handle cannot be closed against fault conditions. All MCCBs should have isolation feature and line load reversibility.
- D. The MCCB shall be provided with door interlock handles. All handles shall be large and robust to carry out the switching operation with ease. The handle shall clearly indicate the "ON", "OFF" and "TRIP" positions. The handle shall be able to be locked in the "ON" or "OFF" positions. When locked in the "ON" position it shall still be possible for the handle to indicate "TRIP" when the MCCB has tripped. An interlock release mechanism shall be provided to enable the door to be opened when the MCCB is locked in the "ON" position.
- E. Multi-pole MCCB shall have a common-trip bar so that a fault condition on any one pole of the MCCB will cause all poles to trip simultaneously.
- F. The MCCB interrupting capacity shall be not less than that indicated on the drawings and back up discrimination/ cascading charts should be submitted of the OEM.
- G. MCCBs of ratings 200A and above shall be of Busbar termination type, adaptable for use with bolts and cable lugs.
- H. Automatic change over MCCBs shall be of the motorised type, fully withdrawable, with both mechanical and electrical interlock. The transfer operation shall be controllable by an adjustable time delay of between 0.1 to 30 sec. The actual transfer time of the MCCBs shall not exceed 2 sec. The motor mechanism shall utilise universal motor with electromagnetic clutch and shall be equipped with full handles to allow manual operation of the MCCB. All automatic change over MCCBs shall have a minimum mechanical life of 10,000 operations.
- I. MCCB when used for motor protection shall have characteristics suitable for the motor starting. Standard range MCCB shall not be substituted for motor protection circuits.
- J. All fully withdrawable MCCB shall have interlocks to prevent withdrawal when the MCCB is "ON".
- K. All main moulded case circuit breaker shall be provided with at least 2 pairs N/O and N/C auxiliary contact.
- L. Indicating lamps shall be of the panel mounting, LED type and shall have execution plates marked with its function wherever necessary. The colour of the lamp cover shall be red for 'ON' and green for 'OFF' indicating lamps shall be provided with series resistor.

2.03 MINIATURE CIRCUIT BREAKERS (MCB)

- A. MCBs shall comply with IEC 898:1995. They shall be of the current limiting type having a sealed ambient temperature independent thermal magnetic tripping mechanism providing overload and short circuit protection. All MCBs shall be of 35mm D/N symmetrical rail mounted type.

- B. The breaking capacity of MCBs shall be at least equal to the prospective fault level at the point installation, unless back-up by a current limiting upstream breaker of the same make.
- C. The MCB operating mechanism shall be mechanically trip free from the operating handle so as to prevent the contacts from being held closed against short circuit and overload conditions. It shall be of the automatic resetting type.
- D. The individual operating mechanism of each pole of a multi-pole MCB shall be directly linked within the MCB casing and not with the operating handles.
- E. The operating handle shall be of the toggle type with possibility for mounting of padlocking facility.
- F. Each pole shall be provided with bi-metallic thermal element for overload protection and magnetic element for short circuit protection.
- G. It shall be possible to fit on site auxiliaries like shunt-trip coil, under-voltage release, ON/OFF switch or alarm switch.

2.04 RESIDUAL CURRENT CIRCUIT BREAKERS (RCCB)

- A. RCCB shall comply with BS 4293 and shall be of the current operated type.
- B. The RCCBs shall be manufactured to trip within 0.1 second for 30 mA.
- C. The RCCBs shall be of 2-pole construction for single phase and 4-pole construction for 3 phases.
- D. All RCCBs shall be complete with test buttons.
- E. All RCCBs shall be batch tested and bear the appropriate test label of approval to SEB requirement.
- F. All RCCBs shall be of high sensibility type as appropriate and as specified in the drawing. They shall be of surge proof manufacture to prevent nuisance tripping due to transient over voltage.

PART 3 – EXECUTION

3.1 TESTING AND COMMISSIONING

- A. All Switch gears shall be inspected & tested in the presence of Owner/ Consultant's representative and certified by the installation Engineer that it is safe before supply is energized, and that all the equipment comply with the requirements of the Specification.
- B. All routine tests specified in relevant Indian/British Standards shall be carried out on all circuit breakers.
 - 1. Test for protective relay operation by primary or secondary injection method.
 - 2. Operation of all meters.
 - 3. Secondary wiring continuity test
 - 4. Insulation test with 1000 Volts megger, before and after voltage test.
 - 5. HV test on secondary wiring and components on which such test is permissible (2 KV for one minute)

6. Simulating external circuits for remote operation of breaker, remote indicating lights and other remote operations, if any.
 7. Measurement of power required for closing/trip coil of the breaker.
 8. Pick up and drop out voltages for shunt trip and closing coils.
 9. CT Polarity test.
 10. Tests to prove correct operation of controls, interlocks, tripping and closing circuits, indications, etc.;
 11. Interfacing test with BMS control function.
 12. All other tests required by the Engineer to verify compliance with the Specification.
- C. Vendor shall provide all facilities such as power supply, testing instruments and apparatus required for carrying out the tests.
- D. Required copies of test certificates for all the tests carried out along with copies of type test certificates and certificates from Sub-Vendor for the components procured from them are to be submitted before dispatch of switch boards.

3.2 TOOLS

- A. One complete set of all special or non-standard tools required for installation, operation and maintenance of the switch board shall be provided. The manufacturer shall provide a list of such tools with his quotation.

3.3 SPARES

- A. The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

3.4 QUALITY ASSURANCE

- A. Quality Assurance shall follow the requirements of Owner/ Consultant as applicable.
- B. Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser's requirements.

3.5 DEVIATIONS

- A. Deviation from specification must be stated in writing at the quotation stage.
- B. In absence of such a statement, it will be assumed that the requirements of the specifications are met without exception.
- C. If any of the above tests fail to comply with the requirements of this Specification in any respect whatsoever at any stage of manufacture, test, erection or on completion at site, the Engineer may reject the item or defective component thereof, whichever is considered necessary, and after adjustment or modification as directed by the Engineer, the Contractor shall submit that item for further inspection and/or test. In the event of the defective item being of such nature that the requirements of this Specification cannot be fulfilled by adjustment or modification, such item is to be replaced by the Contractor at his own expense, to the entire satisfaction of the Engineer.

END OF SECTION