INTERPLANT STANDARD - STEEL INDUSTRY		
IPSS	**GENERAL TECHNICAL SPECIFICATION FOR LV SWITCHGEAR**	**IPSS:1-04-029-15**
	Based on IS 60947(Part 1) : 2004 & IS 8623 (Part 1): 1993	

0. FOREWORD

0.1 This Inter Plant Standard has been prepared by the Standards Committee on Switchgear and Controlgear, IPSS 1:4 with the active participation of the representatives of the steel plants, major consulting organisations and established manufacturers of LV Distribution Switchgear, and was adopted in April 2015.

0.2 Interplant Standards for steel industry primarily aim at achieving rationalization and unification of parts and assemblies used in steel plant equipment and accessories, and provide guidance in indenting stores or equipment (or while placing orders for additional requirements) by individual steel plants. For exercising effective control on inventories, it is advisable to select a fewer number of sizes (or types) from among those mentioned in this standard, for the purpose of company standards of individual steel plants. It is not desirable to make deviations in technical requirements.

0.3 This standard is generally based on IS 60947 (Part 1) : 2004 `Low voltage switchgear and control-gear: Part 1 General rules and IS 8623 (Part 1):1993 `Low voltage switchgear and control-gear assemblies: Part 1 Requirements for type tested and partially type tested assemblies,

1. SCOPE

1.1 This Interplant Standard covers the general technical specifications of LV Distribution Switchgear for rated voltages up to and including 1000 V ac and 1500 V dc for use in Steel Plants.

1.2 Items like motor control centres (MCCs) for which separate Inter Plant Standards have been brought out, are excluded from the scope of this standard.

2. SERVICE CONDITIONS

2.1 Ambient Temperature –The reference ambient temperature shall be 50 deg C unless otherwise specified.

2.2 Altitude – The altitude shall not exceed 1000 m unless otherwise specified.

2.3 **Ambient Air** - The ambient air may contain a fair amount of conductive dust and corrosive gases.

2.4 **Humidity** - The maximum relative humidity shall be 100%. However, both maximum ambient temperature and maximum relative humidity are not likely to occur simultaneously.

3. ELECTRICAL DESIGN

3.1 Electrical Power Supply

1) Unless otherwise specified

- Rated main circuit voltage: 415 V± 10%, 3 phase, 50 Hz ±5% with solidly grounded neutral.

- Rated control circuit voltage: 110V ac or 240 V ac± 10% and shall be single phase as specified in the technical specification.

2) Auxiliary dc supply, wherever specified, shall not be more than 220 V dc.

3.2 Insulation Level

1) Rated insulation voltage : 1100 V

2) One minute power frequency withstand voltage :
- 2.5 kV for power circuits
- 2 kV for control circuits

3) Clearance in air (Minimum)
- Phase to Phase – 25 mm
- Phase to Earth – 25 mm

3.3 Short Circuit Strength

1.	Rated short time withstand current (for power bus bars and air circuit breakers)	Not less than the system short circuit level specified for 1 sec.
2.	Rated peak withstand current	Not less than 2.1 times the system short circuit level.

3.4 Functional Requirements

3.4.1 Automatic Bus Transfer and Momentary paralleling scheme for Double ended LT Switchboards

All the switchboards with sectionalised buses will be normally operated with the bus coupler breakers in open condition.

Auto / Manual / Independent changeover between the two normal incomers and their bus-coupler will be provided with the following features through appropriate selector switch.

3.4.1.1 Auto Mode

For prolonged under voltage on any one of the bus sections, the respective incoming breaker will trip and the bus coupler breaker will close provided the other bus section is healthy and bus coupler is selected for auto changeover. Total changeover time will be adjustable between 1 to 5 seconds. This auto changeover will be blocked if the incoming breaker had tripped on fault. In case bus coupler trips on auto closing, no further closing shall be permitted till the system is reset. Changeover back to the normal source of supply will be affected manually.

3.4.1.2 Manual Mode

Manual live changeover facility will be provided for all the switchboard. For planned outage of one of the normal incoming supplies, the respective selected incomer will be tripped automatically after the bus section breaker is closed manually. Also for restoration of normal power supply, the buscoupler will trip after the respective incoming breaker is closed. For this purpose, a trip selector shall be provided for selecting the breaker to be tripped and momentary paralleling shall be done after phase comparison of both the power supplies through check synchronization relay. Thus, depending on the selection made, the selected breaker will be tripped once all the three breakers are closed manually, thus maintaining continuity of supply for the complete switchboard.

A timer with a time delay on pick up of 0.5 - 5 sec. for annunciation of the running breaker failing to trip within a preset time, (i.e. If the two sources remain paralleled for more than a preset time) will be provided. Latest breaker tripping provision will be included in the changeover scheme in addition to annunciation.

3.4.1.3 Independent Mode

Provision for manual independent (dead bus) closing of a bus-coupler after an intentional manual trip/ outage due to under voltage of any one incomer will be provided.

3.4.1.4 PT Requirement

One set of three phase 415/110 V, 50 VA PT in each incomer and on each bus to be envisaged for U/V relays & for syn. check relay. Only PT signals shall be used for auto changeover and momentary paralleling.

3.4.2 Control Supply Scheme

1) The control power supply for indication, alarm, annunciation, etc shall be through a control transformer, protected by HBC fuses/ MCCB on primary side and fuse/MCB on secondary side.

2) The primary of the control transformer shall be connected between two phases on the line side of the incoming circuit-breaker.

3) The change-over of control supply is to occur automatically through the contacts of the voltage sensing relays of two sections and the line contactor. For auto change-over, a contactor of sufficient current rating shall be used. In addition, a flag type relay along with a lamp indication when asked for shall be used for indication only.

4) Two control transformers shall be there for every switchboard, each rated for the full control power requirements of the switch board.

5) Switchboards with one bus-section :

- One control transformer working and one other stand-by
- Manual change-over arrangement.

6) Switchboards with two and three or more bus-sections :

- One control transformer for each bus section
- Automatic change-over for switchboards with automatic bus transfer
- Manual change-over otherwise.

7) Control supply to each feeder through individual MCBs/fuse. Separate fuses shall be provided for spring charging motors, for indication lamps and for closing/tripping circuits of each cubicle

8) Control supply `ON' indication on door.

3.4.3 Protection Requirements

1) Each circuit breaker feeder shall be provided with inbuilt microprocessor based release as specified with Long time, Short time, Instantaneous and Ground fault (LSIG) protection.

2) One auxiliary relay for each of the transformer faults shall be provided as applicable.

a) For oil type transformer
   i) Winding temp High Trip
   ii) Buchholz Trip
   iii) Oil temp High Trip
   iv) PRD operated trip
   v) Winding temp High Alarm
   vi) Buchholz Alarm
   vii) Oil temp High Alarm
   viii) Oil level low Alarm

b) For dry type transformer
   i) Winding temp High
   ii) Winding temp High Alarm

c) Alll the above signals shall be annunciated in the panel. In addition to this, spare contacts shall be wired to terminal block for wiring to upstream

d) If LV switchboard is directly fed from transformer then stand-by earth fault relay (Electromechanical type) of transformer shall be mounted at the incomer of LV switchboard. Standby earth fault relay contact shall be wired with closing & tripping circuit of incomer. Also, contact of this relay shall be wired up to TB for taking to upstream sub-station breaker for inter tripping.

e) Provision shall be made for tripping of incomer breaker on tripping of upstream feeding breaker. Inter trip shall be received through flagged auxiliary relay.

3.4.4 Annunciation Scheme

1) Requirement for attended premises :

   Audio signalling for all faults with distinct tones for `warning' and `emergency' with Accept, Test and Reset push buttons; attempt to reset with fault conditions still persisting to re-actuate the audible alarm. The annunciation system will have first up logic.

2) A warning and emergency signaling shall be provided to indicate the tripping of one control circuit breaker and both control circuit breakers respectively.

3) Minimum 2 NO+ 2 NC auxiliary contacts and 1 NO + 1 NC master trip relay contact shall be available with suitably wired up to TB for taking the status of the incoming and bus coupler to the feeding HT breaker cubicle.

3.4.5 Indication and Metering –

Unless otherwise specified, following colour of the indication lamps for each feeder shall be provided

ON	-	Red
OFF	-	Green
TRIP CKT HEALTHY	-	White
FAULT/ TRIP	-	Amber
SPRING CHARGED	-	Blue

At each incomer, indicating lamps for 3 phase supply availability at the incoming side to be provided. All indicating lamps shall be LED type with LVGP feature.

Unless otherwise specified, following indicating meters shall be provided in each feeder

I/C & B/C	-	3 Ammeter, 3 Voltmeter, 1 Multifunction meter
O/G	-	1 Ammeter with SS, 1 Multifunction meter

4. GENERAL ARRANGEMENT

1) Factory built assembly shall incorporate drawout type air circuit breakers.

2) Assembled distinct vertical sections, shall comprise of:

   a) Circuit breaker compartments with air circuit breakers with operating handle, push buttons, indicating lamps, meters, etc,.

   b) Bus bar at the rear running horizontally (at the top) and vertically with removable covers or doors at the rear.

   c) A relaying/metering compartment on the front where required.

   d) Cable compartment

3) Incomers and bus couplers should not be located adjacent to each other for carrying out safe maintenance of bus coupler panel and to avoid total collapse of both the sections in case of fire.

4) *Cable entry* – Sufficient space and support arrangement shall be provided inside each panel to accommodate LV cable termination kits and sealing kits suitable for the type, size and number of cables to be terminated.

5) Mounting heights (unless otherwise specified) :

a)	Operating devices (centre line)	1800 mm (max)
b)	Indicating instruments	2000 mm (max) (top line) 500 mm (min) (bottom line)

4.6 All outgoing circuit breakers shall have incoming supply at the top side of circuit breaker and outgoing from the bottom contacts of circuit breaker for safety reasons and uniformity.

4.7 Circuit breakers below 1000A rating can be arranged in multi-tier configuration. Single tier arrangement shall be adopted for circuit breakers rated 1000A and above.

5. CONSTRUCTIONAL FEATURES

5.1 Mechanical Design

1) Sheet steel clad, floor mounted, free standing design.

2) CRCA Sheet steel used shall be of 2 mm thickness (min) for all members except :

   a) Doors and covers where it may be 1.6 mm (min), and

   b) Partitions with no component mounted there on and having no structural function where it may be 1 mm (min). Degree of protection IP52 or better upto 1600A and IP42 or better for higher rating. Manufacturers to furnish derating calculation for selection of equipment at ambient temperature for 50^{o}C if the equipment is designed for less than 50^{o}C.

3) A base channel/frame of minimum height 75 mm and thickness 3.0 mm shall be provided to prevent corrosion of sheet and to facilitate cleaning of floors.

4) Cadmium plated or zinc bichromated and passivated or electro-galvanized hardware. In case of spring washers, the manufacturer shall ensure hydrogen de-embrittlement after galvanizing.

5) Transport unit not longer than 2.5 metres.

6) Removable lifting arrangement for each transport unit.

7) Extensibility on both sides of the panel.

8) 3.0 mm thick removable undrilled gland plates (non-magnetic material for single core cables wherever specified).

9) Doors with bolting arrangement or removable bolted sheet steel covers at the rear.

10) Independent door having handle padlocking arrangement with concealed hinges with the door not forming part of the drawout truck.

11) The door flap shall open through more than 90^{o} angle.

12) All breakers of similar rating shall be interchangeable.

13) Preferably, largest breakers shall be installed at the lowermost compartment (mainly I/C, B/C & O/G big breakers) for smooth handling and safety.

5.2 Labels

1) Switchboards designation name plate at the centre on the top of the board with letters not less than 25 mm high.

2) Panel designation number on each panel; both in front and rear.

3) Inscription plate for each feeder on the front door and rear.

4) Door/front mounted devices to have labels preferably directly below them.

5) Labels made of non-rusting metal with engraved inscriptions of white letters on black background. The minimum letter height shall be 5 mm, 10 mm and 25 mm for devices, main feeders and labels on the panels respectively. Metallic labels shall be riveted. Use of screwed aluminium labels are also permissible.

6) Label designation subject to approval.

7) Bus side and cable side shutters labeled for identification.

5.3 Surface Treatment

1) All sheet steel work shall undergo a process of degreasing, pickling in acid, cold rinsing and phosphatizing and then sprayed with a corrosion resistant primer followed by stove enameling. Two coats of final paint shall be given thereafter and shall be further stove enameled. Any other process of metal treatment may also be accepted subject to specific agreement with the purchaser. Thickness of coating shall not be less than 80 microns average.

2) Shade of paint both for exterior of the panel shall be as per the purchaser requirement. The interior of the panel shall be painted with white colour. However all the incomers shall be painted red and buscouplers as off-white unless specified otherwise.

6. BUSBARS AND CONNECTIONS

1) Three phase and neutral buses unless otherwise specified.

2) Power buses of EC grade aluminium alloy equivalent to E91E WP as per IS 5082:1998 `Wrought aluminium and aluminium alloy bars, rods, tubes and sections for electrical purposes (*second revision*)' or high conductivity electrolytic grade copper as per IS 613:2000 `Copper rods and bars for electrical purposes (*third revision*)'.

3) Control and auxiliary buses shall be either copper bus or single core multistrand PVC copper cable of electrolytic grade copper as specified.

4) The continuous rating of the main horizontal bus not less than the rating of the incomer specified; where not specified, the rating to be selected for atleast 125% of the maximum demand of the switchboard taking into account spare feeders.

5) The vertical bus ratings:

For incomer	:	Not less than that of horizontal bus
For outgoing	:	Not less than that of the outgoing breaker, irrespective of release setting.

6) Neutral bus rating not less than 50% of phase bus.

7) Final operating temperature under continuous operation in enclosure limited to 90^{o}C by thermometer method for busbar and 75 ^{o}C for enclosure.

8) Both horizontal and vertical bus bars to be designed and supported to withstand the thermal and dynamic stress corresponding to rated short time and peak withstand currents specified.

9) Cross-section of main horizontal bus to be uniform throughout the switchboard and continuous in one transport unit.

10) Bus bar arrangement as per IS 11353:1985 `Guide for uniform system of marking and identification of conductors and apparatus terminals' and IS 5578 : 1984 'Guide for marking of insulated conductors'. The incoming and outgoing bus configuration shall be mutually agreed between purchaser and supplier.

11) Phase identification by colour in each panel (Red, Yellow and Blue for phases and black for neutral).

12) Busbar joints and tap-off connections of bolted type with zinc bichromated/ cadmium coated high tensile steel bolts and nuts, fish plates with accessories at the end of a transport unit for site connections.

13) Busbar support insulators including inter panel bushings of non-hygroscopic material having high impact and dielectric strength with adequately high tracking index.

14) The bus bar layout in the incoming circuit breaker shall be such that safe approach for reaching the either outgoing or incoming terminals of the circuit breaker.

15) Colour coatable insulating heat shrinkable sleeves are to be provided to all the busbars including droppers.

7. INTERNAL CONTROL WIRING

1) Control wiring by 1100 V grade PVC insulated, single core multi-stranded copper conductor of minimum cross-section 1.5 mm^2. However, cross section of CT circuit wires shall not be less than 2.5 mm^2.

2) Flexible wires, protected against mechanical damage for wiring to door-mounted devices.

3) Wires identified at each end in accordance with schematic diagrams by printed type ferrules.

4) *Colour code for control wiring* :

ac	-	black
dc	-	light gray
earth	-	Green

5) All connections external to a feeder, all the auxiliary contacts of the LT breaker and all spare contacts of the relays/ release wired upto terminal blocks.

6) Interconnection between panels of adjacent shipping sections to be brought out to a separate terminal block; wires for interconnection properly labelled, looped and bunched inside the panel for connection at site.

7) Not more than two connections on any one terminal.

8. EXTERNAL TERMINATIONS

8.1 Control Termination

1) 800V grade multi-way terminal blocks of non-tracking moulded plastic polymer based compounds, polyamide, complete with insulated barriers, stud type terminals and identification strips. There shall be separate dedicated terminal block for all external connections. All the terminal blocks shall be shrouded.

2) Aux power and control terminals shall be segregated and identified.

3) Control terminals of minimum rating 10 A suitable to receive 2.5 mm^2 copper conductor.

4) 20% spare terminals with a minimum of four in each control terminal block to be provided.

8.2 Power Termination

1) Terminal shall be suitable for accepting number of cables/ bus trunking as specified by the purchaser.
2) Wherever more than one cable has to be terminated per unit, the arrangement shall permit connection and disconnection of individual cable separately without disturbing other cables.
3) Extension bus links shall be insulated and adequately spaced for terminating multiple cables of all sizes.

9. COMPONENTS

9.1 Air Circuit Breakers

9.1.1 Electrical Features

a. Air break triple pole drawout type conforming to IS 60947.
b. Rated continuous current as specified.
c. Symmetrical breaking capacity and 1 second withstand rating of the breaker not less than the system short circuit level specified.
d. Performance category : P2
e. Auxiliary contacts : 6 NO + 6 NC minimum

9.1.2 *Operating Mechanism*

a. Manual or power operated mechanism as specified
b. Spring charged stored energy mechanism to ensure high speed closing and tripping independent of the operating forces.
c. Anti pumping and trip free feature
d. Emergency tripping by mechanically operated trip push button (shrouded to prevent accidental closing) acting directly on the trip bar.
e. Closing operation of the breaker to charge the tripping spring, ready for tripping.
f. Mechanical indication to show :
   ⇒ Closing spring charged
   ⇒ Breaker ON/OFF/TRIP
g. Breaker to close only when spring fully charged
h. Non-reset type operation counter

i. For manually operated breakers.
   ⇒ Independent manual charging of closing spring and closing by handle.
   ⇒ Alternatively, closing by mechanical push button with spring previously charged by handle.

j. For electrically operated breakers :
   ⇒ Charging of closing spring by motor
   ⇒ closing by closing coil
   ⇒ spring charging motor and closing coil suitable for rated control voltage (Universal voltage rating unless otherwirse specified).
   ⇒ One opening and one closing operation without control supply.
   ⇒ Provision also for manual closing with spring charging motor automatically decoupled as soon as charging handle is inserted.

9.1.3 Drawout Features

1) 3 distinct positions viz. `Service', Test' and `Isolated' with the door closed.

2) Mechanical position indication and locking/ latching facility for all 3 positions.

3) *Power connections* – Male contacts must be provided on panel cradle and female contacts will be provided on breakers.

4) *Control connections* – sliding or plug-socket type, mechanically coded to prevent wrong insertion; continuous rating 16 A minimum.

9.1.4 Safety Interlocks

1) Breaker cannot be closed in any intermediate position other than the 3 fixed positions.

2) With the breaker closed, it cannot be racked from any of the 3 positions to another. Provision for defeat of this interlocking shall be provided only for `isolated' to `test' position.

3) Mechanical stopper to prevent accidental falling while withdrawing.

4) *Door can be opened only when* :

   - breaker is OFF and
   - is in `test/isolated' position.

Note: Design of the door shall be such that the circuit breaker should not be put back in to operating position for door opening.

5) Remote closing of breaker in test/isolated position is not permitted.

6) Insertion of breaker into `Service' position not possible if the shutters are not free.

9.1.5 Protective release of circuit breaker

Unless and otherwise specified, all circuit breakers shall be provided with direct acting self powered protective release for Long Time, Short Time, Instantaneous and Ground fault protection (LSIG). Release can be of conventional thermo-magnetic type or microprocessor based as specified by the purchaser.

Thermo-magnetic release shall be provided with dial type setting knob and dip switches for setting. Microprocessor based releases shall be provided with graphical display and soft touch buttons for setting.

The microprocessor based release shall have the following feature:

1) The release control unit shall be interchangeable on site for adaptation to changes in the installation.
2) Sensors shall be non-magnetic or of the Rogosky type for accurate current measurements.
3) The control unit shall measure the true RMS value of the current.
4) The control unit shall comprise of a thermal memory to store temperature-rise data in the event of repeated overloads or earth faults. It shall be possible to disable this function if necessary.
5) The release shall be settable at site with separate setting range for pickup & time setting.
6) Each protection i.e S/C, O/L & E/F shall have individual indications. Fault indications shall have retention feature till it gets acknowledged without requiring any external control voltage and battery backup. The fault indications shall be self powered.

9.2 **Control Circuit Fuses**

1) Link type with breaking capacity 50 kA (min) conforming to IS 13703 (Part 1): 1993 `LV fuses for voltages not exceeding 1000 V ac or 1500 V dc: Part 1 General requirements

2) Visible operation indicator

3) Fuse pullers with insulated handles, where required.

9.3 **Current Trasformers**

1) Cast resin or Moulded case (Poliamide) encapsulated, conforming to IS 2705:1992 `Current transformers (*second revision*).

2) Secondary rating : 5 A

3) To withstand the thermal and dynamic stresses corresponding to rated short time and peak withstand currents specified.

4) Measuring CTs

Accuracy class : 1.0
Instrument security : not more than 5

5) The minimum burden

: 5 VA, for measuring CTs without interposing CT
: 10 VA, for measuring CTs with interposing CT, and
: 5 VA, for protection CTs if specified

However, the actual burden to meet the requirements of relays, instruments and leads associated with the particular CT includes 10% spare capacity and shall be finalized with the purchaser.

6) For motor feeders wherever specified, interposing CT of 5/1A, 5VA or 4-20mA current transducer shall be provided in the 'Y' phase for remote LCS metering.

9.4 **Protective & Auxiliary Relays**

1) Flush mounting type in dust proof cases.

2) Protective relays of withdrawable type, auxiliary relays of fixed type.

3) Trip circuits automatically broken & CT circuit shorted when a relay is withdrawn.

4) Hand reset type mechanical operation indicator

5) Minimum 2 pairs of contacts, of rating :

Continuous	:	5 A
ac 11	:	0.5 A, 240 V
dc 11	:	0.5 A, 220 V, L/R = 40 ms

9.5 **Annunciators :**

1) Microprocessor based facia window type with white heat resistant plastic material, inscriptions engraved in black.

2) Lighting unit with LEDs shall be provided. Colour of Window & LED shall be as follows

TRIP (Emergency) Signals	-	RED
Alarm (Warning) Signals	-	Amber

3) Facia window and lighting unit plug-in type assembly.

4) Control circuits of individual channels on glass epoxy coated plug-in type PCBs in bin assembly, plug sockets mechanically coded to avoid wrong insertion.

5) Fault ACCEPT, system RESET and TEST push buttons common for the system. The annunciation system will be provided with first up logic.

6) *Sequence of operation* (unless otherwise specified) :

a) On incidence of fault : Hooter ON; lamps FLASH

b) On pressing ACCEPT PB
1^{st} time : Hooter OFF; lamps STEADY, First fault FLASHING
2^{nd} time : Hooter OFF; All lamps STEADY

c) On pressing RESET PB :

If fault cleared :	Hooter OFF; lamps OFF
If fault persists :	Hooter ON; lamps FLASH

7) Stabilized and short-circuit proof dc power supply module for the system operation included with the unit.

8) 20% spare windows with minimum of 2.

9) Suitable for either NO or NC logic of potential free contact. The change-over from one to the other logic shall be possible at site.

10) Audio-signalling equipment shall be of continuous rating with dB level of 60 dB at one meter. Separate audible signal for Alarm & Trip Signals.

11) Wherever specified, DC fail annunciation shall be annunciated with the help of AC supply and AC Bell

9.6 Indicating Instruments

Each feeder in the switchboard shall be provided with indicating instruments like voltmeter, ammeter, frequency meter, PF meter, energy meter, multifunction meter etc as specified by the purchaser. Number and type of

meter (analogue or digital) as specified by the purchaser shall be provided in each feeder of the switchboard.

9.6.1 Analogue Indicating Meters

1) Conforming to IS 1248 (Part 1): 2003 `Direct acting indicating analogue electrical measuring instruments and their accessories : Part 1 General requirements and IS 2419 : 2012 Dimensions for panel mounted indicating and recording electrical instruments

2) Accuracy class : 1.0

3) Shall have 96 sqmm square flush case, taut band type

4) Vibration proof, suitable for vertical flush mounting.

5) Parallax free design with glare free front covers.

6) Dial plate white with numerals and letters in black and knife edge pointers.

7) Magnetically screened and temperature compensated with zero adjustment device.

8) Voltmeters to be protected with HRC fuses placed as close to the bus bar as possible.

9) Ammeters for motor feeders with normal scale upto full load value and supressed scale upto 6 times beyond full load for indication of motor starting current.

10) Ammeters and voltmeters shall be analogue type only on the panel.

9.6.2 Digital Indicating Meters

1) Confirming to IS 13875 : Part 1 : 1993 Digital measuring instruments for measurement & control: General specifications concerning terms, tests & data sheet details

2) Accuracy class - 0.5

3) LED type display, minimum $3^1/_2$ digit display.

4) Minimum size of 96 sqmm square, shall be vibration proof & suitable for vertical flush mounting.

5) Shall be suitable for external control supply same as available in the switchboard.

6) Wherever specified, Microprocessor based Electronic Multi Function Meter (MFM) with load survey facility and RS 485 communication port with necessary software / hardware for connectivity to SCADA (Parameters A, V, KW, KWH, KVA, KVAR, PF). 3 line LED display shall be provided.

9.7 **Indicating Lamps**

~~1.~~ LED lamps for indication will be LED lamps 60 milli-candle with leakage voltage protection.

1) *Colour* :

ON	-	Red
OFF	-	Green
TRIP CIRCUIT HEALTHY	-	White
FAULT/WARNING	-	Amber
SPRING CHARGED	-	Blue

9.8 **Control Transformers** – [Ref IPSS:1-04-013-02 ` Control Transformers (first revision)]'

1) Dry type self ventilated.

2) Taps on primary : $\pm$ 2.5% and $\pm$ 5%.

9.9 **Control & Selector Switches**

1) Control switches for circuit breaker ON/OFF control – 3 position, spring return to neutral with lost motion device and pistol grip handle.

2) Other control and selector switches – stay put type with wing type knobs.

3) *Ammeter selector switches* – 4 position, make before break.

4) Voltmeter selector switches – 4 position.

5) *Rating* :

Continuous	:	10 A
ac 11	:	4 A, 240 V
dc 11	:	0.5 A, 220 V dc, L/R = 40 ms

6) Colour : Black

9.10 **Push Buttons**

1) *Rating* :

Continuous	:	10 A

ac 11	:	1.5 A at 240 V
dc 11	:	0.5 A at 220 V dc, L/R = 40 ms

2) *Colour* :

ACCEPT	:	Blue
RESET	:	Black
TEST	:	Yellow

3) It is desirable that ammeter selector switch may be done away with, as 3 ammeters can be used to measure line current.

9.11 Emergency push button with mush-room head (Red colour) of press to lock and turn to release type may be included for tripping HT breaker from PCC.

9.12 Control and indication devices (such as voltmeter, indicating lamp etc) mounted on switchboard compartment door shall not be directly connected to a circuit having voltage more than 240V. Wherever these devices are functionally required to be connected to a circuit having voltage more than 240V, the same shall be connected through potential transformer having secondary voltage not exceeding 240V. Primary and secondary of the potential transformer shall be provided with appropriate circuit breaker.

10 PROTECTIVE EARTHING

1) Continuous earth bus of minimum size 50 x 6 mm copper or equivalent aluminium designed to carry the peak short circuit and short time fault current as specified.

2) Provided at the bottom extending throughout the length of the board, bolted/brazed to the frame work of each panel with an earthing terminal at each end for terminating external earth conductor.

3) Vertical earth bus for earthing individual functional units.

4) All non-current carrying metal work (including metallic cases of instruments and other panel mounted components) effectively bonded to the earth bus.

5) Hinged doors earthed through flexible earthing braid.

6) Looping of earth connection resulting in loss of earth connection to other devices when the loop is broken, not permitted.

7) Withdrawable units provided with self-aligning, spring loaded, silver plated copper scraping earth contacts of make before/break after type ensuring earth continuity from the `service' to the `test' position.

11 BREAKER HANDLING TRUCK

1) For withdrawing the breaker from the switchboard, the number of tracks as agreed upon by the purchaser and the manufacturer.

2) Height of platform adjustable to suit the levels at which the breakers are mounted.

3) Adequate mechanical strength

4) Guide rails and stops.

12. TESTS

12.1 Type Test

Type test certificates for tests conducted earlier on similar rating & design of specified equipment shall be submitted. Tests shall be in line with relevant referred IEC/IS. In case type test certificate for similar rating & design of equipment is not available with the contractor, the same shall be conducted in the presence of PURCHASER representative. Type tests certificates shall not be older than 5 years from the date of submission of the relevant certificates during approval stage. The type test certificate shall be provided for the same manufacturing unit from where supply is being made. All type test reports shall be from the NABL accredited/ equivalent foreign laboratory.

Specified type test or special tests shall be conducted at manufacturer works on the offered equipment, if purchaser so desires, even if type test certificates are available.

At least following type test certificates shall be submitted by the supplier for each supply. However purchaser may ask for other type test certificates as per the relevant IEC/ IS.

a) Temperature rise test as per IS 8623. (Type test certificate shall be for minimum 3 panels if offered switchboard is having more than 3 panels)

b) Short circuit breaking and making capacity.

c) Short time rating of CB and switchboard.

d) Verification of degree of protection for enclosure

12.2 Routine Tests

Routine test on all equipment shall be conducted at manufacturer works as per latest IS/ IEC as referred. Tests shall also confirm to International Standards VDE/DIN/BS (in case corresponding test are not mentioned in IS/ IEC).

At least following routine tests shall be conducted by the supplier for each supply. However, additional tests as required by purchaser shall be conducted as per relevant IEC/ IS

a) Verification of dielectric strength, protective circuits etc according to IS 8623 (Part 1):1993.

b) Tests to show interchangeability of drawout trucks.

c) Tests to show proper operation of mechanical interlocks.

d) Operation & functional tests including automatic bus transfer & Momentary paralleling (where specified).

e) Tests of air circuit breakers including operation test, calibration of releases, measurement of contact resistance, etc.

f) Operation test for circuit breakers etc. with normal control voltage and closing at 85-110% and trip at 70-110% of normal control voltage

g) Polarity test for CTs.

h) Checking of protective earthing circuits

13 Data to be furnished for the purpose of procurement.

13.1 SLD with number of feeder, No & Type of cable per feeder, ACB rating, CT ratio, no of voltmeter, ammeters, PF meter, Freq meter, Multi function meter in each feeder etc
13.2 Short circuit rating and time of the switchboard
13.3 Control voltage-240V AC
13.4 Type of release –Microprocessor based
13.5 Functional requirement – Auto changeover/ momentary paralleling/ None
13.6 Colour of the panel – 631 as per IS 5/ RAL 7032/ any other colour
13.7 Number of breaker handling trucks per switchboard.

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