

 IPSS	GENERAL TECHNICAL SPECIFICATION FOR INDOOR HIGH VOLTAGE SWITCHGEAR <i>(FIRST REVISION)</i>	IPSS:1-04-030-15
	BASED ON IS 12729:2004, IEC60694:2002, IEC62271-1:2007, -100:2008, -200:2003	Formerly: IPSS:1-04-030-97

0. FOREWORD

- 0.1 This Interplant 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 organizations and established manufacturers of High Voltage 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 the following standards:
- a) *IS 12729:2004* - General Requirements for switchgear and controlgear for voltages exceeding 1000 V.
 - b) *IEC 60694:2002* - Common specifications for high-voltage switchgear and controlgear standards.
 - c) *IEC 62271-1:2007* - High-voltage switchgear and controlgear - Part 1: Common specifications
 - d) *IEC 62271-100:2008* - High-voltage switchgear and controlgear - Part 100: Alternating current circuit-breakers
 - e) *IEC 62271-200:2003* - High-voltage switchgear and controlgear - Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV

1. SCOPE

- 1.1 This Interplant Standard covers the general technical specifications for indoor HV Switchgear for use in Steel Plants, but excludes the requirements for arc furnace applications.

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 and moisture also.
- 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 Electric Power Supply

- 1) Rated voltage, 3 phase, 50 Hz, 3.3/6.6/11/33 kV, as specified.
- 2) Suitable for operation under voltage variation $\pm 10\%$ and frequency variation $\pm 5\%$.
- 3) The system neutral shall be either solidly earthed, unearthed or resistance earth system.
- 4) The system short circuit level shall be as specified by the purchaser [from the preferred ratings given in the relevant standard].
- 5) The control & signalling supply shall be 110/220 V dc and auxiliary supply shall be 110/240 V ac and 220/110 V dc as specified.

3.2 Insulation Level

Corresponding to the rated voltage as below:

Nominal voltage (kV)	3.3	6.6	11	33
Highest system voltage (kV)	3.6	7.2	12	36
One minute power frequency withstand voltage (kV)	10	20	28	70
1.2/50 microsecond impulse withstand voltage (kV)	40	60	75	170

Purchaser may ask for the following clearances in case of **unearthed** system

	3.3kV	6.6 kV	11kV
Phase to phase (mm)	50	90	110
Phase to earth (mm)	50	90	110

3.3 Short Circuit Strength

- 1) Rated short time withstand current shall not be less than the system short circuit level specified for 3 seconds.
- 2) Rated peak withstand current shall not be less than 2.5 times the system short circuit level.

3.4 Functional Requirements

3.4.1 Automatic Bus Transfer Scheme and Momentary paralleling for Double ended 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 will be provided, 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). 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.

3.4.2 *Control & Auxiliary Supply Scheme*

- 1) Separate 240 V ac source for space heaters, panel illumination and socket outlets.
- 2) The auxiliary ac supply shall be from an external source or from secondary auxiliary transformers provided in the switchboard as specified.
 - a) The auxiliary transformers should normally be mounted on draw-out trucks like the circuit-breakers. The cubicles shall be adequately dimensioned with proper cooling and ventilation arrangement. This should be protected by suitable HRC fuses on the primary side and MCCBs or MCB on the secondary side.
 - b) One auxiliary transformer for each bus-section, rated for full capacity of the switchboard shall be provided. In case of failure of supply from any auxiliary transformer in a multi section switchboard, another shall takeover automatically to maintain continuity of supply. A similar auto changeover scheme when two auxiliary supplies are provided externally instead of through auxiliary transformers. Necessary status indication lamps shall be provided for auxiliary transformers in service.

- 3) The dc supply (arranged externally from battery) used for relay and control circuit as well as for spring charging motors of the HV breakers. Wherever spring charging motor is ac, provision of line with ac supply shall be made. For spring charging, universal motors shall be provided.

- 4) Control supply to each functional unit fed over individual MCB.

3.4.3 Auxiliary Buses for Control & Protection

- 1) ac Control supply Bus
- 2) dc Control supply Bus
- 3) PT secondary voltage Bus
- 4) Under voltage bus - for tripping of motors, wherever required.

- 3.4.4 Provision of Metal Oxide Surge Suppressor* - Surge suppressors shall be provided for all outgoing breakers at the load side terminals or in the safe location as per purchaser's requirement to limit the switching surges to values specified. Surge suppressor shall be installed after the CT when placed in the cable compartment.

3.4.5 Annunciation Scheme

- 1) Flag indications for all faults for which individual protective relays have been specified.
- 2) ON, OFF & Trip indication lamps for all breakers.
- 3) `Warning' signalling (as applicable) on individual panels.
 - a) All transformer warning signalling conditions (signal from corresponding transformer control panel/substation).
 - b) Loss of trip circuit supply including trip circuit unhealthiness.
 - c) Earth fault/earth leakage in case of unearthed system
 - d) Control supply failure
 - e) PT fuse failure

- f) Bus-coupler failed to close on auto-changeover
 - g) Any other signal as per purchaser's requirement.
- 4) 'Emergency' signalling for tripping of HT breaker on fault.
 - 5) One common signal for 'warning' and one signal for 'emergency' from each panel to be wired to a common annunciation panel of the switchboard, where specified.
 - 6) Microprocessor based annunciators for 'warning' and 'emergency' signalling conditions on individual panels of fascia window type. Common audio signalling with 'Accept', 'Reset' and 'Test' push buttons for the switchboard where common annunciation panel not specified. Audio signalling to have distinct tones for 'warning' and 'emergency'.
 - 7) Where specifically asked for, for breakers feeding motors and controlled from remote, the closing impulse and tripping impulse shall come through contactors of suitable ratings to enable fault tracing.
- 3.5 Ventilation** - The temperature rise limit as specified in this standard shall be achieved with natural ventilation only. No forced cooling shall be used.

4. GENERAL ARRANGEMENT

- 1) The switchgear shall be of metal clad, self standing, dust proof construction, indoor cubicle type, internal arc tested for designed fault current, fitted with floor rolled truck mounted VCB in fully draw out execution, horizontal isolation. VCB shall be truck mounted so that it directly rolls on to the floor when taken outside without usage of any external breaker handling truck.
- 2) Each cubicle shall be of compartmentalized construction as per "Loss of Service continuity" and "Partition Metallic" criteria of latest edition of IEC 62271-200 and shall have following separate compartments
 - a) Main compartment for housing the drawout trucks.
 - b) HV bus bar compartment.
 - c) Compartment for CT and outgoing cable/bus terminations.
 - d) LV Compartment

- 3) LV compartments containing metering, protection, and control equipment shall be so designed and constructed, that these shall permit, accessibility for inspection or checking without the need of the switching 'off' HT-power. The mounting of the instruments shall be such that they are not effected by vibrations generated by switching operations.
- 4) Drawout trucks of the same type and rating interchangeable.
- 5) For drawout PTs, provision shall be made for locking in the pushed-in position to avoid disengagement due to vibration.
- 6) Provision for easy access to CT secondary without disturbing cable connections.
- 7) Cable entry from the bottom at the rear side. Minimum 700 mm clear height for cable termination for voltages upto 11 kV and 900 mm for voltages above 11 kV.
- 8) As far as possible relays, control switches, meters and indicating lamps on the swing panel of the LV compartment. However, relays with flags, shall be mounted on the swing panel only.
- 9) Space heaters, panel illumination with door switch and power sockets in each panel.
- 10) Maximum mounting heights :

Operating devices	:	1900 mm
Indicating instruments:		2100 mm
- 11) Breaker cubicle door should have padlocking facility.
- 12) Manual/ Mechanical tripping arrangement for emergency tripping of CBs shall be available.
- 13) The switchgear cubicle shall be provided with a position changing gear arrangement in such a way that by engaging detachable device from outside the front door, it shall be possible to move the breaker truck and change position without opening the cubicle door. Facilities for pad locking in each position shall be provided.
- 14) All the buscouplers shall be provided with separate withdrawable link panel with necessary interlocking arrangement.

- 15) Panel shall be of type tested design for internal arc test for a duration of ≥ 500 msec for the design fault current magnitude.

5. CONSTRUCTIONAL FEATURES

5.1 Mechanical Design

- 1) Sheet steel clad, floor mounted, free standing design.
- 2) Sheet steel used shall be of 2 mm thickness (minimum) for load bearing members, except the partitions with no component mounted thereon and having no structural function where it may be 1 mm (minimum). The sheet steel shall be cold rolled continuously annealed only and 1.6 mm thickness for non load bearing members.

Suitable stiffeners are to be provided on doors/covers where instruments/relays are mounted.

- 3) Degree of protection IP – 4X
- 4) Assembled on base channel of structural steel of minimum height 50 mm, painted black.
- 5) Earthed metallic barriers between compartments and between vertical sections except busbar chamber.
- 6) Seal-off bushings should be provided wherever bus bars pass through metallic partitions
- 7) Zinc bichromated and passivated hardware.
- 8) Transport unit not larger than 3.2 metres.
- 9) Removable lifting arrangement for each transport unit.
- 10) Lockable front doors with concealed hinges with the door not forming part of the drawout truck.
- 11) Extensibility on both sides of the panel.
- 12) Removable sheet steel covers shall be lift up bolted type at the rear
- 13) Explosion vents for different chambers.

- 14) Pressure relief flaps which can not be easily opened from outside to release pressure that, builds up in the event of arcing faults inside the cubicle.
- 15) Anti condensation heaters of suitable wattage with thermostat control.
- 16) Suitable slotted channel shall be provided in the cable chamber for clamping the cable.
- 17) Internal arc withstand capacity according to IEC 62271-200 for duration greater than or equal to 500 ms.
- 18) The minimum panel width for 6.6kV and 11kV panel shall be maintained as 800mm to ensure ease of maintenance

5.2 Labels

- 1) Switchboard designation name plate at the centre 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 shall be on the unremoveable part of the panel on the front and the back.
- 4) Door/front mounted devices to have labels directly below them, giving the nomenclature and purpose of the device.
- 5) Labels made of non-rusting metal with engraved inscriptions of white letters (minimum 3 mm high) on black back-ground.
- 6) Colour for incomer and sectionalizer & tie breaker should be red and white respectively painted at the front & back portion of upper half top of the swing door. Painted mimic should be available on both front and backside.
- 7) Label designation and size of lettering subject to approval.
- 8) Bus side and cable side shutters labelled for identification.
- 9) All non rusting metal labels shall be fixed by metallic riveting only

5.3 Surface Treatment

- 1) All metal parts of the panel to undergo surface treatment that includes derusting, cleaning chemically, degreasing, pickling in acid, cold rinsing, phosphating and passivating followed by spraying with two coats of zinc oxide primer and baking in oven.
- 2) Shade of paint :

Panel interior:	Off white shade
Exterior:	Powder coated, colour as specified by the purchaser

However all the incomers shall be painted red and buscouplers as off-white unless specified otherwise.

6. BUSBARS AND CONNECTIONS

- 1) Power buses of EC grade aluminium alloy equivalent to E91E WP as per IS 5082:1998 or high conductivity electrolytic grade copper as per IS 613 :2000 as specified by the purchaser.
- 2) Control and auxiliary buses of electrolytic grade copper.
- 3) The continuous rating of the main horizontal bus shall not be less than the rating of the incomer specified.
- 4) The vertical bus rating :
 - a) For incomer: Not less than that of horizontal bus.
 - b) For outgoing: Not less than that of the highest nominal rating of outgoing breaker. Only the jumpers connected to CT shall be rated according to CT rating
- 5) Final operating temperature under continuous operation in enclosure limited as per IEC-62271-1 with ambient of 50 deg C.
- 6) 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.

- 7) Cross-section of main horizontal bus to be uniform throughout the switchboard and continuous in one transport unit.
- 8) Bus bar arrangement according to IS 11353:1985.
- 9) Phase identification by use of paint in each panel.
- 10) Straight run of busbars should be sleeved with full voltage insulation and tap-offs and joints should be shrouded with removable shrouds of full voltage insulation. The sleeve shall be heat shrinkable, non tracking, low absorption type rated for full insulation level of the switchboard
- 11) Bus bar joints and tap-off connection of bolted type with zinc bichromated high tensile steel bolts, nuts and spring washers; fish plates with accessories at the end of a transport unit for site connections.
- 12) Bus bar support insulators of non-hygroscopic material having high impact and dielectric strength with an anti tracking contour shall be used.

7. INTERNAL CONTROL WIRING

- 1) Control wiring by 1100 V grade PVC insulated, single core multi-strand copper wire of minimum cross-section 1.5 sq. mm. However for CT and inter panel connections this shall be with minimum 2.5 sq. mm. copper.
- 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 grey
PT & CT	: RYB
Earth	: Green
- 5) All connections external to a feeder, all the auxiliary contacts of the HV breaker and all spare contacts (which is not wired) of the relays brought to terminal blocks.

- 6) Interconnection between panels of adjacent shipping sections to be brought out to a separate terminal block.
- 7) Not more than two connections on any one terminal.
- 8) In terminal blocks - separate groups shall be provided for power supply, CT circuits, PT circuits, close, trip circuits and telemetry circuits etc to avoid mix-up.
- 9) C.T. secondary wires from C.T. chamber to relay chamber should have protection against mechanical damage and damage from nearby flashover by proper use of heat proof sleeve/conduit.
- 10) Control wires shall be run in earthed metallic flexible conduits when laid in HV chamber.

8. EXTERNAL TERMINATIONS

8.1 Control Terminations

- 1) 660 V grade multiway terminal blocks of non-tracking stud type polyamide complete with insulated barriers, open type terminals, washers, screws and spring washer and identification strips. Terminals for CTs shall be disconnecting type.
- 2) Control terminals of minimum rating 16 Amps and suitable to receive 2 Nos.2.5 sq.mm copper conductor.
- 3) 20% spare terminals in each control terminal block.
- 4) CT metering terminal shall have provision for external meter connection during running condition.
- 5) Control terminals for external termination shall be located in the relay compartment only. All terminals going out of the switch board shall be brought to a separate terminal board marked "External Termination". These will be easily accessible.
- 6) Complete control wiring shall be done with round lugs only

8.2 Power Terminations

- 1) Suitable for accepting cable/ bus trunking as specified.

- 2) Sufficient space and support arrangement inside each panel to accommodate HT cable termination kits and sealing kits suitable for the type, size and number of cables to be terminated.
- 3) Where the required number of cable terminations cannot be accommodated in the cabling chamber of the main panel, dummy panels to be provided adjacent to the switch panel.
- 4) Where more than one cable have to be terminated per unit, the arrangement shall permit connection and disconnection of cables separately without disturbing other cables.
- 5) Where specified, the following cable termination accessories, suitable for the type, size and number of cables to be terminated, to be supplied with the switchboard:
 - a) Cable sockets with all HT terminals (Socket set at such an angle that cable tails can be brought up for termination with minimum bending and setting).
 - b) HT cable termination and sealing kits.
 - c) Compression type brass cable glands and crimping type tinned heavy duty copper lugs for HT, LT power and control cables.

9. COMPONENTS

9.1 HT Circuit Breaker

9.1.1 Electrical Features

- 1) Triple pole breaker conforming to IEC 62271-100 & IS 13118:1991.
- 2) Arc quenching medium : vacuum
- 3) Rated voltage, rated continuous current, short time rating and duration, fault interrupting rating, all as specified.
- 4) Peak making current : 2.5 times symmetrical breaking current
- 5) Percentage of dc component according to IEC 62271-100.
- 6) Total break time: Less than 3 cycles.

- 7) Leakage current for the vacuum interrupter bottle shall not be more than 1.0 mA at the specified high voltage test across the open contact.
- 8) Rated operating sequence: O-0.3sec-CO-3Min- CO
- 9) Auxiliary contacts :

6 NO + 6 NC minimum preferably convertible from NO to NC and vice versa at site.

Rating

Continuous	:	10 A
ac 11	:	4 A at 240 V
dc 11	:	0.5 A at 220 V

9.1.2 Operating Mechanism

- 1) Spring charged stored energy mechanism to ensure high speed closing and tripping independent of operating forces.
- 2) Closing spring charged through universal motor with provision for manual charging through handle, insertion of handle to decouple the motor. Motor shall be automatically disconnected when the spring is charged.
- 3) Spring charging motor to automatically charge the closing spring for next closing operation when the breaker is closed.
- 4) Closing operation of the breaker to charge the tripping spring ready for tripping.
- 5) Closing and tripping initiated through dc operated coils designed to operate for 85-110% and 70 - 110% of rated control voltage respectively. Additional provision for closing and opening without electric power by mechanical means.
- 6) Trip free feature for all means of closing.
- 7) Electrical and mechanical antipumping feature for circuit breakers up to 36 kV.
- 8) Non-reset type operation counter.

9) Mechanical indication to show:

- a) closing spring charged/discharged.
- b) breaker ON/OFF

9.1.3 Drawout Features

- 1) 3 distinct positions viz SERVICE, TEST and ISOLATION.
- 2) Latching facility for all 3 positions
- 3) Mechanical position indication and locking.
- 4) Provision to move the breaker from one position to another through a detachable device from outside without opening the door, when agreed upon by the user and the manufacturer.
- 5) Power connections - self-aligning, plug-in type contacts between silver plated copper and silver plated copper. Spring load jaw type contact shall be on withdrawable truck of the breaker.
- 6) Control connections - plug socket type mechanically coded to prevent wrong insertion; continuous rating 16 A minimum. Provision for locking of control plug to avoid looseness during operation shall be considered.

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 three positions to another.
- 3) Truck can not be racked into service position with the door open. Door interlock shall have defeat feature.
- 4) Unless control connections are engaged
 - a) door can not be closed
 - b) truck can not be moved to `Service' position
- 5) Unless control connections are disengaged, truck cannot be withdrawn beyond the isolated position.

- 6) Control connections can not be disengaged with the truck in 'Service' position.
- 7) Insertion of breaker into 'Service' position not possible if safety shutters are not free.
- 8) 'Bus-link' truck can not be withdrawn with the buscoupler in 'Service' position.
- 9) Insertion of breaker into a cubicle rated for higher/lower current not possible.
- 10) Door can be opened only when
 - a) breaker is OFF, and
 - b) is in 'Isolated' position
- 11) Remote closing of breaker not permitted with door open.
- 12) Padlocking facility in test & service position to be made available

9.1.5 Safety Shutters

- 1) Spring loaded, positively operated by the travel of the drawout truck.
- 2) Locking facility in the closed position.
- 3) Independent operating mechanism for bus side and cable side shutters.
- 4) Metallic
- 5) Busbar/ cable marking on safety shutters.

9.2 Earthing Switch/ Truck

- 1) Facility for earthing cable buses of outgoing feeders as well as bus bar shall be envisaged, through earthing truck for various sizes of cubicles in switchboard.
- 2) Provision shall be made to indicate any presence of voltage prior to earthing of the outgoing cables, bus bars or main bus bars.
- 3) For floor mounted CB, cable side and bus side earthing truck should have PT and same type and size of CB as of switch board. There should be

mechanical and electrical interlock between PT voltage and the CB closing mechanism. The earthing will take place on operation of CB.

- 4) Earthing truck shall have an audible alarm system for detecting the presence of voltage on the earthing terminal.
- 5) Integral earth switch with necessary mechanical & electrical interlock may be considered upto 11kV application.

9.3 Potential Transformers

- 1) As per IS 3156:1992 'Voltage Transformers', resin cast, dry type.
- 2) Preferred VA ratings: 75, 100, 200.
- 3) Suitable for 190% rated capacity for 30 seconds for earthed system and 8 hours for unearthed system.
- 4) Accuracy Class 1.0
- 5) Neutral points brought out for 3 phase PTs.
- 6) Voltages and phases as specified.
- 7) Selection of PT should conform to reliable operation of neutral displacement relay in the open-delta winding in an isolated neutral system wherever probability of floating neutral exists.
- 8) It may be mentioned that PT will be mounted in drawout type carriage. PT may be mounted in a separate panel or below withdrawable breaker. Final decision may be left with the user.
- 9) PT shall be of class B insulation unless otherwise specified.
- 10) PT shall be provided with fuses on HV side

9.4 Current Transformers

- 1) CTs shall be cast resin encapsulated, conforming to IS 2705:1992. Type of CT shall be as follows

Below 400A – Wound Primary

400A & Above – Bar primary / Window type

Upto 100A – Short time Current as per switchboard rating for 1 sec

Above 100A – Short time Current as per switchboard rating & time specified

- 2) Secondary rating 1 Amp.
- 3) To withstand the thermal and dynamic stresses corresponding to rated short time and peak withstand currents.

4) *Measuring CTs:*

Accuracy class : a) Tarrif = 0.2
b) Non-tarrif = 0.5

Instrument security : Not more than 5
factor

5) *Protection CT*

Accuracy class and accuracy limit factor:

General O/C & E/F : 5P20

Motor protection : 5P20

Differential protection: PS (to match the protection relay)

- 6) The minimum burden - 15 VA for measuring and 10 VA for protection CTs. However, the actual burden to meet the requirements of relays, instruments and leads associated with the particular CT including 20% spare capacity.
- 7) Core balance CTs (where specified) matching the relay provided for earthfault and sensitive to detect a minimum primary current of 2 Amps.
- 9) CT shall be of class B insulation unless otherwise specified.
- 10) ICT of 1A secondary and 10VA burden for all motor feeders for remote metering.

9.5 Auxiliary Transformers

- 1) As per IS 11171:1985, Dry type power Transformers.
- 2) HV side taps $\pm 5\%$, $\pm 2.5\%$

- 3) Neutral point brought out.
- 4) Rating and voltages as specified.

9.6 Protective and Auxiliary Relays

- 1) Flush mounting type in dust proof cases.
- 2) Protective relays of withdrawable type, auxiliary relays of fixed type. All protective relays should be of numerical type. IEC 61850 protocol should be used wherever communication to SCADA or DCS is required.
- 3) Trip circuits automatically broken & CT circuit shorted when a relay is withdrawn.
- 4) Hand reset type mechanical operation indicator for flagged Aux relays.
- 5) Minimum 2 pairs of contacts of rating:
 - Continuous - 5 amps
 - ac 11 - 0.5 amps, 240 V
 - dc 11 - 0.5 amps, 220 V, L/R = 40 ms
- 6) All voltage relays suitable for dc control supply specified with 50-110% variation in voltage.
- 7) Test facility by plugs from the panel front.

9.7 Annunciators

- 1) Micro processor based window facia type with white heat resistant plastic material, inscriptions engraved in black.
- 2) Lighting unit with LED.
- 3) Facia window and lighting unit in 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.

- 6) Sequence of operation (unless otherwise specified)
 - a) On incidence of fault: Hooter ON; lamps FLASH
 - b) On pressing ACCEPT PB: Hooter OFF; lamps STEADY
 - c) On pressing RESET PB.
 - If fault cleared : Hooter OFF; lamps OFF
 - If fault persists : Hooter ON; lamps FLASH
 - d) Should have first in last out facility.
- 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 changeover from one to the other logic shall be possible at site.
- 10) Audio-signalling equipment shall be of continuous rating.

9.8 Indicating and Integrating Instruments

- 1) Indicating instruments conforming to IS 1248:2003 'Direct acting indicating analogue electrical measuring instruments and their accessories' and integrating instruments conforming to IS 13010, 13779, 8530, 14415, 14390 or 14372 whichever is applicable (Parts of IS 722 have either been withdrawn or superseded by standards mentioned here in).
- 2) Accuracy Class:

Indicating meters: 1.0
- 3) Ammeters for motor feeders with normal scale up to full load value and suppressed scale beyond full load for indication of motor starting current.
- 4) Frequency meters : Digital type with readings upto 2 decimals.
(where applicable)
- 5) Power factor meter : 3 phase type with range 0.3 lag to 0.3 lead.

- 7) Analogue indicating : Taut band type with minimum size meters 96 x 96 mm.
- 8) Vibration proof, suitable for vertical flush mounting.
- 9) Parallax free design with glare free front covers.
- 10) Dial plate : White, with numerals and letters in black.
- 11) Magnetically screened and temperature compensated.
- 12) Voltmeters to be protected with HBC fuses placed as close to the bus bar as possible.
- 13) 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.

9.9 Transducers for Telemetry

- 1) dc analogue signal dual output of 4-20 mA for continuous parameters like voltage, current, power, frequency, etc as per the requirement specified.
- 2) Pulse/BCD output for energy monitoring.
- 3) Provision of adjustments to compensate errors in primary circuit.
- 4) Accuracy class – 0.5, Distortion factor < 0.2%
- 5) Transducer shall be suitable for ambient condition inside panel .

9.10 Indicating Lamps

- 1) LED with integral modules shall be provided. All LEDs shall have LVGP (low voltage glow protection) feature.
- 2) Colour :

ON	:	Red
OFF	:	Green
TRIP CIRCUIT HEALTHY	:	White

SPRING CHARGING/ READY TO CLOSE	:	Blue
FAULT/WARNING	:	Amber

9.11 Control and 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 or 7 position, as required.
- 5) Rating:

Continuous	:	10 A
ac 11	:	4 A, 240 V
dc 11	:	0.5 A, L/R = 40 ms.
- 6) Colour : Black

9.12 Push Buttons

- 1) Rating:

Continuous	:	10 A
ac 11	:	1.5 A at 240 V
dc 11	:	0.5 A at 220 V, L/R = 40 ms.
- 2) Colour:

ACCEPT	:	Blue
RESET	:	Black

TEST : Yellow

9.13 Control Circuit Fuses - HBC link type conforming to IS 13703:1993 'LV fuses for voltages not exceeding 1000 V ac or 1500 V dc (superseding IS 9224)'.

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 & other panel mounted components)
- 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 scrapping earth contacts of make before/break after type ensuring earth continuity from service to the test position.

11. TEST AND MAINTENANCE EQUIPMENT

- 1) Each board to be supplied with
 - a) One set of test plugs
 - b) Any other special purpose tools for maintenance.

12. TESTS

12.1 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.

- 1) Physical inspection including:
 - a) Checking with respect to general arrangement like feeder disposition, terminations, wiring etc.
 - b) Proper functioning of mechanical interlocks.
 - c) Interchangeability of drawout breakers of the same rating.
 - d) Checking of mechanical work like surface finish, movement and proper engagement of withdrawable breakers, fixing of doors, etc.
- 2) Operational and functional Checks with respect to single line diagram and control circuits.
- 3) Operation test for circuit breakers etc. with normal control voltage and closing at 85-110% and trip at 70-110% of normal control voltage.
- 4) Tests to check polarity and accuracy of CTs.
- 5) Dielectric test of the switchboard.
- 6) Checking of protective earthing circuits
- 7) Measurement of breaker contact resistance and each feeder contact resistance.
- 8) Breaker closing/opening time.

12.2 Type Tests

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) Short circuit breaking and making capacity.
- b) Short time rating of CB and switchboard.
- c) Mechanical and electrical endurance test.
- d) Internal arc withstand test as per IEC 62271-200.
- e) Temperature rise test as per IEC 62271-200. (Type test certificate shall be for minimum 3 panels if offered switchboard is having more than 3 panels)
- f) Impulse withstand test as per IEC 62271-200 (With bare busbars).
- g) Double earthfault test (for switchboard used in unearthed system)

13 Data to be furnished for the purpose of procurement.

- 13.1 SLD with number of feeder, No & Type of cable per feeder, VCB rating, CT details, no of voltmeter, ammeters, PF meter, Freq meter, Multi function meter in each feeder etc
- 13.2 Voltage level. short circuit rating & time of the switchboard
- 13.3 Type of system earthing : Effectively earthed/ Non-Effectively earthed / Unearthed(Resonant earthed)
- 13.4 Control Voltage – 110V DC/ 220V DC
- 13.5 Type of protective relays – Numerical
- 13.6 Functional requirement – Auto changeover/ momentary paralleling/ None

- 13.7 Colour of the panel - 631as per IS 5/ RAL 7032/ any other colour
- 13.8 Earthing arrangement : Integral earth switch/ earthing truck.

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