

TECHNICAL SPECIFICATION
SECTION-SWITCHGEAR - ISOLATOR

Following are the major changes made in the Technical specification, Section- Switchgear - ISOLATOR,

Clause No.	Major Modification
1.2.1	Interpole cables deleted from scope of manufacturer
3.1(e)	Current Density value deleted
5(m)	Common Marshalling Box deleted
5(n)	Plug-in type terminals for interconnecting cables deleted

Notes: The above is the list of major changes with respect to previous revision (Rev. 11/11A). However, the bidders are advised to read the entire section for other changes and quote accordingly.

SWITCHGEAR – ISOLATOR

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Annexure-I

SWITCHGEAR - ISOLATOR

1.0 GENERAL

- 1.1** The Isolators and accessories shall conform in general to IEC: 62271-102/103 except to the extent explicitly modified in specification and shall be in accordance with requirement of BPS.
- 1.2** Complete isolator with all the necessary items for successful operation shall be supplied including but not limited to the following:
- 1.2.1** Isolator with complete Support Insulators, operating rod insulator, base frame, linkages, operating mechanism, control cabinet, interlock etc.
- 1.2.2** All necessary parts to provide a complete and operable isolator installation, control parts and other devices whether specifically called for herein or not.
- 1.2.3** The isolator shall be designed for use in the geographic and meteorological conditions as given in Section-GTR and Section-Project.

2.0 DUTY REQUIREMENTS

- a) Isolators and earth switches shall be capable of withstanding the dynamic and thermal effects of the maximum possible short circuit current of the systems in their closed position. They shall be constructed such that they do not open under the influence of short circuit current.
- b) The earth switches, wherever provided, shall be constructionally interlocked so that the earth switches can be operated only when the isolator is open and vice versa. The constructional interlocks shall be built in construction of isolator and shall be in addition to the electrical interlocks. Suitable mechanical arrangement shall also be provided for delinking electrical drive for manual operation.
- c) In addition to the constructional interlock, isolator and earth switches shall have provision to prevent their electrical and manual operation unless the associated and other interlocking conditions are met. All these interlocks shall be of failsafe type. Suitable individual interlocking coil arrangements shall be provided. The interlocking coil shall be suitable for continuous operation from station DC supply and within a variation range as stipulated in Section-GTR.
- d) The earthing switches shall be capable of discharging trapped charges of the associated lines.
- e) The isolator shall be capable of making/breaking normal currents when no significant change in voltage occurs across the terminals of each pole of isolator on account of make/break operation.

3.0 CONSTRUCTIONAL FEATURES

Isolators shall be outdoor, off-load type. Earth switches shall be provided on isolators wherever called for, with possibility of being mounted on any side of the isolator. 245kV & below isolator design shall be double break type, unless specified otherwise. Isolator design shall be such as to permit addition of earth switches at a future date. The features and constructional details of isolators, earth switches and accessories shall be in accordance with requirements stated hereunder:

3.1 Contacts

- a) The contacts shall be self aligning and self cleaning type and shall be so designed that binding cannot occur after remaining in a closed position for prolonged period in a heavily polluted atmosphere.
- b) No undue wear or scuffing shall be evident during the mechanical endurance tests. Contacts and spring shall be designed so that readjustments in contact pressure shall not be necessary throughout the life of the isolator or earthing switch. Each contact or pair of contacts shall be independently sprung so that full pressure is maintained on all contacts at all time.
- c) Contact springs shall not carry any current and shall not lose their characteristics due to heating effects.
- d) The moving contact of double break isolator shall have preferably turn-and-twist type or other suitable type of locking arrangement to ensure adequate contact pressure.
- e) Flexible braided copper, where used, shall have corrosion resistant coating such as tinning or silvering.

3.2 Base

Each single pole of the isolator shall be provided with a complete galvanised steel base provided with holes and designed for mounting on a standard supporting structure. Common base frame shall be provided for 220/132/33 kV isolators suitable for mounting on pipe structures.

3.3 Blades

- a) All metal parts shall be of non-rusting and non-corroding material. **All current carrying parts shall be made from high conductivity electrolytic copper including terminal pad.** Bolts, screws and pins shall be provided with lock washers. Keys or equivalent locking facilities if provided on current carrying parts shall be made of copper silicon alloy or stainless steel or equivalent. The bolts or pins used in current carrying parts shall be made of non-corroding material. Ferrous parts, other than stainless steel shall not be used in close proximity of main current path. All ferrous castings, if used elsewhere shall be made of malleable cast iron or cast-steel. No grey iron shall be used in the manufacture of any part of the isolator.
- b) The live parts shall be designed to eliminate sharp joints, edges and other corona

producing surfaces, where this is impracticable, adequate corona rings shall be provided. Corona shields are not acceptable. Corona rings shall be made up of aluminum/aluminum alloy (as applicable).

- c) Isolators and earthing switches including their operating parts shall be such that they cannot be dislodged from their open or closed positions by short circuit forces, gravity, wind pressure, vibrations, shocks, or accidental touching of the connecting rods of the operating mechanism.
- d) The isolator and earth switch shall be designed such that no lubrication of any part is required except at very infrequent intervals. i.e. after every 1000 operations or after 5 years whichever is earlier.

3.4 Insulator

- a) The insulator shall conform to IS: 2544, IEC-60168 and IEC-60815. The porcelain of the insulator shall conform to the requirements stipulated under Section-GTR.
- b) Pressure due to the contact shall not be transferred to the insulators after the main blades are fully closed.
- c) Insulator shall be type and routine tested as per IEC-60168. Besides, following additional routine/acceptance tests shall also be conducted:
 - (i) Bending load test in four directions at 50% of minimum bending load guaranteed on all insulators, as a routine test.
 - (ii) Bending load test in four directions at 100% of minimum bending load as a sample test on each lot.
 - (iii) Torsional test on sample insulators of a lot.
 - (iv) Ultrasonic test as a routine test.
- d) Requirement of Insulators of Isolators shall be as follows:

i) For 420 kV Insulator

Cantilever strength (min.)	=	1000kg
Top PCD	=	127 mm
No. of holes	=	4 x M16
Bottom PCD	=	325 mm
No. of holes	=	8 x 18mm dia

ii) For 245 kV Insulator

Cantilever strength (min.)	=	1000kg
Top PCD	=	127 mm
No. of holes	=	4 x M16
Bottom PCD	=	275 mm
No. of holes	=	8 x 18mm dia

iii) **For 145 kV Insulator**

Cantilever strength (min.)	=	600kg
Top PCD	=	127 mm
No. of holes	=	4 x M16
Bottom PCD	=	254 mm
No. of holes	=	8 x 18mm dia

3.5 Name Plate

The name plate shall conform to the requirements of IEC incorporating year of manufacture.

4.0 EARTHING SWITCHES

- a) Where earthing switches are specified these shall include the complete operating mechanism and auxiliary contacts.
- b) The earthing switches shall form an integral part of the isolator and shall be mounted on the base frame of the isolator.
- c) Earthing switches (33kV) shall be only locally operated.
- d) Each earth switch shall be provided with flexible copper braids for connection to earth terminal. These braids shall have the same short time current carrying capacity as the earth blade. The transfer of fault current through swivel connection will not be accepted.
- e) The plane of movement and final position of the earth blades shall be such that adequate electrical clearances are obtained from adjacent live parts in the course of its movement between ON and OFF position.
- f) The frame of each isolator and earthing switches shall be provided with two reliable earth terminals for connection to the earth mat.
- g) **The earth switch (HDE Copper only for both fixed and moving contact) should be able to carry the same fault current as the main blades of the Isolators and shall withstand dynamic stresses.**
- h) 245 & 145 kV earth switches shall also comply with the requirements of IEC-62271-102, in respect of induced current switching duty as defined for Class-B and short circuit making capability class E-0 for earthing switches.
- i) Earth switch blade in open condition shall not project (from the centre line of Insulator) by more than 2810mm for 220kV.

5.0 OPERATING MECHANISM

- a) **The bidder shall offer motor operated Isolators and earth switches for all voltage levels above and including Isolators of 36 kV.**
- b) Control cabinet/operating mechanism box shall conform to the requirement

stipulated in Section-GTR and shall be made of cast aluminium/aluminum sheet of adequate thickness (minimum 3 mm) or stainless steel (grade-304) of minimum thickness 2mm.

- c) A “Local/Remote” selector switch and a set of open/ close push buttons shall be provided on the control cabinet of the isolator to permit its operation through local or remote push buttons.
- d) Provision shall be made in the control cabinet to disconnect power supply to prevent local/remote power operation.
- e) Motor shall be an AC motor and conform to the requirements of Section- GTR.
- f) Suitable reduction gearing shall be provided between the motor and the drive shaft of the isolator. The mechanism shall stop immediately when motor supply is switched off. If necessary a quick electro-mechanical brake shall be fitted on the higher speed shaft to effect rapid braking.
- g) Manual operation facility (with handle) should be provided with necessary interlock to disconnect motor.
- h) Gear should be of forged material suitably chosen to avoid bending/jamming on operation after a prolonged period of non-operation. Also all gear and connected material should be so chosen/surface treated to avoid rusting.
- i) Blocked rotor test of motor shall be conducted as a routine test. During the blocked rotor test, overload protection relay should operate to prevent failure of motor.
- j) Only stranded conductor shall be used for wiring. Minimum size of the conductor for control circuit wiring shall be 1.5 sqmm. (Copper).
- k) The operating mechanism shall be located such that it can be directly mounted on any one of the support structure.
- l) Snap type limit/auxiliary switches shall be used with Factory set values. No adjustment shall be required at site during commissioning.

6.0 OPERATION

- a) The main Isolator and earth switches shall be gang operated in case of 245 kV, 145 kV & 33kV. However, Tandem Isolators shall be individual-pole operated. The operating mechanism of all the three poles shall be well synchronized and interlocked.
- b) The design shall be such as to provide maximum reliability under all service conditions. All operating linkages carrying mechanical loads shall be designed for negligible deflection and strain less than 1%. The length of inter insulator and interpole operating rods shall be capable of adjustments, by means of screw thread which can be locked with a lock- nut after an adjustment has been made. The isolator and earth switches shall be provided with “over dead center” device in the operating mechanism at open and close position to prevent accidental opening by wind, vibration, short circuit forces or movement of the support structures.

- c) Each isolator/pole of isolator and earth switch shall be provided with a manual operating handle enabling one man to open or close the isolator with ease while standing at ground level. Non-detachable type manual operating handle shall have provision for padlocking. For detachable type manual operating handles, suitable provision shall be made inside the operating mechanism box for parking the detached handles. The provision of manual operation shall be located at a convenient operating height from the base of isolator support structure.
- d) The isolator contacts shall be positively driven by the operating mechanism continuous control throughout the entire cycle of operation. The operating pipes and rods shall be sufficiently rigid to maintain positive control under the most adverse conditions and when operated in tension or compression for isolator closing / opening operation. They shall also be capable of withstanding all torsional and bending stresses due to operation of the isolator. Wherever supported, the operating rods shall be provided with bearings on each support and at the ends. The operating rods/ pipes shall be provided with suitable universal couplings to account for any angular misalignment.
- e) All rotating parts shall be provided with grease packed roller or ball bearings in sealed housings designed to prevent the ingress of moisture, dirt or other foreign matter. Bearings pressure shall be kept low to ensure long life and ease of operation. Locking pins wherever used shall be rust- proof.
- f) Signaling of closed position shall not take place unless it is certain that the movable contacts, have reached a position in which rated normal current, peak withstand current and short time withstand current can be carried safely. Signaling of open position shall not take place unless movable contacts have reached a position such that clearance between contacts is atleast 80% of the isolating distance.
- g) The position of movable contact system (main blades) of each of the Isolators and earthing switches shall be indicated by a mechanical indicator at the lower end of the vertical rod of shaft for the Isolators and earthing switch. The indicator shall be of metal and shall be visible from operating level.
- h) The contractor shall furnish the following details alongwith quality norms, during detailed engineering stage:
 - (i) Current transfer arrangement from main blades of isolator alongwith milli volt drop immediately across transfer point.
 - (ii) Details to demonstrate smooth transfer of rotary motion from motor shaft to the insulator alongwith stoppers to prevent over travel.

7.0 TERMINAL CONNECTOR STUD/PAD:

The isolator terminal pads/studs shall be made of high quality copper and shall be conforming to industry standard for rated current. The terminal pad shall have protective covers which shall be removed before interconnections. Only terminal pads shall be used for current ratings above 1250A. Terminal pads shall be mounted below the current transfer contacts so that the cantilever pull from the terminal connector is not transferred through the current transfer point to the support insulator. The terminal pad shall be

suitable for horizontal plane connection with terminal connector.

8.0 SUPPORT STRUCTURE:

245 kV/145/36 kV Isolators along with Earth switches shall be suitable for mounting on standard support structures.

9.0 TESTS:

9.1 In continuation to the requirements stipulated under Section-GTR the isolator alongwith its earthing switch and operating mechanism should have been type tested as per IEC/IS and shall be subjected to routine tests in accordance with IEC-62271-102. Minimum 1000 Nos. mechanical operations in line with mechanical endurance test, M0 duty, shall be carried out on 1 (one) isolator out of every lot of Isolators, assembled completely with all accessories including insulators, as acceptance test for the lot. The travel characteristics measured at a suitable location in the base of insulator along with motor current/power drawn, during the entire travel duration are to be recorded at the start and completion and shall not vary by more than (+/-) 10% after completion of 1000 cycles of operation. After completion of test, mechanical interlock operation to be checked.

9.2 The test reports of the type tests as per IEC 62271-102 and the following additional type tests (additional type tests are required for isolators rated above 72.5 kV only) shall also be submitted for the Employer's review.

- (i) Radio interference voltage test as per Annexure-A of Section-GTR.
- (ii) Corona Extinction Voltage test as per Annexure-A of Section-GTR
- (iii) Seismic withstand test on isolator mounted on Support structure as per Annexure-B of Section-GTR. The test shall be performed in the following position :

Isolator open	E/S Closed
Isolator open	E/S Open
Isolator Closed	E/S Open

10.0 MANDATORY SPARES:

Bidder shall include in his proposal mandatory spares as mentioned in the BPS.

11.0 TECHNICAL PARAMETERS: As per table given at **Annexure-I:**

12.0 PRE-COMMISSIONING TESTS

12.1 Contractor shall perform any additional test based on specialties of the items as per the field Q.P./Instructions of the equipment manufacturer or Employer without any extra cost to the Employer. The Contractor shall arrange all instruments required for conducting these tests alongwith calibration certificates at his own cost.

An indicative list of tests on isolator and earthswitch is given below. For pre-commissioning procedures and formats for Isolators and Grounding switch.

- (a) Insulation resistance of each pole

- (b) Manual and electrical operation and interlocks
- (c) Insulation resistance of control circuits and motors
- (d) Ground connections
- (e) Contact resistance
- (f) Proper alignment so as to minimize vibration during operation
- (g) Measurement of operating Torque for isolator and Earth switch
- (h) Resistance of operating and interlocks coils
- (i) Functional check of the control schematic and electrical & mechanical interlocks
- (j) 50 operations test on isolator and earth switch

12. 2 **The Contractor shall ensure that erection, testing and commissioning of Isolators above 36 kV class shall be carried out under the supervision of the Isolator manufacturer's representative and the cost of the same shall be included in the erection price of the respective equipment.**

Annexure-I

1. Technical Parameters for 765kV, 400kV, 220kV and 132kV Isolators

Sl. No.	Description	Unit	800kV ISO	420kV ISO	245kV ISO	145kV ISO
1	Rated voltage	kVrms	800	420	245	145
2	Rated frequency	Hz	50	50	50	50
3	No. of poles	Nos.	3	3	3	3
4	Design ambient temperature	°C	50	50	50	50
5	Type		Outdoor	Outdoor	Outdoor	Outdoor
6	Rated current at 50 ^o C ambient temperature	A	3150	3150	As per BPS	As per BPS
7	Rated short time withstand current of isolator and earth switch	kA	40 / 50 for 1 sec (as applicable)	40 /50 /63 for 1 sec (as applicable)	40 / 50 for 1 sec (as applicable)	31.5 for 1 sec
8	Rated dynamic short time withstand current of isolator and earth switch	kAp	102kAp	100 kAp / 125 kAp / 157.5 kAp (as applicable)	100 kAp / 125 kAp (as applicable)	80kAp
9	Temperature rise over design ambient temperature	As per Table-3 of IEC-62271-1				

10	Rated mechanical terminal load	N	As per table III of IEC-62271-102 or as per value calculated in Section-GTR whichever is higher			
11	Mechanical Endurance Class	Isolator-M2 E/S-M0				
12	Operating mechanism of isolator/earth switch	A.C. Motor operated				
13	No. of auxiliary contacts on each isolator	Besides requirement of this spec., 5 NO + 5 NC contacts wired on each isolator to terminal block exclusively for Employer’s use in future.				
14	No. of auxiliary contacts on each earthing switch	Besides requirement of this spec., 3 NO + 3 NC contacts wired on each isolator to terminal block exclusively for Employer’s use in future.				
Sl. No.	Description	Unit	800kV ISO	420kV ISO	245kV ISO	145kV ISO
15	Max. Operating time	secs	20 sec. for Isolator and 25 seconds for earth switch	20 secs	12 secs	12 secs
16	Number of terminal in control cabinet	All contacts & control circuits are to be wired up to control cabinet plus 24 spare terminals evenly distributed.				
17	Rated Insulation levels					
a)	Full wave impulse withstand voltage (1.2/50 microsec.)					
i)	between line terminals and ground	kVpeak	±2100	±1425	±1050	±650
ii)	between terminals with isolator open	kVpeak	±2100 kVp impulse on one terminal and 455 kVp power frequency voltage of opposite polarity on other terminal	±1425 kVp impulse on one terminal and 240 kVp power frequency voltage of opposite polarity on other terminal	±1200	±750
b)	Switching impulse withstand voltage (250/2500 micro-second) dry and wet					
i)	between line terminals and ground	kV peak	± 1550	± 1050	-NA-	-NA-

ii)	between terminals with Isolator open	kV peak	1175 kVp impulse on one terminal and 650 kVp power frequency voltage of opposite polarity on other terminal	900 kVp impulse on one terminal and 345 kVp power frequency voltage of opposite polarity on other terminal	-NA-	-NA-
c)	One minute power frequency dry withstand voltage					
i)	between line terminals and ground	kV rms	830	520	460	275
ii)	between terminals with isolator open	kV rms	1150	610	530	315
18	Minimum Corona extinction voltage with Isolator in all positions	KV rms	508	320	156	92
19	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz. in all positions	micro volts	2500 at 508 kVrms	1000 at 266 kVrms	1000 at 156 kVrms	500 at 92 kVrms
20	Minimum Creepage distance					
i)	Phase to ground	mm	As per Section-GTR	As per Section-GTR	As per Section-GTR	As per Section-GTR
21	Seismic acceleration		As per IS:1893	As per IS:1893	As per IS:1893	As per IS:1893
22	Thermal Rating of Auxiliary Contacts	A	10 A at 220 V DC	10 A at 220 V DC	10 A at 220 V DC	10 A at 220 V DC
23	Breaking Capacity of auxiliary contacts		2 A DC with circuit time constant not less than 20 ms	2 A DC with circuit time constant not less than 20 ms	2 A DC with circuit time constant not less than 20 ms	2 A DC with circuit time constant not less than 20 ms
24	Distance between support structures foundations (within same phase)	m	6.0	4.0	2.5	-
25	System neutral earthing		Effectively Earthed	Effectively Earthed	Effectively Earthed	Effectively Earthed

Note: The above insulation levels are applicable for altitude up to 1000 meters above M.S.L. For higher altitudes, suitable correction factor as per relevant IEC shall be applied.

2. Technical Parameters for 72.5 kV, 36 kV and 11 kV Isolator

Sl. No.	Description	Unit	72.5kV ISO	36kV ISO	12kV ISO
1	Rated voltage	kVrms	72.5	36	11
2	Rated frequency	Hz	50	50	50
3	No. of poles	Nos.	3	3	3
4	Design ambient temperature	°C	50	50	50
5	Type		Outdoor, Mechanically gang operated	Outdoor, Mechanically gang operated	Outdoor, Mechanically gang operated
6	Rated current at 50 ⁰ C ambient temperature	A	As per requirement	As per requirement	As per requirement
7	Rated short time withstand current of isolator and earth switch	kA	25 kA for 3 sec	25 kA for 3 sec	25 kA for 3 sec
8	Rated dynamic short time withstand current of isolator and earth switch	kAp	62.5kAp	62.5kAp	62.5kAp
9	Temperature rise over design ambient temperature	As per Table-3 of IEC-62271-1			
10	Rated mechanical terminal load	N	As per IEC or as per value calculated in Section- GTR whichever is higher		
11	Mechanical Endurance Class		Isolator-M1 E/S-M0		
12	Operating mechanism of isolator/erathswitch		Isolator - A.C. Motor operated E/S - A.C. Motor operated	Isolator - - A.C. Motor operated E/S - A.C. Motor operated	Isolator - Manual operated E/S – Manual operated
13	No. of auxiliary contacts on each isolator	Besides requirement of this spec., 5 NO + 5 NC contacts wired on each isolator to terminal block exclusively for Employer’s use in future.			
14	No. of auxiliary contacts on each earthing switch	Besides requirement of this spec., 3 NO + 3 NC contacts wired on each isolator to terminal block exclusively for Employer’s use in future.			
15	Max. Operating time	sec	12 sec.	12 sec.	NA for manual operation
16	Number of terminal in control cabinet	All contacts & control circuits are to be wired up to control cabinet plus 24 spare terminals evenly distributed.			
17	Rated Insulation levels				

a)	Full wave impulse withstand voltage (1.2/50 microsec.)				
i)	between line terminals and ground	kVpeak	±325	±170	-
ii)	between terminals with isolator open	kVpeak	±375 kVp	±180 kVp	-
b)	One minute power frequency dry withstand voltage				
i)	between line terminals and ground	kV rms	140	70	-
ii)	between terminals with isolator open	kV rms	160	80	-
18	Minimum Creepage distance				
i)	Phase to ground	mm	As per Section-GTR	As per Section-GTR	As per Section-GTR
19	Seismic acceleration		As per IS:1893	As per IS:1893	As per IS:1893
20	Thermal Rating of Auxiliary Contacts	A	10 A at 220V/110V DC	10 A at 220V/110V DC	10 A at 220V/110V DC
21	Breaking Capacity of auxiliary contacts		2 A DC with circuit time constant not less than 20 ms	2 A DC with circuit time constant not less than 20 ms	2 A DC with circuit time constant not less than 20 ms
22	Distance between support structures foundations (within same phase)	m	As per layout		
23	System neutral earthing		Effectively Earthed	Effectively Earthed	Effectively Earthed