

Standard Specification
for
Isolator

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1 GENERAL REQUIREMENT

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

2 DUTY REQUIREMENT

- 2.1 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.
- 2.2 The earth switches, wherever provided, shall be constructional 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. **In addition to constructional interlock, locking device as per relevant IEC shall also to be provided.**
- 2.3 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 fail-safe type. Suitable individual interlocking coil arrangements shall be provided. The interlocking coil shall be suitable for continuous operation from DC supply and within a variation range as stipulated in Section-GTR.
- 2.4 The earthing switches shall be capable of discharging trapped charges of the associated lines.
- 2.5 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 CONSTRUCTIONAL FEATURES

Isolators shall be outdoor, off-load type. **Earth switches shall be provided on isolators wherever called for, with the possibility of being mounted on any side of the isolator.** 800kV isolator design shall be double break or vertical break or knee-type. 420kV & below rated isolators shall be double break type, unless specified otherwise. **The 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 and shall be so designed that binding cannot occur after remaining in closed position for prolonged periods of time 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 re-adjustments in contact pressure shall not be necessary throughout the life of the isolator or earthing switch. Each contact or pair of contacts should be independently sprung so that full pressure is always maintained on all contacts.
- 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. **Minimum thickness of silver plating on all contact points of male and female contact shall be 25 microns.**

3.2 Base:

Each single pole of the isolator shall be provided with a complete galvanized steel base provided with holes and designed for mounting on a supporting structure. A common base frame shall be provided for 400/220/132kV 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/aluminium. 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 proximity to the 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 aluminium/aluminium alloy.
- 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 IEC 60815 and IEC 60168. 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) Dimensions and Cantilever Strength of Insulator

	800kV	420kV	245kV	145kV
Min. Cantilever Strength	10kN			6kN
Top PCD	225mm	127 mm	127 mm	127 mm
No. of holes	4 x M16	4 x M16	4 x M16	4 x M16
Bottom PCD	356 mm	325 mm	275 mm	254mm
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 EARTHING SWITCHES

- i. Where earthing switches are specified, these shall include the complete operating mechanism and auxiliary contacts.
- ii. The earthing switches shall form an integral part of the isolator and shall be mounted on the base frame of the isolator.
- iii. Earthing switches shall only be locally operated.
- iv. Each earth switch shall be provided with flexible copper/aluminium 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.
- v. The plane of movement and final position of the earth blades shall be such that adequate electrical clearances are obtained from adjacent live parts during its movement between ON and OFF position.
- vi. The frame of each isolator and earthing switches shall be provided with two reliable earth terminals for connection to the earth mat.
- vii. The earth switch should be able to carry the same fault current as the main blades of the Isolators and shall withstand dynamic stresses.
- viii. 800kV, 420 kV & 245 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 E0**.
- ix. Earth switch blade in open condition shall not project (from the centre line of Insulator) by more than 4200mm for 420kV and 2810mm for 220kV respectively.

5 OPERATING MECHANISM

- a) The bidder shall offer motor operated Isolators and earth switch. Isolators of 36 kV and below and earth switches of 72.5 kV and below rating shall be manual operated.
- b) Control cabinet/operating mechanism box shall conform to the requirement of the project and shall be made of **adequate thickness of cast aluminium/aluminum sheet (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) The motor shall be an **AC motor** and conform to the requirements of the 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 the motor supply is switched off.** If necessary, a quick electromechanical 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 chosen / surface treated to avoid rusting.
- i) Only stranded conductor shall be used for wiring. Minimum size of the conductor for control circuit wiring shall be **1.5 sq.mm. (Copper).**
- j) **The operating mechanism shall be located such that it can be directly mounted on any one of the support structures.**
- k) Snap type limit/auxiliary switches shall be used with factory set values. No adjustment shall be required during commissioning.

6 OPERATION

- a) The main Isolator and earth switches shall be individual pole operated for 800/420 kV and gang operated in case of 245 kV & 145 kV. However, 245 kV Tandem Isolators shall be individual pole operated. The operating mechanism of 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 in one movement 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 the 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. They shall also be capable of withstanding all torsional and bending stresses due to the operation of the isolator. Wherever supported, the operating rods shall be provided with bearings on either end. 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 rustproof.
- 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 at least 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 along with quality norms, during the detailed engineering stage.
 - I. **Current transfer arrangement** from main blades of isolator along with milli volt drop immediately across transfer point.
 - II. Details to demonstrate smooth **transfer of rotary motion** from motor shaft to the insulator along with stoppers to prevent over travel.

7 TERMINAL CONNECTOR STUD/PAD

The isolator terminal pads/studs shall be made of high-quality copper or aluminum. 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. The terminal pads for all isolators with 3150A & above rating shall have six holes for terminal pad.

8 SUPPORT STRUCTURE

800 kV/420 kV/245 kV/145 kV Isolators shall be suitable for mounting on support structures which is to be supplied in accordance with stipulations of project requirement.

9 TESTS

- 9.1 The isolator along with 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, 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 the test, mechanical interlock operation to be checked.

For Earth switch, 100 operations in acceptance test shall be carried out in each lot.

9.2 The test reports of the type tests and the following additional type tests (additional type tests are required for 72.5 kV & above Isolators only) as per Section-GTR shall also be submitted for the Employer's review.

- a) Radio interference voltage test (for 245 kV & above Isolators only).
- b) Corona Extinction Voltage test (for 420 kV & above Isolators only).
- c) Seismic withstand test on isolator mounted on Support structure shall be performed in the following position.

Isolator Open	ES Close
Isolator Open	ES Open
Isolator Close	ES Open

10 PRE-COMMISSIONING TESTS

An indicative list of tests is given below. For pre-commissioning procedures and formats for Isolators and Earthing switch, Employer's Standard pre-commissioning document will be the reference document and shall be provided during detailed engineering.

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

- Insulation Resistance of each pole.
- Manual and Electrical operation and interlocks.
- Insulation resistance of control circuits and motors.
- Ground connections.
- Contact Resistance measurement.
- Proper alignment to minimize vibration during operation.
- Resistance of operating and interlocks coils.
- Functional check of the control schematic and electrical & mechanical interlocks.
- 50 operations tests on isolator and earth switch.

Note: The contractor shall ensure that erection, testing and commissioning of Isolators above 72.5 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

11 MAJOR TECHNICAL PARAMETERS

11.1 Technical Parameters for 765kV, 400kV, 220kV and 132kV Isolators

S. No.	Description	Unit	800kV ISO	420kV ISO	245kV ISO	145kV ISO
1	Rated voltage	kVrms	800	420	245	145
2	Rated frequency	Hz	50			
3	No. of poles	Nos.	3			
4	Design ambient temperature	° C	50			
5	Type		Outdoor			
6	Rated current at 50°C ambient temperature	A	3150	3150	1600A /3000 A (as applicable)	1250
7	Rated short time withstand current of isolator and earth switch	kA	50kA for 1 sec	63kA for 1 sec	50kA for 1 sec	40kA for 1 sec
8	Rated dynamic short time withstand current of isolator and earth switch	kAp	125 kAp	157.5 kAp	125 kAp	80kAp
9	Temperature rise over design ambient temperature	As per Table-14 of IEC 62271-1				
10	Rated mechanical terminal load	As per Table 4 of IEC 62271-102				
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., 4 NO + 4 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., 2 NO + 2 NC contacts wired on each earth switch to terminal block exclusively for Employer’s use in future.				
15	Max. Operating time	secs	20 sec. for Isolator and 25 sec for earth switch	20 secs	12 secs	12 secs
16	Number of terminals in control cabinet	All contacts & control circuits are to be wired up to control cabinet plus 10 spare terminals evenly distributed.				
17	Rated Insulation levels					
a)	Full wave impulse withstand voltage (1.2/50 microsec.)					
i)	between line terminals and ground	kV _{peak}	±2100	±1425	±1050	±650
ii)	between terminals with isolator open	kV _{peak}	±2100kVp impulse on one terminal and 455kVp power frequency voltage of opposite polarity on other terminal	±1425kVp impulse on one terminal and 240kVp 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}	1175kVp impulse on one terminal and 650kVp power frequency voltage of opposite polarity on other terminal	900kVp impulse on one terminal and 345kVp 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 kV _{rms}	1000 at 266 kV _{rms}	1000 at 156 kV _{rms}	500 at 92 kV _{rms}
20	Minimum Creepage distance					
i)	Phase to ground	mm	As per Section- GTR			
21	Seismic acceleration		As per IS:1893			
22	Thermal Rating of Auxiliary Contacts	A	10A at 220V DC			
23	Breaking Capacity of auxiliary contacts		2A 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			

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.

11.2 Technical Parameters for 72.5 kV, 36 kV and 11 kV Isolator

S. No.	Description	Unit	72.5kV ISO	36kV ISO	12kV ISO
1	Rated voltage	kV _{rms}	72.5	36	11
2	Rated frequency	Hz	50		
3	No. of poles	Nos.	3		
4	Design ambient temperature	°C	50		
5	Type		Outdoor, mechanically gang operated		
6	Rated current at 50°C ambient temperature	A	As per requirement		
7	Rated short time withstand current of isolator and earth switch	kA	25kA for 3 sec		
8	Rated dynamic short time withstand current of isolator and earth switch	kAp	62.5kAp		
9	Temperature rise over design ambient temperature	As per Table-14 of IEC 62271-1			
10	Rated mechanical terminal load	As per Table 4 of IEC 62271-102			
11	Mechanical Endurance Class	Isolator-M1 E/S-M0			
12	Operating mechanism of isolator/earth switch		Isolator - A.C. Motor operated. E/S – Manual operated	Isolator - Manual operated. E/S – Manual operated	Isolator - Manual operated. E/S – Manual operated

13	No. of auxiliary contacts on each isolator	Besides requirement of this specification, 4 NO + 4 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 specification, 2 NO + 2 NC contacts wired on each earth switch to terminal block exclusively for Employer's use in future.			
15	Max. Operating time	sec	12 sec.	NA (manual operation)	
16	Number of terminals in control cabinet	All contacts & control circuits are to be wired up to control cabinet plus 10 spare terminals evenly distributed.			
17	Rated Insulation levels				
a)	Full wave impulse withstand voltage (1.2/50 microsec.)				
i)	between line terminals and ground	kV _{peak}	±325	±170	-
ii)	between terminals with isolator open	kV _{peak}	±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		
19	Seismic acceleration		As per IS:1893		
20	Thermal Rating of auxiliary Contacts	A	10A at 220V/110V DC		
21	Breaking Capacity of auxiliary contacts		2A 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		

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.