

TECHNICAL SPECIFICATIONS

CHAPTER 3C-SWITCHGEAR ISOLATOR

for

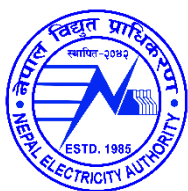
PACKAGE KC-6

of

KOSHI CORRIDOR 220kV TRANSMISSION LINE PROJECT

IFB No.: KOSHI/NEA/KC-6

**Procurement of Design, Supply, Installation, Testing and
Commissioning of 220kV(GIS)/132kV Substation Expansion at
Dhungesanghu Substation**



नेपाल विद्युत प्राधिकरण

(नेपाल सरकारको स्वामित्व)

Nepal Electricity Authority

(A Government of Nepal Undertaking)

CHAPTER 3C-SWITCHGEAR ISOLATOR**1.0 GENERAL:**

- 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 Chapter 2-GTR.
- 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 Chapter 2-GTR and Chapter 1-PSR.

2.0 DUTY REQUIREMENTS:

- a) Isolators and earth switches shall be capable of withstanding the dynamic and thermal effects of the rated short circuit current of the systems in their closed position. They shall be constructed such that they do not open under 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 Chapter 2-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. 420kV & below rated isolators 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 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.
- f) **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 galvanised steel base provided with holes and designed for mounting on a standard supporting structure. Common base frame shall be provided for 400/220/132kV isolators suitable for mounting on pipe/lattice 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 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.
- 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-60168 and IEC-60815. The porcelain of the insulator shall conform to the requirements stipulated under Chapter 2-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:

ii) **For 420 kV Insulator:**

Cantilever strength (min.)	=	10 kN
Top PCD	=	127 mm
No. of holes	=	4 x M16
Bottom PCD	=	325 mm
No. of holes	=	8 x 18mm dia

iii) **For 245 kV Insulator:**



Cantilever strength (min.)	=	10 kN
Top PCD	=	127 mm
No. of holes	=	4 x M16
Bottom PCD	=	275 mm
No. of holes	=	8 x 18mm dia

iv) **For 145 kV Isolator:**

Cantilever strength (min.)	=	6 kN
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.

3.6 Locking device (applicable for 132kV and above):

- a) Locking device between Disconnectors and earth switches (wherever applicable) are to be provided and shall be designed to meet the requirement as per latest edition of IEC 62271:102.

For this, mechanical arrangements must be there to stop any forceful act (like push button operation of motor, handle operation etc) to operate earth switch (while main isolator is in closed position) or vice versa. Mechanical arrangements to be provided to hold operating pipe connected to motor shaft. Trapped Key Interlocking solution between Isolator and Earth switch is to be provided in such a way that each Isolator shall be connected with a mechanism with Key trapped in it. Once Isolator is completely open (Locally or Remote) the key will be released and blocks the isolator rotating pipe for any movement and same key shall be utilized to make Earth switch to operate.

The earth switch shall be locked at two positions:

- (i) In normal condition the earth switch is blocked mechanically so that it cannot be rotated until trapped key from key exchange box (in case of bus isolator)/isolator is released.
 - (ii) Once connected to earth, rotating shaft shall be blocked at that position with key out and can only be operated once key is again placed in E/S.
- b) The Locks used for earth switch shall be of electromechanical type lock. Lock and mechanical arrangement to hold rotating shaft must be suitable for long term outdoor operation and accordingly, stainless-steel material is to be used and enclosure of lock shall be such that ingress of dust and moisture inside is prevented.
- c) In case of new substation, for interlock between bus isolators and bus earth switch, locks along with key is to be provided for present and future bays. In such case, key exchange box (IP 55 Class) is also to be provided (with provision of spares as per envisaged future) for each bus. The key exchange box will have arrangement of N Key IN and one key OUT, where N is the number of bus isolators of particular bus (present + future). In case of substation extension (where above system has been implemented), bus



isolators are to be provided with mechanical arrangement at shaft compatible with existing locks.

- d) Strength of mechanical interlock/shaft blocking must be designed as per IEC 62271-102 in such a way that it can withstand during motor- operation, the strain produced by the motor starting torque at the maximum motor supply voltage.
- e) The locking device must be type tested as per IEC 62271 102.

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 shall be only locally operated.
- d) Each earth switch shall be provided with flexible copper/aluminum 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 should be able to carry the same fault current as the main blades of the Isolators and shall withstand dynamic stresses.
- h) 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 E-0 for earthing switches.
- i) Earth switch blade in open condition shall not project (from the centre line of Insulator) by more than 4200mm for 400kV and 2810mm for 220kV respectively.

5.0 OPERATING MECHANISM:

- a) The bidder shall offer motor operated Isolators and earth switches. Earth switches of 36 kV and below rating shall be manual operated.
- b) Control cabinet/operating mechanism box shall conform to the requirement stipulated in Chapter 2-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 Chapter 2- 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) 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 structure.
- k) 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 individual pole operated for 420 kV and gang operated in case of 245 kV & 145 kV. However, 245/145 kV 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 ~~either~~ 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 indi- cator 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. **Type test to verify the proper functioning of the position- indicating device shall be carried out as per requirement of latest edition of IEC 62271-102.**
- h) The contractor shall furnish the following details along with quality norms, during 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.

7.0 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.

8.0 SUPPORT STRUCTURE:

420 kV/245 kV/145/72.5 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 Chapter 2-GTR the isolator alongwith its earthing switch and operating mechanism should have been type tested as per IEC and shall be subjected to routine tests in accordance with **latest edition** of IEC-62271-102. Minimum 1000 Nos. mechanical operations in line with mechanical endurance test, M0 duty, shall be carried out on 1 (one) isolator (**not applicable for earth switch**) out of every lot of Isolators, assembled completely with all accessories including insulators, as acceptance test for the lot. **For Earth Switch, 100 operations in acceptance test shall be carried out in each 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 **latest** IEC 62271-102 and the following additional type tests shall also be submitted for the Employer's review.
- (i) **RIV (for $\geq 245\text{kV}$)** and Corona Extinction Voltage test as per Annexure-A of Chapter 2-GTR
 - (ii) Seismic withstand test on isolator mounted on Support structure as per Annexure-B of Chapter 2-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:

Mandatory spares shall be as per 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 along with calibration certificates at his own cost.
- (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 measurement
 - (f) Proper alignment so as to minimize vibration during operation
 - (g) 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 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.



Annexure-I

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

Sl. No.	Description	Unit	420kV ISO	245kV ISO	145kV ISO
1	Rated voltage	kVrms	420	245	145
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	Outdoor	Outdoor
6	Rated current at 50°C ambient temperature	A	As per BPS	As per BPS	As per BPS
7	Rated short time withstand current of isolator and earth switch	kA	63 for 1 sec	50 for 1 sec	40 for 1 sec
8	Rated dynamic short time withstand current of isolator and earth switch	kAp	157.5 kAp	125 kAp	100kAp
9	Temperature rise over design ambient temperature		As per Table-14 of IEC-62271-1		
10	Rated mechanical terminal load	N	As per Table 4 of IEC-62271-102		
11	Mechanical Endurance Class		Isolator-M2, E/S-M0		
12	Operating mechanism of isolator/erathswitch		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 earth switch to terminal block exclusively for Employer's use in			
15	Max. Operating time	secs	20 secs	12 secs	12 secs
16	Number of terminal in control cabinet	All Contacts			
17	Rated Insulation levels				
a)	Full wave impulse withstand voltage (1.2/50 microsec.)				
i)	between line terminals and ground	kVpeak	±1425	±1050	±650



Sl. No.	Description	Unit	420kV ISO	245kV ISO	145kV ISO
ii)	between terminals with isolator open	kVpeak	±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	± 1050	-NA-	-NA-
ii)	between terminals with Isolator open	kV peak	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	520	460	275
ii)	between terminals with isolator open	kV rms	610	530	315
18	Minimum Corona extinction voltage with Isolator in all positions	KV rms	320	156	92
19	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz. in all positions	micro volts	1000 at 266 kVrms	1000 at 156 kVrms	500 at 92 kVrms
20	Minimum Creepage distance				
i)	Phase to ground	mm	As per Chapter - GTR	As per Chapter-GTR	As per Chapter-GTR
21	Seismic acceleration		As per PSR	As per PSR	As per PSR
22	Thermal Rating of Auxiliary Contacts	A	10 A at 220/110 V DC	10 A at 220/110 V DC	10 A at 220/110 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



Sl. No.	Description	Unit	420kV ISO	245kV ISO	145kV ISO
24	Distance between support structures foundations (within same phase)	m	4.0	2.5	-
25	System neutral earthing		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°C ambient temperature	A	As per BPS	As per BPS	As per BPS
7	Rated short time withstand current of isolator and earth switch	kA	40 kA for 1 sec	31.5 kA for 1 sec	25 kA for 3 sec
8	Rated dynamic short time withstand current of isolator and earth switch	kAp	100kAp	80kAp	62.5kAp
9	Temperature rise over design ambient temperature	As per Table-14 of IEC-62271-1			
10	Rated mechanical terminal load	N	As per Table 4 of IEC-62271-102		
11	Mechanical Endurance Class		Isolator-M1 E/S-M0		
12	Operating mechanism of isolator/earthswitch		Motor operated	Isolator – Motor operated E/S – Manual operated	Isolator – Motor 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 earth switch to terminal block exclusively for Employer's use in future.			
15	Max. Operating time	sec	12 sec.	12 sec. for motor	12 sec. for motor operated



				operated NA for manual	NA for manual
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 Chapter-GTR	As per Chapter-GTR	As per Chapter-GTR
19	Seismic acceleration		As per PSR	As per PSR	As per PSR
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

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.

