BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

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TYPE OF DOC.	TECHNICAL SPECIFICATION			NAME	RJ	VK	RS
TITLE: 400kV,72.5kV & 33kV ISOLATORS AND EARTH SWITCHES				SIGN			
				DATE	14/01/15	17/1/15	03/02/15
				GROUP	TBEM	W.O. No	
CUSTOMER	POWER GRID CORPORATION OF INDIA LTD.						
PROJECT	765kV/400kV Agra UPPTCL (New) Substation						

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SECTION - 1

1.1 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of 420 kV,72.5kV & 36 kV Isolators and earth switches without support insulators, terminal connectors and structure to site.

This section covers the scope and quantities of 420 kV, 72.5kV & 36 kV Isolators. The Specific Technical Requirements for the above item as specified by the customer (PGCIL) are given in Section-2. The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification.

In case of any discrepancies between the requirements mentioned under Section-1/Section-2 and those specified in the Section-3, the specifications given under Section-1/Section-2 shall prevail and shall be treated as binding requirements.

The equipment is required for the following project:

Name of the Customer : POWER GRID CORPORATION OF INDIA LIMITED (PGCIL)
Name of the Project : 765kV/400kV Agra UPPTCL (New) Substation

The scope of supplies shall be as per commercial terms and conditions enclosed separately with the enquiry.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

All equipments shall perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation.

All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow, (wherever applicable) short circuit etc for the equipment.

The equipment shall also comply to the following:

a) To facilitate erection of equipment, all items to be assembled at site shall be "match marked".
b) All piping, if any between equipment control cabinet/operating mechanism to marshalling box of the equipment, shall bear proper identification to facilitate the connection at site.

Equipments and system shall be designed to meet the following major technical parameters as brought out hereunder.

1	Rated voltage (kV, rms)	**420**	**72.5**	**36**
2	Rated insulation levels:			
a	Full wave impulse withstand voltage (1.2/50 micro sec.)			
	- between line terminals and ground	± 1425 kVp	± 325 kVp	± 170 kVp
	- between terminals with isolator open	± 1425 kVp impulse on one terminal and 240 kVp power freq.voltage of opposite polarity on other terminal	± 375 kVp	± 180 kVp
b	Switching impulse withstand voltage (250/2500 micro sec.) dry and wet			
	- between line terminals and ground	± 1050 kVp		NA
	- between terminals with isolator open	900 kVp impulse on one terminal and 345 kVp power freq. voltage of opposite polarity on other terminal		NA
c	One minute power frequency dry and wet withstand voltage			
	- between line terminals and ground	520 kV rms	140 kV (rms)	70 kV (rms)
	- between terminals with isolator open	610 kV rms	160 kV (rms)	80 kV (rms)
	corona extiction voltage (kV rms) with isolator in all positions	320 (min)	-	-
d	Max. radio interference Voltage (micro-volts) for Frequency between 0.5 MHz and 2 MHz at 266 kV rms for 400 kV system and 156 kV rms for 220 kV system in all positions of the equipments.	1000	-	-
3	Minimum creepage distance	10500	1813	900
4	Phase to phase spacing (mm) (min)	6000/ 7000	2000	1500
5	Rated short time withstand Current of isolator and earth switch.	50 kA for 1 Sec	25 kA for 3 sec	25 kA for 3 sec
6	Rated dynamic short circuit withstand Current of 400kV isolator and earth switch	125 kAp		
7	Operating mechanism of Isolator	Motor	Motor	Manual
8	Operating mechanism of earth switch	Motor	Manual	Manual
9	Rated frequency (Hz)	50		
10	No.of poles	3		

11	Design ambient Temperature (oC)	50
12	System neutral earthing	Effectively Earthed
13	Seismic acceleration	0.3g horizontal
14	Thermal Rating of auxiliary contracts	10 A at 220 V DC or 110 V DC
15	Breaking capacity of auxiliary contacts	2 A DC with circuit Time constant of not less than 20 ms
16	Temperature rise over design Ambient temperature	As per Table-3 of IEC-62271-1
17	Rated mechanical Terminal load	As per table III of IEC-62271-102 or as per the value calculated in Section 3 whichever is higher
18	Type	Outdoor, HDB
19	Min. No. of auxiliary contacts On each isolator (For 400kV)	Besides requirement of this spec., the bidder shall wire up 12 NO +12 NC +4 MBB to TBs (Reversible) for purchaser's future use
20	Min. No. of auxiliary contacts On each earthing switch (For 400kV Isolators and Earth Switch)	Besides requirement of this spec., the bidder shall wire up 10 NO +10 NC to TBs (Reversible) for purchaser's future use, for Bus Earth switch 15 NO + 15 NC shall be provided.
21	Operating time for 400kV Isolators	12 sec. or less
22	Number of terminals in Control cabinet (inter-pole Cabling shall be supplied By the supplier)	(1) All contacts and control circuits are to be wired upto control cabinet including potential free auxiliary contacts of Isolator/Earth switch. (2) Additional 24 nos. evenly distributed spare TBs in Master to be provided for interpole cabling of Auxiliary contacts (employer's use). (3) Sufficient TBs shall be provided in control cabinet for looping of AC supply from master to follower of Isolator and earth switch.
23	TB size & Type	(1) TBs shall be stud type (2) Power Cable-Each TBs Should be Suitable for terminating two wires of 10 Sq. mm size on each side (3) Control cable- Each TBs Should be Suitable for terminating two wires of 2.5 Sq. mm size on each side
24	Local remote switch indication of Isolator for Substation Automation system (SAS)	**Yes**

1.3 BILL OF QUANTITIES

1.3.1 Main Items

Sl. No	Description	Unit	Quantity
1.	420 kV, 3150 A, **1 phase**, 50 kA for 1 sec, double break isolators **with one Earth switch** with accessories excluding Post insulators complete in all respects	Nos	07
2.	420 kV, 3150 A, **1 phase,** 50 kA for 1 sec, double break isolators **with out Earth switch** with accessories excluding Post insulators complete in all respects	Nos	05
3.	420 kV, 3150 A, **3 phase,** 50 kA for 1 sec, double break isolators **with one Earth switch** (individual pole operated for isolator/earth switch) with accessories excluding Post insulators complete in all respects	Nos	36
4.	420 kV, 3150 A, **3 phase,** 50 kA for 1 sec, double break isolators **with two Earth switch** (individual pole operated for isolator/earth switch) with accessories excluding Post insulators complete in all respects	Nos	02
5.	72.5kV, 630A, 3Ph.25kA for 3s , HDB Isolator without earth switch mechanically ganged , motor operated excluding Post insulators	Nos.	02
6.	36kV, 630A, 3Ph.25kA for 3s , HDB Isolator without earth switch mechanically ganged , manually operated excluding Post insulators to be mounted on double pole structure	Nos.	01
7.	Supervision of erection , testing and commissioning of all of Isolator and earth switches	Lot	1
8.	Training charges for Isolators at Site for 1 day	Lot	1

4 P i's checked spent.

NOTE:

1) The insulators, terminal connectors and structure will be supplied by BHEL. Equipment mounting hardware on structure shall be supplied by vendor. Inter pole cables and glands shall be supplied by BHEL.

1.3 BILL OF QUANTITIES

1.3.1 Main Items

Sl. No	Description	Unit	Quantity
1.	420 kV, 3150 A, **1 phase**, 50 kA for 1 sec, double break isolators **with one Earth switch** with accessories excluding Post insulators complete in all respects	Nos	07
2.	420 kV, 3150 A, **1 phase,** 50 kA for 1 sec, double break isolators **with out Earth switch** with accessories excluding Post insulators complete in all respects	Nos	05
3.	420 kV, 3150 A, **3 phase,** 50 kA for 1 sec, double break isolators **with one Earth switch** (individual pole operated for isolator/earth switch) with accessories excluding Post insulators complete in all respects	Nos	36
4.	420 kV, 3150 A, **3 phase,** 50 kA for 1 sec, double break isolators **with two Earth switch** (individual pole operated for isolator/earth switch) with accessories excluding Post insulators complete in all respects	Nos	02
5.	72.5kV, 630A, 3Ph.25kA for 3s , HDB Isolator without earth switch mechanically ganged , motor operated excluding Post insulators	Nos.	02
6.	36kV, 630A, 3Ph.25kA for 3s , HDB Isolator without earth switch mechanically ganged , manually operated excluding Post insulators to be mounted on double pole structure	Nos.	01
7a	Supervision of erection , testing and commissioning of all 400kV Isolators and earth switches	Lot	1
7b	Supervision of erection , testing and commissioning of all 72.5kV Isolators	Lot	1
7c	Supervision of erection , testing and commissioning of 33kV Isolator	Lot	1
8	Training charges for Isolators of at Site for 1 day	Lot	1

NOTE:

1) The insulators, terminal connectors and structure will be supplied by BHEL. Equipment mounting hardware on structure shall be supplied by vendor. Inter pole cables and glands shall be supplied by BHEL.
2) Respective dates for the commencement of erection , testing and commissioning activities of Isolators shall be communicated to manufacturers from time to time as per the readiness of site.

1.3.2 Mandatory Spares

(A) 420 kV Double Break/ Isolators (3150A) (50 kA)

Sl. No	Description	Unit	Quantity
1.	One complete pole of 3150A, 50kA for 1 s , HDB Isolator with 1 earth switch including Motor operating mechanism for Isolator and earth switches without post insulators , structures and terminal connectors	No	1
2.	Copper contact fingers for female & male contacts	Set	2
3.	Open/Close contactor assembly, timers, key interlock push button switch & auxiliary switches	Set	1
4.	Limit Switch	Nos.	2
5.	Terminal Pads	Nos.	3
6.	Corona Shield rings	Nos.	3

1.4 TYPE TESTING

Bidder shall submit valid type test reports (as per relevant IEC/IS Standard) for approval. The type test reports submitted shall be of tests conducted within last 10 years prior to the date of bid opening i.e. 28.04.14. The bidder should have conducted type test on identical or similar equipment/ components to those offered. In case type test reports are found to be technically unacceptable to BHEL/PGCIL, the type test shall be conducted without cost and delivery implication to BHEL.

1.5 QUALITY PLAN

Bidder to follow valid PGCIL approved Quality Plan as per PGCIL procedure. In case the bidder don't have PGCIL approved QP, it will be the bidder's responsibility to get its QP approved directly from the ultimate customer.

1.6 SUPERVISION OF ERECTION, TESTING & COMMISSIONING

Bidder shall quote charges for supervision of erection, testing & commissioning of all offered isolator and earth switch (Voltage class wise). Field test Reports of Isolators and Earth switches

should be signed by supplier's representative. BHEL site will inform the supplier regarding readiness of site. Bidder may have to visit site multiple times depending on the readiness of site.

1.7 TRAINING :

The successful bidder shall give training in the field of erection, testing, operation and maintenance to UPPTCL/BHEL's Personnel at Substation site.

Note: Bidder should include price for training and Charges for Tutorials & other training materials for the trainees in the quoted price for Training charges main items. No payment shall be made to supplier against training charges or any type of expanses incurred by supplier for training .

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SECTION II

EQUIPMENT SPECIFICATION

2.1 GENERAL

This section covers the general technical requirements of Isolator. In case of any discrepancies between the requirements mentioned in this section and those specified in other sections of this specification, this shall prevail after section 1 and shall be treated as binding requirements.

2.2 TECHNICAL REQUITREMENT OF EQUIPMENT

The manufacturer whose Isolators are offered, should have designed, manufactured, tested as per IEC/IS or equivalent standard and supplied the isolator for the specified system voltage and fault level and should be in satisfactory operation for at least 2 (two) years as on 28.04.14.

2.3 APPLICABLE STANDARDS

The Isolator shall conform to the following Indian / International standards:

Three phase induction motors	: IS:325 - 1978
Alternating current disconnectors and earthing switches:	IS:9921- 1985
Alternating current disconnectors and earthing switches	: IEC:62271-102 (2001-12)
High Voltage Switches	: IEC-60265
Common Specification for High Voltage Switchgear and control gear	: IEC60694
Schedule of preferred ratings, Manufacturing Specification and Application Guide for High Voltage Air Switches, Bus Supports and Switch accessories	: ANSI-C37.32
Test Code for high voltage air switches	: ANSI-C37.34
Power switching equipment	: NEMA-SG6
Method for testing uniformity of coating of zinc coated articles.	: IS:2633- 1986
Recommended practice for hotdip galvanizing on iron & steel	: IS:2629 - 1985
Electric power connectors	: IS:5561- 1970
Method for determination of mass of zinc coating on iron and steel articles.	: IS:6745- 1972

Low voltage switchgear and Controlgear General rules (Part 1) : IS:13947- 1993

Dimension for steel plates, sheets, strips and flats for general engg. purposes : IS:1730- 1989

Dimension for wrought Al and Al alloy sheet & strip : IS:2676- 1981

2.4 DESIGN AND CONSTRUCTIONAL FEATURES

2.4.1 General

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.420 kV & below rated isolator shall be double break type unless specified otherwise.

The equipment shall be three pole type and such units shall be electrically ganged (for 420kV Isolators) operated to perform the service requirement as specified in section 1.

Complete isolator with all the necessary items for successful operation shall be supplied including but not limited to the following:
Isolator assembled with operating rod, insulator, base frame, linkages, operating mechanism, control cabinet, interlocks etc.

The design shall be such that changes in mounting and connection can be made at site without excessive labour and with minimum replacement of parts.

The isolator shall be designed for use in the geographic and meteorological conditions as given in Section-3 of this technical specification..

Live metal parts (except insulator caps & bases) shall be non-rusting, non corroding metal. The current carrying parts shall be non-ferrous.

Factory adjustment shall be so made that field adjustments will not be required on the isolators and earth switch. When interphase connections are attached to the rotating insulator in the field all phases shall make and break simultaneously.

The equipment shall be designed for the rated normal current and shall be capable of withstanding the electrical and mechanical stresses imposed by the system fault current as specified in Section 1. They shall be so constructed that they do not open under the influence of short circuit current. Further the temperature rise due to this short time current shall not cause any damage to the insulation of the current carrying parts.

The switches shall be complete with rigid bases and shall be supplied with suitable channels, nuts and bolts for mounting on steel structure.

All ferrous parts shall be hot dip galvanised in accordance with relevant standards as detailed in clause 2.2.

Design of isolators and associated earthing switches shall provide positive control of blades in all position with minimum mechanical stress on the insulators. Fixed guides shall be provided that proper setting of contacts shall be obtained when blade is out of alignment even by 25mm in either direction for horizontal centre break.

2.4.2 Duty Requirement

Isolators and earth switches shall be capable of withstanding the dynamic and thermal effects of the maximum possible short circuit current of the system in their closed position. They shall be constructed such that they do not open under influence of short circuit current..

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 interlock . Suitable mechanical arrangement shall also be provided for delinking electrical drive for manual operation.

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 inter-locking coil shall be suitable for continuous operation from 220VDC supply and within a variation range ±10%.

The earthing switches shall be capable of discharging trapped charges of the associated Lines.

The isolator shall be capable of making/breaking normal currents when no significant change in voltage occurs across the terminal of each pole of the isolators on account of make/break operation.

Isolators rated for above 72.5kV shall be of extended mechanical endurance class-M2 as per IEC-62271-102. Isolators rated for 72.5kV & below shall be of extended mechanical endurance class-M1 as per IEC 62271-102. All earth switches shall be of M0 duty.

2.4.3 Constructional Features

The features and constructional details of Double Break Isolators/Vertical Break/Knee-type isolators, earth switches and accessories shall be in accordance with requirements stated hereunder:

2.4.3.1 Contacts

a) The contacts shall be self aligning and self cleaning and so designed that binding cannot occur after remaining closed 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 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 loose their characteristics due to heating effects.

d) The moving contact of double break isolator shall have turn-and -twist type or other suitable type of locking arrangement to ensure adequate contact pressure.

2.4.3.2 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 supporting structure.

2.4.3.3 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 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.

2.4.4 Insulators details (Excluded from scope)

a) The Insulator shall conform to IS:2544 and/or IEC-60168. The Porcelain of the insulator shall conform to the requirements stipulated under section-3 and shall have a minimum cantilever strength 1000kG for 800kV Insulators.

b) Pressure due to contact shall not be transferred to the insulators after the main blades are fully closed.

c) The Parameters of the insulators shall meet the requirements specified under section-3.

d) Insulator shall be type and routine tested as per IEC 60168. Besides following additional tests shall also be conducted:

i) Bending load test in four direction 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 tet on each lot.

iii) Torsional test on sample insulator of a lot.

iv) Ultrasonic test as a routine test.

400 kV Insulator: (For Isolator)

Top PCD	=	127 mm
No. of holes	=	4 x M16 mm dia
Bottom PCD	=	325 mm
No. of holes	=	8 x 18 mm dia

Post insulators for Isolators shall be supplied by BHEL separately.

2.4.5 Name Plate:

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

2.4.6 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) The earthing switches shall be constructionally interlocked with the isolator so that the earthing 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 be provided for de- linking electrical drive for manual operation.

e) 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.

f) 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.

g) The frame of each isolator and earthing switches shall be provided with two reliable earth terminals for connection to the earth mat.

h) Isolator design shall be such as to permit addition of earth switches at a future date. It should be possible to interchange position of earth switch to either side.

i) The earth switch should be able to carry the same fault current as the main blades of the Isolators and shall withstand dynamic stresses.

j) 800kV, 420kV & 245kV Earth Switch shall also comply with the requirements of IEC-62271-102, in respect of induced current switching duty aas defined for class B and short circuit making capability class E-0 for earthing switches.

2.4.7 Operating Mechanism

a) The bidder shall offer motor operated Isolators and earth switches. Isolators of 36kV and below and earth switches of 72.5kV and below rating shall be manual operated.

b) Control cabinet/operating mechanism box shall conform to the requirement stipulated in Section-3 and shall be made of cast aluminum/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-3 of this specification..

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 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 ending/ 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)The test report for blocked rotor test of motor shall be submitted as per the equipment of clause 23 of Section: 3 (General Technical specification of Technical Specification.

j) Clause deleted

k) Only stranded conductor shall be used for wiring. Minimum size of the conductor for control circuit wiring shall be 1.5 sq.mm. (Copper).

l) The operating mechanism shall be located such that it can be directly mounted on any one of the support structure.

2.4.8 Operation

a) The main Isolator and earth switches shall be individual pole operated for 420kV and gang

operated in case of 245kV & 145kV.operating mechanism of the three poles shall be well synchronised 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. 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 center" device in the operating mechanism to prevent accidental opening by wind, vibration, short circuit forces or movement of the support structures.

c) Each isolator/pole of isolator and earthswitch 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 isolator support structure.

d) The isolator shall be provided with positive 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 operation of the isolator. Wherever supported the operating rods shall be provided with bearings on 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 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 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.

2.4.9 Terminal Connector Stud/Pad

The isolator terminal pads/studs shall be made of high quality copper or aluminium and shall be conforming to Australian standard AS-2935 for rated current. The terminal pad shall have protective covers which shall be removed before interconnections.

2.5 Tests

Bidder should have all type test reports conducted within last 10 years from the date 28.04.14 as per relevant IS/IEC. The type tests conducted earlier should have either been conducted in accredited laboratory(accredited based on ISSO/IEC Guide 25/17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by POWERGRID or representative authorized by POWERGRID or utility or representative of accrediated test lab or reputed consultant.

In case if the type tests have been conducted earlier than **10 years** as on 28.04.14, bidder shall repeat type testing without any price implication to BHEL.

The isolator alongwith its earthing switch and operating mechanism 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 test, mechanical interlock operation to be checked.

Following additional type tests reports shall also be submitted for customer's review and acceptance

(i)Radio interference voltage test as per Annexure-A of Section-3

(ii)Corona Extinction Voltage test as per Annexure-A of Sectiion-3

(iii)Seismic withstand test on isolator mounted on Support structure as per Annexure-B of Section-3. The test shall be performed in the following position :

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

2.5.1 PRE-COMMISSIONING TESTS

An indicative list of tests on isolator and earthswitch is given below. For pre- commissioning procedures and formats for Isolators and ground switch, Doc.No.:CF/ISO/07/R-4, dated 01/04/13 under POWERGRID Document no. D-2-01-03-01-04 will be the reference document. This document will be available at respective sites and shall be referred by the contractor. Contractor shall perform any additional test based on specialties of the items as per the field Q.P./instructions of the equipment Supplier or Purchaser without any extra cost to the Purchaser. The Contractor shall arrange all instruments required for conducting these tests alongwith calibration certificates and shall furnish the list of instruments to the Purchaser for approval.

(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.

2.6 INFORMATION TO BE FURNISHED BY THE SUB CONTRACTOR

Information/ documents to be furnished at the TENDER / CONTRACT STAGE shall be as given below: (marked `X' in the appropriate column)

	AT TENDER STAGE	AT CONTRACT STAGE
Technical offer with details of equipment, scope etc.	√	-
Guaranteed Technical particulars	√	√
Schedule of Tests to be conducted	√	
Schedule of deviations, if any, clause-wise, with respect to technical specifications.	√	-
List of past supplies complete with purchase & project ref. qty. order ref. etc. where identical equipment have been supplied.	√	-

SECTION II

GA drg with dimensions & weight and foundation/ fixing details.	√	√
Drg & Data submission schedule (Datewise to be furnished at contract stage shall be specified here)	√	√
	AT TENDER STAGE	AT CONTRACT STAGE
Type test Reports.	√	√
Bar chart showing the time schedule indicating the time required for design, submission of drawing, manufacture of equipment, test and inspection.	√	-
Routine / Acceptance test reports.	-	√
Installation , Operation & Maintenance Manual.	-	√
Field Quality Plan for receipt and storage, installation, testing and commissioning with details of test equipment, tests to be conducted and acceptance values	-	√
List of Special Tools and Tackles ,If required	√	√

SECTION-3

PROJECT DETAILS & GENERAL SPECIFICATION

SITE INFORMATION

	Particular	Details
a)	Owner	UP POWER TRANSMISSION CORPORATION Ltd
b)	Customer	POWERGRID
c)	Project Title	765kV/400kV Agra UPPTCL (New)Substation
d)	Location	AGRA
e)	Transport Facilities	RAOD/TRAIN
	SITE CONDITIONS	
a)	Max. ambient air temp.	50°C
b)	Min. ambient air temp.	0°C
c)	Max. design ambient temp.	50°C
d)	Design reference temp.	50°C
e)	Average Humidity	Max. 100%
f)	Special corrosion conditions	No
g)	Solar Radiation	1.2kW/sqmtr
h)	Atmospheric UV radiation	High
i)	Altitude above sea level	Less than 1000meter
j)	Pollution Severity	High Pollution level (25mm/kV)
k)	Seismic Zone	As per the seismic zone defined in the relevant BIS but not less than 0.3g horrizontal
	WIND DATA	
	Wind velocity	As per IS
	Average No. of thunderstorm days per annum	As per IS

SECTION-3

1.0 GENERAL

This Chapter covers Technical Requirements and requirements of auxiliary items.

a) Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or needed for erection, completion and safe operation of the equipment as required by applicable codes unless included in the list of exclusions.

b) Material and components not specifically stated in this specification but which are necessary for satisfactory operation of the equipment and accessories specified in this specification shall be deemed to be included unless specifically excluded and shall be supplied at no extra cost.

c) Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition.

d) In case any Deviation Schedule, Bid Proposal Sheet, Schedule of Data Requirements (DRS), test reports or any other document/information are not furnished along-with the bid, the bid is liable to be rejected. Unless brought out clearly, the Bid will be deemed to conform to the specification scrupulously. All deviations from the specification shall be clearly brought out in the respective deviation schedule.

Auxiliary supplies as described below would be available at site.

Normal Voltage (Volts)	Variation in voltage	Frequency (Hz)	Phase	Neutral connection
415	+ 10 %	50 + 5 %	3 Ph- 4wire	Solidly earthed
240	+ 10 %	50 + 5 %	1 Ph-2wire	Solidly earthed
220	+ 10 %	DC		Isolated(2 wire system)
48		DC		Isolated(2 wire system) (+ Earthed)

f) The Bidder shall clearly indicate in the bid, the specific standards in accordance with which the works will be carried out.

g) The equipment must be new, of highest grade, the best quality of their kind, to best engineering practice and latest state of art, and in accordance with purpose for which they are intended and ensure satisfactory performance throughout the service life.

h) All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same materials and workmanship as the corresponding parts of the equipment. Where feasible, common components, units shall be employed in different pieces of equipment in order to optimize the spare part stock-up and utilization.

i) The requirement regarding external RIV as specified for equipment shall include the terminal fittings and the equipment shall have been tested preferably with fittings, if any.

2.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

a) The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain, restrike etc.

b) The equipment shall be able to withstand forces due to wind load, short circuit, system over voltages, fluctuations, frequency variations etc., all forces considered together.

3.0 SUPPORT STRUCTURES (If in the scope of Bidder)

a) The support structures should be hot dip galvanised with minimum 610 gram/m2 net of zinc.

b) The design calculations taking into account the environmental conditions of the substations shall be furnished for sizing of the structures.

4.0 STANDARDS

a) The equipment to be furnished under this specification shall conform to latest issue with all amendments of standard specified under respective Chapters of this Specification.The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other. The bidder shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC.When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

b) Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards referred shall also be accepted.

c) In case governing standards for the equipment is different from IS or IEC, the salient points of difference shall be clearly brought out in additional information schedule alongwith English language version of standard or relevant extract of the same. The equipment conforming to standards other than IS/IEC shall be subject to POWERGRID's approval.

5.0 ENGINEERING DATA AND DRAWINGS

5.1 The list of drawings/documents which are to be submitted to the Purchaser shall be discussed and finalised by the Purchaser at the time of award.The supplier shall necessarily submit all the drawings/ documents unless anything is waived.

5.2 The Contractor shall submit 4 (four) sets of drawings/ design documents /data / detailed bill of quantity and 1 (one) set of test reports for the approval of the Purchaser. The contractor shall also submit the softcopy of the above documents in addition to hardcopy.

5.3 Drawings

5.3.1 All drawings submitted by the Contractor shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, dimensions, internal & the external connections, fixing arrangement required and any other information specifically requested in the specifications.

5.3.2 Drawings submitted by the Contractor shall be clearly marked with the name of the Purchaser, the unit designation, the specifications title, the specification number and the name of the Project. POWERGRID has standardized a large number of drawings/documents of various make including type test reports which can be used for all projects having similar requirements and in such cases no project specific approval (except for list of applicable drawings alongwith type test reports) is required. However, distribution copies of standard drawings/documents shall be submitted as per provision of the contract. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in SI units.

5.3.3 The review of these data by the Purchaser will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect substation layout. This review by the Purchaser may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the Purchaser shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

5.4 All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Purchaser. Approval of Contractor's drawing or work by the Purchaser shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

5.5 All engineering data submitted by the Contractor after final process including review and approval by the Purchaser shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the Purchaser in Writing.

5.0 ENGINEERING & Approval Procedure

The scheduled dates for the submission of the drawings as well as for, any data/information to be furnished by the Purchaser would be discussed and finalised at the time of award. The following schedule shall be followed generally for approval and for providing final documentation.

i)	Approval/comments/ Purchaser on initial	As per agreed by schedule submission
ii)	Resubmission (whenever required)	Within 3 (three) weeks from date of comments
iii)	Approval or comments	Within 3 (three) weeks of receipt of resubmission.
iv)	Furnishing of distribution copies (5 hard copies per substation and one scanned copy (pdf format) for Corporate Centre)	2 weeks from the date of approval
v)	Furnishing of distribution copies of test reports	
(a)	Type test reports (one scanned softcopy in pdf format per substationplus one for corporate centre & one hardcopy per substation)	2 weeks from the date of final approval
(b)	Routine Test Reports (one copy for each substation)	-do-
vi)	Furnishing of instruction/ manuals (2 copies per substation and one softcopy (pdf format) for corporate centre & per substation)	As per agreed schedule operation
(vii)	As built drawings (two sets of hardcopy per substation & one softcopy (pdf format) for corporate centre& per substation)	On completion of entire works

NOTE :

(1) The supplier may please note that all resubmissions must incorporate all comments given in the earlier submission by BHEL/POWERGRID or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.

(2) All drawings should be submitted in softcopy form, however substation design drawings like SLD, GA, all layouts etc. shall also be submitted in AutoCAD Version. SLD, GA & layout drawings shall be submitted for the entire substation in case of substation extension also.

(3) The instruction Manuals shall contain full details of drawings of all equipment being supplied under this contract, their exploded diagrams with complete instructions for storage, handling, erection,commissioning,testing, operation, trouble shooting, servicing and overhauling procedures.

(4) If after the commissioning and initial operation of the substation,

Approval Procedure

the instruction manuals require any modifications/ additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the supplier to BHEL/POWERGRID.

(5) The manufacturer shall furnish to the Purchaser catalogues of spare parts.

(6) All As-built drawings/documents shall be certified by site indicating the changes before final submission.

6.0 MATERIAL WORKMANSHIP

6.1 General Requirement

6.1.1 Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended.

6.1.2 Incase where the equipment, materials or components are indicated in the specification as "similar" to any special standard, the Purchaser shall decide upon the question of similarity. When required by the specification or when required by the Purchaser the Contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the supplier.

6.1.3 The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the BHEL/POWERGRID.

6.1.4 Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

6.1.5 All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be considered as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, levelling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances, instructions and the

Specifications. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits suitable guards shall be provided for the protection of personnel on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purposes. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

6.1.6 The supplier shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The supplier shall apply all operational lubricants to the equipment installed by him.

6.1.7 All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help POWERGRID in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

6.1.8 Corona and radio interference voltage test and seismic withstand test (for 132kV and above voltage level) procedures for equipments shall be in line with the procedure given at Annexure-A and B respectively.

6.2 Provisions For Exposure to Hot and Humid climate

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favourable to the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

6.2.1 Space Heaters

6.2.1.1 The heaters shall be suitable for continuous operation at 240V as supply voltage. On-off switch and fuse shall be provided.

6.2.1.2 One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the compartment and electrical connections shall be made sufficiently away from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

6.2.1.3 Suitable anti condensation heaters with the provision of thermostat shall be provided.

6.2.2 FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on parts which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment.Such surfaces or parts shall be protected against the application of the varnish.

6.2.3 Ventilation opening

Wherever ventilation is provided, the compartments shall have ventilation

openings with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds and suitable provision shall be made so as to avoid any communication of air / dust with any part in the enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc.

6.2.4 Degree of Protection

The enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall provide degree of protection as detailed here under:

a) Installed out door: IP- 55
b) Installed indoor in air conditioned area: IP-31
c) Installed in covered area: IP-52
d) Installed indoor in non air conditioned area where possibility of entry of water is limited: IP-41.
e) For LT Switchgear (AC & DC distribution Boards) : IP-52

The degree of protection shall be in accordance with IS:13947 (Part-I) / IEC-60947(Part-I) / IS 12063 / IEC-60529. Type test report for degree of protection test, shall be submitted for approval.

6.3 RATING PLATES, NAME PLATES AND LABELS

Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Purchaser. The rating plate of each equipment shall be according to IEC requirement.

All such nameplates, instruction plates, rating plates of transformers, reactors, CB, CT, CVT, SA, Isolators, C & R panels and PLCC equipments shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

6.4 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment covered under the scope of the specifications, into successful Operation, shall be furnished by the supplier unless specifically excluded under the exclusions in these specifications and documents.

7.0 DESIGN IMPROVEMENTS / COORDINATION

7.1 The bidder shall note that the equipment offered by him in the bid only shall be accepted for supply. However, the Purchaser or the Contractor may propose changes in the specification of the equipment or quality thereof and if the Purchaser & contractor agree upon any such changes, the specification shall be modified accordingly.

7.2 If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in

with the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

7.3 The supplier shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

7.4 The supplier has to coordinate designs and terminations with the agencies (if any) who are Consultants/Contractor for the Purchaser. The names of agencies shall be intimated to the successful bidders.

7.5 The supplier will be called upon to attend design co-ordination meetings with the Engineer, other Contractor's and the Consultants of the Purchaser (if any) during the period of Contract. The Contractor shall attend such meetings at his own cost at POWERGRID Corporate Centre, Gurgaon (Haryana) or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

8.0 QUALITY ASSURANCE PROGRAMME

8.1 To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the supplier's Works or at his Sub- contractor's premises or at the Purchaser's site or at any other place of Work are in accordance with the specifications, the supplier shall adopt suitable quality assurance programme to control such activities at all points necessary. The detailed programme shall be submitted by the contractor after the award for reference. A quality assurance programme of the supplier shall generally cover the following:

(a) His organisation structure for the management and implementation of the proposed quality assurance programme:

(b) Documentation control system;

(c) Qualification data for bidder's key personnel;

(d) The procedure for purchases of materials, parts components and selection of sub-Contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.

(e) System for shop manufacturing and site erection controls including process controls and fabrication and assembly control;

(f) Control of non-conforming items and system for corrective actions;

(g) Inspection and test procedure both for manufacture and field activities.

(h) Control of calibration and testing of measuring instruments and field activities;

(i) System for indication and appraisal of inspection status;

(j) System for quality audits;

(k) System for authorising release of manufactured product to the Purcahser.

(m) System for handling storage and delivery; and

(n) A quality plan detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.

POWERGRID/BHEL or his duly authorised representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the supplier/his vendor's quality management and control activities.

8.2 Quality Assurance Documents

The supplier would be required to submit all the Quality Assurance Documents as stipulated in the Quality Plan at the time of POWERGRID/BHEL inspection of equipment/material

9.0 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

9.1 All equipment being supplied shall conform to type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective sections.

9.2 The reports for all type tests as per technical specification shall be furnished by the supplier alongwith equipment / material drawings. However, type test reports of similar equipments/ material already accepted in POWERGRID shall be applicable for all project with similar requirement. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by POWERGRID or representative authorized by POWERGRID or Utility or representative of accredited test lab or reputed consultant.

The test reports submitted shall be of the tests conducted within last 10 (ten) years prior to the date of bid opening i.e. 26.08.11. In case the test reports are of the test conducted earlier than 10 (ten) years prior to the date of bid opening, the contractor shall repeat these test(s) at no extra cost to BHEL.

However, in case of instrument transformers, the following type tests should have been conducted within 5 (five) years prior to the date of bid opening.

i) Lightning Impulse Test

ii) Switching ImpulseTest

iii) Multiple Chopped Impulse Test (For CT)

iv) Chopped Impulse Test (For CVT)

In case the test reports are of these tests (for instrument transformers) as mentioned above are conducted earlier than 5 (five) years prior to the date of bid opening i.e. 26.08.11, the contractor shall repeat these test(s) at no extra cost to the purchaser.

Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification or any/all type tests not carried out, same shall be

The supplier shall intimate the BHEL/POWERGRID the detailed program about the tests atleast two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

Further, in case type tests are required to be conducted/repeated and the deputation of Inspector/Purchaser's representative is required, then all the expenses shall be borne by the supplier.

9.3 The Purchaser intends to repeat the type tests on Power Transformer and Shunt Reactor except Dynamic short circuit tests on transformers, for which test charges shall be payable as per provision of contract. The price of conducting type tests shall be included in Bid price and break up of these shall be given in the relevant schedule of Bid Proposal Sheets. These Type test charges would be considered in bid evaluation. In case Bidder does not indicate charges for any of the type tests or does not mention the name of any test in the price schedules, it will be presumed that the particular test has been offered free of charge. Further, in case any Bidder indicates that he shall not carry out a particular test, his offer shall be considered incomplete and shall be liable to be rejected. BHEL/POWERGRID reserves the right to witness any or all the type tests. The BHEL/POWERGRID also reserves the right to waive the repeating of type tests partly or fully and in case of waival, test charges for the same shall not be payable.

The Purchaser shall bear all expenses for deputation of purchaser's representative(s) for witnessing the type tests under this clause except in the case of re-deputation if any, necessitated due to no fault of the purchaser.

For outdoor receptacles, trefoil clamps, diesel engine, alternator, motors, cable glands, lighting fixtures, ACSR/AAC conductor, IPS aluminum tube and junction boxes, type test reports are not required to be submitted for the makes indicated at Annexure-E /POWERGRID approved list of subvendors. For the new makes(other than those indicated at Annexure-E / POWERGRID approved list of subvendors), type test reports as per relevant standard shall be submitted for POWERGRID's approval.

9.4 The Purchaser, his duly authorised representative and/or outside inspection agency acting on behalf of the Purchaser shall have at all reasonable times free access to the Contractor's/sub-vendors premises or Works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the Works during its manufacture or erection if part of the Works is being manufactured or assembled at other premises or works, the Contractor shall obtain for the Engineer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. Inspection may be made at any stage of manufacture, despatch or at site at the option of the Purchaser and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

9.5 The supplier shall give the Purchaser /Inspector fifteen (15) days written notice for on-shore and six (6) weeks notice for off-shore material being ready for joint testing including contractor and POWERGRID. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Purchaser/inspector, unless witnessing of the tests is virtually waived, will attend

notified as being ready for test/inspection, failing which the Contractor may proceed alone with the test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of tests in triplicate.

9.6 The Purchaser or Inspector shall, within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Purchaser /Inspector giving reasons therein, that no modifications are necessary to comply with the Contract.

9.7 When the factory tests have been completed at the Contractor's or Sub- Contractor's works, the Purchaser/inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Purchaser /Inspector, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the Engineer/Inspector. Failure of the Purchaser /Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the Works. The completion of these tests or the issue of the certificate shall not bind the Purchaser to accept the equipment should, it, on further tests after erection, be found not to comply with the Contract. The equipment shall be dispatched to site only after approval of test reports and issuance of CIP by the Purchaser.

9.8 In all cases where the Contract provides for tests whether at the premises or at the works of the Contractor or of any Sub-Contractor, the Contractor except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Purchaser /Inspector or his authorised representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Purchaser /Inspector or to his authorised representative to accomplish testing.

9.9 The inspection by Purchaser and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract.

9.10 The Purchaser will have the right of having at his own expenses any other test(s)of reasonable nature carried out at Contractor's premises or at site or in any other place in addition of aforesaid type and routine tests, to satisfy that the material comply with the specification.

9.11 The Purchaser reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipments for these tests shall be provided by the Purchaser.

10.0 TESTS

10.1 Pre-commissioning Tests

On completion of erection of the equipment and before charging, each item of the

such tests with the equipment shall be thoroughly cleaned and then inspected jointly by the Purchaser and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The list of pre-commissioning tests to be performed are given in respective chapters and shall be included in the Contractor's quality assurance programme.

10.2 Commissioning Tests

10.2.1 The available instrumentation and control equipment will to be used during such tests and the Purchaser will calibrate, all such measuring equipment and devices as far as practicable.

10.2.2 Any special equipment, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.

10.2.3 The specific tests requirement on equipment have been brought out in the respective chapters of the technical specification.

10.3 The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning the equipment and the switchyard. However necessary fee shall be reimbursed by POWERGRID on production of requisite documents.

11.0 PACKAGING & PROTECTION

11.1 All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the Purchaser, the Contractor shall also submit packing details/associated drawing for any equipment/material under his scope of supply, to facilitate the Purchaser to repack any equipment/material at a later date, in case the need arises. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken into account. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. Purchaser takes no responsibility of the availability of the wagons.

11.2 All coated surfaces shall be protected against abrasion, impact, discolouration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

12.0 FINISHING OF METAL SURFACES

12.1 All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts & bolts and spring washers shall be electro galvanized to service condition 4.All steel conductors including those used for earthing/grounding (above ground level) shall also be galvanized according to IS:2629.

12.2 HOT DIP GALVANISING

12.2.1 The minimum weight of the zinc coating shall be 610 gm/sq.m and minimum average thickness of coating shall be 86 microns for all items

equipment having thickness 6mm and above. For steel lower than 6mm thickness equipment the requirement of coating thickness shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq. m minimum.

12.2.2 The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

12.2.3 After galvanizing. no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

12.2.4The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per IS-2633.

12.2.5 Sharp edges with radii less than 2.5 mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.

- Coating thickness
- Uniformity of zinc
- Adhesion test
- Mass of zinc coating

12.2.6 Galvanised material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

12.3 PAINTING

12.3.1All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS-6005 "Code of practice for phosphating iron and sheet". All surfaces, which will not be easily accessible after shop assembly, shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swaf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

12.3.2 After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.

12.3.3 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat

12.3.4 The exterior and interior colour of the paint in case of new substations shall preferably be RAL 7032 for all equipment, marshalling boxes, junction boxes, control cabinets, panels etc. unless specifically mentioned under respective sections of the equipments. Glossy white colour inside the equipments /boards/panels/junction boxes is also acceptable. The exterior colour for panels shall bematching with the existing panels in case of extension of a substation. Each coatof primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments.

12.3.5 In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc., the procedure shall be submitted alongwith the Bids for Purchaser's review & approval.

12.3.6 The colour scheme as given below shall be followed for Fire Protection and Air
Conditioning systems

S.No.	PIPE LINE	Base colour	Band colour
Fire Protection System			
1	Hydrant and Emulsifier system pipeline	FIRE RED	-
2	Emulsifier system detection line – water	FIRE RED	Sea Green
3	Emulsifier system detection line – Air	FIRE RED	Sky Blue
4	Pylon support pipes	FIRE RED	
Air Conditioning System			
5	Refrigerant gas pipeline – at compressor suction	Canary Yellow	-
6	Refrigerant gas pipeline – at compressor discharge	Canary Yellow	Red
7	Refrigerant liquid pipeline	Dark Admiralty Green	-
8	Chilled water pipeline	Sea Green	-
9	Condenser water pipeline	Sea Green	Dark Blue

12.3.7 For aluminium casted surfaces, the surface shall be with smooth finish. Further, in case of aluminium enclosures the surface shall be coated with powder (coating thickness of 60 microns) after surface preparation for painting.

13.0 HANDLING, STORING AND INSTALLATION

13.1 In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Purchaser or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented. Commercial use of switchyard equipment means completion of all site tests specified and energisation at rated voltage.

13.2 Contractor may engage manufacturer's Engineers to supervise the unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions ofthe manufacturer's supervisory Engineer(s) and shall extend full cooperation to them.

13.3 The contractor shall have to ensure that the hard and flat indoor and outdoor storage areas are in place prior to commencement of delivery of material at site. Contractor shall also ensure availability of proper unloading and material handling equipment like cranes etc. and polyester/nylon ropes of suitable capacity to avoid damage during unloading and handling of material at site. All indoor equipments shall be stored indoors. Outdoor equipment may be stored outdoors but on a hard and flat raised area properly covered with waterproof and dustproof covers to protect them from water seepage and moisture ingress. However, all associated control panels, marshalling boxes operating boxes etc. of outdoor equipments are to be stored indoors only.Storage of equipment on top of another one is not permitted if the wooden packing is used. Material opened for joint inspection shall be repacked properly as per manufacturer's recommendations.During storage of material regular periodic monitoring of important parameters like oil level / leakage, SF6 / Nitrogen pressure etc. shall be ensured by the contractor.

13.4 In case of any doubt/misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the Purchaser. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/instructions correctly.

13.5 Where assemblies are supplied in more than one section, Contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses.Contractor shall also do necessary adjustments/alignments necessary for properoperation of circuit breakers,isolators and their operating mechanisms. All components shall beprotected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.

13.6 Supplier shall be responsible for examining all the shipment and notify the Purchaser immediately of any damage, shortage, discrepancy etc. for the purpose of Purchaser's information only. The Contractor shall submit to the Purchaser every week a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.

13.7 The supllier shall be fully responsible for the equipment/material until the same is handed over to the Purchaser in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the equipment/material while in storage as well as after erection until taken over by Purchaser, as well as protection of the same against theft, element of nature,

13.8 Where material / equipment is unloaded by Purchaser before the Contractor arrives at site or even when he is at site, Purchaser by right can hand over the same to Contractor and there upon it will be the responsibility of Contractor to store the material in an orderly and proper manner.

13.9 The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment which requires indoor storage.

13.10 The words 'erection' and 'installation' used in the specification are synonymous.

13.11 Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.

13.12 Equipment Bases

A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base unless otherwise agreed to by the Purchaser. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.

14.0 TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipment. However, these tools and tackles shall be separately, packed and brought on to Site.

15.0 AUXILIARY SUPPLY

15.1 The sub-station auxiliary supply is normally met through a system indicated under section "Electrical & Mechanical Auxiliaries" having the following parameters. The auxiliary power for station supply, including the equipment drive, cooling system of any equipment, air-conditioning, lighting etc shall be designed for the specified Parameters as under. The DC supply for the instrumentation and PLCC system shall also conform the parameters as indicated in the following.

Normal Voltage	Variation in Voltage	Frequency in HZ	Phase/Wire	Neutral connection
415V	± 10%	50 ± 5%	3/4 Wire	Solidly Earthed.
240V	± 10%	50 ± 5%	1/2 Wire	Solidly Earthed.
220V	190V to 240V	DC	-	Isolated 2 wire System
48V	_	DC	_	2 wire system (+) earthed

Combined variation of voltage and frequency shall be limited to ± 10%.

16.0 SUPPORT STRUCTURE (If in the scope of supplier)

16.1 The equipment support structures shall be suitable for equipment connections at the first level i.e 14.0 meter, 8.0 meter and 5.9 meter from plinth level for 765 kV,420 kV and 245 kV substations respectively. All equipment support structures shall be supplied alongwith brackets, angles, stools etc. for attaching

corrosion. the operating mechanism, control cabinets & marshalling box (wherever applicable) etc.

16.2 Support structure shall meet the following mandatory requirements:

16.2.1 The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or supporting insulators to the bottom of the equipment base, where it rests on the foundation pad shall be 2.55 metres.

17.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

17.1 All power clamps and connectors shall conform to IS:5561 & NEMA CC1 and shall be made of materials listed below :

a)	For connecting ACSR conductors	Aluminum alloy casting, conforming to designation A6 of IS:617 and all test shall conform to IS:617
b)	For connecting equipment ter-minals made of copper with ACSR conductors	Bimetallic connectors made from aluminum alloy casting, conforming to designation A6 of IS:617 with 2mm thick bimetallic liner and all test shall conform to IS:617
c)	For connecting G.I	Galvanised mild steel shield
d)	i) Bolts, nuts & Plain, washers	i) Electrogalvanised for sizes below M12, for others hot dip galvanised.
	ii) Spring washers items 'a' to 'c'	ii) Electro-galvanised mild for steel suitable for atleast service condition-3 as per IS:1573

17.2 Necessary clamps and connectors shall be supplied for all equipment and connections.The requirement regarding external corona and RIV as specified for any equipment shall include its terminal fittings. If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of work.

17.3 Where copper to aluminum connections are required, bi-metallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current carrying or subjected to stress.

17.4 Low voltage connectors, grounding connectors and accessories for grounding allequipment as specified in each particular case, are also included in the scope of Work.

17.5 No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanised. Copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminum body or 2 mm thick bi-metallic strips shall be provided for Bi-metallic clamps.

17.6 All casting shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

17.7 Flexible connectors, braids or laminated straps made for the terminal clamps for bus posts shall be suitable for both expansion or through

(fixed/sliding) type connection as required. In both the cases the clamp height (topof the mounting pad to centre line of the tube) should be same.

17.8 Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified ambient temperature. The rated current for which the clamp/connector is designed with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on the hardware.

17.9 All current carrying parts shall be designed and manufactured to have minimum contact resistance.

17.10 Clamps and connectors shall be designed to be corona controlled.

17.11 Tests

17.11.1 Clamps and connectors should be type tested as per IS:5561 and shall also be subjected to routine tests as per IS:5561. Following type test reports shall be submitted for approval as per clause 9.2 above except for sl. no.(ii) & (iii) for which type test once conducted shall be applicable (i.e. the requirement of test conducted within last ten years shall not be applicable).

i) Temperature rise test (maximum temperature rise allowed is 35°C over 50°C ambient)

ii) Short time current test

iii) Corona (dry) and RIV (dry) test (for 220 KV and above voltage level clamps)

iv) Resistance test and tensile test

18.0 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT

18.1 All types of boxes, cabinets etc. shall generally conform to & be tested in accordance with IS-5039/IS-8623, IEC-60439, as applicable, and the clauses given below:

18.2 Control cabinets, junction boxes, Marshalling boxes & terminal boxes shall be made of sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be atleast 2.0 mm thick cold rolled or 2.5 mm hot rolled or alternately 1.6 mm thick stainless steel can also be used. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminum enclosed box the thickness of aluminum shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.

18.3 A canopy and sealing arrangements for operating rods shall be provided inmarshalling boxes / Control cabinets to prevent ingress of rain water.

18.4 Cabinet/boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of the gasket shall be such that it does not get damaged/cracked

(fixed/sliding) during the operation of the equipment as required. In both the (fixed/sliding)
cases the clamp height

18.5 All doors, removable covers and plates shall be gasketed all around with suitably profiled EPDM/Neoprene gaskets. The gasket shall be tested in accordance with approved quality plan, IS:11149 and IS:3400. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

18.6 All boxes/cabinets shall be designed for the entry of cables from bottom by meanof weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. Gland plate shall have provision for some future glands to be provided later, if required. The Nickel plated glands shall be dust proof, screw on & double compression type and made of brass. The gland shall have provision for securing armour of the cable separately and shall be provided with earthing tag. The glands shall conform to BS:6121.

18.7 A 240V, single phase, 50 Hz, 15 amp AC plug and socket shall be provided in the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.

18.8 For illumination, a fluorescent tube or CFL of approximately 9 to 15 watts shall be provided. The switching of the fittings shall be controlled by the door switch. .

For junction boxes of smaller sizes such as lighting junction box, manual operated earth switch mechanism box etc., plug socket, heater and illumination is not required to be provided.

18.9 All control switches shall be of MCB/rotary switch type and Toggle/piano switches shall not be accepted.

18.10 Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire shall be terminated on to the earthing pad and secured by the use of self etching washer. Earthing of hinged door shall be done by using a separate earth wire.

18.11 The bay marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/feruling by pasting the same on the inside of the door.

18.12 a) The following routine tests alongwith the routine tests as per IS:5039 shall also be conducted:

i) Check for wiring

ii) Visual and dimension check

b) The enclosure of bay marshalling kiosk, junction box, terminal box shall conform to IP-55 as per IS:13947 including application of, 2.5 KV rms for 1
(one) minute, insulation resistance and functional test after IP-55 test.

19.0 Deleted.

20.0 TERMINAL BLOCKS AND WIRING

20.1 Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All interphase and external connections to equipment or to control cubicles will be made through terminal blocks.

20.2 Terminal blocks shall be 650V grade and have continuous rating to carry the maximum expected current on the terminals and non breakable type. These shall be of moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-disconnecting stud type of Elmex or Phoenix or Wago or equivalent make.

20.3 Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.

20.4 The terminal shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally.

20.5 The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable.

20.6 The terminal blocks shall be of extensible design.

20.7 The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

20.8 The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.

20.9 Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

a)	All circuits except CT/PT circuits	Minimum of two of 2.5 sq copper flexible.
b)	All CT/PT circuits	Minimum of 4 nos. of 2.5 sq copper flexible.

20.10 The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live.

20.11 Atleast 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

20.12 There shall be a minimum clearance of 250 mm between the First/bottom row of terminal block and the associated cable gland plate for outdoor ground mounted marshalling box and the clearance between two rows of terminal blocks shall be a minimum of 150 mm.

20.13 The supplier shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets. For equipments rated for 400 kV and above the wiring required in these items shall be run in metallic ducts or shielded cables in order to avoid surge overvoltages either transferred through the equipment or due to transients induced from the EHV circuits.

20.14 All input and output terminals of each control cubicle shall be tested for

surgewithstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The Contractor shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

21.0 LAMPS & SOCKETS

21.1 Sockets

All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

21.2 Hand Lamp:

A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF Switch for connection of hand lamps.

21.3 Switches and Fuses:

21.3.1 Each panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breaker / switchfuse units. Selection of the main and Sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

21.3.2 All fuses shall be of HRC cartridge type conforming to IS:9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage.

22.0 Bushings, Hollow Column Insulators, Support Insulators:

22.1 Bushings shall be manufactured and tested in accordance with IS:2099 & IEC- 60137 while hollow column insulators shall be manufactured and tested in accordance with IEC-62155/IS:5621.The support insulators shall be manufactured and tested as per IS:2544/IEC-60168 and IEC-60273. The insulators shall also conform to IEC-60815 as applicable.The bidder may also offer composite hollow insulators, conforming to IEC-61462.

22.2 Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain Porcelain used shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.

22.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.

22.4 Support insulators/bushings/hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

22.5 When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be

surgewithstand capability in accordance with the relevant IEC Publications caused by the insulators/bushings when operating at the normal rated voltage.

22.6 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

22.7 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued up porcelain parts by grinding and metal parts by machining. Insulator/bushing design shall be such as to ensure a uniform compressive pressure on the joints.

22.8 Tests

In bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS: 2099 & IS:2544 & IS : 5621.

23.0 MOTORS

Motors shall be "Squirrel Cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and shall be subjected to routine tests as per applicable standards. The motors shall be of approved make.

23.1 Enclosures

a) Motors to be installed outdoor without enclosure shall have hose proof enclosure equivalent to IP-55 as per IS: 4691. For motors to be installed indoor i.e. inside a box, the motor enclosure, shall be dust proof equivalent to IP-44 as per IS: 4691.

b) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.

c) Motors shall have drain plugs so located that they will drain water resulting from condensation or other causes from all pockets in the motor casing.

d) Motors weighing more than 25 Kg. shall be provided with eyebolts, lugs or other means to facilitate lifting.

23.2 Operational Features

a) Continuous motor rating (name plate rating) shall be at least ten (10) percent above the maximum load demand of the driven equipment at design duty point and the motor shall not be over loaded at any operating point of driven equipment that will rise in service.

b) Motor shall be capable at giving rated output without reduction in the expected life span when operated continuously in the system having the particulars as given in Clause 15.0 of this Section.

23.3 Starting Requirements:

a) All induction motors shall be suitable for full voltage direct-on-line starting. These shall be capable of starting and accelerating to the rated speed alongwith the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops

d capability in accordance with the relevant IEC Publication caused by the insulation for 30% of the rated voltage. The normal rated voltage.

b) Motors shall be capable of withstanding the electrodynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.

c) The locked rotor current shall not exceed six (6) times the rated full load current for all motors, subject to tolerance as given in IS:325.

d) Motors when started with the driven equipment imposing full starting torque under the supply voltage conditions specified under Clause 15.0 shall be capable of withstanding atleast two successive starts from cold condition at room temperature and one start from hot condition without injurious heating of winding. The motors shall also be suitable for three equally spread starts per hour under the above referred supply condition.

e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than starting time with the driven equipment of minimum permissible voltage by at least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the Bidder shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speed lower than 20% and open for speeds above 20% of the rated speed. The speed switch shall be capable of withstanding 120% of the rated speed in either direction of rotation.

23.4 Running Requirements:

a) The maximum permissible temperature rise over the ambient temperature of 50 degree C shall be within the limits specified in IS:325 (for 3 - phase induction motors) after adjustment due to increased ambient temperature specified.

b) The double amplitude of motor vibration shall be within the limits specified in IS: 4729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.

c) All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes with rated load commencing from hot condition.

23.5 TESTING AND COMMISSIONING

An indicative list of tests is given below. Contractor shall perform any additional test based on specialities of the items as per the field Q.P./Instructions of the equipment Contractor or Purchaser without any extra cost to the Purchaser. The Contractor shall arrange all instruments required for conducting these tests alongwith calibration certificates and shall furnish the list of instruments to the Purchaser for approval.

(a) Insulation resistance.

(b) Phase sequence and proper direction of rotation.

(c) Any motor operating incorrectly shall be checked to determine the cause and the conditions corrected.

be insulated to 80% of the rated voltage the norma

ANNEXURE-A

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1. General

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for external corona (for 400kV & above) both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage (RIV) for 132kV and above.

2. Test Levels:

The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

3. Test Methods for RIV:

3.1 RIV tests shall be made according to measuring circuit as per International Special-Committee on Radio Interference (CISPR) Publication 16-1(1993) Part -1. The measuring circuit shall preferably be tuned to frequency with 10% of 0.5 Mhz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts.

3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107-1964, except otherwise noted herein.

3.3 In measurement of, RIV, temporary additional external corona shielding may be provided. In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, and 110% of the specified RIV test voltage for all equipment unless otherwise specified.The specified RIV test voltage for 765kV, 400 kV, 220 KV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

3.5 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a noise meter. A calibration procedure
of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to voltage read by noisel meter.

4. Test Methods for Visible Corona

90% of the rated voltage / the normal rated voltage.

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 110% of specified corona extinction voltage and maintained there for five minutes. In case corona inception does not take place at 110%, test shall be stopped, otherwise test shall be continued and the voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e. 85%, 100%, and 110%. Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f/5.6 or equivalent. The photographic process shall be such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connector so as to show corona on bushing, insulators and all parts of energised connectors. The photographs shall be framed such that test object essentially, fills the frame with no cut-off.

For recording purpose, modern devices utilizing UV recording methods such as image intensifier may also be used.

4.1 The test shall be recorded on each photograph. Additional photograph shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence.

4.2 In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Purchaser's inspector, after determining the best camera locations by trial energisation of test object at a voltage which results in corona.

4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.

4.4 However, both test shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of Purchaser's inspector if, in his opinion, it will not prejudice other test.

5. Test Records:

In addition to the information previously mentioned and the requirements specified as per CISPR or NEMA 107-1964 the following data shall be included in test report:

a) Background noise before and after test.

b) Detailed procedure of application of test voltage.

c) Measurements of RIV levels expressed in micro volts at each level.

d) Results and observations with regard to location and type of interference sources detected at each step.

e) Test voltage shall be recorded when measured RIV passes through 100microvolts in each direction.

f) Onset and extinction of visual corona for each of the four tests required shall be recorded.

5. **Test Records:**

ANNEXURE-B

SEISMIC WITHSTAND TEST PROCEDURE

The seismic withstanding test on the complete equipment (for 132kV and above)shall be carried out along with supporting structure.

The Bidder shall arrange to transport the structure from his Contractor's premises/POWERGRID sites for the purpose of seismic withstand test only.The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the Terminal Pad of the equipment and any other point as agreed by the Purchaser. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the POWERGRID.

Annexure- E

LIST OF THE MAKES FOR WHICH TYPE TEST REPORTS NOT REQUIRED TO BE SUBMITTED

S.No.	ITEM DESCRIPTION	MAKE
1.	Out door receptacles	CGL/ B&C / BCH / Sakti, Chennai /Indo Asian
2.	Trefoil clamp	Moulded Fibre Glass Products, Calcutta
3.	Diesel Engine	Cummins / Ruston & Hornsby
4.	Alternator	AVK / KIRLOSKAR / STAMFORD
5.	Motors	KEC / Siemens/ NGEF/Crompton/ABB
6.	Cable Glands	Sunil & Co. / Arup/ Comet / QPIE
7.	Junction Box	Sarvana / ECS / C&S /Vikas/ Maktel/Unilac/Jasper/ Amara raja
8.	Lighting Fixtures	Phillips/CGL/Bajaj
9.	ACSR Conductor (Bersimis/ Moose/ Zebra)	Sterlite/Apar/HVPL/ Sharavathy/Hiren Aluminium Ltd./Smita/Deepak Cables/Polycab wires/Cabcon
11.	AAC Conductor (BULL)	Sterlite/Cabcon
12	G.S. Earthwire	Sharavathy/Bharat Wire Ropes/Ramswarup

NOTE : For a new make other than above/POWERGRID approved list of sub vendor, type test reports as per relevant standard shall be submitted for Purchaser's approval.

SECTION-IV

GUARANTEED AND TECHNICAL PARTICULARS FOR ISOLATORS AND ISOLATOR-CUM-EARTHING SWITCHES

ISOLATORS / GROUNDING SWITCHES

1. General

a) Name of the Manufacturer

b) Country of Manufacturer

c) Manufacturer's type designation

d) Standard applicable for isolators and earthing switches

e) Rated Voltage Ur (KV)

f) Rated Current Under site conditions (A) at 50° C ambient

g) Rated frequency (Hz)

h) Number of poles

I) Whether all 3 poles are ganged mechanically

j) Phase to phase spacing

k) Type of installation

2. Guaranteed Ratings

a) Rated short time current of isolator for IS (KA) and dynamic current (KAP)

b) Opening time of isolator and earth switch (s)

c) Closing time of isolator

d) Temperature rise over 50° C ambient temperature corresponding to maximum continuous current (°C)

3. Dielectric withstand capacity of completely assembled isolator/isolator and earth switch

a) One minute dry power freq. Withstand test voltage(KV rms)

i. against ground (KV rms)

ii. Across isolating distance (KV rms.)

b) 1.2/50 micro's impulse withstand test voltage

i. Against ground (KVP)

ii. Across isolating distance (KVP)

c) 250/2500 micro sec. switching surge withstand test voltage (dry & wet)

i. Against ground (KVP)

ii. Across isolating distance (KVP)

d) Corona extinction voltage (KV rms)

e) Radio interference level at 1.1 Ur/_/3 (in micro volts at 1.0 MHz)

f) Total creepage distance to ground (mm)

4. Operating Mechanism

A) For Main Blades

a) Type of motor operating/manually driven mechanism

b) Manufacture's Type designation

c) Rated torque of the mechanism (Kg-m)

d) Type and rating of motor

B) For Earth Switches

a) Type of motor operating /manually driven mechanism

b) Manufacturer's type mechanism

c) Rated torque of the mechanism

d) Type and rating of motor

4.1. Interlocks

a) Whether mechanical/constructional interlock between isolator & earth switch provided

b) Details of electrical interlock enclosed for

i. Isolator

ii. Earth switch

c) Arrangement provided to prevent electrical or manual operation unless interlock conditions are satisfied

d) Whether interlock coil is continuously rated

e) Rated DC control voltage and variation allowed

f) Power consumption (W)

4.2. Controls

a) Rated DC control voltage (V)

b) Limits of voltage

c) Power consumption of control coils (W)

5. Constructional Features

a) Minimum clearance in air

i. Between phases (mm)

ii. Between live parts to earth (mm)

iii. Distance between terminals of same phase (mm)

b) Whether position of earth switch can be interchanged at site to either side of pole

c) Minimum clearance between live part and earth switch blade throughout the entire operation arc of earth switch (mm)

d) Terminal pad details

i. Diameter & length

ii. Material of pad

e) Insulator data

i. Height

ii. Type

iii. No. of insulator Stacks/phase

iv. No. of insulators/ Stacks

f) Main contacts

i. Type of contacts

ii. Contact area (cm^2)

iii. Material of contacts

iv. Contact pressure (Kg/cm2)

v Maximum current density under normal current carrying capacity (A/cm2)

vi. Thickness of silver plating

g) Number of auxiliary contacts on isolator/ pole for Owner's use

h) Number of auxiliary contacts on earth switch/pole for Owner's use

l) Auxilary contacts

i. Rated voltage (V)

ii. Rated continuous Current (A)

iii. Rated DC breakin current with 20 rms time constant (A)

j) Mounting dimensions isolators

i. Distance between supports

ii. Top dimensions o support

k) Height from mounting plane to top of terminal stud

l) Whether cable glands required included in the scope for inter pole cabling to be done bythe Owner

6. Literature

a) Type test reports as per IEC 129

b) OGA drawings for isolator with & without earth switches

c) Operation manual for isolators

d) Details of motor operating/manually driven mechanism

e) Recommended drawing for mounting details for isolator and drives

f) Details of constructional interlock

Additional data to be filled in for Pantograph Isolators

1. Limits of contact zone for Pantograph isolators

   i. Horizontal deflection (mm)

   ii. Vertical deflection (mm)

   iii. Longitudinal (mm)

CONTROL CABINETS

1. Manufacturer's Name

2. Indoor/Outdoor application

3. Design ambient air temp (° C)

4. Standards applicable

5. Thickness of sheet steel (mm) and whether cold rolled or hot rolled

6. Degree of protection provided

7. Bill of material for all the equipment mounted on control cabinet giving the following details :

   a) Make and type

   b) Applicable Standard

   c) Voltage rating

   d) Current rating

   e) Duty class, if applicable

   f) Manufacturer's Catalogue No

   g) Total heat load of cabinet (for purpose of ventilation requirement)

8. Colour of finish paint IS : 5

   a) Outside

   b) Inside

9. Control Wiring

a) Size of Conductor

i) for CT circuits
ii) for other circuits

b) Conductor Solid/Stranded

c) Number of Strands / conductor

10. Terminal Blocks

a) Make & type

b) Current rating

i) Power terminals (A)

ii) Other terminals (A)

11. Space Heater Rating at 240 V AC

12. Control cabinet drawing showing the following

a) Outline dimensions floor openings floor/ wall/pedestal fixing arrangements weights etc.

b) Front view, inside view showing the mounting arrangement of various equipment

13. Schematic/wiring diagram of control cabinet enclosed

14. Interconnection drawing showing Owner's external cable, connections to the control cabinet enclosed

15. Type test report to verify degree of protection enclosed.

16. Details of terminal rows :

i) Whether arranged vertical or horizontal

ii) Clearance from adjacent components

iii) Distance between rows

iv) Whether transparent protection cover provided

SECTION V

TECHNICAL CHECK LIST FOR ISOLATORS / EARTHING SWITCHES

(INFORMATION TO BE FURNISHED WITH OFFER)

BIDDERS ARE INSTRUCTED TO

WRITE **'YES'** UNDER CLOUMN '2', IF THE INFORMATION / SCHEDULE IS FURNISHED / ENCLOSED WITH THE OFFER, **OR**
WRITE **'NO'** UNDER CLOUMN '2', IF THE INFORMATION / SCHEDULE IS NOT FURNISHED / ENCLOSED WITH THE OFFER, **OR**
WRITE **'NOT APPLICABLE (NA)'** UNDER CLOUMN '2', IF THE INFORMATION / QUERY / SCHEDULE IS NOT RELEVANT TO THEM, **AND**

RETURN THIS CHECKLIST AS THE PART OF THE OFFER DULY SIGNED BY THEM.

	ISOLATORS / GROUNDING SWITCHES	1	2	3
S.No.		Specified Requirement	Confirmation Yes/No	Comments, if Col.2 is No
1.	Rated Voltage (KV)	400kV/66kV/36kV		
2.	Type of Isolator	HDB		
3.	Equipment mounting	Structure (400kV & 66kV)/ Mounting on double pole structure (33kV)		
4.	Standard applicable for isolators and earthing switches	IEC:62271-102 (2001-12), IS:9921-1985		
5.	Rated Current Under site conditions (A) at 50° C ambient-	3150A FOR 400kV/ 630A for 66kV & 33kV		
6.	Rated short time withstand Current of Isolator and Earth switch for 1 Sec	50kA (400kV)/25kA for 3s for 66kV & 33kV		
7.	Rated dynamic short circuit withstand Current of Isolator and Earth switch	125kAp for 400kV		
8.	Rated frequency (Hz)	50		
9.	Number of poles	3		
10.	Phase to phase spacing(mm)	6000(400kV)/2000 (66kV)/1500(33kV)		
11.	Whether all 3 poles are ganged	Electrically (400kV)/mechanicall		

SECTION V

TECHNICAL CHECK LIST FOR ISOLATORS / EARTHING SWITCHES

	ISOLATORS / GROUNDING SWITCHES	1	2	3
S.No.		Specified Requirement	Confirmation Yes/No	Comments, if Col.2 is No
		y (66kV & 33kV)		
12.	Opening time of isolator and earth switch (Sec.)	Less than 20		
13.	Closing time of isolator (Sec.)	Less than 20		
14.	Temperature rise over 50° C ambient temperature corresponding to maximum continuous current (°C)	As per table V of IEC-694		
15.	Seismic Acceleration	0.3 g		
16	Dielectric withstand capacity of completely assembled isolator/isolator and earth switch for 400kV Isolator			
16.1	One minute dry &wet power freq. Withstand test voltage(KV rms)			
	i. against ground (KV rms)	520		
	ii. Across isolating distance (KV rms.)	610		
16.2	1.2/50 micro's impulse withstand test voltage (For 400kV Isolator)			
	i. Against ground (KVP)	±1425		
	ii. Across isolating distance (KVP) -	±1425kVp impulse on one terminal and 240kVp Power frequency voltage of opposite polarity on other terminal		
16.3	250/2500 micro sec. switching surge withstand test voltage (dry & wet)			
	i. Against ground (KVP) -	±1050		
	ii. Across isolating distance (KVP)	900kVp impulse on		

SECTION V

TECHNICAL CHECK LIST FOR ISOLATORS / EARTHING SWITCHES

	ISOLATORS / GROUNDING SWITCHES	1	2	3
S.No.		Specified Requirement	Confirmation Yes/No	Comments, if Col.2 is No
		one terminal and 345kVp Power frequency voltage of opposite freq. voltage on other terminal		
17	Corona extinction voltage (KV rms) –	320		
18.	Total creepage distance to ground (mm) – (25 mm/kV)	10500(400kV)/1813(66kV) /900(33kV)		
19.	Operating Mechanism for Isolator	Motor (400kV & 66kV)/Manual (33kV)		
20.	Operating Mechanism for Earth Switches	Motor(400kV)/Manual (66kV & 33kV)		
21.	Whether constructional interlock between Isolator & Earth switch provided	YES		
22.	Whether interlock between Isolator & Earth switch provided	Mechanical & Electrical		
23.	Arrangement provided to prevent electrical or manual operation unless interlock conditions are satisfied	YES		
24.	Rated Mechanical Terminal Load	As per Table -3 of IEC-62271-102		
25.	Whether interlock coil is continuously rated	YES		
26.	Rated DC control voltage and variation allowed	220V DC		
27.	Material of contacts	Hard drawn electrolytic copper		

SECTION V

TECHNICAL CHECK LIST FOR ISOLATORS / EARTHING SWITCHES

	ISOLATORS / GROUNDING SWITCHES	1	2	3
S.No.		Specified Requirement	Confirmation Yes/No	Comments, if Col.2 is No
28.	Number of auxiliary contacts on isolator/pole for Owner's use	14NO + 14 NC +4MBB		
29.	Number of auxiliary contacts on earth switch/pole for Owner's use	12 NO + 12NC +4MBB		
30.	Rating of Auxiliary contacts	10 A at 220 V DC		
31.	Rated DC breaking current of Auxiliary contacts with 20 ms time constant (A)	2 A		
33	Material of Current carrying parts	Aluminium/ Copper		
34	Insulator Cantilever strength (BHEL's scope)	1000kG		
35	Bottom PCD of Insulators	325mm		
36.	Top PCD of Insulators	127mm		
37	Capability of Isolator for making and breaking the magnetizing/capacitive currents	0.7 A at 0.15 power factor		
38	All valid Type test reports(as per IEC 129) not older than 10 years, available	Yes, available		
39	Induced current switching duty for class B and short ckt making capability class E-0 for earthing switches as per IEC 62271-102	Yes, available		
	List of special Tools & Tackle	Yes /NA		
	CONTROL CABINETS			
40	Application	Outdoor		
41	Degree of protection provided	IP55		
42.	Standard applicable for control cabinet	IS-5093/IS-8623, IEC-439		
43	20 % Spare Terminal Blocks provided in control cabinet	YES		

SECTION V

TECHNICAL CHECK LIST FOR ISOLATORS / EARTHING SWITCHES

	ISOLATORS / GROUNDING SWITCHES	1	2	3
S.No.		Specified Requirement	Confirmation Yes/No	Comments, if Col.2 is No
	General			
44	Powergrid standard approval on 400kV/72.5kV/33kV Isolator drawings	YES		
45	Powergrid standard Type test approval for 400kV/72.5kV/33kV Isolators with validity as on 28.04.14.	YES		
46	MQP approval from Powergrid with validity	YES		
47	Conduction of type test (if any)	Free of cost/chargeable		
48	Fixing hardware of Isolators and MOM box on structure	Included		

Date:
Place:

(Signature of the authorized representative of Bidder / Firm / Company)
Name:
Designation:
Company Seal:

Phone:
Fax:
E-mail:
Mobile:
Website: