



**BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS GROUP
ENGINEERING MANAGEMENT, NOIDA, SECTOR-142**

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Title			Date	Date		Date
420 kV HDB DISCONNECTOR						
			Group	TBEM		
CUSTOMER: TELANGANA STATE POWER GENERATION CORPORATION LTD.						
PROJECT: 5x800 MW YADADRI TPS – 400 kV SWITCHYARD						
LOI NO: ED/TPC/SE-III/YADADRI TPS(5X800MW)/D.No. 102/17, Dated: 17/10/2017						
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SECTION 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of disconnect switch complete with accessories as listed under this specification.

This section covers the specific technical requirements of disconnect switch. This constitutes minimum technical parameters for the above item as specified by the customer (TSGENCO). The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification.

The specification comprise of following sections:

Section-1: Scope, Specific Technical Requirements & Quantities

Section-2: Equipment Specification

Section-3: General Technical Requirements

In case of any conflict between various sections, order of precedence shall be in the same order as listed above.

1.1 THE EQUIPMENT IS REQUIRED FOR THE FOLLOWING PROJECT

Name of customer : Telangana State Power Generation Corp. Ltd.

Name of the project : 400 kV Switchyard at 5X800MW Yadadri TPS

Refer Section - 3 for Project Details and General Specifications.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

Technical Particulars

Technical parameters	Units	400 kV
Installation		Outdoor
Nominal Voltage	kV	400
Highest Voltage	kV	420
Rated Current at 50°C ambient temperature	A	3150
Short time withstand current of isolator and earth switch	kA	63 for 1 sec.
Dynamic Short time withstand current of isolator and earth switch	kAp	157.5
Rated Frequency	Hz	50
Type		Horizontal Double break
Operating mechanism of isolator and earth switch		AC motor operated
Mounting arrangement		Lattice Structure mounted.
Phase to phase spacing	mm	7000
Center-line of bus bar for equipment connection from the base of support structure (plinth level)	mm	8000
Rated Impulse withstand voltage (Dry & Wet)		
- To earth	kV _p	± 1425

Technical parameters	Units	400 kV
- Across open Isolator	kV _p	± 1425 impulse on one terminal and 240kV _p Power frequency voltage of opposite polarity on other terminal(across isolating distance)
Switching surge withstand voltage (Dry & Wet) to earth	kV _p	±1050
Switching surge withstand voltage (Dry & Wet) across open terminals of Isolator	kV _p	± 900 impulse on one terminal and 345 kV _p p. f. voltage of opposite polarity on other terminal(across isolating distance)
Switching surge withstand voltage between phases	kV _p	±1575
One minute power frequency withstand voltage	kV _{rms}	
- To earth		520
- Across open terminals of Isolator		610
Min. Corona extinction voltage	kV _{rms}	320
Rated mechanical terminal load		As per Table III of IEC 62271-102 or calculated value whichever is higher
Isolator arm/blade Material		Aluminium
Main contact		Silver plated copper alloy
Minimum Silver coating on Main Contacts		25 microns
Rated magnetizing current/ capacitive current make and break capacity	A	0.5
Max. Radio Interference Voltage for frequency between 0.5 & 2 MHz (both for open and closed condition):	μV	1000 at 266 kV rms
Total operating time of isolators	sec	Not more than 12 sec
No. of Auxiliary Contacts		14 NO + 14NC + 2MBB for main switch 14 NO + 14 NC for E/S wired to TB in addition to those required for Equipment scheme.
Rated current of aux. Contacts	A	10 at 220 V DC
Breaking capacity of aux. Contacts	A	2 A DC with circuit time constant of not less than 20 ms. At 220 V DC
No. of terminals in control cabinet		All contacts and control circuits are to be wired upto control cabinet plus 24 spare terminals.
Electrical Interlocking contactor for Isolator and Earth switch		Required
Spare way for "Local Mode" and "Remote Mode" of Local/ Remote switch for its use in SAS (Sub Automation System) wired till TBs		Required
Type of TBs (For terminating Aux Power, Aux contacts etc)		Stud Type
Seismic acceleration		0.3 g
Mechanical and electrical safety interlocking to prevent closing of		Required

Technical parameters	Units	400 kV
disconnecter when main earth switch is closed and vice versa.		
Earth switch shall be provided with flexible copper braids for connection to earth terminal.		Required
Isolators arm/blades shall be of Aluminium and contacts shall be made of Copper		Required
Endurance class of Isolators.		M2
Endurance class of Earth switch		M0
The temperature rise over design ambient		As per Table 3 of IEC 62271-1
PROPOSED INSULATOR (Not in vendor scope of supply)		(As per attached drawing)
AUXILIARY SUPPLY		
AC supply for motors		415V $\pm$ 10%, 3- ϕ , 50Hz $\pm$ 5%, 4 wire
AC supply for heaters		240V, 1- ϕ , 50Hz, 2 wire
DC supply for interlocking		220V DC (85%-110%), 2 wire
Weight of zinc coating for galvanized items except Hardware	g/m ²	610
Degree of protection for operating Mechanism box		IP55

1.3 BILL OF QUANTITIES

A) MAIN QUANTITY

Sl. No.	Description	Quantity (Nos.)
1.	400KV, 3150A, 63KA FOR 1S, THREE PHASE, HORIZONTAL DOUBLE BREAK (HDB) TYPE ISOLATOR INDIVIDUAL POLE MOTOR OPERATED, ELECTRICALLY GANGED WITH ONE EARTH SWITCH, INDIVIDUAL POLE MOTOR OPERATED, ELECTRICALLY GANGED, ALONG WITH OPERATING MECHANISM & OTHER ACCESSORIES, BUT WITHOUT INSULATOR, STRUCTURE & TERMINAL CONNECTOR	96 Nos.
2.	400KV, 3150A, 63KA FOR 1S, THREE PHASE, HORIZONTAL DOUBLE BREAK (HDB) TYPE ISOLATOR INDIVIDUAL POLE MOTOR OPERATED, ELECTRICALLY GANGED WITH TWO EARTH SWITCH, INDIVIDUAL POLE MOTOR OPERATED, ELECTRICALLY GANGED, ALONG WITH OPERATING MECHANISM & OTHER ACCESSORIES, BUT WITHOUT INSULATOR, STRUCTURE & TERMINAL CONNECTOR ETC.	04 Nos.
3.	SUPERVISION OF ERECTION TESTING AND COMMISSIONING INCLUDING ALIGNMENT CHECK OF 400KV HORIZONTAL DOUBLE BREAK (HDB) TYPE ISOLATOR & EARTHSWITCH	01 Lot

Note: 1. Total qty. of BOQ may vary from -10% to +10%.
2. Erection, testing and commissioning of one no. 400kV Isolator with earth switches shall be carried out under the supervision of the Isolator manufacturer's representative. The commissioning report shall be prepared and signed by the manufacturer's representative. However required unskilled men power/labour, tools (other than special tools and tackles which shall be in bidder's scope) shall be provided by BHEL.

Note:2 ACCESSORIES REQUIRED

Support Insulators	:	No
HV Power Connectors	:	No
Mounting structure for isolators	:	No
Hardware (Nuts, Bolts & Nuts) for fixing the isolator and accessories to the structure	:	Yes
Double compression brass cable glands	:	No
Base channel (if required as per design)	:	Yes

B) MANDATORY SPARE

Sl. No.	420kV Disconnect Switch	Unit	Quantity
1	COMPLETE POLE WITH OPERATING MECHANISM AND TWO EARTH SWITCHES	Nos.	8
2	FIXED MAIN & ARCING CONTACT ASSEMBLY	Nos.	12
3	SUPPORT BEARING (EACH TYPE)	Set	6
4	HINGE PIN	Nos.	12
5	TERMINAL PAD	Nos.	12
6	AUXILIARY SWITCH ASSEMBLY FOR MAIN BLADE (6 NO + 6 NC)	Set	6
7	AUXILIARY SWITCH ASSEMBLY FOR MAIN BLADE (4 NO + 4 NC)	Set	4
8	LIMIT SWITCHES FOR ONE OPERATING MECHANISM COMPLETE (FOR ISOLATOR AND EARTH SWITCH)	Set	6
9	OPERATING MECHANISM BOX	Nos.	6
10	DRIVE MOTOR WITH GEAR BOX	Set	4
11	OPERATING MECHANISM BOX FOR EARTH SWITCH	Nos.	4

Note: If any item in mandatory spare list is not applicable as per vendor design, vendor to supply the equivalent spare for the same. The same shall be subject to customer approval.

1.4 TYPE TESTS

Bidder shall submit valid type test and additional type tests reports (as per relevant IEC/IS standard) for the tests carried out after 17.10.2012. The tests should have been conducted on identical or similar equipment/components to those offered. In case type test reports are earlier than 17.10.2012 or the reports of type tests are found to be technically unacceptable, the type test shall be conducted by the vendor without cost and delivery implication to BHEL.

1.5 INSPECTION & TESTING

Before being fitted on the equipment, all components shall be subjected to routine tests at the Contractors factory, provided by the relevant IEC/IS standards. A detailed test report proving the successful passing of such tests shall be provided.

Prior to dispatch, the routine & acceptance tests shall be carried out on each item in accordance with the applicable IEC/IS and the material shall be offered for final inspection by BHEL and TSGENCO in accordance with agreed quality plan with 3 weeks advance information. The charges for these shall be deemed to be included in the equipment price.

1.6 QUALITY PLAN

The contractor shall carry out contract works in accordance with sound quality management principles which shall include such as controls which are necessary to ensure full compliance to all requirements of the specification & applicable international standards. These quality management requirement shall apply to all activities during design, procurement, manufacturing, inspection, testing, packaging, shipping, inland transportation, storage, site erection & commissioning. Contractor shall submit detailed Quality Plan for BHEL / customer's approval.

1.7 TITLE BLOCK

The drawings / documents submitted shall be project and product specific and shall incorporate following details:

- a) Project Name : 400 kV Switchyard at 5X800MW Yadadri TPS
- b) Customer Name : Telangana State Power Generation Corp. Ltd.
- c) Consultant Name : TCE, Bangalore
- d) Contractor : BHEL
- e) Customer LOA no. : ED/TPC/SE-III/YADADRI TPS(5X800MW)/D.No. 102/17, Dated: 17/10/2017

1.8 Drawings / Documents

The drawings / documents submitted shall be project and product specific and shall incorporate all project details and title block of the customer as detailed in Section 1, 2 & 3.

The drawings/ documents, as follows shall be used for providing engineering manufacturing clearance of the equipment (420kV Isolators with its Accessories) and furthermore, it shall be used for delay analysis, if any from bidder.

The schedule for submission and resubmission shall be in line with details provided in section-3.

1	420kV Isolators - Drawings & Guaranteed Technical Particulars
2	420kV Isolators - Type Test Reports
3	420kV Isolators - Quality Assurance Plan & Inspection Test Schedule

Date of Submission of first lot of drawings/ documents shall be counted only from the date of submission of reasonably correct drawings/ documents.

The successful bidder shall have to extend all possible supports like timely submission/ re-submission of drawings, visit to end customer to facilitate documents approval without any commercial implications to BHEL. Acceptance of bidder's documents shall be subject to end customer approval. The bidder shall submit the GTP of Isolators & earth switch in the format provided by customer. The format shall be provided to successful bidder.

In addition to no. of sets of documents to be submitted to customer (refer section 3), two sets of all documents submitted for approval / information and five sets of all approved documents shall be provided for BHEL use.

Soft copies in CD-R of documents shall comprise

- i) Scanned images of all approved documents, including drawings.
- ii) Editable versions (AUTO CAD 2000 or High) of all drawings viz. drawings, GTP, Manufacturing and field quality plan, type test reports, O & M instructions / manuals.

SECTION – 2

EQUIPMENT SPECIFICATION

1.1 General

This section covers the general technical requirements of isolators. In case of any discrepancies between the requirements mentioned in this section and those specified in section-3 of this specification, this section shall prevail and shall be treated as binding requirement.

- a) The isolators (disconnectors), earth (ground) switches and accessories shall conform in general to IEC-62271-102 except to the extent explicitly modified in the specification.
- b) Isolators shall be of double break, outdoor, off-load type. Earth switch (ES) shall be provided on isolators wherever called for, with possibility of being mounted on any side of the isolator.
- c) Complete isolator with all the necessary items for successful operation shall be supplied including, but not limited to, one central (common) control cabinet for each 3 phase isolator/earth switch and one control cabinet for each pole with all the required electrical devices mounted therein, complete base frame, linkages, complete operating mechanism etc. All necessary parts to provide a complete and operable isolator installation, control parts and other devices whether specifically called for herein or not.

Isolators / Earth Switches shall alternatively have a standard design of master - follower integrated in three boxes only.

1.2 Standards

The isolator shall strictly conform to the following Indian and International standards, as appropriate

IS: 325 – 1978	Three phase induction motors
IS: 9921	Alternating current disconnectors & earthing switches
IEC-62271-102 IEC-60265	Alternating current disconnectors and earthing switches High Voltage Switches
IEC60694	Common Specification for High Voltage Switchgear and control-gear
ANSI-C37.32	Schedule of preferred ratings, Manufacturing specification and Application Guide for High Voltage Air Switches, Bus Supports

ANSI-C37.34	Test Code for high voltage air switches
NEMA-SG6	Power switching equipment
IS: 2633- 1986	Method for testing uniformity of coating of zinc coated articles
IS: 2629 - 1985	Recommended practice for hot dip galvanizing on iron & steel
IS: 4759 - 1984	Hot dip Zinc coating on structural steel and other allied products.
IS: 5561- 1970	Electric power connectors
IS: 6745-1972	Method for determination of mass of zinc coating on iron and steel articles.
IS: 13947- 1993	Low voltage switchgear and Control gear General rules (Part 1)
IS: 1730- 1989	Dimension for steel plates, sheets, strips and flats for general engineering purposes
IS: 2676- 1981	Dimension for wrought Al and Al alloy sheet & strip

1.3 Design and constructional features

1.4.1 General

The equipment shall be single pole/ three pole type. Three pole units shall be electrically gang operated to perform the service requirement as specified in section 1. 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. 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 inter-phase 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. 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 2.3.

Design of isolators and associated earthing switches shall provide positive control of blades in all position with minimum mechanical stress on the insulators.

1.4.2 Duty Requirement

- a) Isolators and earth switches shall be capable of withstanding the dynamic and thermal effects of the maximum 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.
- b) The earthing switches shall be capable of discharging trapped charges of the associated Lines/buses.
- c) 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.
- d) The isolator shall be capable of making/breaking magnetizing and capacitive currents of at least 0.7A at 0.15 power factor.
- e) Isolator and earth switches shall be able to bear on the terminals the total forces including wind loading and electro-dynamic forces on the attached conductor without impairing reliability or current carrying capacity accordance with IEC-62271-102
- f) The earth switch should be able to carry the same fault current as the main blades of the isolator and shall withstand dynamic stresses.
- g) Isolator shall be of extended mechanical endurance class – M2 as per IEC 62271- 102. All earth switches shall be of M0 duty.

Design of the isolator shall be such as to permit addition of earth switches at a future date. It shall be possible to interchange position of earth switch to either side of pole even at site.

1.4.3 Main Contacts

- a) The isolator shall be provided with high pressure current carrying contacts made of copper on the hinge and jaw ends and all contact surfaces shall be silver plated. The thickness of silver plating shall not be less than 25 microns. The contacts shall be accurately machined and self-aligned.
- b) The contacts shall be of sufficient pressure to ensure effective contact and low contact resistance throughout the life of the switch. The contact pressure shall not exceed a safe working value for the materials in contact and shall cause no abrasion or scarring of the contacts.
- c) The contacts shall be of self-aligning and self- cleaning type and shall be so designed that binding can-not occur after remaining closed for prolonged periods.

- d) 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 earth switch. Each contact or pair of contacts shall be independently sprung so that full pressure is maintained on all contacts at all time. Provision shall be made to adjust the contact pressure.
- e) Contact spring shall not carry any current and shall not lose their characteristic due to heating effects.
- f) The isolator shall be so designed that when operated within their specified rating, the temperature of each part shall be limited to values consistent with a long life for the material used. The temperature shall not exceed the permissible limits given in IEC-62271-102 under specified ambient conditions.
- g) 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.

Arcing contacts, where provided, shall close first and open last so that no damage due to arcing whatsoever shall be caused to the main contacts.

The fixed contact of double break isolators shall be provided with springs which ensure that there is always a positive contact with adequate pressure to give enough contact surfaces for passage of current. The springs provided shall not go out of alignment or get entangled with the moving contact during operation. The springs provided shall be of non-ageing type and its strength shall not reduce appreciably during the life span of the isolator.

1.4.4 Base

Each single pole of the isolator/earth switch shall be provided with a complete galvanised steel base provided with holes and designed for mounting on a supporting structure. The base shall be rigid and self-supporting and shall require no guying or cross bracing between phases other than the supporting structures. The frame of each isolator and earthing switch shall be provided with two reliable ground terminals for connection to the ground mat.

The position of movable contact system (main blades) of each of the isolators and earthing switches shall be indicated by a mechanical position indicator. The indicator shall be of metal and shall be visible from operating level.

1.4.5 Blades

- a) All metal parts shall be of non-rusting and non-corroding metal. 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, pins or springs used in current carrying parts shall be made of non-ferrous and non-corroding material. All castings and hardware other than those in the current carrying parts shall be 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 applicable. Where this is impracticable, adequate corona shields shall be provided. Corona shields/rings etc. shall be made of aluminium/aluminium alloy.
- c) The isolators/earth switch shall be so constructed that the switch blade shall be locked in the open/close position and shall not fall to the closed/open position if the operating shaft gets disconnected.
- d) 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.
- e) The Isolators and earthing switches shall be designed such that lubrication of any part is not required except at very long intervals i.e. after every 1000 operations or after 5 years whichever is earlier.
- f) The switch blade contact shall enter into the counter contact even if it is misaligned by 45 mm in any direction.

1.4.6 Insulator (Excluded from Scope)

Please refer Drawing no. 39831401200 Rev.01 for Insulators to be used in Isolator.
Post insulators for Isolators shall be supplied by BHEL separately.

1.4.7 Earthing Switches

- a) Where specified, the isolators shall be equipped with earthing switches and these shall form an integral part of the isolator and shall be mounted on the base frame of the isolator. The earthing switches shall have complete operating mechanism and auxiliary contacts. The operating mechanism for the earthing switches shall be only locally (motor) operated.
- b) The earthing switch shall be constructional interlocked with the isolator so that earthing switches can be operated only when isolator is open and vice versa. The construction interlock shall be built in construction of isolator and shall be in addition to the electrical and mechanical interlocks provided in the operating mechanism.
- c) In addition to the constructional interlock, isolator and earth switch shall have provision to prevent their electrical and manual operation unless the interlocking conditions are met. All these interlocks shall be of fail-safe type. Suitable individual interlocking coil arrangements shall be provided. The interlocking coil shall be suitable for continuous operation from dc supply and within a variation range as stipulated.
- d) Each earth switch shall be provided with flexible copper/aluminium braids for connection to ground mat. These braids shall have the same short time current

carrying capacity as the earth blades. The transfer of fault current through switch connection will not be accepted.

- e) The plane of movement and final position of the earth blades shall be such that adequate electrical clearances are obtained from adjacent live parts in the course of its movement between ON and OFF position.
- f) The frame of each isolator and earthing switches shall be provided with two reliable earth terminals for connection to the earth mat.
- g) 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.
- h) The earth switch should be able to carry the same fault current as the main blades of the Isolators and shall withstand dynamic stresses.
- i) Earth Switch shall also comply with the requirements of IEC-62271-102, in respect of induced current switching duty as defined for Class-B and short circuit making capability class E-0 for earthing switches.

1.4.8 Operating Mechanism and Control

- a) The isolators and earth switches shall be ac motor operated.
- b) Limit switch for control shall be fitted on the isolator/earth switch shaft, within the cabinet to sense and ensure the open and close positions of the isolator and earth switch.
- c) After final adjustment has been made it shall not be possible for any part of the mechanism to be displaced at any point in the travel sufficient enough to allow improper functioning of the isolator/earth switch whenever it is opened or closed at any speed. All holes in cranks, linkage etc. having moving pins shall be drilled to accurately fit so as to maintain the minimum of slack and loose motion in the entire mechanism.
- d) A "Local/Remote" selector switch and a set of "Open/Close" push buttons shall be provided in the control cabinet of the isolator to permit its operation. A "Local/Remote" selector switch and "Open/Close" push buttons shall also be provided in central control cabinet to permit simultaneous operation of all three phase.
- e) Provision shall be made in the control cabinet to disconnect power supply to prevent local/remote power operation.
- f) Suitable reduction gearing shall be provided between the motor and the drive shaft of the isolator. The mechanism shall stop rapidly when motor supplies are switched off. If necessary a quick electro-mechanical brake may be fitted on the higher speed shaft to effect rapid braking.

- g) Each motor operated mechanism shall be subjected to blocked rotor test.
- h) Control cabinet/operating mechanism box shall conform to the requirement stipulated in Section-3 and shall be made of cast aluminium/aluminium sheet of adequate thickness (minimum 3 mm) or stainless steel (grade-304) of minimum thickness 2mm.
- i) Manual operation facility (with handle) should be provided with necessary interlock to disconnect motor.
- j) 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.
- 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.

The enclosure of the control cabinets shall provide a degree of protection of not less than IP 55 as per IS: 13947 (Part 1). All doors, removable covers and plates shall be gasketed all around with good quality neoprene gaskets.

Cable entry shall be from the bottom. Suitable removable cable gland plate shall be provided on the cabinet for the purpose. Cable glands shall be of double compression type, made of brass and supplied loose. Cable sizes and no. of cable glands will be indicated at the contract drawing approval stage. Suitable space heaters shall be mounted in the cabinet to prevent condensation. Heater shall be suitable for 240V, 50 Hz, single phase A.C. supply.

Terminal blocks shall be of (at least) 650V grade and have 10 amps continuous rating. These shall be moulded, complete with insulated barriers, stud type terminals, complete with washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud terminals with locking type.

The terminal blocks to be provided shall be of either ELMEX OR PHOENIX make, clip on type and shall be such that adjacent terminals can be shorted with the help of links. All terminals shall be clearly marked with identification numbers or letters to facilitate connection to external wiring.

For looping the auxiliary power supply cable, suitable terminals should be provided, for 16/25 sq. mm cables. These terminals are to be separated from the others and fitted with transparent plastic covers and shall have warning labels with red lettering.

The terminal shall be staggered that the connection of external cable to terminal block should be possible without disturbing the rest of the connections. The terminal block arrangements

shall be such as to provide maximum accessibility to all conductor terminations and any arrangement preventing ready access to other terminal screws shall not be accepted.

The arrangements shall be such that it is possible so safely connect or disconnect terminals and replace fuse links on live circuits. Easy access shall be provided for all components on which adjustment or tightening is expected to be done at site, without removal of other components.

1.4.9 Operation

- a) Each pole of the isolator and earth switch shall have individual drives for main blades. The operating mechanism of the three poles shall be well synchronized and interlocked.
- b) The design shall be such as to provide maximum reliability under all service conditions. All operating linkages carrying mechanical loads shall be designed for negligible deflection. The length of inter insulator and inter-pole 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 & earth switches shall be provided with "over centre" device in the operating mechanism to prevent accidental opening by wind or vibration or short circuit forces or movement of the support structures.
- c) Each isolator and earth switch shall be provided with a manual operating handle enabling one man to open or close the isolator or earth switch with ease in one movement while standing at ground level. The manual operating handle shall have provision for padlocking. The operating handle shall be located at 1000 mm from the base of isolator support structure.
- d) The isolator/earth switch 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/earth switch. 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) The transmission of motion from the electrical operating mechanism shall be by rigid members. It is required that, in the event of over torque of the switch mechanism, no part of the main switch mechanism shall bend, twist or shear and so allow the auxiliary switch contacts to operate erroneously.
- f) 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.

- g) The position of movable contact system (main blades) of each of the isolators and earth switches shall be indicated by a mechanical indicator at the lower end of the vertical rod of shaft for the isolators and earth switch. The indicator shall be of metal and shall be visible from operating level.
- h) Signalling 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. Signalling of open position shall not take place unless movable contacts have reached a position such that clearance between contacts is at least 80% of the isolating distance.
- i) Counter balance springs shall be provided for counter balancing the isolators to prevent impact at the end of travel both on opening and closing of the isolator. The spring shall be made of non-rusting type alloy.

1.4.10 Motor operated mechanism

The motor operated mechanism shall be suitable for operation on 415V, 3 phase and 50Hz power supply. The motor shall satisfy the requirements specified in IS: 325.

The scheme shall be so designed that during manual operation the motor drive shall be automatically electrically de-coupled. Suitable reduction gearing shall be provided between the motor and the drive shaft of the isolator. A quick electro mechanical brake shall be fitted on the higher speed shaft.

Limit switches for motor control shall be fitted on the isolator shaft within the cabinet to sense the open and close positions of the isolator. The switches shall be snap type and shall have adequate number of NO/NC contacts for use in the indication scheme. The switches shall be adjusted in a manner so that moving contacts reach their final open and close position with proper alignment.

1.4.11 Auxiliary Switch

14 NO plus 14 NC for Isolator, 14 NO plus 14 NC auxiliary contacts for earth switch shall be provided respectively, besides those used for the Isolator control schematics. All these contacts shall be kept wired to the terminals in their respective operating mechanism box.

All auxiliary switches shall have a continuous current carrying capacity of at least 10 Amps at the rated control voltage and shall be wired up to the terminals in the operating mechanism box. Auxiliary switches which are installed on the frame of isolators or earthing switches shall be suitably protected against accidental arcing from the main circuit. Auxiliary switches shall be mounted in a weather proof housing which shall have provision for entry of conduits of proper sizes, or for fixing of cable glands.

Auxiliary switches which are installed on the frame of the isolators or earthing switches shall

be suitably protected against accidental arcing of the main contact. The breaking capacity of the auxiliary switches shall be adequate for the circuit to be controlled.

The contacts shall be capable of breaking at least 2 Amp in a 220V D.C circuit with a time constant of not less than 20 milliseconds. Fixing hardware on the auxiliary contacts shall not cause hindrance to the movement of the contact fingers.

Auxiliary Contacts shall be capable of being set such that:

- a) Signalling of the closed position shall not take place unless the contact system has reached such a position that the rated normal and rated short time current can be carried safely.
- b) Signalling of the open position shall not take place unless the contact system has reached such a position of at least 80 percent of the isolating distance.
- c) A simultaneous signalling device for all poles of an isolator shall be arranged in such a way that the signal is given only when all poles of the isolator have a position in accordance with (a) and (b) above.

1.4.12 Safety Interlocking

All isolators and isolator-cum-earthing switches shall be suitable for electrical interlocking. In addition to the provision of electrical interlocking, the Isolator and the earthing switch shall also be interlocked through the castle key electro-mechanical interlock. Mechanical interlocks, if applicable, shall be so designed that force cannot be transmitted to points remote from the point at which hand force is applied.

The earth switches wherever provided shall be mechanically and electrically interlocked so that they can be operated only when the isolator is open and vice versa.

In addition to the interlock between isolator and its earth switch, they shall have provision to prevent their electrical and manual operation unless the associated and other interlocking conditions are met. The interlocking arrangement shall be such that operation is prevented even if interlocking conditions change at any stage during electrical or manual operation of isolator. All these interlocks shall be of the 'failsafe' type and shall be suitable for continuous operation from DC supply between 80% and 110% of the rated voltage i.e. 220 volts. Constructional interlock of isolator with earth switch operating mechanism to be provided in case of manually operated isolators.

The operation of earth blade shall not take place when corresponding main isolator is in operation stroke and vice versa. The electrical interlocking scheme shall operate on auxiliary supply as given in Section 1 and shall be subject to purchaser's approval at contract stage.

1.4.13 Control Wiring

All the control and secondary circuits and auxiliary contacts of the isolator shall be wired completely and up to the terminal blocks in the operating mechanism box. The control wiring

shall be of adequate cross-section and not less than 2.5mm^2 copper. All wires shall have PVC insulation for 1100 Volts and shall be suitable for switch board wiring.

At least 20 percent terminals with a minimum of 24 Nos. as spare for future use shall be provided over and above the numbers required, in the MOM box.

1.4.14 Terminal Connector Stud/Pad and Earthing Terminals

The isolators shall be provided with terminal power connectors conforming to IS 5561. All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be deburred and rounded off to prevent corona.

All ferrous parts shall be hot dip galvanised in accordance with the relevant standards mentioned in clause 2.3. Flexible connectors shall be made from tinned copper sheets.

For bimetallic terminal connectors wherever applicable, copper alloy liner of minimum thickness of 4mm shall be cast integral with aluminium body. All the connectors shall be designed and manufactured to have minimum contact resistance. Each isolator and operating mechanism box shall be provided with two number grounding terminals for connecting galvanised MS earth strip to earth mat.

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.

The terminal pad of the isolator shall be capable of taking 4.5" aluminium tube or Twin/Quad - Moose/ Bersimis ACSR conductor under normal, short circuit and meteorological conditions specified.

The terminal of the isolator shall be designed:
For 400 kV: 4.5" Aluminium tube/Twin/Quad - Moose/ Bersimis ACSR conductor

1.4.15 Grounding

Each disconnect switch operating rod shall be separately grounded at a point above the mechanism box. This shall be done by flexible copper braid of adequate section but in no case less than 70mm^2 .

All ferrous parts, except the operating mechanism box shall be hot dip galvanised as per the relevant Indian standards specified in clause 2.3. Electro galvanised hardware may be used only where the hot dip galvanised hardware is not available in the required sizes. Generally, all steel hardware above M10 size should be hot dip galvanised. Hardware should be of GKW or equivalent POWRGRID/TSGENCO approved make. If any other make is used, the same shall be subject to purchaser's approval.

1.4.16 Name Plate

The name plate shall conform to the requirements of IEC 62271-102 incorporating year of manufacture.

1.5 TESTS

The each type of isolator and earth switch along with their operating mechanism shall be subjected/conform to the type tests and shall be subjected to routine tests in accordance with IEC-62271-102. Any other tests if required as per relevant IEC/IS shall be conducted and included.

Additional Type tests

The following additional type tests reports shall also be submitted for customer's review and acceptance. (Additional type tests are required for isolators rated above 72.5kV only)

- (i) Radio interference voltage test (as per Annexure-A of Section-2)
- (ii) Corona Extinction Voltage test (as per Annexure-A of Section-2)
- (iii) Seismic withstand test on isolator mounted on Support structure (as per Annexure-B of Section-2)

The test shall be performed in the following position:

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

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.

1.5.1 PRE-COMMISSIONING TESTS

An indicative list of tests on isolator and earth switch is given below. 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 along with 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.

ANNEXURE-A

Corona and Radio Interference Voltage (RIV) Test

1. General

Unless otherwise stipulated, all equipment (except Auto Transformer & Shunt Reactor) together with its associated connectors, where applicable, shall be tested for external corona 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). The test procedure shall be reviewed for different equipment during submission of MQP/ITP.

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 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 noise level meter.

4. Test Methods for Visible Corona

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 RIV test 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.

- 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 100 microvolts in each direction.
- f) Onset and extinction of visual corona for each of the four tests required shall be recorded.

ANNEXURE-B

SEISMIC WITHSTAND TEST PROCEDURE

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

The supplier shall arrange to transport the structure from his purchaser'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 /Employer. 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 Purchaser.



Project: 5x800 MW YADADRI THERMAL POWER STATION.
Customer: TELANGANA STATE POWER GENERATION CORPORATION LTD

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SECTION - 3

PROJECT DETAILS AND GENERAL SPECIFICATIONS

GENERAL TECHNICAL REQUIREMENTS

1.0 PROJECT DETAILS

Customer	:	M/s Telangana State Power Generation Corporation Ltd.
Project Title	:	5x800MW Yadadri Thermal Power Station
Project Location	:	Veerlapalem Village, Damercherla Mandal, Nalgonda District, Telangana
Nearest Railway station	:	Vishnupuram railway station.
Nearest Road Head	:	NH-9 is at 45km North SH-2 is at 7km South
Nearest Airport	:	Hyderabad (about 150 Km) Chief Engineer (O&M), 5X800MW Yadadri Thermal Power
Postal Address	:	Station, TSGENCO, Village - Veerlapalem, Mandal- Dameracheral, Dist. – Nalgonda, Telangana

1.1 SITE CONDITIONS (FOR DESIGN PURPOSES)

1.1.1 SITE CONDITIONS

a).	Average rainfall per year	:	1124 mm
b).	Maximum hourly rainfall intensity	:	102 mm
c).	Altitude	:	1000 m

1.1.2 DESIGN AMBIENT

a).	Minimum Temperature	:	13.5°C
b).	Maximum Temperature	:	45°C
c).	Design Ambient Temperature	:	50 °C

1.1.3 RELATIVE HUMIDITY

a).	Maximum	::	85%
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1.1.4 WIND PRESSURE (AS PER IS:875-1987)

a). Design wind speed : 44 m/sec.

1.1.5 SEISMIC FACTORS

a). Horizontal Seismic Coefficient : As per latest IS : 1893

b). Vertical Seismic Coefficient : As per latest IS : 1893

} **Zone - III**

1.1.6 ELECTRICAL DATA

		400 kV System	415V AC System	240V AC System	220 V DC System	48 V DC System
1.	Nominal Voltage	400 kV	415 V	240 V	220 V	48 V
2.	Highest System Voltage	420 kV	457 V	264 V	242 V	55 V
3.	No. of phases	3	3	1	NA	NA
4.	Frequency	50 Hz	50 Hz	50 Hz	NA	NA
5.	Voltage variation	± 5%	+10 %	+10 %	+10 % to -15%	+10 %
6.	Neutral Earthing	Effectively Earthed	Solidly Earthed	Solidly Earthed	-	-
7.	Fault Level	63 KA for 1 sec.	50 kA for 1 sec.	50 kA for 1 sec.	15 kA for 1 sec.	-

1.1.7 SYSTEM PARAMETERS

Dry and wet one minute power frequency withstand voltage : 630 kVrms
Dry impulse withstand voltage positive and negative : 1425 kVpeak
Minimum Total Creepage : 25 mm/kV

1.1.8 MINIMUM CLEARANCE (AS PER IS: 10118)

Phase to phase (PP) : 4200 mm
Phase to earth (PE) : 3500 mm
Section clearance : 6500 mm
Minimum ground clearance from plinth level (Plinth level : 300 mm) : 8000 mm



Project: 5x800 MW YADADRI THERMAL POWER STATION.
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Vertical ground clearance to nearest part not at earth
potential of an insulator supporting live conductor/ equipment 2440 mm

1.2 INSTRUCTION TO BIDDERS

The bidders shall submit the technical requirements, data and information as per the technical data sheets, provided in Section-4.

The bidders shall furnish catalogues, engineering data, technical information, design documents, drawings etc fully in conformity with the technical specification. It is recognised that the Manufacturer may have standardised on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to the Purchaser. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously.

1.3 STANDARDS

The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.

The equipment to be furnished under this specification shall conform to latest issue (with all amendments) of specified standards.

In addition to meeting the specific requirement called for in Sections 1 and 2 of the Technical Specification, the equipment shall also conform to the general requirement of the applicable standards, which shall form an integral part of the specification. The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to complement each other. When the specific requirements stipulated in the specifications exceed or differ from those required by the applicable standards, the stipulation of the specification shall take precedence.

Other internationally accepted standards, which ensure equivalent or better performance than that specified in the standards referred, shall also be accepted. The bidder shall submit copies of such standards.

In case governing standard for the equipment is different from IS or IEC, the salient points of difference shall be clearly brought out in the offer along with English language version of standard or relevant extract of the same. The equipment conforming to standards other than IS/IEC shall be subject to Purchaser's / owner's approval. The bidder shall clearly indicate in his bid the specific standards in accordance with which the works will be carried out.



1.4 TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

All equipment being supplied shall conform to type tests and shall be subject to routine and acceptance tests in accordance with requirements stipulated under respective sections. Purchaser reserves the right to witness any or all the tests. The Manufacturer shall intimate the Purchaser the detailed programme about the tests at least three (3) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies. Purchaser reserves the option for getting any or all the type tests repeated on the equipment. The Manufacturer shall also submit type test procedure for approval of the Purchaser.

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 additional type tests not carried out without any additional cost implication to the Purchaser.

The price of conducting all tests and additional type tests is deemed to be included in Bid price. 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.

The purchaser intends to repeat the type tests and additional type tests on cables for which test charges shall be payable as per provision of contract.

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 Contractors 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 Manufacturer shall obtain for the Engineer and for his duly authorized representative permission to inspect as if the works were manufactured or assembled on the Manufacturer's own premises or works. Inspection may be made at any stage of manufacture, dispatch 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.

The Manufacturer shall give the Purchaser/inspector thirty (30) days written notice of any material being ready for testing. Such tests shall be to the Manufacturer's account except for the expenses of the inspector. Unless witnessing of the tests is virtually waived, the Purchaser/ inspector will attend such tests within thirty (30) days of the date of which the equipment is notified as being ready for test/ inspection, failing which the Manufacturer may proceed with the test which shall be deemed to have been made in the Inspector's presence and the Manufacturer shall forthwith forward duly certified copies of test reports in triplicate to the Inspector.

The Purchaser or Inspector shall, within fifteen (15) days from the date of inspection as defined herein, give notice in writing to the Manufacturer, 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



Manufacturer 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.

When the factory tests have been completed at the Manufacturer'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 Manufacturer's Test certificate by the Engineer/ Inspector. Failure of the Purchaser/inspector to issue such a certificate shall not prevent the Manufacturer from proceeding with the Works. The completion of this test 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 MICC by the Purchaser.

In all cases where the Contract provides for tests whether at the premises or at the works of the Manufacturer or of any Sub-Contractor, the Manufacturer 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.

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

The Purchaser will have the right of having at his own expenses any other test(s) of reasonable nature carded out at Manufacturer'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.

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 equipment for these tests shall be provided by the Purchaser.

1.5 MATERIAL/WORKMANSHIP

1.5.1 GENERAL REQUIREMENT

Where the specification does not contain characteristics with reference to workmanship, equipment, materials and components of the covered Equipment it is understood 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 purposes for which they are intended.



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 and shall be used throughout the design. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfil 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 purchaser.

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 be interchangeable with, 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.

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

The Contractor 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 Contractor shall apply all operational lubricants to the equipment installed by him.

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. If such is the case, he shall declare in the proposal where such oil or grease is available. He shall help purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

1.5.2 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.

1.6 COLOUR SCHEME AND CODES FOR PIPE SERVICE

The contractor shall propose a colour scheme for those equipment/Items for which the colour scheme has not been specified in the specification for the approval of purchaser. The decision of purchaser shall be final. The scheme shall include:

Finishing colour of Indoor equipment

Finishing colour of Outdoor equipment.

Finish colour of all cubicles.

Finishing colour of various auxiliary system equipment including piping

Finishing colour of various building items.

All steel structures, plates etc. shall be painted with non-corrosive paint on a suitable primer. It may be noted that normally all electrical equipment in switchyard are painted with shade 631 of IS-5. All The indoor cubicles shall be of same colour scheme and for other miscellaneous items, colour scheme will be approved by the purchaser.

1.7 PAINTING

- a) All sheet steel work shall be phosphated in accordance with the following procedure and in accordance with IS: 6005 "Code of practice for Phosphating Iron and Steel".
- b) Oil, grease, dirt and swerve shall be thoroughly removed from emulsion by cleaning.
- c) 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.
- d) After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute bichromate solution and over drying.
- e) The phosphate coating shall be sealed by the 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.
- f) After application of the primer, two coats of finishing epoxy paint shall be applied, each coat followed by stoving. The panel shall have colour conforming to shade 631 of IS-5 for outside and inside of the panel with black colour for base frame.
- g) Each coat of primer and finishing paint shall be of a slightly different shade to enable inspection of the painting.



- h) Finished painted appearance of panel shall present an asthetically pleasing appearance free from dents and uneven surface.
- i) A small quantity of finishing paint shall be supplied for minor touching up required at site after the installation of the panels.

1.8 PROTECTION

- a) All coated surfaces shall be protected against abrasion, impact, discoloration 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, pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.
- b) All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion.
- c) The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.
- d) Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

1.9 FUNGISTATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on the 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 interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application to the varnish.

1.10 SURFACE FINISH

All interiors and exteriors of tanks, control cubicles and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or other wise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling.



1.11 GALVANIZING

All ferrous parts including all sizes of nuts, bolts, Plain and spring washers, support channels, structures, shall be hot dip galvanised conforming to latest version of IS:2629 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electro-galvanized. Minimum weight of zinc coating shall be 610 gm/sq.mm and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6 mm thickness, requirement of coating shall be as per relevant ASTM.

1.12 AUXILIARY POWER SUPPLY

1.12.1 A.C power supply for auxiliaries will be available at 240 V, 50 C/s 1-phase, 2 wire and 415V, 50 C/s, 3-phase, 4 wire, neutral solidly earthed with variation in frequency of +/-5% and variation in voltage +/-10%

1.12.2 D.C. power supply at 220 V, 2-wire ungrounded will be available 187 V to 242 V.

1.13 INSPECTION AND TESTING

All tests and inspection of the equipment specified shall be performed to the extent and in the manner as stipulated in the relevant standards and in this specification. All type tests/routine tests/acceptance tests as specified shall be conducted in the presence of purchaser. Wherever equipment similar to the one being offered has already been type tested within 5 years from the date of opening the bid. Type tests done in an independent government laboratory or in the presence of representative of State Electricity Board or other reputed public undertakings, the type test reports of the same shall be submitted for scrutiny /approval. If these are found suitable and technically acceptable, conducting of type tests shall be waived off. Otherwise the subcontractor will have to carry out the type tests without any extra cost and without any delivery implications.

1.14 PACKAGING

Aluminium Tube shall be partially packed with Hessians cloths. Similar items shall be grouped and tied with steel wires/strip for convenient handling during transits.

MARKINGS

The following details are to be clearly indicated in the material forwarding documents:

- a) Name and address of the consignee.
- b) Purchase order number.
- c) Name of supplier/s.
- d) Description of equipment / material.



e) Tare weight.

f) Gross weight.

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 account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage wagons 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.

1.15 HANDLING, STORING AND INSTALLATION

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.

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 of the manufacturer's supervisory Engineer(s) and shall extend full cooperation to them.

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.

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 proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected 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 expenses.

Contractor shall be responsible for examining all the shipment 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, pilferage and other such charges claimed by the transporters, railways etc. shall be to the Contractor's account.

The Contractor 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 to 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 such nature, corrosion, damages etc.

The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipments which require indoor storage.

The words erection and installation used in the specification are synonymous. Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.

The minimum phase to earth, phase to phase and section clearance along-with other technical parameters for the various switchyard voltage levels to be maintained shall be strictly as per the approved drawings.

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances, the Contractor shall immediately proceed to correct the discrepancy at his risks and costs.

1.16 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.

1.14 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.

1.15 QUALITY

BHEL quality plan to be followed subject to TBEM / customer's approval.



1.16 DOCUMENTATION

1.16.1 DRAWINGS

All drawings shall be prepared in AutoCAD and ultimate documentation would include drawings/documents on CDs. All dimensions and data shall be in SI metric units.

All items of the equipment should be clearly identified by proper part nos. in the contract drawings. Such parts, which are to be dispatched to site from works in dispatchable units and are reassembled at site, should be marked by proper identification marks at works and indicated in the drawings and quantified. The shipping list should be sent along with the general arrangement drawings for engineer's approval. All the items of the shipping list should be identified in the drawing.

The drawing submitted by the supplier shall be reviewed by the purchaser as far as practicable within two weeks of receipt of drawings and shall be modified by the sub-contractor if any modifications and/or corrections are required by the purchaser. The sub-contractor shall incorporate such modifications and / or corrections and submit the final drawings for approval. Any delay arising out of failure of the subcontractor to rectify the drawings shall not alter the contract completion date.

Further work by the subcontractor shall be in strict accordance with these drawings and no deviation shall be allowed without the written approval of the purchaser.

All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at supplier's risk.

Approval of drawing or work by the purchaser/consultant shall not relieve the subcontractor of any of his responsibilities and liabilities under the contract.

In case of any modifications that may be necessary during erection or commissioning of the equipment, the subcontractor shall carry out modifications in the original drawing & submit 'As Built drawings' and required no. of prints thereof.

1.16.2 INSTRUCTION MANUALS

The supplier shall submit to the purchaser, draft instruction manuals for approval within 30 days of placement of order. The final instruction manuals complete in all respects shall be submitted 60 days before the first shipment of the equipment. The instruction manuals shall contain full details and drawings of all the equipment furnished, the erection procedures, testing, operation & maintenance procedures of the equipment.

If after the commissioning and initial operation of the plant, the instruction manuals require any modification/ addition / changes, the same shall be incorporated and the up- dated final instruction manuals shall be submitted as required.



1.16.3 TITLE BLOCK & DRAWING/ DOCUMENT NUMBERING SCHEME

Title block for drawing / document should be followed as per ANNEXURE-3

1.16.4 DOCUMENTATION SCHEDULE AT CONTRACT STAGE

A.	<u>For approval</u>	<u>No of Copies</u>
	Copies of all drawings with project details, dimension, shipping weights, No. of cases & dimensions, fixing details, tolerance etc.	10
	Copies of type test reports.	5
	Copies of works quality plan & field quality plan.	5
	Copies of installation, operation & maintenance manual.	5
	Copies of drawings on floppies/CDs	1 set
B.	<u>After approval and for information / distribution</u>	
	Copies of all drawings	15
	Copies of installation, operation & maintenance manual including Routine test reports	15
	Sets of RTF of drawings	2
	CDs of Drgs and O & M Manuals	4
C.	<u>As Built Drawings</u>	
	Hard copies of Drawings	15
	CDs	4
	NOTE:	
1.	Any revision of drawings / documents shall be submitted in the same no. of copies submitted first time for approval	
2.	Final drawings / documents shall be submitted in bound volume with customer and project details etc. written on the top.	

ANNEXURE – A

NO DEVIATION CERTIFICATE

It is confirmed that there is no deviation and the offer is in full compliance with the specification. It is also confirmed that there are no deviations in any other form such as comments, variations and or exceptions. Further it is confirmed that at all drawings/ data sheets/ QP/ type tests reports shall be submitted to BHEL for organizing approval of ultimate customer. Also, furnishing of all relevant information/ repetition of type tests (if required for meeting the specification requirement) shall be carried out by us at no extra cost to BHEL and without affecting delivery requirements.

Signature of the authorized representative of Bidder

Name _____

Designation_____

Place_____

Date_____

Company Seal

TECHNICAL CHECK LIST FOR ISOLATORS / EARTHING SWITCHES

(INFORMATION TO BE FURNISHED WITH OFFER)

BIDDERS ARE INSTRUCTED TO

WRITE '**YES**' UNDER CLOUMN '**Confirmation**', if the specified requirement is met, or
WRITE '**NO**' UNDER CLOUMN '**Confirmation**', if the specified requirement is not met and
give comments in the "Remarks" column.

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

SN.	Parameters	Specified Requirement	Confirmation	Remarks
1	Rated Voltage (KV)	420kV		
2	Type of Isolator	HDB		
3	Standard applicable for isolators and earthing switches	IEC:62271-102 (2001-12), IS:9921		
4	Rated Current Under site conditions (A) at 50° C ambient-	3150A		
5	Rated short time withstand Current of Isolator and Earth switch	63kA for 1 Sec		
6	Rated dynamic short circuit withstand Current of Isolator and Earth switch	157.5kAp		
7	Rated frequency (Hz)	50		
8	Number of poles	3		
9	Phase to phase spacing(mm)	7000		
10	Whether all 3 poles are ganged	Electrically		
11	Max. operating time (Sec.)	Less than 12		
12	Earth switch connection to earth mat	Flexible copper braids		
13	Temperature rise over 50° C ambient temperature corresponding to maximum continuous current (°C)	as per IEC 62271-1		
14	Seismic Acceleration	0.3 g		
15	Dielectric withstand capacity of completely assembled isolator/isolator and earth switch			

15.1	One minute dry power freq. Withstand test voltage(KV rms)			
	i. against ground (KV rms)	520		
	ii. Across isolating distance (KV rms.)	610		
15.2	1.2/50 micro's impulse withstand test voltage			
	i. Against ground (KVP)	±1425		
	ii. Across isolating distance (KVP) -	±1425(240)		
15.3	250/2500 micro sec. switching surge withstand test voltage (dry & wet)			
	i. Against ground (KVP) -	±1050		
	ii. Across isolating distance (KVP)	±900(345)		
16	Corona extinction voltage (KV rms) –	320		
17	Radio interference level at 1.1 Ur/_/3 (in micro volts at 1.0 MHz)	1000		
18	Min creepage distance of support & rotating insulator (mm) – (25 mm/kV)	10500		
19	Operating Mechanism for Isolator	Motor/Manual		
20	Operating Mechanism for Earth Switches	Motor/Manual		
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 i) Straight Load(N) ii)Across Load(N)	As per specification		
25	Whether interlock coil is continuously rated	YES		
26	Rated DC control voltage and	220V DC(85%-		

	variation allowed	110%)		
27	Material of contacts	Hard drawn electrolytic copper and the surface shall be silver plated		
28	Thickness of silver plating of contacts	25 micron		
29a)	Number of auxiliary contacts on isolator/pole	14NO + 14 NC + 2MBB		
29b)	Number of auxiliary contacts on earth switch/pole	14 NO + 14 NC		
29c)	No. of TBs on Isolator in the terminal strip provided for Master pole (to be used for interpole cabling)	50		
29c)	No. of TBs on Earth Switch in the terminal strip provided for Master pole (to be used for interpole cabling)	40		
30	Rating of Auxiliary contacts	10 A at 220 V DC		
31	Rated DC breaking current of Auxiliary contacts with time constant not less than 20 ms (A)	2A		
32	Material of Current carrying parts			
	Material of Arm	Aluminium		
	Material of Terminal Pads	Hard Drawn Electrolytic Copper		
34	Height of the centre line of Terminal Pad above ground level	8250		
35	Min Clearance (mm)			
	i) Phase to earth ii) Phase to phase	3500 4200		
36	Capability of Isolator for making and breaking the magnetizing/capacitive currents	0.7 A at 0.15 power factor		
37	All valid Type test reports are available	Yes, available		
	CONTROL CABINETS			
38	Application	Outdoor		
39	Material of control cabinet sheet	Painted sheet steel/AL		
40	Thickness of sheet (mm)	As per specification		

41	Degree of protection provided	IP55		
42	Standard applicable for control cabinet	As per relevant IS/IEC		
43	Whether Hot Dip Galvanised	YES/No		
44	Colour shade of finish paint of control cabinet as per IS : 5			
45	Size of Conductor used in Control Wiring of control cabinet	2.5 sq.mm		
46	20 % Spare Terminal Blocks provided in control cabinet	YES		
47	Terminal Blocks shall be suitable for 4X25 Sqmm Ar. Alu. Cable	YES		
48	Confirm to follow the BHEL/Customer MQP	Confirmed		
49	<i>Following accessories not limited to this is included in scope or not:</i>			
A	<i>Hardware for Structure (BHEL supply) to Base Channel (vendor supply)</i>	YES		
B	<i>Hardware for Base Channel (vendor supply) to Bottom of Post Insulator (BHEL supply*)</i>	YES		
C	<i>Hardware for Top BPI (BHEL supply*) to Male/Female Member</i>	YES		
D	<i>Hardware for Structure (BHEL supply) to MOM Box</i>	YES		
E	<i>Hardware for Structure (BHEL supply) to Earth Switch MOM</i>	YES		
F	<i>Terminal Connectors</i>	NO		
G	<i>Support Structure</i>	NO		

2. TYPE TESTS

Type test reports are earlier than 17.10.2012
on similar material

YES/NO

If the valid type tests reports are not available with the bidder
then the tests shall be conducted by the bidder free
of cost.

YES/NO

**PRE QUALIFICATION REQUIREMENT
OF 420KV HDB DISCONNECTOR FOR YADADRI PROJECT**

Disconnecting switches being offered should be from manufacturer who has manufactured and supplied minimum thirty (30) nos. of Disconnecting switch of offered voltage class or higher, suitable for air insulated substation/ switchyard and which must have been in successful operation for a minimum period of two (2) years as on zero date of Yadadri (17.10.2017).