BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

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TYPE OF DOC.	**TECHNICAL SPECIFICATION**		**NAME**	**NK**	**SK/ DKM**	**RS**
TITLE **220kV AND 33kV DOUBLE BREAK ISOLATORS**			**SIGN**			
			DATE	14.01.13	14.01.13	14.01.13
			GROUP	TBEM	**W.O. No**	**89004**

CUSTOMER	**NHPC LIMITED, FARIDABAD**
PROJECT	**220/33KV SWITCHYARD FOR KISHANGANGA (3X110MW) HEP**
KISHANGANGA CONSORTIUM:	**HINDUSTAN CONSTRUCTION COMPANY (HCC) LTD.** **HALCROW** **SUBCONTRACTOR: BHARAT HEAVY ELECTRICALS LTD.**
CONSULTANT	**HALCROW NOIDA**

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SECTION I

1.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of double break Isolators, earth switches and its all accessories.

This section covers the specific technical requirements of Isolator. In case of any discrepancies between the requirements mentioned in this section and those specified in the following sections of this specification, the specifications given herein shall prevail and shall be treated as binding requirements.
No deviation from the requirements specified in various clauses of this specification shall be allowed. A certificate to this effect shall have to be furnished along with the offer as per attached Annexure-A with check list.

1.1 The equipment is required for the following project.

Name of Customer : NHPC Ltd.

KISHANGANGA CONSORTIUM:

Hindustan Construction Company (HCC) Ltd. / HALCROW

Subcontractor: Bharat Heavy Electricals Ltd.

Name of Consultant : HALCROW Noida

Name of the project : 220/33kV Switchyard for Kishanganga (3x110MW) HEP

Refer Section - 3 for Project Details and General Specifications.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

Since this switchyard is situated at an altitude of 1795M above MSL, the equipment shall be suitable for increased insulation level with an altitude correction factor of 1.1 times the normal values and shall be suitable for operation under prescribed conditions.
[The values of Impulse withstand Voltage & power frequency withstand voltage given in specific technical requirement below have been increased for the higher altitude taking a correction factor of 1.1].

Further the equipment being supplied shall be suitable for operation under sub zero temp, with ice/snow considerations. The equipment shall be suitable for working in the ternperature variation between (-) 12degree C to (+) 38degree C.

Rated voltage kV (rms)	220	33
Rated insulation levels		
Full wave impulse withstand voltage (1.2/50 micro sec.)		
- between line terminals and ground	± 1155 kVp (1050 kVp x1.1)	± 187 kVp (170kVp x1.1)
- between terminals with isolator open	±1320kVp (1200 kVp x 1.1)	± 214.5 kVp (195kVp x1.1)
One minute power frequency dry and wet withstand voltage		
- between line terminals and ground	506 kV rms (460kV rms x1.1)	77kV rms (70kV rms x1.1)
- between terminals with isolator open	583kVrms (530 kV rmsx1.1)	88kV rms (80kV rms x1.1)
corona extiction voltage (kV rms) with isolator in all positions	156	-
Max. radio interference Voltage (micro-volts) for Frequency between 0.5 MHz and 2 MHz at 320 kV rms for 400 kV system and 156 kV rms for 220 kV system & 92 kV rms for 132 kV system.	1000	-
Minimum creepage distance	6125	900
Phase to phase spacing (mm)	4500	1500
Clearances		
Live parts & ground (mm)	2300	480
Between phases (mm)	2700	530
Between fixed contact and blade in open position (mm)	2700	530
Rated current at 50 ^{O}C Ambient temperature (Amp.)	1250	630
Rated short time withstand Current of isolator and earth switch for 1 Sec.	31.5 kA	12.5 kA
Rated dynamic short circuit withstand Current of isolator and earth switch	79 kAp	31.5 kAp
Operating mechanism of Isolator	220V DC Motor & Manual	Manual
Operating mechanism of earth switch	220V DC Motor & Manual	Manual
Minimum make and break capability for capacitive and magnetizing current	.2A	.7A
Rated frequency (Hz)	50	
No.of poles	3	
System neutral earthing	Effectively Earthed	
Rating of auxiliary contracts	10 A at 220 V DC	
Breaking capacity of Auxiliary contacts	2 A DC with circuit time constant of not less than 20 ms	

Temperature rise over design Ambient temperature	as per table V of IEC - 694
Type	Outdoor, HDB
Min. No. of auxiliary contacts On each isolator	Besides requirement of this spec. The bidder shall wire Up 10 NO +10 NC to TBs (reversible) for purchaser's future use + 2MBB (NO+NC)
Min. No. of auxiliary contacts On each earthing switch	Besides requirement of this spec. The bidder shall wire Up 6 NO +6 NC to TBs for purchaser 's future use
Operating time	Les than 12 sec
Number of terminals in Control cabinet (inter-pole Cabling shall be supplied By the supplier)	all contacts and control circuits are to be wired upto control cabinet (plus 20 % or 24 spare terminals whichever is higher, exclusively for employer's use)
Terminal Block for all circuits	As per clause no. 3.15 of Section-3
Isolators with Single Earth switch shall be so constructed that Earth Switch can be installed on either side of the Isolators at site.	
Essential accessories such as hardware for fixing the isolator & its other parts to each other and to the support structure shall be supplied by bidder.	

1.3 BILL OF QUANITITIES

S.No.	DESCRIPTION	QTY
Supply-Main Item		
1.	220 kV, 1250 A, 31.5 kA for 1 sec, 3 phase, Horizontal double Break, 220V DC Motor Operated, mechanically ganged Isolator without Earth Switch, Post Insulators, terminal connectors and structures	15 Nos.
2.	220 kV, 1250 A, 31.5 kA for 1 sec, 3 phase, Horizontal double Break, 220V DC Motor Operated, (Tandem Type) mechanically ganged Isolator without Earth Switch, Post Insulators, terminal connectors and structures	8 Nos.
3.	220 kV, 1250 A, 31.5 kA for 1 sec, 3 phase, Horizontal double Break, 220V DC Motor Operated, mechanically ganged Isolator with one 220V DC Motor operated, mechanically ganged Earth switch but without Post Insulators, terminal connectors and structures	5 Nos.
4.	33 kV, 630 A, 12.5 kA for 1 sec, 3 phase, Horizontal double Break, Manually Operated, mechanically ganged Isolator without earth switch, Post Insulators, terminal connectors and structures	2 Nos.
5.	33 kV, 630 A, 12.5 kA for 1 sec, 3 phase, Horizontal double Break, Manually Operated, mechanically ganged Isolator with one manual operated, rnechanically ganged Earth switch but without post Insulators, terminal connectors and structures	4 Nos.

Supply-Spares		
6.	Complete drive mechanism including motor for 220kV Isolator	1 No.
7.	Complete drive mechanism including motor for 220kV Earth switch	1 No.
8.	Fixed and moving contacts (Each set comprises of 3 fixed and 3 moving contacts) for 33kV Isolator	2 sets
Services		
9	Supervision of Erection, testing & commissioning of one no. 220 kV, 1250 A, 31.5 kA for 1 sec, 3 phase, Horizontal double Break, 220V DC Motor Operated, mechanically ganged Isolator with one Earth Switch at site	1 No.
10	Supervision of Erection, testing & commissioning of one no. 220 kV, 1250 A, 31.5 kA for 1 sec, 3 phase, Horizontal double Break, 220V DC Motor Operated, (Tandem Type) mechanically ganged Isolator without Earth Switch at site	1 No.
11	Supervision of Erection, testing & commissioning of one no. 33 kV, 630 A, 12.5 kA for 1 sec, 3 phase, Horizontal double Break, Manually Operated, mechanically ganged Isolator with one Earth switch at site	1 No.

1.4 ERECTION, COMMISSIONING AND TESTING

The supervision item shall be deemed to include Bidder's assistance in erection, commissioning and testing of isolator at site. However if there are persistent problems of alignment of the subsequent Switches, the bidder's assistance shall be deemed to be included in the offer, for the subsequent erection also, until full satisfaction of the Owner, without any extra charge.

Bidder shall note that the charges for accommodation, meals, travelling, incidental expenses etc to bidder's supervisor/engineer shall not be borne by BHEL. Bidder shall have to arrange al expenses themselves. Accommodation in Customer/BHEL guest house may be provided (Subject to availability) to bidder's supervisor on chargeable basis after getting prior request. All the instruments required for testing/commissioning shall be brought by the bidder.

1.5 TYPE TESTS

The Isolators should have been type tested as per relevant IEC/IS including the followings:

a) Higher insulation levels due to higher altitude (1795 M from MSL) –
Isolators need to withstand higher Impulse levels and higher one minute power frequency withstand voltage as specified in clause 1.2 of this Section.

b) Operation under severe ice loading condition -
Moving contacts of Isolators & earth switches shall be able to operate in the 10mm ice loaded condition at (-) 12 Degree C temperature (Clause no. 6.103 of IEC 62271-102).

c) Operation at temperature limits -

Isolators need to operate at both minimum (-12° C) & maximum (+38° C) temperature specified for site. (Clause no. 6.104 of IEC 62271-102).

1.6 At contract stage, the reports for all type tests including higher insulations and Ice loading as per technical specification shall be submitted for BHEL/NHPC approval. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited base on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by the representatives(s) of NHPC or Utility. The test - reports submitted shall be of the tests conducted within last 5 (five) years prior to the date of bid opening. In case In case the test reports are of the test conducted earlier than 5 (five) years prior to the date of bid opening, the bidder shall repeat these test(s) at no extra cost to the purchaser. **Date of Bid opening is 22.01.09.**

In the event of any discrepancy in the test reports i.e. any test report not acceptable to NHPC due to any design / manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification on any/all additional type tests not carried out, same shall be carried out without any additional cost implication to the Purchaser.

1.7 MINIMUM TECHNICAL QUALIFYING REQUIREMENT

The bidder should have designed, manufactured, type tested as per IEC/IS or equivalent standard and supplied the similar ratings of isolators during last ten (10) years. The equipment so manufactured should have been successfully commissioned at least at three power stations/sub-stations.

1.8 MANUFACTURING QUALITY PLAN

Attached Quality Assurance Plan (Model) for Pothead Yard-Isolator (Enclosed at section-V) shall be followed.

1.9 CHECK LIST

Duly filled and signed checklist shall be submitted along with the offer, in the absence of which, offer may not be considered for evaluation.

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 bidder should have designed, manufactured, type tested as per IEC/IS or equivalent standard and supplied the similar ratings of isolators during last ten (10) years. The equipment so manufactured should have been successfully commissioned at least at three power stations/sub-stations.

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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
High Voltage Switches	: IEC-60265
Common Specification for High Voltage Switchgear and controlgear	: 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	: IS:2629 - 1985

& steel

Hot dip Zinc coating on structural steel and other other allied products.	: IS:4759 - 1984
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 gen engg purposes	: IS:1730- 1989
Dimension for wrought Al and Al alloy sheet & strip	: IS:2676- 1981

Latest versions of all mentioned standards shall be applicable.

2.4 DESIGN AND CONSTRUCTIONAL FEATURES

2.4.1 General

The equipment shall be three pole type and such units shall be mechanically ~~/ electri-cally~~ 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 labor 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 rnade 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 darnage 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 thermic 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. ~~The ability of pantograph isolator for 400 kV to withstand the short circuit forces due to 40kA fault current on 54 meter long strung bus with 7 meter phase to phase spacing shall be clearly brought in the tender.~~

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 and mechanical interlocks provided in the operating mechanism

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 DC supply and within a variation range as stipulated in Section 3.

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.

The isolator shall be capable of making and breaking magnetising/capacitive currents of 0.7A at 0.15 power factor.

Isolator and earth switches shall be able to bear on the terminals the total forces including wind loading and electrodynamic forces on the attached conductor without impairing reliability or current carrying capacity.

2.4.3 Main Contacts

The isolators and isolator-cum-earthing switches shall have heavy duty self-aligning and high pressure contacts and so designed that binding cannot occur after remaining

closed for prolonged periods of time in a heavily polluted atmosphere. The contacts shall be made of hard drawn electrolytic copper. The high pressure type contacts shall wipe the contact surface while opening and closing. The contacts shall be so designed that wiping action shall not cause scouring or abrasion on the contact surfaces. The wiping action shall be sufficient to remove any film of oxide which may be formed during the operation of the switches.

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 through out the life of the isolator or earthswitch. Each contact or pair of contacts shall be independently sprung so that full pressure is maintained on all contacts at all time.

The contacts and other current carrying parts shall be so designed that their temperature rise, under different conditions of operation, shall not exceed the values stipulated in the relevant standards. The temporary rise of temperature due to the passage of rated short circuit current for the specified period shall not cause any annealing or welding of contacts. The surface of the contacts shall be smooth and silver plated having a thickness of not less than 25microns.

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 contractor shall give full details of such contacts along with necessary details of such contacts along with necessary drawings.

The fixed contact of centre break and double break isolators shall be provided with springs which ensure that there is always a positive contact with adequate pressure to give enough contact surface 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. Contact spring shall not carry any current and shall not loose their characteristic due to heating effect.

2.4.4 Blades

The switch blade shall be so assembled that no part of the blade can move relative to the other. Bending and torsional stress shall not exceed 1/3rd of the rated strength of the insulator unit. All movable parts which may be in current path shall be shunted by flexible copper conductors. The conductor shall have sufficient length to prevent breaking. The silver plating on the 'moving' as well as 'fixed' contacts shall not be less than 25 microns.

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 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 also be of stainless steel. All castings and hardware other than those in the current carrying parts shall be of malleable cast iron, hot dip galvanised/electro galvanised, as appropriate.

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 rnade of aluminium/aluminium alloy.

The isolators shall be so constructed that the switch blade will not fall to the closed position if the operating shaft gets disconnected.

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.

The switch shall be designed such that lubrication of any part is not required except at very long intervals. ie. After every 1000 operations at least.

2.4.5 Earthing Switches

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 operated, either electrically or manually.

The earthing blades shall be required to carry peak current and rated short time current as the main blades of the isolators and shall withstand dynamic stresses.

Each earth switch shall be provided with flexible copper 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 swivel connection will not be accepted.

The earthing switch shall be constructionally 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.

The earthing switches shall consist of three earthing links which shall normally reset against the frames when the connected isolator is in the closed position.

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.

The isolators shall be so designed that addition of earth switches shall be possible at a future date. It should be possible to interchange position of earth switch to either side of the pole at site without disturbing constructional interlock.

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

The earthing switches shall also comply with the requirement of IEC-1129, 1992 in respect of induced current switching duty as defined for Class B earthing switches.

2.4.6 Bearings

The design and construction of the various bearings shall have all the features required to withstand the specified climatic conditions so as to ensure dependable and effective operation even after long period of inaction of these isolators and switches. All bearings in the current paths shall be shunted by flexible copper conductors of adequate cross section. Bearing housing shall be sturdy and weather proof. All bearings shall be filled & sealed with first filling of lubricants which shall be long lasting in nature. Facilities shall be provided for lubrication of bearings if not sealed for life and if washers do not have facility of greasing.

2.4.7 Operating Mechanism and Control

The isolators and earth switches shall be 220V DC motor operated/manual as specified in Section 1.

For Manually operated Isolator and Earth switch, the closing and opening operation shall be possible by the rotating movement of the operating handle through a suitably designed gear arrangement at 220V DC. The 'fully closed' to 'fully open' position and vice-versa should be reached within 15 complete rotations of the operating handle. The design of manually operated equipment shall be such that minimum energy is required for operation and one man shall be able to operate without undue effort.

The operating mechanism of the three poles shall be well synchronized and interlocked. It shall also be provided with a pole discrepancy timer and a set of contacts for pole discrepancy remote indication in case of 3 independent operating mechanisms.

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 other poles. The play in the linkages shall not be excessive. 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.

All isolator and earth switches shall be provided with manual operating handles enabling one man to open or close the isolator with ease in one movement only while standing on ground level. The operating handle shall be provided with pad locking arrangement and located at around 1meter from the base of isolator support structure.

All rotating parts including rotating insulator shall be supported on double roller or ball bearings. These shall be protected from the weather by means of covers and grease retainers. Bearing pressure shall be kept low to ensure long life and ease of operation. Locking pins wherever used shall be rustproof.

All isolators and earth switches shall be provided with operating handles and double hinged doors with padlocking arrangement for the operating mechanism box.

A mechanical indicator shall be provided at or near the operating mechanism for positive indication of the open and closed position of the switch.

A flexible conductor of adequate size shall be provided for connecting the vertical operating shaft at the lower end to the station ground bus.

Control Cabinets shall be of Aluminium or Mild Steel as specified in section 1 and shall be dust, water and vermin proof. Unless otherwise specified, thickness of sheet used shall be at least 3 mm. for aluminium and properly braced to prevent wobbling.

The enclosure of the control cabinets shall provide a degree of protection of not less than IP 65 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.

In all the mechanism boxes/control cabinets, suitable space heaters shall be mounted on account of (-) 12 Degree C temperature at site. Heater shall be suitable for 240V, 50 Hz, single phase A.C. supply.

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.

A "Local/Remote" selector switch and a set of open/close push buttons shall be provided on the control cabinet of the isolator and earth switch to permit its operation through local or remote push buttons.

Provisions shall be made in the control cabinet to disconnect power supply to prevent local/remote power operation.

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.

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.

In addition to the requirements given above, following contact zone shall be met in the case of Pantograph isolators

Permissible horizontal deflection	-	0.5 meter
Permissible vertical deflection	-	0.3 meter
Permissible longitudinal deflection	-	0.4 meter

The fixed contact and its tensioning by spring shall be such that there will be a positive contact with adequate pressure to give enough contact surface for passing the current. The springs provided shall not go out of alignment or get with the moving contact during operation. The springs provided shall be of non - ageing antirust type and its strength shall not reduce appreciably during life span of isolator.

2.4.8 Motor operated mechanism

The motor operated mechanism shall be suitable for operation on 220V DC power supply.

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.

2.4.9 Auxiliary Switch

10 NO plus 10 NC for Isolator, 6 NO plus 6 NC auxiliary contacts shall be provided for Isolator and earthswitches respectively, besides those used for the Isolator control schematics. In addition, 5 `NO' & 5 `NC' long wipe auxiliary contacts per pole shall be provided, for discrepancy indication & busbar protection in the remote control room. 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 230V 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) Signaling 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) Signaling 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 signaling 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.

2.4.10 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. The base shall be rigid and self supporting and shall require no guying or cross bracing between phases other than the supporting structures.

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.

2.4.11 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 E/S 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.

2.4.12 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 per cent 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.

2.4.13 Galvanising

All ferrous parts, except the operating mechanism box shall be hot dip galvanised as per the relevant Indian standards specified in clause 2.2.

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 make. If any other make is used, the same shall be subject to purchaser's approval.

2.5 Insulators:

Insulators are not in the scope of supply of bidder. But the following parameters of Post Insulators shall be considered for Isolator.

SN	Parameter	DATA	
1	Type	Solid Core	
2	Voltage class (kV)	220	33
3	Dry and wet one minute power frequency withstand voltage (kVrms)	506	77
4	Dry lightning impulse withstand voltage (kVp)	±1155	±187
6	Max. RIV (in µV) at specified 50-Hz phase to ground voltage in kV	1000 at 156 kV (rms)	-
7	Min. Corona extinction voltage (kV rms)	156	-
8	Total min. cantilever strength (kN)	8	8
9	Applicable standard	As per IS 2544	
10	Total height of insulator (mm)	2300	445
11	P.C.D		
11.1	Top (mm)	127	76
11.2	Bottom (mm)	254	76
12	No. of bolts		
12.1	Top	4	4
12.2	Bottom	8	8
13	Number & Diameter of bolt holes		

	Top (Tapped hole)	4 no.M16	4 no.M16
	Bottom (mm)	8 nos. 18	8 nos. 18
14	Pollution level as per IEC-815	Heavy (III)	
15	Min. total creepage distance (mm)	6125	900

2.6 TESTS

Details of tests to be performed for isolator and earthing switches as per IEC:62271-102(2001-12) shall be as follows

i) Type tests

a) Lightning Impulse voltage test (For higher value as per altitude correction) (As per IEC clause 6.1.6.1. This test shall be performed only on isolator.)

b) Switching Impulse voltage test (For higher value as per altitude correction)

c) Tests on auxiliary & control circuit.(As per IEC 60694 Clause 6.1.10)

d) Temperature rise test

e) Measurement of resistance of main circuit

f) Short time withstand current and peak withstand current tests

g) Operating and mechanical endurance tests

h) Power frequency voltage withstand test

i) Tests for measuring radio interference level and corona extinction voltage test (As per IEC 694 clause 6.2)

j) For operating mechanism boxes following tests shall be carried out :

- Dielectric test according to IEC 60439.1 clause 8.3.2

- Verification of degree of protection IP55 as per IEC 60529

k) Locked blade test on both opening and closing cycle

l) Seismic withstand test on Isolator mounted on Support Structure

m) Operation under severe ice condition (Clause no. 6.103 of IEC 62271-102)

n) Operation at temperature limits (Clause no. 6.104 of IEC 62271-102)

The test shall be performed on one fully equipped unit and shall utilize the maximum supply voltage on the control and motor circuit. The test shall clearly demonstrate that the motor supply MCBs / MCCBs will operate before any deformation of the mechanism linkages or switch parts has taken place. In all cases the main switch and its auxiliary switches shall remain in their correct relative positions at all times.

ii) Routine tests

a) Voltage tests on control and auxiliary circuits (As per IEC 60694 clause 7.2)

b) Measurement of resistance of main circuit (As per IEC 60694 clause 7.3)

c) Mechanical operating tests by simulation (As per IEC 60694 clause 7.101)

d) Test on operating mechanism and recording operating torque.

e) Galvanising Test shall be conducted according to IS:2633.

iii) Additional tests at site

The contractor is required to demonstrate the adequacy of his design and performance of the equipment by carrying out the following additional test at site.

One isolator of each type shall be cornpletely erected at site on its support structure and insulators. After the initial adjustments and alignment, 50 'CLOSE' and 'OPEN' operations shall be carried out, at rated auxiliary supply voltage in case of motorized isolator. No undue time interval shall be allowed between the operations.

SECTION - III

PROJECT DETAILS AND GENERAL SPECIFICATIONS

3.0 INTRODUCTION

Kishanganga Hydroelectric project (3x110=330MW) is located in Baramulla district of Jammu and Kashmir state of India. As a part of the project, 220/33 kV Switchyard is being carried out.

3.1 PROJECT INFORMATION

SL. NO	DESCRIPTION	
a)	Customer	NATIONAL HYDRO ELECTRIC POWER CORPORATION LIMITED (NHPC) **KISHANGANGA CONSORTIUM:** **Hindustan Construction Company (HCC) Ltd.** **HALCROW** **Subcontractor: Bharat Heavy Electricals Ltd. (BHEL)**
b)	Project	220/33kV Switchyard for Kishanganga (3x110MW) HEP
c)	Project locations	Kishanganga Hydroelectric project(3x110=330MW) is located in Baramulla district of Jammu and Kashmir state of India. Refer Project Details from Contract Specification attached herewith.
d)	Nearest Airport	Srinagar is the nearest city, well connected by Air.
e)	Nearest Railway station /Gauge Distance from Railway Station	Jammu is the nearest broad guage railway head
f)	Road Approach	Refer Project Details from Contract Specification attached herewith.
	Transport Limit	Refer Project Details from Contract Specification attached herewith.

3.2 SITE CONDITIONS

SL. NO	DESCRIPTION	
i.	Altitude	About 1795 m above mean sea level.
ii.	Rainfall (Average annual rainfall)	Refer Project Details from Contract Specification attached herewith.
iii.	AMBIENT AIR TEMPERATURE (a) Max. temp	 38 deg C

	(b) Min. temp	-12 deg C
iv.	RELATIVE HUMIDITY (a) Maximum (b) Minimum	 94% 62%

Equipment to be supplied against this specification shall be suitable for satisfactory continuous operation under the above tropical conditions.

Seismic Design

The project is situated in a hilly seismic area and falls within Zone V of the seismic zoning Map of India. Value of horizontal component of peak ground acceleration for Maximum Credible Earthquake (MCE) and for Design basis Earthquake (DBE) shall be 0.36g and 0.18g respectively. The forces being caused by earthquake including hydraulic loads, which may occur additionally, shall be taken into account for the computations. Stresses resulting after including these loads shall not exceed permissible stresses.

The Contractor shall design all equipment supplied under this contract to satisfy the seismic criteria. The Contractor shall submit the method of calculation and relevant codes he intends to use for this purpose.

In addition to above, the IS 1893 shall be adopted for seismic design. Hydrodynamic forces due to seismic conditions shall be considered on HM or EM equipment in addition to hydro static loads.

3.2.1 Auxiliary Supply

Auxiliary electrical equipment pertaining to this project shall be suitable for operation at the following supply system.

Normal Voltage	Variation in Voltage	Frequency (Hz)	Phase/Wire	Neutral Connection
415 Volts	± 10%	50 ± 5%	3/4 wire	Grounded neutral
240 Volts	± 10%	50 ± 5%	½	effectively earthed
220 Volts	± 10%	DC	2 wire	Ungrounded, with earth fault detection
48 Volts	± 10%	DC	2 wire	Ungrounded, with earth fault detection

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

3.3 INSPECTION, TESTING AND INSPECTION CERTIFICATE

All equipment being supplied shall conform to type tests and shall be subject to routine tests in accordance with relevant standards.

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 test/routine tests/acceptance tests as specified shall be conducted in the presence of BHEL/NHPC. Wherever equipment similar to the one being offered has already been type tested in an independent government laboratory or in the presence of representative of State Electricity Board or other reputed public undertakings, Type test reports of the same shall be submitted

for approval of BHEL /NHPC.

If these are not found technically acceptable, contractor will have to carry out the type test without any extra cost and/ or delivery implications in presence of BHEL/NHPC.

Where specified by the purchaser, type tests will have to be conducted by the sub-contractor on the equipment in the scope of supply. Such test shall be witnessed by the customer and BHEL, for which the test charges and delivery implications if any shall be indicated separately by the sub-contractor.

The contractor shall give the Owner/Inspector 3 week's written notice of any material being ready for inspection/testing. Such tests shall be to the Contractor's account except for the expenses' of the Inspector.

The purchaser NHPC/BHEL or their authorized representative shall have at all reasonable times free access to the contractor's works and shall have the power at all reasonable times to inspect the material and workmanship of the works during manufacturing or erection if part of the works is being manufactured or assembled at other premises. Inspection may be made at any stage of manufacture, dispatch or at site at the option of NHPC/BHEL and the equipment if found unsatisfactory due to bad workmanship or quality is liable to be rejected.

When the factory tests have been completed at the subcontractor's works the Owner/Inspector shall issue a certificate to this effect after completion of tests. But if the tests are not witnessed by the Owner/Inspector, the waival shall be issued by the Owner/Inspector within fifteen (15) days of the receipt of the Contractor's test certificate. Failure of the Owner/Inspector to issue such a waival shall not prevent the contractor from proceeding with the works. The completion of these tests or the issue of the waival shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the Contract. However, in case of waivals, the contractor shall ensure to carry out the testing as per approved quality plans and specification requirements and send two copies of all the test results to the Owner for his review and approval.

In all cases where the Contract provides for tests at the premises or works of the contractor, the contractor, except were otherwise specified shall provide free of charge such items as labor materials, electricity, fuel; water, stores, apparatus and instruments as may be reasonably demanded by Owner/Inspector or his authorized representatives to carry out such tests.

The Inspection by Employer 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.

The owner will have the right of having at his own expenses any other test(s) of reasonable nature carried out at contractor 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 Employer reserves the right for getting any field tests conducted on the completely assembled equipment at site.

3.4 QUALITY ASSURANCE PROGRAMME

The supplier should adopt suitable quality assurance programme to control all necessary activities to ensure that the equipment and / or services under the scope are in accordance with

this specification. A quality plan detailing out the specific quality measure and procedures adopted for controlling the quality characteristics to be submitted for BHEL and NHPC approval.

The quality programme is defined by ISO 9001, 1994 Quality systems - Model for quality assurance in design, development, production, installation and servicing.

3.5 DOCUMENTATION

The Contractor shall submit a detailed list of all drawings he proposes to submit for approval/information after the award of the contract. This list shall be revised and extended, as necessary, during the progress of work.

All drawings submitted by the Contractor shall be in sufficient detail to indicate the type, size, arrangement weight of' each component, breakdown for packing and shipment, the external connections, fixing arrangements required, the dimensions required for installation and interconnections with other equipment land materials. clearances and spaces required between various portions of equipment and any other information specifically requested.

After the award of the Contract, the Contractor shall submit, (as per the Distribution Schedule enclosed at the end of this section as a Table) copies of design basis reports/concept notes, design calculations, material specifications and detailed drawings as called for in the Contract for the Owner's / Owner's, Representative review. The Contractor must satisfy the Owner's / Owner's Representative as to the validity of his design with reference to the requirements of Statutory Codes / Authorities, local regulations and the contract specifications.

All dimensions on drawings shall be in Metric Units, unless otherwise specified. The details in the drawings shall be in English language only.

Drawings submitted by the Contractor will be checked/reviewed by the Owner/Engineer and comments, if any, on the same will be conveyed to the Contractor. It is the responsibility of the Contractor to incorporate correctly all the comments conveyed by the Owner/Engineer on the Contractor's drawings. The drawings which are approved with comments are to be resubmitted to the owner/Engineer for purpose of records. Such drawings will not be checked/reviewed by the Owner/Engineer to verify whether all the comments have been incorporated by the Contractor. If the Contractor is unable to incorporate certain comments in his drawings he shall clearly state in his forwarding letter such non-compliance along with valid reasons and justification.

The Contractor shall not be relieved of his obligations under the Contract if he has not included features in the specification, including but not limited to his Guarantee obligations stated herein, by incorporating the Owner's / Owner's Representative comments.

Any work performed or material ordered by the Contractor prior to receipt of drawings stamped 'Approved with comments as noted', by the Owner/Engineer Shall be at the risk of the Contractor. After print of any drawing has been returned 'Approved', the Contractor may release the parts covered by the drawing, for production.

Drawings prepared by the Contractor and approved by the Owner/Engineer shall be considered as a part of the Contract Specification. However, examination and approval of the drawings by the Qwner/Engineer shall not relieve the Contractor of his responsibility for

engineering, design, workmanship, materials and construction under the Contract.

If, at any time before the completion of the work, changes are made necessitating revision of approved drawings, the Contractor shall make such revisions and proceed in the same routine as for the original approval.

3.5.1 OTHER REQUIREMENTS OF DOCUMENTATION

Upon completion of the installation, the Contractor shall furnish a complete set of drawings on reproducible tracing film on which the VENDOR/Contractor shall make in a neat and accurate manner, a complete record of all changes and revisions to, the original design, as installed in the completed work. These drawings shall be submitted to the Owner/Engineer.

AS BUILT DRAWINGS

The Contractor shall prepare and submit to the Owner/Engineer "As- Built drawings" of the Works, showing all Works as executed. The drawings shall be prepared as the Works proceed, and shall be submitted to owner/Engineer for his inspection. The Contractor shall obtain the consent of the Owner as to the drawing size, the referencing system and other pertinent details.

The drawings/documents distribution schedule shall be as indicated below.

The title block of drawings shall contain the following information incorporated in all contract drawings

CUSTOMER	National Hydroelectric Power Corporation Limited (NHPC)				
PROJECT	220/33kV Switchyard for Kishanganga (3x110MW) HEP KISHANGANGA CONSORTIUM: Hindustan Construction Company (HCC) Ltd. HALCROW Subcontractor: Bharat Heavy Electricals Ltd. (BHEL)				
BHEL P.O. No.		**PROJ. DOC. No.**		**REV. No.**	
CONTRACTOR	BHARAT HEAVY ELECTRICALS LIMITED				
VENDOR'S STANDARD TITLE BLOCK					

DOCUMENTS TO BE SUBMITTED ALONGWITH OFFER

1) **Drawings**
2) **Guaranteed Technical Particulars**
3) **Type Test Reports**
4) **Manufacturing Quality Plan**

DOCUMENTATION SCHEDULE AT CONTRACT STAGE

A	**For Approval**
7 (6+1)	Copies of GA drawings with projects details, dimension, equipment weight, fixing details, tolerances and terminal details etc.
7 (6+1)	Copies of type test reports
7 (6+1)	Copies of shipping list detailing the description & quantities of all items being dispatched separately, with shipping weights, number of cases and dimensions.
7 (6+1)	Copies of manufacturing and field quality plan.
B	**After Approval and For Information/Distribution.**

220kV & 33 KV DOUBLE BREAK ISOLATOR

11 (10+1)	Copies of All drawings plus 2 Set Reproducibles.
11 (10+1)	Bound sets containing all 'as built' drawings/manuals, type and routine test reports etc. along with sub-vendor's test reports for all bought out assemblies/components/parts including Internal wiring diagrams and exploded diagrams of assemblies/ parts, shall be furnished plus 2 Set IR
11(10+1)	Copies of Installation, Operation & Maintenance manual.
11(10+1)	Sets of Spare parts catalogue.
5	Set of Computer CD-ROMs containing all 'as-built' drawings/documents.

All the technical documents and drawings required to be furnished under this contract as per specification shall be prepared in internationally accepted software of latest version used for preparation of documents and drawings.

All the drawings and documents shall be submitted in presentable folders properly bound and catalogued for easy retrieval / reference. Drawings shall be submitted in A0 / A2 /A3 and all documentation in A4 size. All drawings shall be digitally printed/ plotted. Ammonia print/ blue print shall not be accepted.

Time schedule of drawings/documents required at contract stage shall be furnished by the supplier.

Material shall not be dispatched without the approval of test certificates by purchasers.

3.6 MATERIALS AND WORKMANSHIP

3.6.1. GENERAL REQUIREMENTS

Where the specification does not contain characteristics with reference to workmanship, equipment materials and component 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 the best engineering practice and suitable for the purpose for which they are intended.

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

Incase where the equipment material or components are indicated in the specification as "similar" to any special standard, the employer shall decide upon the question of similarity. When required by the specification or required by the employer the supplier shall submit, for approval, all the information concerning the material or 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.

The design of the work shall be such that Installation, future expansions, replacement 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 part shall be accurately positioned and retained 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 Employer.

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 material and workmanship as the corresponding parts of the equipment supplied under specification. Where feasible, common component units shall be employed in different pieces of the equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

All material and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practice 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, grouping, leveling, aligning, coupling of or bolting down to previously installed equipment bases/ foundation, performing the alignment check and final adjusting prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances and instruction and the specification. 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 purpose. The spare equipment(s) shall be installed at designated location and tested for healthiness.

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 purpose 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.

All oil, grease and other consumables used in the Works/Equipment shall be purchased in India unless the Supplier 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 Employer in establishing equivalent India make and Indian supplier. The same shall be applicable to other consumables too.

A cast iron or welded steel base plate shall be provided for all rotating equipments which are to be installed on a concrete base unless otherwise agreed to by the Employer. Each base plate shall support the units and its drive assembly, shall be of design with pads for anchoring the units and shall have a raised up all around and shall have threaded in air connections, If so required.

All components exposed to rain shall be designed with sloped upper surface to avoid water pools.

3.7 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

All power clamps and connectors shall confirm to IS:5561 & NEMA CCI and shall be made of materials listed below:

220kV & 33 KV DOUBLE BREAK ISOLATOR

a	For connecting ACSR	Aluminium alloy casting conforming to designation A6 of IS:617 and shall be tested for all test as per IS:617
b	For connecting equipment terminals made of copper with ACSR conductors	Bimetallic connectors made from Aluminium alloy casting conforming to designation A6 of IS:617 with 2mm thick liner and shall be tested as per IS:617
c	For connecting GI shield wire	Galvanised mild steel
d	I) Bolts, nuts & plain washer galvanised II) Spring washers for items 'a' to 'c'	i) Electro galvanisation for sizes below Ml2, for others hot dip Galvanised ii) Electro Galvanised mild steel suitable for at least service condition-3 as per IS: 1573

Each equipment shall be supplied with the necessary terminals and connectors, as required by the ultimate design for the particular installation. The conductor termination of equipment shall be suitable for Twin/ single Zebra/ Moose ACSR Conductor with 250 mm Sub-Conductor spacing. The requirement regarding external RIV as specified for any equipment shall include its terminal fittings and the equipment shall be factory tested with the connectors in position

Where copper to aluminium 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. The design details of the joint shall be furnished to the employer by the supplier.

Low voltage connectors, grounding connectors and accessories for grounding all equipment as specified in each particular case, are also included in the scope of work.

No current carrying part of any clamp shall be less than 12 mm thick. All ferrous parts shall be hot dip galvanized. Copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminium body for Bi-metallic clamps.

Lateral load deflection test shall be carried out as an acceptance test. The test procedure and accepted norms shall be mutually discussed and agreed to.

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

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 with respect to the specified reference ambient temperature shall also be indelibly marked on each component of the clamp/connector, except on the hardware.

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

Clamps and connectors shall be designed to be corona controlled. RIV level for 220 kV/ 132 kV system shall not be more then 1000 micro volts respectively at the specified test voltage as per IS/NEMA

3.7.1. TESTS

Clamps and connectors shall confirm to type tests and shall be subjected to routine tests as per IS:5561

3.7.2. HIGH VOLTAGE TERMINAL

The high voltage terminals shall be preferably made of aluminium or aluminium alloy. If copper terminals are used, they shall be tin-plated. The conductor termination of equipment shall be either expansion, sliding or rigid type suitable for ACSR Conductor./Aluminium tube.

3.7.3. GROUND TERMINAL EARTHING

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 star of self etching washer. Earthing of hinged door shall be done by using a separate earth wire.

3.8 NAME PLATES, RATING PLATES AND LABELS

a) Each main and auxiliary item of equipment is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved the following:

i) Manufacturer's name
ii) Type number
iii) Serial number
iv) Rated voltage
v) Rated impulse withstand voltage
vi) Rated power frequency withstand voltage
vii) Rated frequency
viii) Rated current
ix) Rated short circuit breaking current
x) Rated short time current (rms) & duration.

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 Employer. The rating plate shall confirm to IEC requirement.

b) All such name plates, instruction plates, rating plates etc. shall be in bilingual with Hindi inscription first followed by English. Alternatively, two separate plates one with Hindi & the other with English inscription may be provided.

3.9 PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE

Outdoor and indoor equipment supplied shall be suitable for service and storage under tropical conditions of high & low temperature, high humidity, heavy rainfall and environment favourable to the growth of fungi and mild dew.

3.9.1. SPACE HEATERS

The heater shall be suitable for continuous operation at 240 V AC supply voltage and shall be provided with on – off switch and fuse.

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

The heaters shall be suitably designed to prevent any contact between the heater wire and air and shall consist of coiled resistance wire centred in metal sheath and completely encased in a highly compacted powder of Magnesium Oxide or other material to prevent any contact between the wires. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built in to an envelop of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in vitreous glaze. The surface temperature of the heaters shall be restricted to a value, which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

3.9.2. FUNGISTATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied to 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 shaft be protected against the application of the varnish.

3.9.3. VENTILATION OPENING

In order to ensure adequate ventilation, components shall have ventilation openings provided with fine wire mesh of brass or galvanized steel 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.

3.9.4. DEGREE OF PROTECTION

The enclosures of the control cabinets, junction boxes and marshalling boxes to be installed shall provide degree of protection as detailed here under:

a) Installed outdoor: IP-65
b) Installed Indoor in air conditioned area: IP-40 or higher
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) or IEC-947 (Part-I). Type test report for degree of protection test, on each type of the box shall be submitted for approval.

3.9.5. TROPICALISATION

All equipment shall be suitable for installation in a tropical monsoon area having hot, humid climate and dry and dusty seasons with ambient conditions as specified. All control wiring, equipment and accessories shall be protected against fungus growth, condensation, vermin and other harmful effects due to a tropical environment.

3.10 SURFACE TREATMENT, PAINTING AND FINISHING OF METAL SURFACES

3.10.1. GENERAL

All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use shall be hot-dip galvanized after fabrication. High tensile steel nuts and bolts and spring washers shall be electro-galvanized to service condition. All steel conductors Including those used for earthing/grounding (above ground level shall also be galvanized according to IS:2629.

3.10.2. HOT DIP GALVANIZING

220kV & 33 KV DOUBLE BREAK ISOLATOR

The minimum weight of the zinc coating shall be 610g/sq.m and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For Items lower than 6mm thickness requirement of coating thickness shall be as per relevant ASTM.

The galvanized surfaces shall consist of a continuous and uniform thick coaling of zinc, firmly adhering to the surface of steel. The finished surfaces shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, plate 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.

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.

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

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

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

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

3.10.3. PAINTING

All 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 before hand to be treated and protected for the life of the equipment The surface which are to be finish painted after installation, shall be shop painted with atleast two coats of primer. Oil, grease, dirt and swart 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.

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 or ready mixed, stoving type zinc chromate primer, the first coat may be flash dried, while the second coat shall be stoved.

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

The exterior colour of the paint shall be as per shade No.:631 of IS-5 and inside shall be glossy white. Each coat of 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.

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 along with the bids for employer's review & approval.

3.11 CASTING

All castings shall be true to pattern, free from defects and of uniform quality and condition. The surface of castings, which do not undergo machining, shall be free from foundry irregularities. The casting shall be tested for NDT, chemical, mechanical and metallographical tests. This shall be specified in quality plan for the specific equipment. Iron casting material shall be in accordance with ASTM A 126 class B. Steel casting shall be manufactured in accordance with ASTM A 27 and shall be subject to appropriate tests and inspection.

3.12 FORGINGS

If requested by purchaser, forging shall be tested by magnetic particle, dye penetration, radiographic, ultrasonic or any combination of methods, which may suit material type and forging design. The testing is to be carried out according to appropriate ASTM standards. The forging shall be tested for mechanical and metallographical tests as per ASTM.

3.13 FABRICATED COMPONENTS

All components machined or fabricated from plate, sheet or bar stock shall meet the material requirements of ASTM. Structural steel, rolled shapes, bars etc. shall comply with the latest ASTM for A36.

All or a representative number of such components shall be subjected to one or more of the tests: visual, dye penetration, magnetic particle (transverse and longitudinal), ultrasonic or radiograph. These tests shall be in accordance with the ASTM. The acceptance shall be as per ASTM Specifications.

3.14 CONTROL CABINETS, JUNCTION BOXES, TERMINALS BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENTS

Unless otherwise specifically called for or described in these Contract documents all electrical appliances shall conform to the applicable IEC Publications.

The cubicles and enclosures shall be of protection class IP 40 or higher according to their location. For outside installation and area which are humid, corrosive, and prone to dripping and/ or spray of water, the protection class of cubicles shall be IP 65. Cubicles housing electronic cards/modules such as of unit control boards/local control boards, digital governors, static excitation equipment shall be of protection class of IP 5X.

Cables shall have at least 1000 V PVC insulation except for 220V DC and tele-metering or communication system equipment for which 650V and 300 V ratings respectively are acceptable.

For current and potential transformer secondary circuits the minimum cross section of the conductors shall not be less than 4.0 mm2.

Wiring shall terminate at terminal blocks at one side only. Where tap connections are required, they shall be made on terminal blocks. Wiring shall be neatly arranged and laid in

wire ways accessible from the front door. The wire ways shall not be filled more than 70 %.

Each cubical shall be provided with an earthing bar (PE) of sufficient cross section carrying any possible fault current without undue heating. All metallic parts of the cubicle not forming part of the live circuits, all instrument transformer terminals to be earthed and other earthing terminals as well as all cable screens and PE-wires shall be connected to the earthing bar.

All internal equipment and wiring shall be neatly and clearly marked as indicated on the schematic and wiring diagrams. Internal wiring and cables shall be marked with sleeve type engraved marking. Marking system and marking material shall be subject to approval by Employer. Identification of the respective conductors shall be in accordance with the requirements of IEC publication 60204. In cable, having five conductors or more the individual conductors shall be numbered throughout the entire length. In cables having less than five conductors colour coding in accordance with IEC Recommendations 60204 shall be used.

Cubicles and control panel enclosures shall be of cold rolled sheet steel with minimum thickness for load bearing members as 2.5mm and non load bearing as 2 mm, of rigid, self-supporting construction and supplied with channel bases made to ensure no bulging takes place.

Cubicles shall be fitted with close fitting, gasketted, hinged, lift-off doors capable of being opened through 180 deg. The doors shall be provided with integral lock and master key.

Cubicles and panels shall be vermin proof. Removable gland plates shall be supplied and located to provide adequate working clearance for the termination of cables. Under no circumstances shall the floor/roof plate be used as a gland plate. The cables and wiring shall enter from bottom or top as approved or directed by the Engineer.

The cubicles and panels shall be adequately ventilated, if required, by vents or louvers, and shall be so placed as not to detract from the appearance. All ventilating openings shall be provided with corrosion-resistant metal screens or a suitable filter to prevent entrance of insects or vermin. Space heating elements with thermostatic control shall be included in each panel.

Where cubicles are split between panels for shipping, terminal blocks shall be provided on each side of the split with all necessary cable extensions across the splits. These cable extensions shall be confined within the panels with suitable internal cable ducts.

Unless stated otherwise, all cubicles and panels shall be provided with a ground bus with 40mm copper bar extending through out the length. Each end of this bus shall be drilled and provided with lugs for connecting ground cables ranging from 70 to 120mm2.

The standard phase arrangement when facing the front of the motor control centres and switchboard shall be RYB from left to right, from top to bottom and front to back. All instruments, devices, buses and other equipments involving 3 phase circuits shall be arranged and connected in accordance with the standard phase arrangement, where possible. Electrical clearances shall conform to applicable standards and shall not require cutting away of adjacent framework.

All instruments, control knobs and indicating lamps shall be flush mounted on the panels.

Relays and other devices sensitive to vibration shall not be installed on doors or hinged panels, and no equipment shall be installed on rear access doors.

The instrument and control wiring, including all electrical interlocks and all interconnecting wiring between sections, shall be completely installed and connected to terminal blocks by the manufacturer.

The arrangement of control and protection devices on the panels and the exterior finish of the panels shall be subject to the approval of the Engineer. The interior of all cubicles and panels shall have a mat white finish unless specified otherwise.

Switched interior light and socket outlets shall be provided for all cubicles and control panels.

All cubicles and control panels shall be provided with lamacoid nameplates, identifying the purpose of the panel and all of its components.

Control switches, indicating lamps and instruments

Measuring converters

The converters shall be suitable for direct connection to the secondary circuits of the potential and current transformers used, or other sensors, each as they apply. The converters shall be static type, having all accessories to provide an output signal of 4-20 mA, filtered DC.

For the measuring converters the following minimum requirements shall be fulfilled:
Current transducers shall be single-phase, of accuracy class 0.5 or better.
Voltage transducers shall be single-phase of accuracy class 0.5 or better.

W and VAr transducers shall be two elements, three-phase. Accuracy class of the transducers shall be 0.5 or better.

Measuring transformers

Potential transformer secondary windings shall be rated $110/\sqrt{3}$ V
Current transformer secondary windings shall have a rated current of 1A/2.5A /5A.

3.14.1. EARTHING:

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 star of self etching washer. Earthing of hinged door shall be done by using a separate earth wire.

3.14.2. TESTS

a) The marshalling kiosks shall be subject to routine tests as per IS:5039

b) The following routine tests shall also be conducted:

I) Check for wiring
II) Visual and dimension check

Marshalling kiosks shall be provided with danger plate and a diagram showing the numbering /connection / ferruling by pasting the same on the inside of the door.

3.15 TERMINALS, TERMINAL BLOCKS AND WIRING

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Control circuits and power circuits shall be completely separated by use of divided or separate terminal blocks

Terminal blocks shall be 1100V grade and have continuous rating to carry the maximum expected current on the terminals. The terminal blocks shall be cage clamp type (Wago or equivalent) or non-disconnecting stud type (Elmex type CAT-M4 or equivalent). The insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.

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.

The terminal blocks shall be of expandable design.

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

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.

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

All circuits except CT /PT circuits	Minimum of two of 2.5 sq. mm copper flexible
All CT/ PT circuits	Minimum of 2 nos. of 6 sq. mm copper flexible

The arrangements shall be made 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.

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

There shall be minimum clearance of 250 mm between the first/ bottom row of terminal block and the associated cable gland plate. Also, the clearance between two rows of terminal blocks shall be a minimum of 150 mm.

All terminal blocks shall be mounted in an accessible position with the spacing between adjacent blocks not less than 100 mm and space between the bottom blocks and the cable gland plate being a minimum of 200 mm. Sufficient terminals shall be provided to allow for the connection of all incoming and outgoing cables, including spare conductors and drain wires. In addition, 20 percent spare terminals shall be provided. In enclosed cubicles, the terminal blocks shall be inclined toward the door for facilitating terminations.

Terminals shall be of the channel mounting type and shall comprise a system of individual

terminals so that terminal blocks can be formed for easy and convenient cabling consistent with the high reliability required of the circuits.

Terminal blocks shall be provided with shorting links and paralleling links where applicable and mounting identification numbers and/or letters.

Terminal blocks shall disconnecting link type for CT, PT and incoming supplies AC/DC & for balance fixed link type conforming to the applicable standards. The smallest size to be used shall be designated for 2.5-sq. mm wire and not more than two conductors shall be connected under one terminal clamp.

Terminal identification shall be provided corresponding to wire number of connected leads.

Circuit terminals for 415 V AC shall be segregated from other terminals and shall be equipped with no inflammable, transparent covers to prevent contact with live parts. Warning labels with red lettering shall be mounted thereon in a conspicuous position.

Equipment wiring

All wiring connections shall be readily accessible and removable for test or other purposes. Wiring between terminals of the various devices shall be point to point.

Splices or tee connections between terminal points are not acceptable. Wire runs shall be neatly trunked inside the panels or in wiring troughs. Whenever possible, unused areas of the panels shall be kept free of wiring to facilitate the installation of future equipments.

Multiconductor cables shall be connected to the terminal blocks in such a manner as to minimise crossovers. Approved claw washers of crimp type connector shall be used to terminate all small wiring. Each conductor shall be individually identified at both ends through a system providing ready and permanent identification, utilising slip-on ferrules approved by the Engineer.

Markers may be typed individually or made up from sets of numbers and letters firmly held in place. Open markers will not be accepted.

Markers must withstand a tropical environment and high humidity and only fungus proof materials will be accepted. Ferrules of adhesive type are not acceptable.

All trip circuits shall employ markers having a red background.

Sensitive control circuits shall be effectively shielded against extraneous signals and interference. A separate terminal shall be provided for termination of individual cable shields, which will be grounded at source end only.

3.16 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS:

Bushings shall be manufactured and tested in accordance with IS: 2099 & IEC: 137 while hollow column insulators shall be manufactured and tested in accordance with IEC 233/IS 5621. The support insulators shall be manufactured and tested as per IS 2544/IEC 168 and IEC 273. The insulators shall also conform to IEC 815 as applicable.

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.

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

Supports 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.

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 caused by the insulators/bushings when operating at the normal rated voltage.

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.

All iron parts shall be hot dip galvanized 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.

3.17 MOTORS

Motors shall be "Squirrel Cage" three phase induction motors/220V DC Motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and shall conform to type tests and shall be subjected to routine tests as per applicable standards. The motors shall be of approved make.

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.

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

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

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

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.

Motors shall be capable at giving rated output without reduction in the expected life span when operated continuously in the system

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All induction motors shall be suitable for full voltage direct-on-line starting and accelerating to the rated speed along with the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 80% of the rated voltage.

Motors shall be capable of withstanding the electro-dynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.

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.

Motors when started with the driven equipment imposing full starting torque under the supply voltage conditions 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.

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 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.

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.

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.

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.

3.18 SEISMIC WITHSTAND TEST PROCEDURE

The seismic withstand test on complete equipment shall be carried out along with the supporting structure. The Supplier shall arrange to transport the structure from the structure supplier's works/ project site or alternatively arrange the structure as per approved drawings 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 pads of the equipment and any other point as agreed by BHEL / customer. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of BHEL / customer.

3.19 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 operations, shall be furnished by the contractor unless specifically excluded under the exclusions in these specifications and documents.

220kV & 33 KV DOUBLE BREAK ISOLATOR

3.20 PACKING AND SHIPPING

All the equipment 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. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken account.

The Contractor shall mark all containers with the implementing document number pertinent to the shipment. Each shipping container shall also be clearly marked on at least two sides as follows:

- Consignee : to be furnished at a later date
  - Contract No. :
  - Country of Origin :
  - Port of entry :
  - Item number (if applicable) :
  - Package number, in sequence :
  - and quantity per package :
  - Description of Works :
  - Net and gross weight, volume :

The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to Improper packing. Employer takes no responsibility of the wagons.

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The power house and switchyard would also have illumination system, grounding system, Public address system and PLCC system.

3.0 SALIENT FEATURES OF THE PROJECT

Based upon preliminary designs, the salient features of the project are as under:

Location	
State	Jammu & Kashmir
District	Baramulla
River	Kishanganga
Dam site	Gurez valley-100m u/s of Malik Kadal bridge
Latitude	34° 39' 00"
Longitude	74° 45' 08"
Powerhouse site	Near village Kralpora Tehsil Bandipura
Latitude	34o 28' 17"
Longitude	74o 38' 28"
Hydrology	
Catchment area	1815 Km^2
Maximum observed flood	740 cumec
Probable max. flood	2000 cumec
Average Annual run off	1342.5 Mcum
Annual rainfall	676 mm
Annual snowfall (in terms of water equivalent)	1206 mm
Reservoir	
Full Reservoir Level	El. 2390.00 m
Maximum Reservoir level	El 2390.00 m
Minimum Draw Down Level	El. 2384.50 m
Gross storage up to FRL	18.35 Mcum
Dead storage capacity	10.80 Mcum
Live storage capacity	7.55 Mcum
Diversion tunnel	
Number	1
Size, Shape	6.5m diameter, Horse shoe
Length	560 m
Diversion capacity	286 cumec

Dam

Type	Concrete face rock fill dam
Maximum height above Deepest river bed	37 m
Elevation of top of dam	El. 2395.00m

Spillway

Design flood	2000 cumecs
Type	Chute spillway
Crest Elevation	El 2370 m
No.& size of spillway gates	3 Nos., 7.0m (w) x 9.5m (h)
Maximum discharge over Spillway per meter width	95.23 cumec / m
Energy dissipation	Flip bucket
Crest level of spilling channel	El 2389.00 m
Width of spilling channel	12.5 m

Intake

Invert level	El 2378.80 m
No. & size of opening	2 nos. , 4.25m(w) x 2.5m (h)

Head Race Tunnel

Number	1
Size & Shape	5.4m HS (DBM) / 5.2 Circular (TBM)
Length	23.5 km .
Design discharge	58.4 cumec

Construction Adit

No. & length	Inlet Adit 200 m Adit-1 500m Surge shaft end adit 300 m

Surge shaft

Diameter	15 m
Height	112 m
Type	Restricted orifice
Maximum surge level	El. 2415.00 m
Minimum surge level	El. 2325.00 m

Pressure shaft

No. & Type	One, stepped, circular, Steel lined
Diameter	4.0m diameter, trifurcating into three 2.10 m diameter penstocks

Powerhouse complex

Type	Underground
Installed capacity	330 MW
No. of units	3
Powerhouse cavern	113 m(l) x 21.3m (w) x 46.5m (h)
Transformers hall cavern	75 m (l) x 15m (w) x 15.2m (h)
Service bay level	El 1735.80m
C/L of machines	El 1723.50m
Elevation of bottom of draft tube	El 1714.00m
Type of turbine	Pelton wheel
Design Max. gross head	665m
Rated net head	640m
Ventilation cum cable tunnel	
Size, shape	4m x 4m, D-shape
Length	580 m
Access tunnel	
Size, shape	8.0m (w) x 6.5 m (h) D-shape
Length	686m
Adit to powerhouse crown	
Size, shape	6m x 6m, D-shape
Length	184 m

Tail Race System

Tunnel	D-shape
Length	700 m (approx)
Diameter	5.0 m
Open channel portion	
Length	100 m

Switchyard

Size & location	200m x 130m near Kralpora village

Power Generation

Installed capacity	330 MW

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Peaking capacity during lean period 330 MW

Annual Design Energy generation 1350 MU

4.0 ACCESS TO AND WITH IN THE PROJECT AREA.

4.1 General

The Kishanganga Hydro electric project is located in the great Himalayan ranges close to the LOC. The dam site of the project is situated in Gurez valley and power house site is at Bandipora in Kashmir valley of J&K state. Srinagar is the nearest city, well connected by Air. Approximate distances of Project from different important towns are as below.

	Dam site	Power House Site
From Delhi	1025 km	955 km
From Jammu	440 km	370 km
From Srinagar	140 km	70 km

4.2 Jammu – Srinagar Road

(1) The principal access road to the Site is the approximately 300 km long National highway NH-1A connecting Jammu to Srinagar. This road is under the administrative control of BRO (Border Roads Organisation) which is responsible for the maintenance of this road.

Along certain stretches of NH-1A, the slopes above the road become unstable when saturated during the monsoon time and the road gets blocked by the resulting landslides and rock falls. Such blockages will, in general, be cleared by BRO as soon as reasonably possible. .

(2) NH1A between Banihal and Quazigund passes through a road tunnel known as Jawahar Tunnel and has height and width restrictions. Cross-section of tunnel is enclosed as plate-4.1
(The Contractor has to keep in view, of above mentioned critical dimensions of Jawahar Tunnel for transportation of his Construction Equipment and Electromechanial & Hydromechanical Plant & Machinery).

4.3 Srinagar – Bandipora road

(1) First 8 km stretch of this road (Between Srinagar and Sheltang) is covered under National Highway 1 A.

(2) The next 50 Kms(i.e KM 8 to 58) between Shetang and Bandipora is also a National highway with double lane specification and plain ruling gradient. While in general the formation width of this road is between 7

to 10 m , at certain locations the formation width available is restricted to 4m only.

(3) Bridge Details

- At KM 25, Sumbal RCC bridge (168 m length) with loading capacity 70 R.
- At KM 27, Nadinara steel bridge(18.5 m length) with loading capacity 18 R. However, this nallah portion can also be crossed by diversion road through Nandinara Village. Any temporary additional measures for diversion road shall be planned and executed by the Contractor.
- At KM 41.9, Ajass RCC bridge (14 m length) with loading capacity 70 R.
- At KM 53.75, RCC bridge (10 m length) with loading capacity 70R.
- At KM 53.80, RCC bridge (5 m length) with loading capacity 70R.
- At KM 54.70, Steel Bridge on papchan nallah (A) with length 29 m and loading capacity 18 R. At KM 54.80, Steel bridge on Papchan nallah(B) with length 29 m and loading capacity 18 R. However, these nallah portions can also be crossed during the lean season through bed crossing. Any temporary additional measures for crossing of these nallahs shall be planned and executed by the Contractor.

4.4 Bandipora – Surge shaft top stretch of road

1. The total length of this reach of the road is 21 km. The road is class 9H with ruling gradient and with formation width of 5.95 m.
2. At Km .3 of this road there is a steel bridge on Madumati Nallah with length 75.73 m and loading capacity 24 R. At the same location, a RCC Bridge with length 55 m and loading capacity 70 R is under construction. *by BRO.* However, the nallah can also be crossed during the lean season through bed crossing. Any temporary additional measures for crossing of this nallah shall be planned and executed by the Contractor.

4.5 Bandipora – Dam site road

1. Bandipora- Dam site road beyond surge shaft top is 51 km (KM 21 to 72) long. Between KM 21 to 39, road is class 9 H with ruling gradient

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with formation width of 5.95 m. Between KM 39 to 60, road is class 9 (Snow bound specification) with ruling gradient with formation width 7.45 m.Between KM 60 to 72 and beyond, road is again class 9 H with ruling gradient with formation width 5.95 m.

2. This road is maintained by Border Roads Organisation (BRO). This road remains open only for approximately 5-6 months i.e May/ June to November in a year and for rest of the period of the year remains blocked due to heavy snow fall as it passes through Razdan pass at an altitude of 3600 m.

3. Bandipora - Gurez road is a strategic road. Contractor shall plan his movements in coordination with concerned authorities. Owner shall provide assistance in such co-ordination. Up-gradation and maintenance of Bandipora - gurez road if required by the Contractor for transportation of his Construction Equipment shall be done by the Contractor with specific approval from BRO. Bridge Details

   - At KM 55.0, SSRBB type bridge with length 21.34 m and loading capacity 24 R.
   - At KM 59.5, SSRBB type bridge with length 18.29 m and loading capacity 24R.
   - At KM 66.0, HAMILTON type bridge with length 18.29 m and loading capacity 18 R.

     However the above nallahs can also be crossed during the lean season through bed crossing. Any temporary-additional measures for crossing of these nallah shall be planed and executed by the Contractor.

   - At KM 66.95, TSRBB type bridge with length 44.12 m and loading capacity 18R (Kanjalwan Bridge on Kishanganga River)
   - At KM 71.80, TSRBB type bridge with length 42.87 m and loading capacity 24 R (Malik Bridge on KIshanganga River)
   - At KM 72.2, HAMILTON type bridge with length 12.19 m and loading capacity 18R on Dudkhatu nallah. However, the nallah also be crossed during the lean season through bed crossing.

     Any temporary additional measure for crossing of the nallah shall be planned and executed by the Contractor.

4.6 Access to Gurez valley during winter:

Hellcopter access (between Bandipora-Gurez or Srinagar – Gurez) is must during winter to continue at least the underground works pertaining to HRT at inlet Adit and Adit 1 during the period November to May. The Contractor shall be required to tie up this arrangement with Indian Army / Indian Air Force authorities. Owner shall provide any assistance for coordination with concerned authorities.

4.7 Access roads to permanent works

4.7.1 Access roads with in Power house complex

Following access roads shall be required in power house complex.

Access road to main access tunnel

Access road to switch yard/ ventilation tunnel

Access road to tail race outlet

Access road to various adits of pressure shaft

Access road to Surge shaft bottom and for TBM tunneling

Access road to surge shaft top

The land for these roads shall be made available by Owner free cost. The detailed planning, engineering, construction and maintenance shall be done by the Contractor.

4.7.2 Access roads for HRT adit 1 and with in Dam complex

The HRT Adit 1 portal is situated on Bandipora – Gurez road near Kanzalwan. Various access and temporary haul roads for access to different locations in dam complex shall be planned, constructed and maintained by the Contractor.

4.7.3 Land for Permanent Works

The land for the Permanent Works shall be handed over in a phased manner as per the following schedule subject to Contractor complying with the requirement under GCC Article 46.1:

Sl. No.	Allocation of Land for	Time from the date of Order to Commence
1	Dam Area including Intake Adit and Diversion Tunnel Area.	4 Months
2	Adit-I Area	4 Months
3	Surge Shaft Area and T.B.M Adit Area	4 Months
4	Power House Area and Construction Adits to Pressure Shaft.	9 Months
5	T.R.T and Switchyard Area.	9 Months

For the purpose of land acquisition the layout of the Project structures, should normally be as per the Project Profile to the extent possible. However, in case of change in Project Layout due to unavoidable circumstances the bidder shall note that the land acquisition for any new location would take about 1 year.

5.0 Local facilities and services in the project area

5.1 Availability of land for Contractor's infrastructure for main works

The Contractor has to make his own arrangement to develop infrastructure for all their men and material required during the construction period. The necessary residential and labour camps including other facilities like water supply, sanitation etc. are to be developed by the Contractor on his own.

Private land is available for Contractor's use at Badwan, Wampore, Dawar and Kanjalwan for dam site and at Bandipore and near by villages for powerhouse site. The Contractor will be responsible for arranging land for his infrastructure and other facilities in these areas.

All the camps, facility areas, main works area etc. are required to be fenced and protected by the Contractor on his own.

5.2 Identified source of water supply for Contractor's use

The main source of water supply for construction purposes as well as domestic use is river Kishanganga and various nallas for dam site area and Madumati nallah, Bonar nallah for power site. Necessary pumping arrangements for supply of water and filtration/treatment facilities, if required, are to be made by the Contractor of his own.

5.3 Arrangement of construction power for Contractor's use for main works and their establishment

The construction power is of vital importance for construction of any project and needs to be planned properly so that uninterrupted power is available at all times. The Contractor shall have to make his own arrangement for construction power as well as power for township/auxlliary power by his own diesel generating sets to meet their full requirement. Further, the Contractor has to provide distribution facilities and necessary safety precautions on their own.

5.4 Communication facilities available

Nearest BSNL telephone exchange is at Bandipore, a satellite exchange has been established by BSNL at Dawar (Gurez).The existing telephone system is not reliable and the contractor may have to install his own communication system like V-SAT, LDST etc. on his own.

5.5 Details about local taxes including works contract taxes leviable presently in the state of J&K

The following taxes / royalty are leviable from the Contractor: -

a) Works Tax (J&K. Sales tax)
b) Royalty on boulders, aggregates, etc.
c) Sales tax on royalty.
d) Income tax on payments.
e) Excise duty as applicable.
f) Customs duty on imports

J&K entry tax on the goods shall be chargeable at Lakhanpur as per Schedule I&II of J&K entry tax on Goods Act 2000.

The above is meant for general information only and the Bidder should verify the same for rates and additional taxes/levies etc. if any, before filling his price Bid.

5.6 Inner line permit / Pass, if required for contractors and his workmen

Inner line permit/ pass is not required in the state of J&K at present. However, for foreign national, the inner line permit/pass may be required.

5.7 Availability of nearest fuel station

The Contractor has to make arrangement for his own fuel station having sufficient storage capacity for meeting his petrol and HSD requirement. The nearest fuel station is available in Sopore town only which is 30 km from Bandipore (and extension counter located at Bandipore), while Indian Oil depot is available at Srinagar.

5.8 Issue of materials to the contractor

All the construction material required for the construction of Project shall have to be arranged by the Contractor himself. In view of the availability of approach by road for only 5-6 months in a year at dam site, sufficient storage shall be required to be created by the Contractor to ensure the availability of construction material and machinery required for full year working.

5.9 Law and Order situation

The proposed Dam site, located in Gurez valley falls within the shelling range from Pakistan border. The proposed Powerhouse site is located near Bandipora town and its surrounding areas have witnessed sporadic incidents of militancy and hence vulnerable to security. Incidents of militancy in and around the Project Area are reported in national and international media from time to time. The Owner shall be providing general security for the Project through CISF/BSF. However the Contractor will be responsible for any additional security in terms of G.C.C, Article 11.2.

5.10 Other relevant Information

The manpower engaged by the Contractor for the works of the project shall be mainly from local population to the extent available. However, in case of non-availability of highly skilled/semi skilled manpower among local population, the same shall be arranged from outside Gurez/Bandipora.

Reduction in efficiency of man and machinery in high altitude may be taken care of by the tenderers while quoting tender bids.

The project has only 500 Kg portable explosive license at dam site and 400 Kg portable explosive license at power house site. The Contractor shall have to arrange his own explosive magazine and the license of the capacity as per his requirement.

The location of the batching plant, crushing plant and other installations etc. shall be finalized by Contractor himself as per his convenience and as per the convenience of local people/administration.

HINDUSTAN CONSTRUCTION CO. LTD. MUMBAI

Bidder's Appreciation Of The Project

Our technical team comprising of experienced Engineers have visited the site at different times. The team made first site visit in last week of September 2006 and second site visit in last week of October 2006.

This appreciation is broadly based on our site visit and gives an account of our understanding of all principal technical and logistic problems related to transportation and installations, handling of the construction equipments, materials, and availability of land, infrastructures, local taxes and laws and construction of works.

Following is a summary of various aspects of the project, which is based on, our site visits and information collected:

- Location of the site and Access to the site from railhead, airport and highways and large cities.
- Project Roads – Permanent and temporary
- Problems related to transportation and erection of heavy construction equipments.
- Quarries and borrow areas for aggregates, sand and clay
- Source of cement, steel, explosives and other material and transport & storage.
- Rainy season, river flows and river banks
- Disposal areas
- Location/land for site installations like crushing plant, batching plant, site offices, stores, workshop and colony for officers, staff and workers etc.
- Water and Power supply
- Communication, medical banks, post office.
- Local conditions – Local taxes and laws.
- Other project specific matters.

Above aspects are explained in detail below:

1.1 Location of the site and Access to the site from railhead and highways and large cities

The Kishanganga HE project is located in the state of Jammu and Kashmir. Logistically the project has been divided in to two work centers one at powerhouse and other at Dam site (Gurez valley). Dam site, Part of HRT (inlet adit and Adit-I) of the project is located in Gurez valley and Surge shaft, pressure shaft and powerhouse are near Bandipora in Kashmir valley. Srinagar is the nearest city, well connected by Air. Following table gives the approximate distances of Project from various important cities

	Dam Site	Powerhouse site
From Delhi	1025 Km	955 Km
From Jammu	440 Km	370Km
From Srinagar	140 Km	70 Km

Structures form surge to powerhouse are located near Bandipora and can be accessed using NH-1A and 50km limb NH connecting NH-1A at Sh[illegible] to

Bandipora. On this route, there are bridges with carriage capacity varying from 70R to 18R. Wherever low capacity bridges are located we can cross the Nallah through the bed during lean season.

Dam complex (Gurez valley):
Road from powerhouse to dam site is predominantly class 9H except for about 20 km which is of class-9. On this stretch, there are bridges with carrying capacity varying from 24R to 18R. All Nallahs can be crossed through bed during lean season.

Jammu is the nearest BG railway head and Srinagar is the nearest airport. All materials and equipments will have to be transported from Jammu by utilizing NH-1A.

1.2 Project Roads – Permanent & Temporary

The present statuses of roads, which have been inspected by us during our site visit, are as under:

- The principal access road to the site is NH-1A: Slopes above the road have become unstable along certain stretches and frequent landslides during monsoon block the roads. BRO is undertaking the road clearing activity in case of blockages.
- Srinagar – Bandipora road: This road is NH-1A and 50km limb of NH connecting NH-1A at Shetang to Bandipora. Generally the road width is 7-10m but somewhere the width is restricted to 4m only. On this route, there are bridges with carriage capacity varying from 70R to 18R. Wherever low capacity bridges are located we can cross the Nallah through the bed during lean season.
- Bandipora – Surge shaft top stretch of road: Length of this road is 21 km and it is class 9H with ruling gradient and formation width of 5.95m. There is a 24 R class steel bridge across Madumati Nallah at 3 km of this road. The length of this bridge is bout 76-M. At the same location BRO is constructing a "70 R" class RCC Bridge and length is about 55m.
- Bandipora – Dam site road: Length of this road beyond surge shaft top is 51 km, having varying width from 5.95m - 7.45m. This road during winter months due to heavy snow fall remains blocked and remains open only for 5-6 months i.e. May/June to November in a year.
- Bridge details: In the following table we have given the details about the various bridges in project area

Chainage In Km	Type of Bridge	Length (m)	Loading capacity
55	SSRBB type	21.34	24R
59.5	SSRBB type	18.29	24R
66	HAMILTON type	18.29	18R
66.95	TSRBB type - Kanjalwan bridge over Kishanganga river	44.12	18R
71.80	TSRBB – Mallai Kadal bridge	42.87	24R
72.2	HAMILTON type	12.19	18R

However, where existing bridges have inadequate capacity, the Nallahas may be crossed through the bed during lean season. Some temporary measures like new access, filling & clearing later may be required at these locations.

The project foresees following permanent access roads, which are required to be constructed by the EPC contractor.

- To main access tunnel
- To switchyard / ventilation tunnel
- To tail race outlet
- To various adits of pressure shaft
- To surge shaft bottom and for TBM tunneling
- To surge shaft top

Apart from above permanent roads following temporary roads have to be constructed for construction purposes.

- Construction access on left bank and right bank
- Temporary haul roads in Dam complex
- Temporary roads in powerhouse
- Various access roads to batching plants, crushing plant, colony area etc.

Temporary access road can be designated to an average 10% gradient, taking into consideration of traffic ability of hauling equipment.
A bridge over Dudkhatu nallah near Intake adit is also required.

1.3 Problems related to Transportation and erection of heavy construction equipments:

Problems in Equipment transport

Construction equipments required are dozers, excavators, drilling jumbos, batching plant (to be brought in parts), crushing plant (in parts), concrete-placing arrangements etc. These equipments will come from all parts of the country. Tunnel Boring machine and certain E&M equipments are to be imported in parts and will come from Mumbai / Kandla port.

All of these equipments will have to be transported by road from port or from other source. These will travel first to Jammu and via NH 1A to Bandipore. While traveling through NH 1A, the equipments will have to pass through Jawahar tunnel, which has size limitation. So, we keep an options of (a) unloading these equipments, specially the parts of E&M / HM equipments which have larger sizes, to certain terrace like plots on either sides (approximately 20 km) of NH 1A and transship them on smaller vehicles or (b) Design the TBM specially cutter head and other components including EM equipments suitable to pass the tunnel and also the road conditions beyond Bandipore.

The road from Bandipore to Gurez valley has lesser width and vehicles with 7-8 tons load can access through. The road has to be strengthened at some places. During material and equipment transportation we have to avoid traffic congestion and road accidents by taking following measures:

- Load trucks / trailers only to allowable capacities keeping in view the gradient and nature of roads and also the pulling power of the vehicle.
- Heavily loaded vehicles will generally travel during nighttime when traffic will be minimum, so as to minimize traffic congestion.
- If needed, organize a dummy load to run along the route to understand the problems.
- Employ experienced agencies for transportation of equipments / materials.
- Dismantle all the heavy equipments in such a manner so that their transportation over the bridges and Jawahar tunnel is within permissible limits.

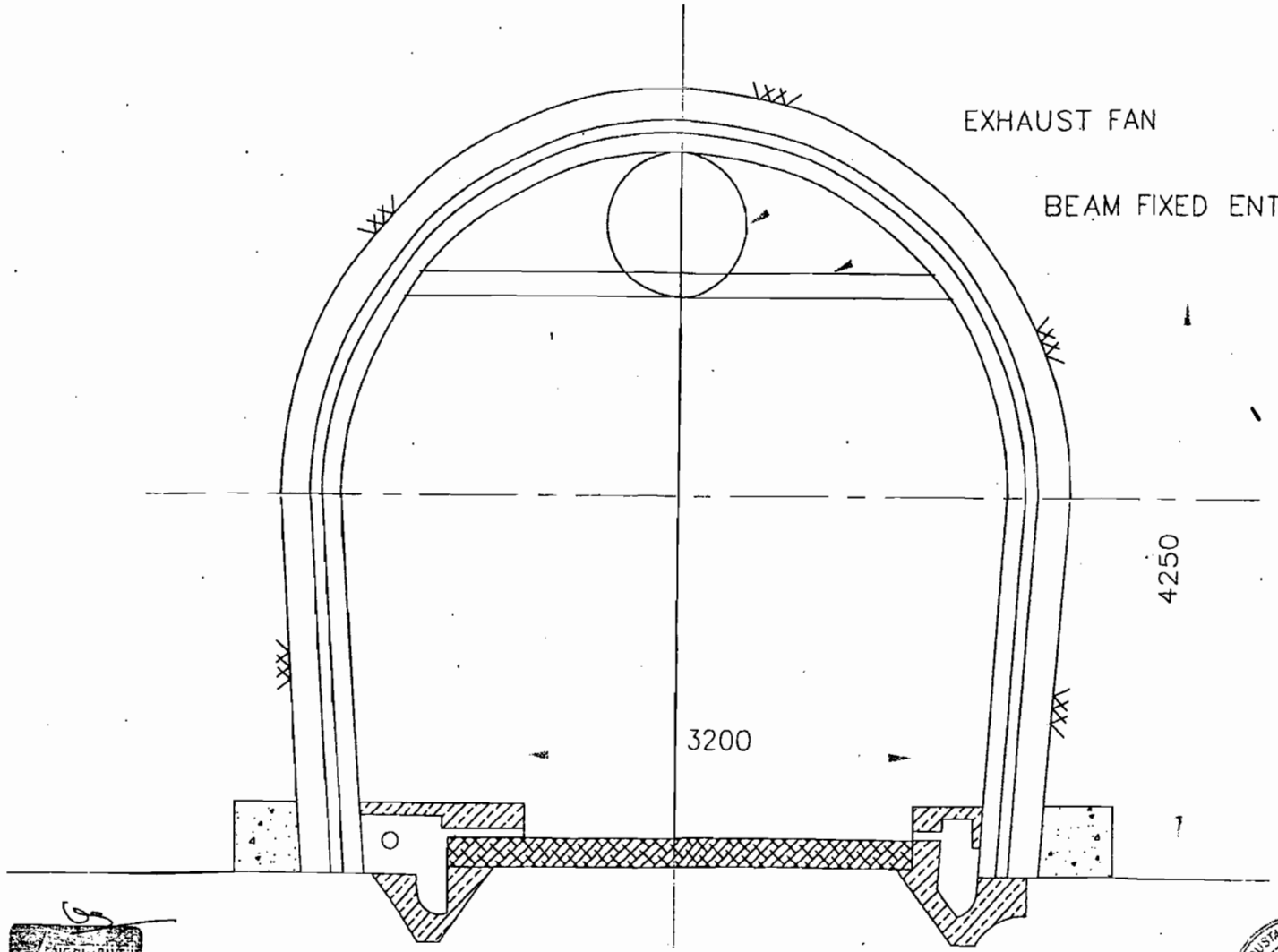
Problems in Equipment erection:

(a) Crushing plant: We do not envisage any problem in the erection of crushing plants.
(b) Batching plants, cement storage, aggregate bins: We do not envisage any problem in the erection of these equipments.
(c) Concrete placing arrangements: We do not envisage any problem in the erection of concrete placing arrangement.
(d) TBM: TBM can be erected on the flat terrace near the proposed portal of TBM adit / adit-2.

1.4 Quarries and borrow areas for aggregate, sand and clay.

NHPC have carried out detailed investigations for availability and testing of construction materials for use as concrete aggregate, rock fill material, semi-pervious material and impervious soil. In total twelve river bed deposits / shoals, three rock quarries, three deposits of semi-pervious material and three impervious soil deposits have been investigated. These have been listed in the Vol-I of Tender document.

We have visited the deposits and checked their feasibilities. In additional to the material sources as above, use of excavated material from open excavation, riverbed excavation, tunnel excavation and powerhouse excavation as concrete aggregate and rock fill materials can also be considered.



C/S OF JAWAHAR TUNNEL NH–1A

SECTION IV

GUARANTEED TECHNICAL PARTICULARS FOR ISOLATORS/EARTH SWITCH

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 rnechanism

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

I) 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) Leaflets & literature bringing out salient features of equipment offered

g) 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) — NA —

2. Whether details of ability of Pantograph isolators to withstand forces due to wind load and short circuit, enclosed

3. Whether OGA drawing of counter contact of pantograph isolators enclosed

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 frorn adjacent cornponents

iii) Distance between rows

iv) Whether transparent protection cover provided

SECTION - V

Manufacturing Quality plan

Attached Quality Assurance Plan (Model) for Pothead Yard-Isolator, page no. 1, 10, 11, 12 and 13 of 37 shall be followed.

12.MODEL QUALITY ASSURANCE PLAN (QAP) FOR OUTDOOR POTHEAD YARD EQUIPMENT

Special Instructions: -

1. Contractors/Manufacturers/Sub-suppliers are advised to submit QAP for equipments/ materials after incorporating all tests for bought out items, in process inspection and final inspections as per their latest manufacturing practice and Indian/ International Standards (with latest amendments, if any).
2. Contractors/Manufacturers/Sub-suppliers are required to use properly calibrated instruments /equipments during testing/inspection, for which necessary calibration certificates are required to be provided/presented to the Inspecting Officer.
3. Contractors/Manufacturers/Sub-suppliers have to make on their own all arrangements for testing facilities at their works for testing of equipments/materials.
4. One set of complete test certificates as per the requirement of QAP be made available to the Inspecting Officer at the time of inspection/testing.
5. All the records, as per the requirement of QAP are to be made available for review by the Inspecting Officer during inspection.
6. Field tests are to be carried out as per the requirements of the contract / purchase order.

QUALITY ASSURANCE PLAN (MODEL)

PROJECT : KISHANGANGA H.E. Project
NAME OF EQUIPMENT : Pothead Yard - Isolators

CLIENT: NATIONAL HYDROELECTRIC POWER CORPORATION LTD.
VENDOR :
NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS/ CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
A	RAW MATERIAL AND BOUGHT OUT ITEMS								
1	Reduction Gear Unit.								
a)	Visual	Visual	100%	Tech. Spec./Appd.drg./IS Code	TC	2/3	-	1	TC
b)	Dimensional	Measurement	Sampling Plan	-do-	TC	2/3	-	1	TC
c)	Operational	Visual	-do-	-do-	TC	2/3	-	1	TC
d)	Chemical Analysis	Chemical	-do-	-do-	TC	2/3	-	1	TC
2	Auxiliary Switch								
a)	Visual	Visual	100%	Tech. Spec./Appd.drg./ IS:9921 & IEC:129	TC	2/3	-	1	TC
b)	I.R.Test	Electrical	-do-	-do-	TC	2/3	-	1	TC
c)	H.V.Test	Electrical	-do-	-do-	TC	2/3	-	1	TC
d)	Mechanical Endurance Test	Mechnical	Sampling Plan	-do-	TC	2/3	-	1	TC
e)	Temp. Rise Test	Temperature	-do-	-do-	TC	2/3	-	1	TC
3	Interlock Coil								
a)	Visual Inspection	Visual	100%	Tech. Spec./Appd.drg./IS:3842	TC	2/3	-	1	TC
b)	I.R.Test	Electrical	-do-	-do-	TC	2/3	-	1	TC
c)	H.V.Test	Electrical	-do-	-do-	TC	2/3	-	1	TC
d)	Operational Check	Visual	-do-	-do-	TC	2/3	-	1	TC

Note: a. In 'Inspection Agency' column figure 1,2,or 3 to be filled. 1- will indicate 'NHPC', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier',
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point
c. Test certificates shall be submitted at the time of final inspection.

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Signature
NHPC (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

PROJECT : KISHANGANGA H.E. Project
NAME OF EQUIPMENT : Pothead Yard - Isolators

CLIENT: NATIONAL HYDROELECTRIC POWER CORPORATION LTD.
VENDOR :
NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS/ CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE / ACCEPTANCE DOCUMENTS / NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
4	Copper Strips (Fingers in female contact & earth switch fingers)								
a)	Visual	Visual	100%	Tech. Spec./ IS:1897	Log Sheet	2/3	-	1	RR
b)	Dimensional	Measurement	100%	-do-	TC	2/3	-	1	TC
c)	Chemical	Chemical	Sampling plan	-do-	TC	2/3	-	1	TC
5	Copper Tube (Main blade arm, E.T.S. Grade as drawn condition)								
a)	Overall finish	Visual	100%	Tech. Spec./ IS:2501&IS:191	Log Sheet	2/3	-	1	RR
b)	Dimensional	Measurement	100%	-do-	TC	2/3	-	1	TC
c)	Chemical Composition	Chemical	Sampling plan	-do-	TC	2/3	-	1	TC
6	Springs								
a)	Visual	Visual	100%	Tech.Spec./IS:4454 & AISI:304	Log Sheet	2/3	-	1	RR
b)	Dimensional	Measurement	Sampling plan	-do-	TC	2/3	-	1	TC
c)	Load Test	Mechanical	-do-	-do-	TC	2/3	-	1	TC
7	Operating Mechanism								
a)	Visual	Visual	100%	Tech.Spec./IS:9921	Log Sheet	2/3	-	1	RR
b)	Operation Test	Visual	-do-	-do-	TC	2/3	-	1	TC
c)	I.R.Test	Electrical	-do-	-do-	TC	2/3	-	1	TC
d)	H.V.Test	Electrical	-do-	-do-	TC	2/3	-	1	TC

Note: a. In 'Inspection Agency' column figure 1,2,or 3 to be filled. 1- will indicate 'NHPC', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.
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Signature
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Signature & Seal
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QUALITY ASSURANCE PLAN (MODEL)

PROJECT : KISHANGANGA H.E. Project
NAME OF EQUIPMENT : Pothead Yard - Isolators

CLIENT: NATIONAL HYDROELECTRIC POWER CORPORATION LTD.
VENDOR :
NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS/ CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
8	Motor								
	All Routine Test	Electrical	-do-	Tech.Spec./IS:325	TC	2/3	-	1	TC
9	Motor Operating Mechanism								
a)	Dimensional Checks	Measurement	100%	Tech. Spec./Appd. drg.	TC	2/3	-	1	TC
b)	Checks as per BOM.	Visual	-do-	-do-	TC	2/3	-	1	TC
c)	Wiring Check	Visual	-do-	-do-	TC	2/3	-	1	TC
d)	Torque Measurement	Mechanical	-do-	-do-	TC	2/3	-	1	TC
B.	IN PROCESS INSPECTION								
1	Silver Plating of Current carrying Pathe								
a)	Plating Thickness	Measurement	Sampling plan	Tech. Spec./IS Code.	TC	2/3	-	1	TC
2	Galvanising of M.S. Material								
a)	Visual	Visual	100%	Tech.Spec./IS:2633 & IS:4759	Log Sheet	2/3	-	1	RR
b)	Galvanising of M.S.	Chemical	Sampling plan	-do-	TC	2/3	-	1	TC

Note: a. In 'Inspection Agency' column figure 1,2 or 3 to be filled. 1- will indicate 'NHPC', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.

Signature
NHPC (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

QUALITY ASSURANCE PLAN (MODEL)

PROJECT : KISHANGANGA H.E. Project
NAME OF EQUIPMENT : Pothead Yard - Isolators

CLIENT: NATIONAL HYDROELECTRIC POWER CORPORATION LTD.
VENDOR :
NIT/P.O. REFERENCE :

SR. NO.	ITEM /COMPONENTS/ CHARACTERISTICS	NATURE OF CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENTS / ACCEPTANCE NORMS	RECORD FORMAT	INSP. AGENCY			REMARKS
						Perform	Witness	Verify	
3	Bearings								
a)	Galvanising	Chemical	100%	Tech. Spec./IS Code.	TC	2/3	-	1	TC
b)	Greasing of Bearings, Checking of Function & Rust Protection.	Visual	-do-	-do-	TC	2/3	-	1	TC
C. 1	Final Inspection Routine Tests								
a)	Power Frequency Voltage Tests on Control and Auxiliary Circuit.	Electrical	100%	Tech. Spec./IS:9921 & IEC:62271	JIR	2/3	1	-	CHP
b)	Measurement of Resistance of the Main Circuit.	-do-	-do-	-do-	JIR	2/3	1	-	CHP
c)	Mechanical Operating Tests.	Mechanical	-do-	-do-	JIR	2/3	1	-	CHP
d)	Dimensional Checks on Isolators.	Measurement	-do-	Tech. Spec./Appd. drg.	JIR	2/3	1	-	CHP
e)	Galvanisation Test	Chemical	Sampling plan	Tech. Spec./IS:2633	JIR	2/3	1	-	CHP

Note: a. In 'Inspection Agency' column figure 1,2 or 3 to be filled. 1- will indicate 'NHPC', 2- will indicate 'supplier' & 3- will indicate 'sub-supplier'.
b. In 'Remarks' column following abbreviations shall be used - RR-Review of Records, T.C. - Test Certificate Submission & CHP - Customer Hold Point.
c. Test certificates shall be submitted at the time of final inspection.

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Rev.-01

Signature
NHPC (QA&I DEPT.)

Signature & Seal
(VENDORS Q.C. DEPT. OR REPRESENTATIVE)

Technical Specification Doc.No. TB 329 316 009 and TB 329 316 013

220kV & 33 KV DOUBLE BREAK ISOLATOR

CHECK LIST

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.

THE OFFERS WITHOUT THE CHECK LIST MAY NOT BE CONSIDERED FOR THE EVALUATION.

	ISOLATORS / GROUNDING SWITCHES	**1**	**2**	**3**
S.No.		Specified Requirement	Confirmation Yes/No	Comments, if Col.2 is No
1.	Rated Voltage (KV)	220/33		
2.	Type of Isolator	Outdoor, HDB		
3.	Standard applicable for isolators and earthing switches	IEC:62271-102 IS:9921		
4.	Rated Current Under site conditions (A)	1250 for 220kV & 630 for 33kV		
5.	Rated short time withstand Current of Isolator and Earth switch for 1 Sec.	31.5kA for 220kV & 12.5kA for 33kV		
6.	Rated dynamic short circuit withstand Current of Isolator and Earth switch	79kAp for 220kV & 31.5kAp for 33kV		
7.	Rated frequency (Hz)	50		
8.	Number of poles	three		
9.	Phase to phase spacing(mm)	4500 for 220kV & 1500 for 33kV		
10.	Whether all 3 poles are ganged	Mechanically		
11.	Opening time of isolator and earth switch (Sec.)	Less than 12		
12.	Closing time of isolator & earth switch (Sec.)	Less than 12		

	ISOLATORS / GROUNDING SWITCHES	**1**	**2**	**3**
S.No.		Specified Requirement	Confirmation Yes/No	Comments, if Col.2 is No
13.	Temperature rise over 50° C ambient temperature corresponding to maximum continuous current (°C)	As per table V of IEC-694		
14.	Seismic Acceleration	0.36 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)	506kVrms for 220kV & 77kVrms for 33kV		
	ii. Across isolating distance (KV rms.)	583kVrms for 220kV & 88kVrms for 33kV		
15.2	1.2/50 micro's impulse withstand test voltage			
	i. Against ground (KVP)	± 1155 kVp for 220kV & ± 187 kVp for 33kV		
	ii. Across isolating distance (KVP) -	± 1320 kVp for 220kV & ± 214.5 kVp for 33kV		
16.	Corona extinction voltage (KV rms) –	156 for 220kV		
17.	Radio interference level at 1.1 Ur/_/3 (in micro volts at 1.0 MHz)-	1000 for 220kV		
18.	Total creepage distance to ground (mm) – MINIMUM	6125 for 220kV & 900 for 33kV		
19.	Operating Mechanism for Isolator	220V DC Motor + Manual for 220kV isolator & Manual for 33kV Isolator		
20.	Operating Mechanism for Earth	220V DC		

	ISOLATORS / GROUNDING SWITCHES	**1**	**2**	**3**
S.No.		Specified Requirement	Confirmation Yes/No	Comments, if Col.2 is No
	Switches	Motor + Manual for 220kV isolator & Manual for 33kV Isolator		
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	220 V		
27.	Material of contacts	Hard drawn electrolytic copper		
28.	Thickness of silver plating of contacts	25 micron		
29.	Number of auxiliary contacts on isolator/pole for Owner's use	10 NO + 10 NC +2 MBB		
30.	Number of auxiliary contacts on earth switch/pole for Owner's use	6 NO + 6 NC		
31.	Rating of Auxiliary contacts	10 A at 220 V DC		
32.	Rated DC breaking current of Auxiliary contacts with 20 ms time constant (A)	2 A		
33.	Material of Current carrying parts	Aluminium/		

	ISOLATORS / GROUNDING SWITCHES	**1**	**2**	**3**
S.No.		Specified Requirement	Confirmation Yes/No	Comments, if Col.2 is No
		Copper		
34.	Capability of Isolator for making and breaking the magnetizing/capacitive currents	0.7 A at 0.15 power factor		
35.	All valid Type test reports (As per clause no. 1.6 of section-1)	Available and list is enclosed.		
36	Type Test reports for higher insulation (As per clause no. 1.5 (a) of section-1)	Available and reports are enclosed		
37	10 mm Ice loading type Test report (As per clause no. 1.5 (b) of section-1)	Available and reports are enclosed		
38	Operation at Temperature limits (As per clause no. 1.5 (c) of section-1)	Available and reports are enclosed		
	CONTROL CABINETS /MECHANSIM BOX			
39.	Application	Outdoor		
40.	Material of control cabinet sheet	Aluminium/Sheet steel(cold rolled or hot rolled)		
41.	Thickness of sheet (mm) Aluminium Sheet steel (Hot rolled) Sheet steel (Cold rolled)	 3 2.5 2		
42	Degree of protection provided	IP65		
43.	Standard applicable for control cabinet	IS-5093/IS-8623, IEC-439		
44	Whether Hot Dip Galvanised	YES/No		
45.	Colour shade of finish paint of outside & inside of control cabinet as per IS : 5	Shade No. 631 & glossy white		
46.	Size of Conductor used in Control Wiring of control cabinet	4 & 2.5 sq.mm		
47.	20 % Spare Terminal Blocks provided in control cabinet	YES		
48.	Confirm to follow the BHEL/Customer	Confirmed		

	ISOLATORS / GROUNDING SWITCHES	**1**	**2**	**3**
S.No.		Specified Requirement	Confirmation Yes/No	Comments, if Col.2 is No
	MQP			
49	Annexure-A: No deviation certificate is enclosed duly signed	Enclosed		
50	Heater considered	Considered		
51	Terminal blocks as per clause no. 31.15 of section-3	Considered		
52	Write up enclosed along with the offer for explaining suitability of Isolator design for higher altitude, low temperature and ice loading	Enclosed.		
53	Suitability of BPI as per clause no. 2.5 of section-2.	Suitable		

Annexure-A

NO DEVIATION CERTIFICATE

It is confirmed 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, variation and/ or exceptions. Further it is confirmed that at all drawings/data sheets/ QP/ type test 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 & without affecting delivery requirements.

Signature of the representative of the Bidder

Name----------

Designation----------

Place----------

Date----------