TECHNICAL PRE-QUALIFICATION REQUIREMENT

Name of Project: 765/132kV AIS Switchyard Extn. at NTPC SIPAT STPP Stage-III (1x800 MW)
Name of Customer: NTPC Limited
Name of Item: 132kV XLPE Cable & accessories

TECHNICAL PRE-QUALIFICATION REQUIREMENT
a) The bidder/ ~~Sub-vendor~~ should have manufactured and supplied following cables: At least 1kms of XLPE insulated power cables of 132kV or higher voltage grade, executed in one or more orders and which must have been in successful operation for a minimum period of two (2) years prior to the date of Techno-Commercial bid opening (i.e. 10.07.2024). and b) 132 kV Cable Accessories The bidder/ its sub-vendor should have manufactured and supplied minimum fifteen (15) nos. of cable Accessories supplied of 132kV grade cables or above, and which must have been in successful operation for a minimum period of two (2) years prior to the date of Techno-Commercial bid opening (i.e. 10.07.2024).

SUPPORTING DOCUMENTS TO BE ATTACHED

Sr	Required Criteria	Supporting Documents to be submitted by bidder along with technical bid
1	Manufacturing	Approved Drawings/ GTP/ Approved Quality Plan/ Factory Inspection Test Report etc. of offered item.
2	Supply	PO/ Dispatch clearance/ LR/ Material Receipt certificate at site / installation or commissioning certificate etc. of offered item.
3	Successful operation	Successful operation means certificate issued by the Employer/Utility certifying the operation without any adverse remark.

Notes (General points):

1. Consideration of offer shall be subject to customer's approval of bidder's, if applicable.

2. Bidder to submit all supporting documents in English. If documents submitted by bidder are in language other than English, a self- attested English translated document should also be submitted.

3. Notwithstanding anything stated above, BHEL reserves the right to assess the capabilities and capacity of the bidder to perform the contract, should the circumstances warrant such assessment in the overall interest of BHEL.

4. After satisfactory fulfilment of all the above criteria/ requirement, offer shall be considered for further evaluation as per NIT and all the other terms of the tender.

5. Bidder to submit complete documents complying above Pre-qualification Criterion (PQR) along with duly filled 3K document. (format attached)

PREPARED BY	REVIEWED BY	APPROVED BY
BAIDYANATH YADAV	DILEEP KRISHUKLA	VIVEK KAPIL
MANAGER-TBEM	DGM-TBEM	AGM-TBEM

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT
NOIDA

DOCUMENT NO.	TB-435-316-TS-002	REV 00	Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECFICATION	NAME	BY	DKS	VK
Title: 132kV XLPE Cable with accessories		SIGN			
		DATE	14.11.25	14.11.25	14.11.25
		GROUP	TBEM		
		WO No.	CS-8003-001-2-FC/SC/TC-COA-7491/7492/7493		
CUSTOMER	NTPC Limited				
PROJECT	765/400/132kV AIS Switchyard Extension at NTPC SIPAT STPP Stage-III (1 x 800 MW)				

Contents

Remarks: Bidder to note that data and details of guaranteed technical particulars shall not be reviewed during technical evaluation/ scrutiny, hence compliance of guaranteed technical particulars in line with technical specification shall be bidder's responsibility.

Rev. No.	Date	Altered	Checked	Approved	
Distribution				To	
				Copies	

SECTION 1:
SCOPE, PROJECT SPECIFIC TECHNICAL REQUIREMENTS & BILL OF QUANTITIES

1. Scope

This technical specification covers the requirements of design, engineering, manufacturing, inspection including third party inspection and testing at manufacturer's works before supply, proper packing and delivery to project site, unloading & storage at site, and installation/ laying, termination, jointing, dressing, testing at site & commissioning complete with all materials, support structures at designated locations including hardware and anchoring bolts, accessories, commissioning spares & maintenance spares, consumables, special spanners, tools & tackles, any specific required ancillary services & mandatory spares etc. including training of BHEL/ Customer personnel, if required at site for the equipment (**132kV XLPE Cable with Accessories**) complete in all respect for efficient & trouble-free working mentioned under this specification.

Hence, scope of work under this requisition shall include but not be limited to basic and detailed engineering, as required, manufacturing, supply, transportation to site, inspection at manufacturer's work, installation/ laying, commissioning including site testing along with necessary equipment, training to Customer/ BHEL personnel, if required, supply of all mandatory spares, commissioning spares, special tools and tackles as required in drawings, standard specifications, standards etc. attached or referred with technical specification.

This section covers the specific technical requirements of the equipment (**132kV XLPE Cable with Accessories**). This constitutes minimum technical parameters for the above item as specified by the BHEL/ Customer. The offered equipment (**132kV XLPE Cable with Accessories**) shall also comply with the Section-3 (Project Details and General technical requirements for all equipment under the Project) and Section-2 (Equipment Specification Under Scope of Supplies) of this specification.

The specification comprises of following sections:

Section-1	:	Scope, Project Specific Technical Requirements & Bill of Quantities
Section-2	:	Equipment Specification under scope of Supplies/ Service
Section-3	:	Project Details & General Technical Requirements (For All Equipment under the Project)
Section-4	:	Annexures Annexure-A: Compliance Certificate to Technical Specification Annexure-B: Deviation/ Change Request to Technical Specification Annexure-C: Guaranteed Technical Particulars Annexure D: Technical Checklist

The following order of priority shall be followed. In case of conflict between requirements specified in various documents, the more stringent one shall be followed. BHEL/ Customer concurrence shall, however, be obtained before taking a final decision in such matters.

1. Statutory Regulations

   In particular, the latest version of the following statutory regulations, as applicable, shall be followed for system,

- o Indian Electricity Act
- o CEA regulations
- o The Factory Act
- o Requirements of other statutory bodies as applicable, e.g. CEA etc.

2. Section-1
3. Section-2
4. Section-3
5. Codes & Standards

Bidder shall furnish list of conflicts/ ambiguities/ deviations, if any, along with their technical offer and also furnish the basis that is considered for submitting technical offer. BHEL/ Customer will resolve listed conflicts prior to award. In case of ambiguity, bidder shall inform BHEL/ Customer of their interpretation. In case bidder fails to convey the same prior to award, BHEL/ Customer decision on interpretation shall be considered final if need arises during the execution. No additional cost or extra time on account of conflicts/ ambiguities/ deviations shall be admissible.

In general, no deviation from the requirements specified in various clauses of this specification shall be allowed and hence, a certificate to this effect shall have to be furnished along with the offer (Annexure-A), however bidder shall furnish list of conflicts/ ambiguities/ deviations (Annexure-B), if any. Any conflicts/ ambiguities/ deviations mentioned elsewhere in technical offer shall not be reviewed.

The equipment (**132kV XLPE Cable with Accessories**) is required for the following project:

Name of the Customer	:	**NTPC Limited**
Name of Main Contractor	:	**Bharat Heavy Electricals Limited**
Name of the Project	:	**765/400/132kV AIS Switchyard Extn. at NTPC SIPAT STPP Stage-III (1x800 MW)**

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

2. Codes & Standards

The equipment (**132kV XLPE Cable with Accessories**) shall comply with the latest edition of the following standards as applicable,

IEC 60840	Power cables with extruded insulation and their accessories for rated voltages above 30kv (Um=36kv) up to 150 kV (Um=170kv) Test methods and requirements
IEC 60060	High Voltage Test Techniques
IEC 60066	Environment test
IEC 60183	Guide to the selection of high voltage cables
IEC 60187	General definitions and test requirements
IEC 60068	Seismic test methods for equipment
IEC 60137	Bushings for alternating voltage above 1000V (Outdoor bushing)
IEC 60183	Guide to the selection of high voltage cables
IEC 60228	Conductors of insulated cables

IEC 60229	Tests on cable over sheaths which have a special protective function and are applied by extrusion
IEC 60230	Impulse tests on cables and their accessories
IEC 60270	Partial discharge measurements
IEC 60287	Calculations of the continuous current rating of cables
IEC 60331	Fire resisting characteristic of electric cables
IEC 60332	Tests on electric cables under fire Part-I conditions – Test on a single vertical insulated wire or cable
IEC 60376	Specifications & acceptance of new Sulphur Hexaflouride (SF6) Gas
IEC 60506	Switching impulse test on EHV insulators
IEC 60540	Test methods for insulations and sheaths of electric cables and cords
IEC 60754	Tests on gases evolved during combustion of electric cables
IEC 60811	Common test methods for insulating and Part–I sheathing materials of electric cables (Sec-1) – Methods for general application –Measurement of thickness and overall dimensions – Tests for determining the mechanical properties
IEC 60811 (Sec-2)	Common test methods for insulating Part-1 and sheathing materials of electric cables – Methods for general application – Thermal ageing methods.
IEC 60811 (Sec-3)	Insulating and sheathing materials Part-1 of electric cables- Common test methods – General application –Methods for determining the density – Water absorption Test-Shrinkage test
IEC 60811 (Sec-4)	Common test methods for insulating Part-1 and sheathing materials of electric cables – Methods for general application – Tests at low temperature
IEC 60811	Insulating and sheathing materials Part-2 of electric and optical cables –(Sec-1) Common test methods –Methods specific to elastomeric compounds– Ozone resistance, hot set and mineral oil immersion tests.
IEC 60811	Common test methods for insulating Part-3 and sheathing materials of electric (Sec-1) cables – Methods specific to PVC compounds – Pressure test at high temperature - Tests for resistance to cracking
IEC 60811	Common test methods for insulating Part-3 and sheathing materials of electric (Sec-2) cables – Methods specific to PVC compounds – Loss of mass test Thermal stability test
IEC 60811	Common test methods for insulating Part-4 and sheathing materials of electric (Sec-1) cables – Methods specific to Polyethylene (PE) and polypropylene (PP) compounds – Resistance to environmental stress cracking – wrapping test after thermal ageing in air – Measurement of the melt flow index – Carbon black and / or mineral content measurement in PE.
IEC 60859	Cable connections for gas insulated metal enclosed switchgear
IEC 60885	Electrical test methods for Part – 3 electric cables – Test methods for partial discharge measurements on lengths of extruded power cables
IEC 61462	Composite Insulators- Hollow insulators for use in outdoor and indoor electrical equipment - Definitions, test methods, acceptance criteria and design recommendations
IEC 5831	PVC Compound
IEC 62067	Power cables with extruded insulation and their accessories for rated voltages above 150 kV (Um=170kV) upto 500 kV (Um=550kV)–Test methods and

	requirements
IS 72	Galvanizing of steel structure
IS 1893	Criteria for earthquake resistant design of structures.
IS 2062	Structural steel (standard quality)
IS 2633	Methods for testing uniformity of coating in Zn-coated articles
IS 5216	Guide for safety procedures and practice in electrical works.
IS 5561	Electric power connectors
IS 10418	Drums for electric cables
ANSI/ IEEE	Guide for Electrical safety and Std 80-1986 sub-station grounding
	Indian Electricity Act 1910
	Indian Electricity Act 1956

3. Specific Technical Requirements

Specific technical requirements for the equipment (**132kV XLPE Cable with Accessories**) shall be as follows,

Sl. No.	**Description**	**Technical Parameters at EL 1000**
1.	Type of cable	132kV, 1Cx800sqmm copper stranded copper compacted circular conductor, extruded semi conducting compound conductor screen, cross linked polyethylene (XLPE) dry cured insulation, extruded semi conducting compound insulation screen, bedding of swellable type water blocking semi conducting tape, copper wire screen with copper binder tape (as per requirement), aluminum or lead or lead alloy sheath and extruded PVC outer sheath with overall graphite coating or overall extruded semiconducting layer suitable for outdoor installation in air, in built up concrete trench and/or directly buried in soil with chances of flooding by water.
2.	No. of Phases per circuit	3
3.	Rated voltage, kVrms	132
4.	Highest system voltage, kVrms	145 (As per applicable IS/ IEC)
5.	Highest system voltage, kVrms	50±5%
6.	Rated Short circuit withstand current at a rated voltage for 1sec, kArms	Not less than 31.5kA for, - for conductor - for metallic sheath

7.	Rated continuous Current, kArms	570 (Subject to laying conditions to be be finalized during detailed engineering stage)
8.	Overload Capacity	NIL
9.	Maximum allowable temperature for cable and accessories a) At rated full load and at site conditions b) The conductor temperature after a short circuit for 1 second shall not exceed (with conductor temp. at inception of short circuit as 90˚C)	 90˚C 250˚C
10.	Basic impulse insulation level (1.2/50 micro second wave), kVpeak	650
11.	Laying conditions, a) Built up Cable Trench b) Earthing of screen c) Ambient air temperature d) Type of atmosphere e) Ground temperature f) Thermal resistivity of soil	 500 mm centre to centre (typical) Bonded at both ends/ Cross bonded to earth (to be decided during detailed engineering) 50˚C Heavily polluted 40˚C 150˚C.cm/watt
12.	Material of insulation	Extruded Cross-linked polyethylene (XLPE)
13.	Insulation screen/ bedding	Extruded semiconducting compound semiconductor tape
14.	Longitudinal water barrier (i.e. Bedding)	Layer(s) of swellable semi conducting tape(s) to be applied over the extruded semi-conducting insulation screen with suitable overlap Semiconducting swelling tape(s) over copper wire screen (if applicable).
15.	Material of Conductor	Plain annealed copper wires in accordance

		with IEC 60228 or equivalent
16.	Copper equivalent cross-sectional area of conductor, sqmm	800
17.	Shape of conductor	Circular
18.	Conductor screen	Extruded layer of semiconducting compound
19.	Maximum resistance of conductor at 20 deg C	0.0221 Ω/km
20.	Metallic sheath (i.e. Inner sheath (material)	Aluminum or lead or lead alloy
21.	Outer protective sheath	Extruded black PVC compound, in accordance with IEC-60840
22.	Type of metallic sheath earthing	Solidly earthed through disconnecting link box
23.	Cable circuit details	3 cores for Circuit -1/2
24.	Creepage distance for termination	25mm/kV
25.	Sheath voltage	Sheath voltage to ground under normal operating condition shall not exceed 65V
26.	Laying method	Cables shall be laid in air, in built up concrete trenches and/ or directly buried in soil
27.	Cable configuration	Flat form
28.	Screen earthing method	To be finalized during detailed engineering stage
29.	System earthing	Effectively earthed (solidly grounded)

Notes:

1. Bidder shall submit following design calculations,
   (i) Insulation dimensions including thickness of inner/ outer sheath and semi-conducting layers.
   (ii) Verification of thermal withstand capacity of XLPE cables for short circuit current.
   (iii) Conductor, conductor sheath, insulation and structure losses.
   (iv) Temperature rise
   (v) Cooling and anti-condensation behavior.
   (vi) Voltage gradient calculations for operating voltage, highest system voltage and for transient voltage.
   (vii) Supporting steel structure design and calculations.
   Mechanical forces and stresses induced in cable conductor and metallic sheath to prove the mechanical strength.

2. Further to above, bidder shall also submit the following design calculations,
   (i) Design calculations for sizing and short circuit withstand capability of the conductor and metallic sheath, along with copper wire screen & copper binder tape, (as applicable) shall be submitted during detailed design stage.
   (ii) Design calculations for thermal withstanding capacity for short circuit current (conductor & sheath).
   (iii) Calculation indicating that the 800sqmm copper (equivalent) conductor single phase 132kV XLPE cable is capable to carry 570A continuous current.
   (iv) Calculations of cable for following,
   - Screen/ sheath voltage under full load condition,
   - Screen/ sheath voltage during an external three phase symmetrical through-fault
   (v) Calculations for screen/ sheath voltage/ current and the recommended method for metallic screen bonding and screen sizing shall be designed in such a manner so that it can carry the earth fault current level of the system, considering system is solidly grounded.

4. Other General Requirements

The other general requirements for the equipment (**132kV XLPE Cable with Accessories**) shall be in line with **Annexure 3- Scope Division Matrix** as per following details,

1. Schedule
   - Bidder shall submit detailed bar chart for engineering approval, site installation, testing and commissioning activities.
   - Bidder shall submit list of consumables with shelf life of fewer than two years, if applicable and same shall be dispatched just before the erection and only after specific clearance from BHEL/ NTPC.
   - In addition to this, packing of XLPE cable accessories shall be suitable for long term storage without any deterioration in quality and performance (min. 2 years, if required).
2. Open/ closed store
   - Open/ closed store area shall be provided by BHEL; however, bidder shall provide their requirement of space in open/ closed store during tender stage only.
   - In addition to this, bidder shall also provide their standard recommendations for precautions to be taken during unloading and storage etc. for approval of BHEL/ NTPC.
   - Unloading of XLPE cables and its accessories at site, storage in open/ closed store as per requirement shall be in bidder's scope.
   - During storage of materials in BHEL provided open/ closed store, watch and ward shall be provided by BHEL, however, in case materials are taken out from store, it shall be bidder's responsibility to arrange the watch and ward round the clock.
3. Office facility at project site
   - Office facilities including sitting arrangement, stationary, printer etc. and accommodation for bidder's staff at project site along with local conveyance shall be in bidder's scope.
   - Arrangement of drinking water and personal protective equipment for staff and workers shall be in bidder's scope.
4. Site Staff including site supervisor, qualified jointers and workers

- Site staff including site supervisor, skilled technician, qualified jointer and other workers along with tools & tackles, testing instruments, general tools and tackles, special tools and tackles, Tools and plant is deemed to be included in bidder's scope including loading, unloading and transportation.
- Termination/ jointing of cables shall be done by skilled and experienced jointer certified by OEM and duly approved by BHEL/ NTPC.

5. Construction supply
   - For construction requirements, the necessary power supply at site shall be provided by BHEL at one point only, however supply requirements for HV AC/ DC testing etc. shall be arranged by bidder only. Power supply provided shall be on chargeable basis.
6. Cable supporting rack assembly structure & termination/ sealing end supporting structure
   - The XLPE cables shall be laid on Cable supporting rack assembly structure on cable trench, however same shall be supplied by BHEL.
   - Supporting structure for outdoor termination/ cable sealing end shall consist of galvanized steel members, however same shall be supplied by BHEL.
   - Bidder to note that block-outs, bracket supports, fixtures / inserts, anchor fasteners necessary for proper installation of XLPE cable shall be in bidder's scope.
   - Installation and fixing of materials required for earthing for complete route of XLPE cable and its end termination shall be in bidder's scope. The earth grid connection shall not be available at all points in route and, hence provisions of independent earthing including rod electrode etc. shall be deemed to be included in bidder's scope.
   - The associated activities including cutting, drilling, welding, painting and fabrication etc. including minor civil works required for completion of XLPE cable work shall be in bidder's scope.
7. Installation of XLPE cable
   - The XLPE cables shall be laid in air, in built up concrete trenches and/ or directly buried in soil, as per site requirement.
   - The XLPE cable shall be installed in a snaked shape to absorb the thermal expansion and contraction of the cables or suitable arrangements shall be proposed by the bidder for the cable laying so as to compensate the thermal expansion and contraction for temperatures variations.
   - General & Special tools required for laying, hauling, installation and dismantling of the XLPE cables and its accessories shall be in bidder's scope.
   - Materials required for repair and maintenance of cables during laying/ after laying, if found/ observed during pre-commissioning stage shall be arranged by bidder to make it good to the satisfaction of BHEL/ Customer.
8. Termination and jointing of cable sealing end
   - Tools & tackles, testing instruments for termination/ jointing, tools for termination, scaffolding for support and making platform at elevated position, arrangement for controlled environment, crane/ hydra for lifting, heating arrangement etc. to complete termination and jointing work complete in all respect shall be bidder's scope.
   - Cable accessories damaged during installation, testing & commissioning shall be made good/ repaired/ replaced by bidder to the satisfaction of BHEL/ NTPC.
9. Site Testing & Commissioning
   - Testing instruments/ kits including HV AC/ DC testing kit and partial discharge

measurement equipment for field test, if required shall be provided by bidder along with valid calibration certificate.

- Bidder shall depute its qualified testing & commissioning engineer at site for successful testing and commissioning of XLPE cable system.
- Bidder shall submit complete methodology for conduction of site tests for further approval of BHEL/ NTPC before testing & commissioning activities.
- Different cable circuits may be commissioned at different point of time, and hence deployment the resources at multiple times at site in line with actual requirement is envisaged.

10. Training of BHEL/ Customer personnel
    - Training of BHEL/ customer personnel on 132kV XLPE cable and accessories shall be provided at vendor's works. However, to & fro travelling charges, lodging and boarding charges for BHEL/ customer personnel shall not be borne by bidder.
11. Drum length and tolerance
    - XLPE Cables shall be supplied in tentative drum lengths of approximate 700 meters for required 132kV XLPE cable unless otherwise specified. However, exact drum lengths shall be finalized during route survey. Due consideration shall be given to the route length & proposed screen bonding scheme to finalize drum lengths and transportation.
    - The non-returnable cable drums shall be supplied with definite cable length (to be informed before start of manufacturing) within +2 m tolerance and hence, bidder shall not be reimbursed for excess lengths supplied, other than as specified. Cable drums with shorter lengths shall not be accepted.
    - Each cable end shall be hermetically sealed by means of PVC/ Rubber/ non-hygroscopic sealing compound caps so as to protect the cable from outside moisture & ingress of water during transit, storage and laying. At top cable end, pulling eye shall be provided.
12. Basic Arrangement
    - The two bays of 132kV switchyard shall be connected to 132kV station transformers by two circuit of 1Cx800sqmm Copper conductor XLPE cable.

5. Bill of Quantities

1. Schedule of quantities for supply & services for the equipment (**132kV XLPE Cable with Accessories**) shall be as per **ANNEXURE 1- BOQ for 132kV Cable with Accessories**. However, any supply/ service not appearing herein but required for completeness of the work is deemed to be included in bidder's scope.
2. Bidder may please be noted that the exact cable length shall be decided after joint route survey during site visit and making precise measurements at contract stage. Manufacturing cable cut length and drum length shall be determined with consultation & approval with BHEL/ NTPC.
    a. The Payment of cables length for supply shall be as per approved quantities by BHEL/NTPC.
    b. The Payment of cables length installation will be as per actual measurement at site which shall also include cable terminations.
    c. The exact length may vary by -20% to +20% at contract stage based on actual measurement at site and calculations submitted by the bidder. However, Individual quantity of other items may vary to any extent and may get deleted during contract/

execution stage.

d. The bidder must fill up all the details required for offered item/s. Instead of indicating "refer drawing, or as per IS/IEC", the exact value/s must be filled in.

6. Drawings / Documents required for Engineering Manufacturing Clearance

Drawings/ documents detailed as per **Annexure 2- Details for Lot wise Technical Clearance for Manufacturing** shall be used for providing technical clearance for manufacturing of the equipment (**132kV XLPE Cable with Accessories**), which shall be used for engineering delay analysis, if applicable for respective group.

The technical clearance for manufacturing shall be provided Lot wise, however, lot item can be clubbed together subject to condition of approval of drawing/ documents. Technical clearance for manufacturing shall be issued after approval of drawings in Category-I (approval without any comments)/ category-II (approval with comments) from customer/ BHEL, however it shall be sole discretion of engineering department to include/ exclude the drawing/ document earmarked for consideration for any particular Lot. In case drawing/ document are not duly stamped in category-1/ category-2 by customer, BHEL stamp/ confirmation shall be treated final to proceed further.

Date of Submission of drawings/ documents shall be counted only from the date of submission of reasonably correct drawings/ documents.
The successful bidder shall have to extend all possible support such as timely submission/ re-submission of drawings, visit to end customer to facilitate documents approval without any commercial implications to BHEL. Acceptance of bidder's documents shall be subject to end customer/ NTPC approval.

7. Type Testing

Bidder shall ensure that the equipment (**132kV XLPE Cable with Accessories**) being procured should have valid type test certificates as specified in IS/ IEC standards (e.g. IEC 60840/ 61462) (amended up to date) at any independent laboratory/ NABL accredited laboratory of respective country. The validity of type test reports shall be 10 years from the techno-commercial bid opening date.
The complete type test certificates and data sheets for cables and its accessories shall be furnished by bidder. If the tests conducted are not to the satisfaction of BHEL/ NTPC, the tests shall be re-conducted by bidder without any commercial implication to BHEL.

Further, in case, any of type tests have not been conducted on the offered design or there has been a change in the design after the type tests, the requisite tests shall be conducted by bidder on the offered design by bidder without any commercial implication to BHEL.

8. Quality Plan

The successful bidder shall submit Quality Assurance Plan for **132kV XLPE Cable with Accessories** etc. including in-process inspection methods, tests, records, etc. for BHEL/ consultant/ customer approval. Customer hold points will also be included in the plan, which shall be mutually agreed by the BHEL/ consultant/ customer. In case bidder has reference Quality Assurance Plan agreed with BHEL/ NTPC, same shall be submitted for specific project to BHEL/ consultant/ customer approval. There shall be no commercial implication to BHEL/ NTPC on account of Quality Plan approval.

Superior quality control system shall be adopted to assure high product quality. Raw materials of the best commercial grade quality and high reliability shall be used in the manufacture of the equipment (**132kV XLPE Cable with Accessories**). All materials shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved quality plan. The supplier shall perform all tests necessary to ensure that the material and workmanship conform to the relevant standards and comply with the requirements of the specification. Charges for all tests for the equipment (**132kV XLPE Cable with Accessories**) shall be deemed to be included in bidder's scope.

9. Inspection & Testing

1. the equipment (**132kV XLPE Cable with Accessories**) shall be subject to inspection by BHEL/ NTPC or authorized representative at bidder/ manufacturers' works. Hence, Bidder shall furnish all necessary information concerning the supply to BHEL/ NTPC.
2. The inspector shall have free access to the manufacturer's/ supplier's works for the purpose of inspecting the process of manufacture in all its stages and he will have the power to reject any material, which appears to him to be of unsuitable description or of unsatisfactory quality.
3. Bidder shall give at least 2 weeks' advance notice to BHEL/ NTPC, regarding the date of testing to enable him or his representative to witness the tests. All the tests must be done as per the approved QAP.
4. Bidder shall also furnish factory acceptance test (FAT) from manufacturers for BHEL/ consultant/ customer approval in line with specific requirements.
5. Routine and sample tests shall be carried out as per IEC 60840 on 132kV XLPE cable system.

10. Field Testing & Commissioning

1. Bidder shall carry out the installation, field testing and commissioning of the equipment (**132kV XLPE Cable with Accessories**).
2. Field testing and commissioning of the equipment (**132kV XLPE Cable with Accessories**) shall be done by Bidder/ OEM only.
3. Bidder shall also submit site acceptance testing (SAT) procedures and get them approved from BHEL/ consultant/ customer before carrying out the site testing. Following site test as per IEC 60840, if applicable shall be conducted after laying of cable and installation of accessories.
   - DC voltage test of the over sheath
   - AC voltage test of the insulation, if applicable
   - Partial discharge measurement test, if applicable
4. Bidder/ OEM shall coordinate with manufacturers of other equipment wherever required and shall freely and readily supply all technical information for this purpose as and when called for.
5. Further appropriate testing and commissioning reports and as-built documentation as necessary, shall be submitted.

11. Packing and Dispatch

1. Cables shall be despatched in non-returnable steel drums of suitable barrel diameter, securely battened, with the take-off end fully protected against mechanical damage. Ferrous parts used shall be treated with a suitable rust preventive finish or coating to avoid rusting during transit or storage.
2. The following information shall be marked on the drum,
   a. Reference Standard

b. Manufacturer's name, trade mark/ brand name
c. Type of cable and voltage grade
d. Number of cores
e. Nominal Conductor cross-section area and material
f. Type of insulation
g. Cable code
h. Cable drum number
i. Length of cable in each drum
j. Direction of rotation of the drum (by means of an arrow)
k. Gross weight
l. Year and country of manufacture
m. Location of the cable outer end by an arrow
n. Section of cable route for which the cable is intended.
o. The details indicated in (h), (i), (j), (m) and (n) shall be painted on both sides of the drum.

3. A weather proof tag suitable for 2 years of outdoor, storage shall be affixed to each real, visible without removal of packing material with the information above.
4. The finished cable shall be identified by embossing the following identification on cable external surface at less than 1-meter intervals longitudinally:
   a. Manufacturer's name or trademark
   b. Year of manufacturer
   c. Cable size
   d. Cable rating
   e. Cable code as per IEC 60840 for XLPE insulated cables.
   f. Sequential length mark shall be provided at each metre along with the above markings.
5. Each cable end shall be hermetically sealed by means of PVC/ Rubber/ non-hygroscopic sealing compound cups so as to protect the cable from outside moisture & ingress of water during transit, storage and laying. At top cable end, pulling eye shall be provided.
6. Cable accessories shall be carefully packed for transport by sea, rail and road in such a manner that it is protected against the climatic conditions and for any damage during transportation, transit and storage. Packing of cable accessories shall be suitable for long storage (minimum 2 year).

12. Exceptions

1. Cable support structure & cable rack assembly for Cable sealing end shall not be in bidder's scope. It shall be supplied and erected by BHEL/ its contractor.
2. During storage of materials in BHEL provided open/ closed store, watch and ward shall be provided by BHEL, however, in case materials are taken out from store, it shall be bidder's responsibility to arrange the watch and ward round the clock.
3. For construction requirements, the necessary power supply at site shall be provided by BHEL at one point only, further, supply requirements for HV AC testing etc. shall be provided in case of readiness of switchyard extension bay, however, in case of non-readiness of switchyard extension bay, supply requirements for HVAC including DC testing shall be arranged by bidder only. Power supply provided shall be on chargeable basis.

13. Sub-Suppliers

Bidder should consider NTPC approved make of components and fitments. In case the offered make is not approved by NTPC, bidder has to provide alternate make components without any commercial/ time of delivery implication to BHEL.

14. Terms Used

The terms used in this specification namely, "Employer/ Purchaser/ Owner" refers to NTPC/BHEL & "Contractor/ Sub-contractor/ Manufacturer/ Bidder/Supplier" refers to successful bidder.

15. Abbreviations Used

The following terminology/ acronym hereunder and elsewhere in the technical specification used and their grammatical variations shall unless repugnant to the subject or context thereof, have the following full form hereunder respectively assigned to them, namely,

AC:	Alternating Current
DC:	Direct Current
kV:	Kilovolt
Hz:	Hertz
IP:	Ingress Protection
CSE:	Cable Sealing End
PVC:	Polyvinyl Chloride
HR PVC:	Heat Resistant Polyvinyl Chloride
UV:	Ultra Violet
PE:	Poly Ethylene
XLPE:	Cross-linked Polyethylene
EHV:	Extra High Voltage
EPR:	Ethylene Propylene Rubber
FR:	Flame Retardant
SAT:	Site Acceptance Testing
BOQ:	Bill of Quantities
QAP:	Quality Assurance Plan
NIT:	Notice Inviting Tender
OEM:	Original Equipment Manufacturer
BHEL:	Bharat Heavy Electricals Limited
BIS:	Bureau of Indian Standards
BS:	British Standard
ANSI:	American National Standards Institute
ASTM:	American Society for Testing and Materials
IS:	Indian Standards
IEC:	International Electro Technical Commission
IEEE:	Institute of Electrical & Electronics Engineers
CEA:	Central Electricity Authority
NEMA:	National Electrical Manufacturers Association

16. List of Documents/ Drawings

Following drawing/ documents are attached for information purpose,

1. Annexure 1- BOQ for 132kV XLPE cable with Accessories

2. Annexure 2- Details for Lot wise Technical Clearance for Manufacturing
3. Annexure 3- Scope Division Matrix
4. 132kV Switchyard- Single Line Diagram
5. 132kV Switchyard- Layout Plan & Section Drawing
6. 132kV Cable Routing for Station Transformer

ANNEXURE 1- BOQ for 132kV XLPE Cable with Accessories

Rev No. 00

Sl. No.	Item Description	Long Description	Unit	Qty.
A.	**Supply Item: Cable**			
1	132kV, 1Cx800sqmm Copper conductor XLPE cable	Copper conductor XLPE cable shall be complete in all respect and comprising of following but not limited to, 1. The cable construction shall as per technical specification/ Section-2. 2. The exact cable length shall be decided and finalized after visiting site & making precise measurements at contract stage. Manufacturing lengths and drum length shall be determined with consultation & approval of BHEL/ Customer/ Consultant. however, requirement includes main and spare cables. 3. Bidder shall furnish cable calculations for following during tendering stage only, (a) Screen/ sheath voltage under full load condition, (b) Screen/ sheath voltage during an external three phase symmetrical through-fault. 4. Bidder shall furnish calculations for screen/ sheath voltage/ current and the recommended method for metallic screen bonding and screen sizing shall be designed in such a manner so that it can carry the earth fault current level of the system, considering 132kV system is earthed. 5. Any other item/(s) including cable end caps, pulling eye etc. required to complete the supply in all respect but not limited to above shall be in bidder's scope.	Running meter	15000
2	Bonding cable along with accessories	Bonding cable shall be complete in all respect and comprising of following but not limited to, 1. Bonding cable shall be used for earthing the metallic sheath of XLPE insulated power cables to disconnecting link box and then to earth grid. 2. Size of bonding cable shall be decided based on short circuit requirements and suitable single clamps along with hardwares for fixing of bonding cable shall be part of scope. 3. Any other item/(s) including lugs/ connectors and other accessories required to complete the supply shall be in bidder's scope.	Running meter	200
3	Earthing continuity cable along with accessories	Earthing continuity cable shall be complete in all respect and comprising of following but not limited to, 1. Earthing continuity cable shall be used for earthing continuity wire equalizing earth level between disconnecting links of both ends. 2. Size of earthing continuity cable shall be decided based on short circuit requirements and suitable single clamps along with hardwares for fixing of bonding cable shall be part of scope. 3. Any other item/(s) including lugs/ connectors and other accessories required to complete the supply shall be in bidder's scope.	Running Meter	200
4	Co-axial cable along with accessories	Co-axial cable shall be complete in all respect and comprising of following but not limited to, 1. Co-axial cable shall be used for earthing the metallic sheath of XLPE insulated power cables to disconnecting link box and then to earth grid. 2. Size of Co-axial cable shall be decided based on short circuit requirements and suitable single clamps along with hardwares for fixing of bonding cable shall be part of scope. 3. Any other item/(s) including lugs/ connectors and other accessories required to complete the supply shall be in bidder's scope.	Running Meter	200
	Supply Item: Cable Accessories			
5	132kV, Outdoor Cable Sealing/ Termination End Kit, compatible for 132kV, 1Cx800sqmm, Copper Conductor XLPE cable	Sealing/ termination kit shall be complete in all respect and comprising of following but not limited to, 1. Outdoor cable sealing/ termination ends shall be located in the 132kV Switchyard/ Transformer Yard to connect with other outdoor equipment. 2. The housing of the outdoor sealing end shall be porcelain/ epoxy resin of uniform quality and shall have sufficient strength against mechanical, electrical and thermal stresses and it shall confirm to IEC 61442/ 60840. 3. The colour of porcelain / epoxy resin insulator shall be brown and the minimum creepage distance in millimeters per unit of the highest voltage shall be more than 25 mm/ kV. 4. Cable end terminating kits shall be outdoor type and suitable for the size of conductor, insulation and voltage/ current ratings of the cable. 5. Any other item/(s) such as weather shields/ sealing ends, Copper lugs/ connector suitable for size of conductor, Non-magnetic glands, hardware and other accessories required to complete the supply in all respect but not limited to above shall be in bidder's scope. (1 Set= 1-phase termination requirements)	Set	12
6	132kV, Straight Through Jointing kit, compatible for 132kV, 1Cx800sqmm, Copper Conductor XLPE cable	Straight through jointing kit shall be complete in all respect and comprising of following but not limited to, 1. The cable end terminating kits shall be dry type and suitable for the size of conductor, insulation and voltage/ current ratings of the cable and installation conditions. 2. The jointing kit shall be heat shrinkable type and shall be used for jointing of cables. 3. The jointing kit shall be suitable for Copper cables and to be provided with copper jointing ferrules. 4. Any other items/accessories required to complete the supply in all respects but not limited to above shall be in bidder's scope. (1 Set= 1-phase termination requirements) Please refer clause 11.15 for complete details.	Set	24
7	1nox1-phase Disconnecting Link Box (CCPU) with SVL at Transfomer Yard end	Disconnecting link box/ cable covering protective unit (CCPU) shall be complete in all respect and comprising of following but not limited to, 1. The Transformer Yard end side Disconnecting link box/ Cable Covering Protective Unit (CCPU) shall be provided with sheath voltage limiter (SVL), which shall be of non-linear resistor type and shall be made of zinc oxide compound. 2. Construction and materials of bonding cable shall comply with relevant IEC or equivalent standards and the cross-sectional area shall have enough size to withstand the specified short circuit rating i.e. 31.5kA for 1 sec of the cable system. 3. Any other item/(s) including lugs, outoor shrouds, mounting structure etc. required to complete the supply in all respect but not limited to above shall be in bidder's scope. (1 Set= 1-phase)	Set	6
8	1x1-phase Disconnecting Link Box (CCPU) without SVL at 132kV Switchyard end	Disconnecting link box/ cable covering protective unit (CCPU) shall be complete in all respect and comprising of following but not limited to, 1. The Cable Sealing end side Disconnecting link box/ Cable Covering Protective Unit (CCPU) shall be provided to disconnect the earthing circuit during testing, hence it shall be without sheath voltage limiter (SVL). 2. Construction and materials of bonding cable shall comply with relevant IEC or equivalent standards and the cross-sectional area shall have enough size to withstand the specified short circuit rating i.e. 31.5kA for 1 sec of the cable system. 3. Any other item/(s) including lugs, outoor shrouds/ covers, mounting structure etc. required to complete the supply in all respect but not limited to above shall be in bidder's scope. (1 Set= 1-phase)	Set	6

ANNEXURE 1- BOQ for 132kV XLPE Cable with Accessories

Rev No. 00

Sl. No.	Item Description	Long Description	Unit	Qty.
9	1nox3-phase Disconnecting Link Box (CCPU) with SVL for cross bonding arrangement	Disconnecting link box/ cable covering protective unit (CCPU) shall be complete in all respect and comprising of following but not limited to, 1. Link box shall be used for cross bonding arrangement as per route length. 2. Construction and materials of bonding cable shall comply with relevant IEC or equivalent standards and the cross-sectional area shall have enough size to withstand the specified short circuit rating i.e. 31.5kA for 1 sec of the cable system. 3. Any other item/(s) including lugs, outoor shrouds, mounting structure etc. required to complete the supply in all respect but not limited to above shall be in bidder's scope. (1 Set= 1-phase)	Set	6
10	1nox3-phase Disconnecting Link Box (CCPU) without SVL for cross bonding arrangement	Disconnecting link box/ cable covering protective unit (CCPU) shall be complete in all respect and comprising of following but not limited to, 1. TheLink box shall be used for cross bonding arrangement as per route length. 2. Construction and materials of bonding cable shall comply with relevant IEC or equivalent standards and the cross-sectional area shall have enough size to withstand the specified short circuit rating i.e. 31.5kA for 1 sec of the cable system. 3. Any other item/(s) including lugs, outoor shrouds, mounting structure etc. required to complete the supply in all respect but not limited to above shall be in bidder's scope. (1 Set= 1-phase)	Set	2
11	1-way aluminium/ non-magnetic clamp compatible for 132kV, 1Cx800sqmm, Copper Conductor XLPE cable	Single-way aluminium/ non-magnetic clamp shall be complete in all respect and comprising of following but not limited to, 1. The rising portion of cables at both ends (bent portion) and the intermediate portion shall be clamped with single way aluminium clamps and it shall be fixed at 1.25 meter distance/ in line with short circuit force calculation. 2. The material of cleats shall be aluminium alloy in accordance with relevant IEC/IS or equivalent standards. 3. Any other item/(s) such as mounting/ fixing hardware/ materials with racks assembly and other accessories required to complete the supply in all respect but not limited to above shall be in bidder's scope.	No	12000
12	Miscellaneous Items required for 132kV XLPE cable system	All Miscellaneous Items shall be complete in all respect and comprising of following but not limited to, 1. Items including cable route marker, suitable earthing materials (earthing electrode, earthing terminals, bi-metallic clamps, washers, lugs, pads, hardware etc.) for connection to ground mat risers/ electrode, aluminium blocks for cable snaking, cable spacers, cable suspension devices, cable identification tags, embedments, hardwares etc. 2. Bidder shall submit the list covering the complete requirements. (1Lot=complete requirement for package)	Lot	1
13	Consumables with limited shelf life required for 132kV XLPE cable system	All consumables required to complete the work in all respects shall be in bidder's scope. 1. All consumable materials including wiper, solvent for cleaning, tissue paper etc. and other repair materials for outer sheath etc. shall be supplied. 2. Bidder shall submit the list covering the complete requirements. (1Lot=complete requirement for package)	Lot	1
B.	**Service Item: Cable**			
1	Service Item: Cable- Site survey for route including railway tracks crossings & length finalization of 132kV, 1Cx800sqmm Copper conductor, XLPE cable,	The exact cable length shall be finalized after site survey including railway tracks crossing & making precise measurements at contract stage. Manufacturing lengths and drum length shall be determined with consultation & approval with BHEL/ Customer/ Consultant. 1. The payment of cables lengths for supply shall be as per approved quantities after survey. 2. The Payment of cables length for installation shall be as per actual measurement at site which shall also include cable terminations. 3. The length may vary by -20% to +20% at contract stage based on actual measurement at site and calculations submitted by the bidder. (1Lot=Complete requirement for package)	Lot	1
2	Service Item: Cable- Finalization of methodology, design & drawing for railway track crossing including arrangement of railway/ RDSO approval of 132kV, 1Cx800sqmm Copper conductor, XLPE cable,	Railway Crossing shall be designed & provided as per RDSO/ Railway requirement and approval from Indian Railways shall be required. Details to be shown in separate drawing for approval from Indian Railways and approval to be obtained by Bidder, however needful/ requisite assistance and documentation shall be provided by BHEL/ NTPC. (1Lot=Complete requirement for package)	Lot	1
3	Service Item: Cable- Unloading and verification of 132kV XLPE cables and its accessories at site and shifting to BHEL store,	Site visit for unloading & verification of materials for proper storage and up-keeping at site includes following activities but not limited to, 1. Complete and safe unloading of 132kV XLPE cables with accessories at site. 2. Reconciliation, storage & upkeeping of materials for long storage (min. two years) 3. Further watch & ward shall be under the scope of BHEL/ its contractor, till the materials are in BHEL store.	Lot	1
4	Service Item: Cable- Installation of 132kV, 1Cx800sqmm Copper conductor, XLPE cable in concrete trench/ culvert/ overbridge/ tresle	Installation of Copper conductor XLPE cable shall be complete in all respect and comprising of following but not limited to, 1. Laying of cables in horizontal/ vertical/ bent plane in flat form with proper dressing by fixing single clamps as and where required on support structure in air, in built up concrete trenches and/ or directly buried in soil including crossing of cable tracks. ***This activity shall include cable crossing the railway tracks through structural overbridge/ tresle also. The arrangement of structural overbridge/ tresle shall be provided by BHEL, however, items like HDPE pipe and other protective cover & other accessories for laying of cables on structural overbridge/ tresle shall be included in bidder's scope.*** 2. Arrangement of all special tools & tackles for smooth laying & installation on returnable basis. 3. Cable tags/ marking tags, cable spacers, aluminum blocks for snaking, repair material for outer sheath, cable suspension devices, harwares shall be arranged and provided. 4. Arrangement of sand bags/ any other temporary arrangement shall be provided by bidder. 5. Any other service/(s) required to complete the work in all respects but not limited to above shall be in bidder's scope.	Running meter	15000
5	Service Item: Cable- Installation & crossing of 132kV, 1Cx800sqmm Copper conductor, XLPE cable rossing of Railway Tracks throgh trenchless method/ horizontal directional drilling (HDD) method	Installation & crossing of Copper conductor XLPE cable under Railway Tracks throgh trenchless / horizontal directional drilling (HDD) method complete in all respect and comprising of following but not limited to, 1. Laying of cables in horizontal/ vertical/ bent plane in flat form with proper dressing by fixing single clamps as and where required on support structure ***for crossing of Railway Tracks (approx. 50 meters wide) throgh trenchless/ horizontal directional drilling (HDD) method including arrangement of all the accessorioes like HDPE, bentonite etc. It is also to be noted that soil below the railway tracks are rocky in nature, hence special tools & tackles and machineary may be deployed for above activity.*** 2. Arrangement of all special tools & tackles for smooth laying & installation on returnable basis. 3. Cable tags/ marking tags, cable spacers, aluminum blocks for snaking, repair material for outer sheath, cable suspension devices, harwares shall be arranged and provided. 4. Arrangement of sand bags/ any other permanet/ temporary arrangement shall be provided by bidder. 5. Any other service/(s) required to complete the work in all respects but not limited to above shall be in bidder's scope.	Running meter	1200

ANNEXURE 1- BOQ for 132kV XLPE Cable with Accessories

Rev No. 00

Sl. No.	Item Description	Long Description	Unit	Qty.
6	Service Item: Cable- Installation of bonding cable along with accessories	Installation of bonding cable shall be complete in all respect and comprising of following but not limited to, 1. Bonding cable shall be installed from metallic sheath of XLPE insulated power cables to respective disconnecting link box and then to earth grid. 2. Laying of bonding cables shall be in horizontal/ vertical/ bent plane in flat form with proper dressing by fixing suitable single clamps as and where required on support structure at ends/ rack assembly/ other structure assembly in tunnel. 3. Fixing of cable support structure for supporting termination including fixing arrangements including any other accessories. 4. Any other item/(s) including lugs/ connectors and other accessories required to complete the service shall be in bidder's scope.	Running meter	200
7	Service Item: Cable- Installation of Co-axial cable along with accessories	Installation of Co-axial cable shall be complete in all respect and comprising of following but not limited to, 1. Co-axial cable shall be used for earthing the metallic sheath of XLPE insulated power cables to disconnecting link box and then to earth grid. 2. Laying of bonding cables shall be in horizontal/ vertical/ bent plane in flat form with proper dressing by fixing suitable single clamps as and where required on support structure at ends/ rack assembly/ other structure assembly in tunnel. 3. Fixing of cable support structure for supporting termination including fixing arrangements including any other accessories. 4. Any other item/(s) including lugs/ connectors and other accessories required to complete the service shall be in bidder's scope.	Running meter	200
8	Service Item: Cable- Installation of earthing continuity cable along with accessories	Installation of Earthing continuity cable shall be complete in all respect and comprising of following but not limited to, 1. Earthing continuity cable shall be installed between disconnecting links of both ends. 2. Laying of earthing continuity cable shall be in horizontal/ vertical/ bent plane in flat form with proper dressing by fixing suitable single clamps as and where required on support structure at ends/ rack assembly/ other structure assembly in tunnel. 3. Fixing of cable support structure for supporting termination including fixing arrangements including any other accessories. 4. Any other item/(s) including lugs/ connectors and other accessories required to complete the service shall be in bidder's scope.	Running Meter	200
9	Service Item: Cable- Site/ field testing & commissioning of 132kV, 1Cx800sqmm Copper conductor, XLPE cable system	Field testing & commissioning of Copper conductor XLPE cable shall be complete in all respect and comprising of following but not limited to, 1. Field testing & commissioning of XLPE, Cu conductor cable along with accessories such end termination, straight through joints, if required shall be carrried out in phase manner and hence simultaneous commissioning of all the circuits is not envisaged. 2. Field testing & commissioing shall be done as per approved SAT (site acceptance test), which shall be submitted by bidder and shall be approved by BHEL/ Customer/ Consultant. 3. Field testing & commissioning shall be carried out by skilled & experienced testing engineer. Test instruments including HV AC/ DC testing kit and partial discharge measurement equipment, if applicable along with valid calibration certificates for testing & commissioning shall be brought at site by bidder. 4. Any other service/(s) required to complete the testing & commissioning in all respects shall be in bidder's scope. (1 circuit-no= 1 no of Feeder including spare run of cable)	Circuit-no	2
10	Service Item: Cable Accessories- Termination of 132kV, Outdoor Cable Sealing/ Termination End Kit, compatible for 132kV, 1Cx800sqmm, Copper Conductor XLPE cable	Termination of Outdoor Cable Sealing/ Termination End Kit shall be complete in all respect and comprising of following but not limited to, 1. Termination work shall include all necessary arranngement for access and working such as scaffolding, heighteneded platform, temporary tent with controlled climate etc. 2. Termination/ jointing of cables shall be done by skilled and experienced jointer duly certified by OEM and approved by BHEL/ consultant/ customer. 3. Any other service/(s) required to complete the work in all respect but not limited to above shall be in bidder's scope. (1 set= 1-phase termination work)	Set	12
11	Service Item: Cable Accessories- Jointing of 132kV, Straight Through Jointing kit, compatible for 132kV, 1Cx800sqmm, Copper Conductor XLPE cable	Jointing of Straight Through Jointing kit shall be complete in all respect and comprising of following but not limited to, 1. Termination work shall include all necessary arranngement for access and working such as temporary tent with controlled climate etc. 2. Termination/ jointing of cables shall be done by skilled and experienced jointer duly certified by OEM and approved by BHEL/ consultant/ customer. 3. Any other service/(s) required to complete the work in all respect but not limited to above shall be in bidder's scope. 4. This is optional item and it shall be done at site as per requirement. (1 set= 1-phase termination work)	Set	24
12	Service Item: Cable Accessories- Installation of 1nox3-phase Disconnecting Link Box (CCPU) with SVL at Transfomer Yard end	Installation of Disconnecting Link Box (CCPU) with SVL shall be complete in all respect and comprising of following but not limited to, 1. Installation of Disconnecting Link Box (CCPU) with SVL along with accessories such as suitable earthing arrangements(earthing electrode, earthing terminals, bi-metallic clamps, washers, lugs, pads, hardware etc.) and structural work for mounting. 2. Any other service/(s) required to complete the work in all respects but not limited to above shall be in bidder's scope.	Set	6
13	Service Item: Cable Accessories- Installation of 1nox1-phase Disconnecting Link Box (CCPU) without SVL at 132kV Switchyard end	Installation of Disconnecting Link Box (CCPU) without SVL shall be complete in all respect and comprising of following but not limited to, 1. Installation of Disconnecting Link Box (CCPU) without SVL along with accessories such as suitable earthing arrangements (earthing electrode, earthing terminals, bi-metallic clamps, washers, lugs, pads, hardware etc.) and structural work for mounting. 2. Any other service/(s) required to complete the work in all respect but not limited to above shall be in bidder's scope.	Set	6
14	Service Item: Cable Accessories- Installation of 1nox3-phase Disconnecting Link Box (CCPU) with SVL for cross bonding arrangement	Installation of Disconnecting Link Box (CCPU) with SVL shall be complete in all respect and comprising of following but not limited to, 1. Installation of Disconnecting Link Box (CCPU) with SVL along with accessories such as suitable earthing arrangements(earthing electrode, earthing terminals, bi-metallic clamps, washers, lugs, pads, hardware etc.) and structural work for mounting. 2. Any other service/(s) required to complete the work in all respects but not limited to above shall be in bidder's scope.	Set	6
15	Service Item: Training - Training for 132kV XLPE System of 6no. Engineers (4 no. customer engineers+2 no. BHEL engineers) for a period of at least 7 working days at Manufacturer's works	To and fro travelling charges, lodging and boarding charges of engineer shall be in BHEL/ Customer scope. Only training shall be arranged at Bidder works.	Lot	1

Annexure 2- Details for Lot wise Technical Clearance for Manufacturing

PROJECT NAME **765/400/132kV AIS Switchyard Extension at NTPC SIPAT STPP Stage-III (1 x 800 MW)**

CUSTOMER **M/s NTPC Limited**

ITEM DESCRIPTION **132kV XLPE Cable with accessories**

Sl. No.	BHEL/ Customer Drawing/ Doc. No	Customer Drawing/ Doc. No	Document Title	Approval Category (A- approval, I-Information)	Manufacturing Lot	Submission date	Remarks
1	TB-435-316-36-XLPE-01	--	132kV XLPE Cable Cable Cross Section Drawings and Guaranteed Technical particulars	A	1		1. BHEL shall provide all the technical inputs requirements (e.g. Title Block, Master Drawing list, Layout Plan & Section Drawings, interfacing drawings etc. as applicable) required for submission of drawings/ documents during detailed engineering stage within time line mentioned in activity schedule, pendancy of any input from BHEL, if equired, bidder shall inform within one week time. Subsequent to this Bidder shall provide all drawing/ document within time line mentioned in Activity Schedule. However it is to be noted that total submission time for all drawing/ documents of particular lot shall not exceed time line mentioned in activity schedule of NIT. 2. Submisison date furnished by bidder shall be used for any of contractual requirements/ purpose.
2	TB-435-316-36-XLPE-02	--	132kV XLPE Cable Type Test Reports	A/I	1		
3	TB-435-316-36-XLPE-03	--	Bonding/ Earthing Cable Cross Section Drawings and Guaranteed Technical particulars	A	1		
4	TB-435-316-36-XLPE-04	--	Circuit Single Line Diagram including earthing details, Dimensional and Layout Arrangment (Plan & Section).	A	1		
5	TB-435-316-36-XLPE-05	--	Cable Cutting & Cable Drum Schedule for 132kV XLPE & Bonding/ Earthing Cable	A	1		
6	TB-435-316-36-XLPE-06	--	132kV XLPE Cable Design and Sizing Calculations	A/I	1		
7	TB-435-316-36-XLPE-07	--	132kV XLPE Cable Earthing/ sheath voltage limitation (Voltage Gradient) Calculations	A/I	1		
8	TB-435-316-36-XLPE-08	--	132kV XLPE Temperature Rise & Heat Loss Calculations	A/I	1		
9	TB-435-316-36-XLPE-09	--	132kV XLPE Sizing calculation & short circuit withstand capabilities of Metallic Sheath.	A/I	1		
10	TB-435-316-36-XLPE-10	--	GA Drawing and Guaranteed Technical Particulars of Cable Drum for 132kV XLPE & Bonding/ Earthing Cable	A	1		
11	TB-435-316-36-XLPE-11	--	Quality Assurance Plan & Inspection Test Schedule of 132kV XLPE Cable and its accessories	A	1 & 2		
	TB-435-316-36-XLPE-12						
12	TB-435-316-36-XLPE-13	--	GA Drawing and Guaranteed Technical particulars of 132kV Jointing and Termination Kits	A	2		
13	TB-435-316-36-XLPE-14	--	Type Test Report of 132kV Jointing and Cable Termination Kit	A/I	2		
14	TB-435-316-36-XLPE-15	--	GA Drawing, Guaranteed Technical Particulars and Bill of Materials of Link Box	A	2		
15	TB-435-316-36-XLPE-16	--	Type Test Report of Link Box	A/I	2		
	TB-435-316-36-XLPE-17						
16	TB-435-316-36-XLPE-18	--	GA Drawing, Guaranteed Technical particulars and Bill of Materials of Single Clamps and other Miscellaneous Items (Earthing materials, aluminium blocks for cable snaking, cable spacers, cable suspension devices, cable identification tags, embedments, hardwares etc.)	A/I	*		
17	TB-435-316-36-XLPE-19	--	List of Consumables items for 132kV XLPE Cable System, if applicable	A/I	*		

Lot Description	Item Sl. No. as per BOQ	Remarks
Lot 1	A.1, A.2, A.3,	Covered under separate & dedicated purchase/ work indent request.
Lot 2	A.4, A.5, A.6, A.7, A8, A9, A10, A11	
Lot 3/ Separate Lot	All B's	Covered under separate & dedicated purchase/ work request.

Notes:

1 Drawing/ document marked "*" shall not be considerd for Engineering Delay Analysis. Hence, Materials such as Single Clamp, other miscellaneous items, Consumables, Tools etc. shall not be considered for Engineering Delay Analysis, However, bidder shall ensure timely supply, availability and completeness of work at site without any delay.

2 Drawings/ documents, not mentioned above but required for completeness of work shall be submitted for approval/ Information, if required. However, bidder/ vendor shall ensure that manufacturing of any materials of 132kV XLPE cable system are not getting affected/ put on-hold.

3 In case drawing/ document are not duly stamped in category-1/ category-2 by customer, BHEL stamp/ confirmation shall be treated final to proceed further.

Annexure 3- Scope Division Matrix between BHEL (/its contractor) & Bidder (/Vendor)

PROJECT NAME: 765/400/132kV AIS Switchyard Extension at NTPC SIPAT STPP Stage-III (1 x 800 MW)
CUSTOMER: NTPC Limited

Sl. No.	Activity Schedule	Customer/ THDCIL	BHEL/ its contractor	Bidder/ Vendor	Remarks
A.	**Design & supply work**				
1	XLPE Power Cables			O	
2	Bonding Cable & Earth Continuity Cables			O	
3	Jointing Kits & Termination Kits for XLPE Cables			O	
4	Link Boxes (CCPU) for XLPE Cables			O	
5	One way non-magnetic single clamps			O	
6	Station transformer end termination (Transformer Yard)				
	- Steel structure for supporting the termination work			O	
	- Cover plate/ scaffolding for supporting cable during termination work			O	
	- Suitable clamps at termination area			O	
	- Earthing shrouds/ sleeve and any other arrangements			O	
	- Terminal lugs, if applicable			O	
	- Other miscellaneous items i.e. phase identification, cable tags, fire retardant paint/ outer shrouds, earthing materials etc.			O	
7	Switchyard Cable Sealing end termination (132kV switchyard)				
	- Steel structure for supporting the termination work			O	
	- Cover plate/ scaffoldig for supporting cable during termination work			O	
	- Suitable clamps at termination area			O	
	- Earthing shrouds/ sleeve and any other arrangements			O	
	- Terminal lugs, if applicable			O	
	-Other miscellaneous items i.e. phase identification, cable tags, fire retardant paint/ outer shrouds, earthing materials etc.			O	
8	XLPE Cable ventilation and tunnel area/ XLPE cable route area				
	- Support structure including hanger and rack assembly including anchor fastener/ inserts throughtout the route			O	
	-Miscellaneous items including phase identification, cable tags, fire retardant paint/ outer shrouds, earthing materials etc.			O	
9	Consumables for XLPE cable installation, termination and repair work			O	Detailed list shall be submitted.
10	Mandatory spares			O	
11	Tools for XLPE cable maintenance work			O	Detailed list shall be submitted.
12	Tools and plants for XLPE cable installation and laying work			O	Returnable basis. Detailed list shall be submited.
13	Tools and plants for XLPE cable testing and commissioning work			O	Returnable basis. Detailed list shall be submited.
14	Tools and plants for XLPE cable jointing and terminaton work			O	Returnable basis. Detailed list shall be submited.
11	Any other work as per per specification/ customer requirement for completeness of work			O	
B.	**Installation work**				
1	Unloading of all XLPE cable materials and its accessories at BHEL store			O	Open/ closed store shall be provided by BHEL.
2	Installation of steel structures including rack assembly/ hanger/ support structure on concrete wall/ concerete foundation throughout CVT area/ cable route area			O	Structure shall be installed anchor fasteners/ inserts plats
3	Laying and installation of XLPE power cables with proper dressing, snaking and application of fire retardant paint/ coating, if applicable etc.			O	
4	Clamping of XLPE cables with suitable clamps			O	
5	Termination work for XLPE power cables at Cable Sealing end of Switchyard end			O	Support shall be extended by GIS OEM in GIS termination work
6	Termination work for XLPE power cables at Cable Sealing end of Transformer Yard end			O	
7	Installation and fixing of Link Boxes on the Wall/ Steel Structures/ Cable Trench			O	
8	Laying and installation of bonding and ECC cables between Link Boxes			O	
9	Earthing work throughout in cable route area			O	
10	Any other work as per per specification/ customer requirement for completeness of work			O	
C.	**Testing & commissioning work**				
1	AC Voltage Test of the insulation, if applicable			O	
2	DC Voltage Test on the outer sheath			O	
3	Partial discharge test			O	
4	24-hour AC cable soak (no load) test at rated voltage			O	
5	Temporary Test Bushing for Commissioning Test			O	
6	Gas/ oil Work for Commissioning Test			O	
7	Any other testing & commissioning work as per per specification/ customer requirement			O	
D.	**Civil Works**				
1	Civil works for cable trench/ culvert/ trench cover		O		

Annexure 3- Scope Division Matrix between BHEL (/its contractor) & Bidder (/Vendor)

PROJECT NAME: 765/400/132kV AIS Switchyard Extension at NTPC SIPAT STPP Stage-III (1 x 800 MW)
CUSTOMER: NTPC Limited

Sl. No.	Activity Schedule	Customer/ THDCIL	BHEL/ its contractor	Bidder/ Vendor	Remarks
2	Civil works for foundation of cable sealing end (CSE) at Switchyard end		O		
3	Civil works for foundation of cable sealing end (CSE) at Transformer Yard end		O		
D.	**Others works**				
1	Local transportation for vendor/ bidder officials, supervisory staffs and workers			O	
2	Local transportation of Equipment/ tools/ consumable materials			O	
3	Transportation of all XLPE cable materials inclduing drums and other Materials from Site to Site and from BHEL store yard to Site			O	
4	All Necessary Scaffolding for making platform, Tarpolin for temporary covering, AC for controlled environment and jointing container for jointing tools & tackles etc.			O	
5	BHEL store/ XLPE cable store yard with security arrangement		O		
6	Site area with security arrangement			O	
7	All Necessary permission for gatepass, identity card and work pass			O	
8	Provision of Heavy Equipment for Termination & Commisioning work (Crane, manlift etc.), if required			O	
9	Provision of construction power supply for termination Work			O	
10	Disposal of Waste Materials including empty cable drums and other materials			O	

Notes:

1. Additional/ multiple visits/ idling time are required due to unxpected condition/ force majeure/ not attributable to vendor/ bidder, there shall not be any additional payment for the same.

फर्स्ट एंगल प्रोजेक्शन/FIRST ANGLE PROJECTION

सभी माप मि॰ मी॰ में है/ALL DIMENSIONS ARE IN MM

Drawing is for reference purpose only.

BILL OF QTY. FOR 765kV MAIN EQUIPMENTS:

SL. NO.	DESCRIPTION	UNIT	QUANTITY	SYMBOL	REMARKS
1	765kV, 3150A, 50kA CIRCUIT BREAKER(3-PH) WITH CSD & WITHOUT CLOSING RESISTOR	NOS.	02	#	
2	765kV, 3150A, 50kA, VERTICAL KNEE / DOUBLE BREAK ISOLATOR (3-PH) WITH 1 E/S	NOS.	05		
3	765kV, 3150A, 50kA, VERTICAL KNEE / DOUBLE BREAK ISOLATOR (3-PH) WITH 2 E/S	NOS.	01		
4	765kV, 3000A, 50kA, 6 CORE CURRENT TRANSFORMER (1-PH)	NOS.	09		
5	765KV, 8800pF, 4 CORE CVT (1-PH)	NOS.	03		
6	624kV SURGE ARRESTER (1-PH)	NOS.	03		

SYSTEM PARAMETERS:

SL No	DESCRIPTION	765KV
1.0	RATED VOLTAGE	765 KV
2.0	HIGHEST SYSTEM VOLTAGE	800 KV rms
3.0	RATED FREQUENCY	50 Hz
4.0	MAX. FAULT LEVEL (1 Sec.)	50 KA
5.0	RATED 1 min POWER FREQ. WITHSTAND VOLTAGE	830 KV rms (Ph-E) & 1150 KV rms (Ph-Ph)
6.0	RATED SWITCHING IMPULSE VOLTAGE (DRY & WET)	±1550 KVp (Ph-E) & ±1175 (+650) kVp (across isolating distance)
7.0	FULL WAVE IMPULSE WITHSTAND VOLTAGE	±2100 KVp (Ph-E & Ph-Ph) & ± 2100 (+455) kVp (across isolating distance)
8.0	MINIMUM CREEPAGE DISTANCE - EQUIPMENT	20000 mm
9.0	MINIMUM CREEPAGE DISTANCE - STRING INSULATOR	20000 mm
10.0	SYSTEM EARTHING	EFFECTIVELY EARTH
11.0	RATED DYNAMIC WITHSTAND CURRENT	125 kAp
12.0	PD level	<5 pico coulomb
13.0	Max. Radio interference for freq (0.5MHz-2.0MHz)	2500 micro volts at 508kV rms
14.0	Corona Extinction Voltage	Not less than 508kV rms

765 kV CT (3000A) CORE DETAILS:
(EXTENDED PRIMARY CURRENT 120% OF RATED CURRENT)

CORE NO.	APPLICATION	RATIO	OUTPUT BURDEN (VA)	ACCURACY CLASS	MIN. KNEE POINT VOLTAGE (V)	MAX. CT S.W.R (ohm)	MAX. EXCITING CURRENT AT KPV (mA)	I.S.F.
01	PROTECTION	3000 - 2000 - 1000 / 1 A	-	PS	3000-2000-1000	15-10-5	20-30-60	-
02	PROTECTION	3000 - 2000 - 1000 / 1 A	-	PS	3000-2000-1000	15-10-5	20-30-60	-
03	METERING	3000-2000-1000-500/ 1 A	20-20-20-20	0.2S	-	-	-	<10
04	METERING	3000-2000-1000-500/ 1 A	20-20-20-20	0.2S	-	-	-	<10
05	PROTECTION	3000-2000-1000-500/ 1 A	-	PS	3000-2000-1000-500	15-10-5-2.5	20-30-60-120	-
06	PROTECTION	3000-2000-1000-500/ 1 A	-	PS	3000-2000-1000-500	15-10-5-2.5	20-30-60-120	-

765kV, 8800pF CVT CORE DETAILS:

PARTICULARS	SECONDARY-1	SECONDARY-2	SECONDARY-3	SECONDARY-4
RATED SECONDARY VOLTAGE (V)	$110/\sqrt{3}$	$110/\sqrt{3}$	$110/\sqrt{3}$	$110/\sqrt{3}$
APPLICATION	PROTECTION	PROTECTION	METERING	METERING
ACCURACY	3P	3P	0.2	0.2
OUTPUT BURDEN(MIN)	75 VA	75 VA	75 VA	75 VA
VOLTAGE RATIO	$\frac{765}{\sqrt{3}} / \frac{0.11}{\sqrt{3}}$	$\frac{765}{\sqrt{3}} / \frac{0.11}{\sqrt{3}}$	$\frac{765}{\sqrt{3}} / \frac{0.11}{\sqrt{3}}$	$\frac{765}{\sqrt{3}} / \frac{0.11}{\sqrt{3}}$

NOTE:

1) EQUIPMENT DESIGNATION PHILOSOPHY IS BASED ON EXISTING SLD.

REFERENCE DRAWING :-

NTPC TENDER SLD DRAWING NO. 9500-999-POE-J-001, REV. B

LEGEND:

- PRESENT SCOPE
- FUTURE/EXISTING

ग्राहक ड्राइंग संख्या CUSTOMER DRAWING NO.	8003-001-572-PVE-P-0002
ग्राहक/CUSTOMER	एन टी पी सी लिमिटेड N T P C LIMITED
परियोजना PROJECT	SIPAT STPP STAGE-III (1X800MW)
कार्य संख्या- JOB NO.	435
स्थिति STATUS	CONTRACT

मुद्रण स्केल मीटर में PRINT SCALE IN METRE

पुनरीक्षण REV.	दिनांक DATE	परिवर्तितकर्ता ALTD	जांचकर्ता CHD	अनुमोदनकर्ता APPD
01	16.07.25	RD	RD	SKS

REVISED IN LINE WITH NTPC COMMENTS.

भारत हेवी इलेक्ट्रिकल्स लिमिटेड
BHARAT HEAVY ELECTRICALS LTD
TRANSMISSION BUSINESS GROUP
नोएडा (उ॰प्र॰)/NOIDA (U.P.)

DEPT CODE: M

	नाम NAME	हस्ताक्षर SIGNATURE	दिनांक DATE
तैयारकर्ता/DRN	RD	-SGD-	10.01.25
डिजाइनकर्ता/DESN	RD	-SGD-	10.01.25
जांचकर्ता/CHD	RD	-SGD-	10.01.25
अनुमोदनकर्ता/APPD	SKS	-SGD-	10.01.25

शीर्षक/TITLE: SINGLE LINE DIAGRAM FOR 765/132 KV SWITCH YARD EXTENSION

विभाग DEPT. | स्केल – SCALE– | हस्ताक्षर SIGN | दिनांक DATE

ड्राइंग संख्या/ DRAWING NO. TB-435-316-001

शीट SHEET 01 OF 02 पुनरीक्षण REV. 01

फॉर्मेट साइज A0 FORMAT SIZE A0

PRESENT SCOPE

EXISTING

PUMP HOUSE MAKEUP WATER S/C LINE

BUS-II
132kV MAIN BUS-I (EXISTING)

BUS-I
132kV MAIN BUS-II (EXISTING)

MAIN BUS-I

MAIN BUS-II

BUS CVT-I CVT-II

BUS CVT-II CVT-I

BAY NO-1-15

BAY NO-1-14

1-15 89B
1-15 89A
1-14 89B
1-14 89A
1-15 89BE
1-14 89BE
1-15 52
1-14 52
P2
1-15 CT
1-14 CT
P1
1-15 89LE1
1-14 89LE1
1-15 89L
1-14 89L
1-15 89LE2
1-14 89LE2
1-15 LA1
1-14 LA1
1-15 CSE1
1-14 CSE1

132KV CABLE
132KV CABLE

1-15 CSE2
1-14 CSE2
1-15 LA2
1-14 LA2
ST#7
ST#6

BAY NO-1-13
BAY NO-1-12
BAY NO-1-11
BAY NO-1-10
BAY NO-1-09
BAY NO-1-08
BAY NO-1-07
BAY NO-1-06
BAY NO-1-05
BAY NO-1-04
BAY NO-1-03
BAY NO-1-02
BAY NO-1-01

TO STN. TRANSF.#5
TO STN. TRANSF.#4
TO STN. TRANSF.#3
TO STN. TRANSF.#2
TO STN. TRANSF.#1
TO MISC. TRANSF.#1
TO ~~STN.~~ MISC. TRANSF.#2

BILL OF QTY. FOR 132kV MAIN EQUIPMENTS:

SL. NO.	DESCRIPTION	UNIT	QUANTITY	SYMBOL	REMARKS
1	132kV, 1250A, 31.5kA CIRCUIT BREAKER(3-PH) WITHOUT PIR	NOS.	02		
2	132kV, 1250A, 31.5kA HCB ISOLATOR (3-PH) WITH 1 E/S	NOS.	02		
3	132kV, 1250A, 31.5kA HCB ISOLATOR (3-PH) WITH 2 E/S	NOS.	02		
4	132kV, 1250A, 31.5kA HCB TANDEM ISOLATOR (3-PH) WITHOUT E/S	NOS.	02		
5	132kV, 1200A, 31.5kA, 5 CORE CURRENT TRANSFORMER (1-PH)	NOS.	06		
6	120kV SURGE ARRESTER (1-PH)	NOS.	12		
7	132kV CABLE SEALING END (1-PH)	NOS.	12		

SYSTEM PARAMETERS:

SL No	DESCRIPTION	132KV
1.0	RATED VOLTAGE	132 KV
2.0	HIGHEST SYSTEM VOLTAGE	145 KV rms
3.0	RATED FREQUENCY	50 Hz
4.0	MAX. FAULT LEVEL (1 Sec.)	31.5 KA
5.0	RATED 1 min POWER FREQ. WITHSTAND VOLTAGE	275 KV rms
6.0	RATED SWITCHING IMPULSE VOLTAGE (DRY & WET)	NA
7.0	LIGHTNING IMPULSE WITHSTAND VOLTAGE	±650 KVp (Ph-E & Ph-Ph)
8.0	MINIMUM CREEPAGE DISTANCE - EQUIPMENT	3625 mm
9.0	MINIMUM CREEPAGE DISTANCE - STRING INSULATOR	3625 mm
10.0	SYSTEM EARTHING	EFFECTIVELY EARTH
11.0	RATED DYNAMIC WITHSTAND CURRENT	80 kAp
12.0	Max. Radio interference for freq (0.5MHz-2.0MHz)	1000 micro volts at 92kV rms

132 kV CT (1200A) CORE DETAILS:
(EXTENDED PRIMARY CURRENT 120% OF RATED CURRENT)

CORE NO.	APPLICATION	RATIO	OUTPUT BURDEN (VA)	ACCURACY CLASS	MIN. KNEE POINT VOLTAGE (V)	MAX. CT S.W.R (ohm)	MAX. EXCITING CURRENT AT KPV (mA)	I.S.F.
01	PROTECTION	1200 - 600 / 1 A	-	PS	1200 - 600	6-3	30-60	-
02	PROTECTION	1200 - 600 / 1 A	-	PS	1200 - 600	6-3	30-60	-
03	METERING	1200 - 600 - 300 / 1 A	20-20-20	0.2S	-	-	-	<5
04	PROTECTION	1200 - 600 - 300 / 1 A	-	PS	1200 - 600 - 300	6-3-1.5	30-60-120	-
05	PROTECTION	1200 - 600 - 300 / 1 A	-	PS	1200 - 600 - 300	6-3-1.5	30-60-120	-

NOTE:

1) EQUIPMENT DESIGNATION PHILOSOPHY IS BASED ON EXISTING SLD.

REFERENCE DRAWING :–

NTPC TENDER SLD DRAWING NO. 9500-999-POE-J-001, REV. B

LEGEND:

PRESENT SCOPE

FUTURE/EXISTING

ग्राहक ड्राईंग संख्या CUSTOMER DRAWING NO.	8003-001-572-PVE-P-0002
ग्राहक/CUSTOMER	एन टी पी सी लिमिटेड N T P C LIMITED
परियोजना PROJECT	SIPAT STPP STAGE-III (1X800MW)
कार्य संख्या- JOB NO. 435	
स्थिति STATUS CONTRACT	
मुद्रण स्केल मीटर में PRINT SCALE IN METRE 0 2 4 6 8 10 20 30 40 50	भारत हेवी इलेक्ट्रिकल्स लिमिटेड BHARAT HEAVY ELECTRICALS LTD TRANSMISSION BUSINESS GROUP नोएडा (उ.प्र.)/NOIDA (U.P.)

DEPT CODES		नाम NAME	हस्ताक्षर SIGNATURE	दिनांक DATE
M	तैयारकर्ता/DRN	RD	-SGD-	16.07.25
	डीजाईनकर्ता/DESN	RD	-SGD-	16.07.25
	चीफकर्ता/CHD	RD	-SGD-	16.07.25
	स्वीकृतकर्ता/APPD	SKS	-SGD-	16.07.25

पुनरीक्षण REV.	दिनांक DATE	चीफडीजाईनर ALTD	चीफकर्ता CHD	स्वीकृतकर्ता APPD
01	16.07.25	RD	RD	SKS

REVISED IN LINE WITH NTPC COMMENTS.

शीर्षक/TITLE
SINGLE LINE DIAGRAM
FOR 765/132 KV SWITCH YARD EXTENSION

विभाग DEPT.	स्केल – SCALE–	ड्राईंग संख्या / DRAWING NO. TB-435-316-001
हस्ताक्षर SIGN		
दिनांक DATE		शीट SHEET 02 OF 02 पुनरीक्षण REV. 01

फर्स्ट एंगल प्रोजेक्शन/FIRST ANGLE PROJECTION

सभी माप मि॰ मी॰ मे है/ALL DIMENSIONS ARE IN MM

ड्राइंग संख्या/DRAWING NO. 8003-001-572-PVE-F-024

Drawing is for reference purpose only.

Show proposed fencing with co-ordinates

Show existing fencing with co-ordinates

Approval of document is subject to electrical clearance diagram approval

Show exiting Bus CVT location

Insert text here

Mark distance of fence from the nearest facility

132kv Cable duct shall be as per approved cable details in 132kV Cable routing document. mention the details fo the document in the notes

Physical clearance from the existing tower to be reviewed (appears inadequate) wrt the feasibility of safe excavation and construction of new tower foundation

BHEL to carry out the following also :

1. Laying of earthmat in the proposed expansion area.
2. Rerouting of roads, cable trench,fencing and drains etc as required for proposed expansion (document for the same to be created in the MDL if not already identified)
2. DSLP of proposed expansion

TO ST#7

TO ST#6

BILL OF QTY. FOR 132kV MAIN EQUIPMENTS:

SL. NO.	DESCRIPTION	UNIT	QUANTITY	REMARKS
1	132kV, 1250A, 31.5kA CIRCUIT BREAKER(3-PH) WITHOUT PIR	NOS.	02	
2	132kV, 1250A, 31.5kA HCB ISOLATOR (3-PH) WITH 1 E/S	NOS.	02	
3	132kV, 1250A, 31.5kA HCB ISOLATOR (3-PH) WITH 2 E/S	NOS.	02	
4	132kV, 1250A, 31.5kA HCB TANDEM ISOLATOR (3-PH) WITHOUT E/S	NOS.	02	
5	132kV, 1200A, 31.5kA, 5 CORE CURRENT TRANSFORMER (1-PH)	NOS.	06	
6	120kV SURGE ARRESTER (1-PH)	NOS.	12	
7	132kV CABLE SEALING END (1-PH)	NOS.	12	
8	132 KV, BUS POST INSULATOR (FOR BUS SUPPORT)	NOS.	08	
9	132 KV, BUS POST INSULATOR (FOR ISOLATOR)	NOS.	36	

SYSTEM PARAMETERS:

SL No	DESCRIPTION	132KV
1.0	RATED VOLTAGE	132 KV
2.0	HIGHEST SYSTEM VOLTAGE	145 KV rms
3.0	RATED FREQUENCY	50 Hz
4.0	MAX. FAULT LEVEL (1 Sec.)	31.5 KA
5.0	RATED 1 min POWER FREQ. WITHSTAND VOLTAGE	275 KV rms
6.0	RATED SWITCHING IMPULSE VOLTAGE (DRY & WET)	NA
7.0	LIGHTNING IMPULSE WITHSTAND VOLTAGE	±650 KVp (Ph-E & Ph-Ph)
8.0	MINIMUM CREEPAGE DISTANCE - EQUIPMENT	3625 mm
9.0	MINIMUM CREEPAGE DISTANCE - STRING INSULATOR	3625 mm
10.0	SYSTEM EARTHING	EFFECTIVELY EARTH
11.0	RATED DYNAMIC WITHSTAND CURRENT	80 kAp
12.0	Max. Radio interference for freq (0.5MHz-2.0MHz)	1000 micro volts at 92kV rms
13.0	AUXILIARY SUPPLY VOLTAGE	415V, 3PH AC / 240V, 1PH AC 220V D.C

GENERAL NOTE:

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE MENTIONED.
2. DETAILS OF BMK, CT JB, CVT JB LOCATION SHALL BE SHOWN IN CABLE TRENCH LAYOUT DRAWING.
#3. FGL SHOWN IS TENTATIVE ONLY & TO BE CONFIRMED BY NTPC.
4. EXISTING ROAD & FENCING IN 132KV SWITCHYARD BAY EXTENSION AREA SHALL BE SHIFTED BY BHEL WITHOUT ANY COMMERCIAL IMPLICATION TO NTPC.

REFERENCE DRAWING :–

1. SINGLE LINE DIAGRAM FOR 765/132 KV SWITCH YARD EXTENSION– DRAWING NO. 8003–001–572–PVE–P–0002

LEGEND:

PRESENT SCOPE

FUTURE/EXISTING

ग्राहक ड्राईंग संख्या CUSTOMER DRAWING NO.	8003-001-572-PVE-F-024
ग्राहक/CUSTOMER	एन टी पी सी लिमिटेड N T P C LIMITED
कार्य संख्या- JOB NO. 435	परियोजना PROJECT: SIPAT STPP STAGE-III (1X800MW)
स्थिति- STATUS: CONTRACT	
मुद्रण केवल मीटर में PRINT SCALE IN METRE	भारत हेवी इलेक्ट्रिकल्स लिमिटेड BHARAT HEAVY ELECTRICALS LTD
	TRANSMISSION BUSINESS GROUP नोएडा (उ॰प्र॰)/NOIDA (U.P.)
DEPT CODE: M	

	नाम NAME	हस्ताक्षर SIGNATURE	दिनांक DATE
तैयारकर्ता/DRN	RD	-SGD-	12.08.25
डिजाइनकर्ता/DESN	RD	-SGD-	12.08.25
जांचकर्ता/CHD	RD	-SGD-	12.08.25
अनुमोदनकर्ता/APPD	SKS	-SGD-	12.08.25

संशोधन REV.	दिनांक DATE	तैयारकर्ता/DRN	जांचकर्ता CHD	अनुमोदनकर्ता APPD

शीर्षक/TITLE: 132 KV LAYOUT PLAN & SECTION

विभाग DEPT. | स्केल – SCALE – | ड्राईंग संख्या / DRAWING NO. TB-435-316-002 (132)

हस्ताक्षर SIGN | दिनांक DATE | शीट SHEET 01 OF 02 | पुनरीक्षण REV. 00

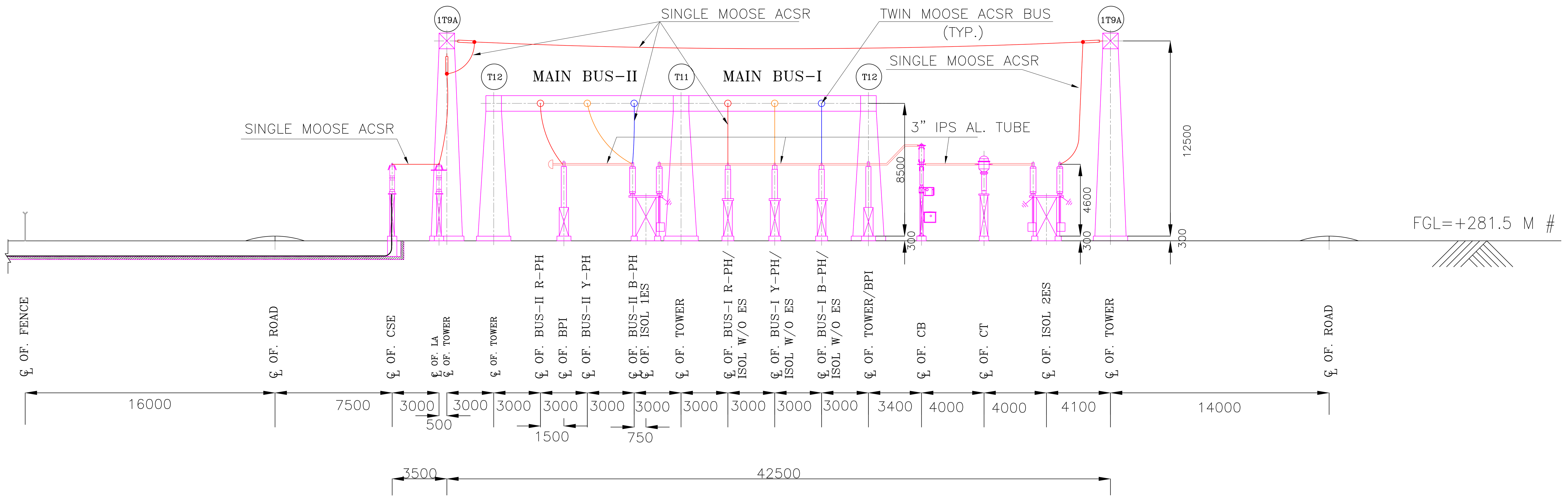
फॉर्मेट साइज़ AO FORMAT SIZE AO

D:\D drive data\PROJECT FOLDER\P_R_O_J_E_C_T_S\NTPC SIPAT STAGE-III\LAYOUT\LAYOUT 132kV_NTPC SIPAT_RO_08.08.2025

फस्ट एंगल प्रोजेक्शन/FIRST ANGLE PROJECTION

सभी माप मि मी में है/ALL DIMENSIONS ARE IN MM

Drawing is for reference purpose only.



SECTION X–X
(132kV ST#6/7 BAY)

MINIMUM CLEARANCE TABLE

Sl.No.	DESCRIPTION	132kV SYSTEM
1	PHASE TO PHASE: FOR CONDUCTOR-CONDUCTOR	1300mm
2	PHASE TO EARTH: FOR CONDUCTOR-CONDUCTOR	1300mm
3	SECTIONAL CLEARANCE	4000mm
4	MIN HEIGHT OF EQPT BUS CENTRE LINE ABOVE PLINTH LEVEL	4600mm

CONDUCTOR DETAILS OF 132 kV SIDE:-

a) MAIN BUS	TWIN MOOSE ACSR AT 8.5 M. (EXTENSION)
b) JACK BUS	SINGLE MOOSE ACSR AT 12.5 M.
c) BAY EQPT BUS	3" IPS AL. TUBE AT 4.6 M; SINGLE MOOSE ACSR
d) DROPPER / JUMPER	SINGLE MOOSE ACSR
e) NO.OF LONG ROD INSULATORS/ PHASE :	
(i) FOR TENSION INSULATOR	2
(ii) FOR SUSPENSION INSULATOR	1
f) SUB CONDUCTOR SPACING:-	250 mm
g) EARTHWIRE.	10.98 MM DIA GS WIRE

ग्राहक ड्राइंग संख्या CUSTOMER DRAWING NO. 8003-001-572-PVE-F-024

ग्राहक/CUSTOMER एन टी पी सी लिमिटेड N T P C LIMITED

परियोजना PROJECT SIPAT STPP STAGE-III (1X800MW)

कार्य संख्या JOB NO. 435

स्थिति STATUS CONTRACT

भारत हेवी इलेक्ट्रिकल्स लिमिटेड BHARAT HEAVY ELECTRICALS LTD

TRANSMISSION BUSINESS GROUP

नोएडा (उ.प्र.)/NOIDA (U.P.)

	नाम NAME	हस्ताक्षर SIGNATURE	दिनांक DATE
तैयारकर्ता/DRN	RD	-SGD-	12.08.25
डिज़ाइनकर्ता/DESN	RD	-SGD-	12.08.25
जाँचकर्ता/CHD	RD	-SGD-	12.08.25
अनुमोदनकर्ता/APPD	SKS	-SGD-	12.08.25

शीर्षक/TITLE 132 KV LAYOUT PLAN & SECTION

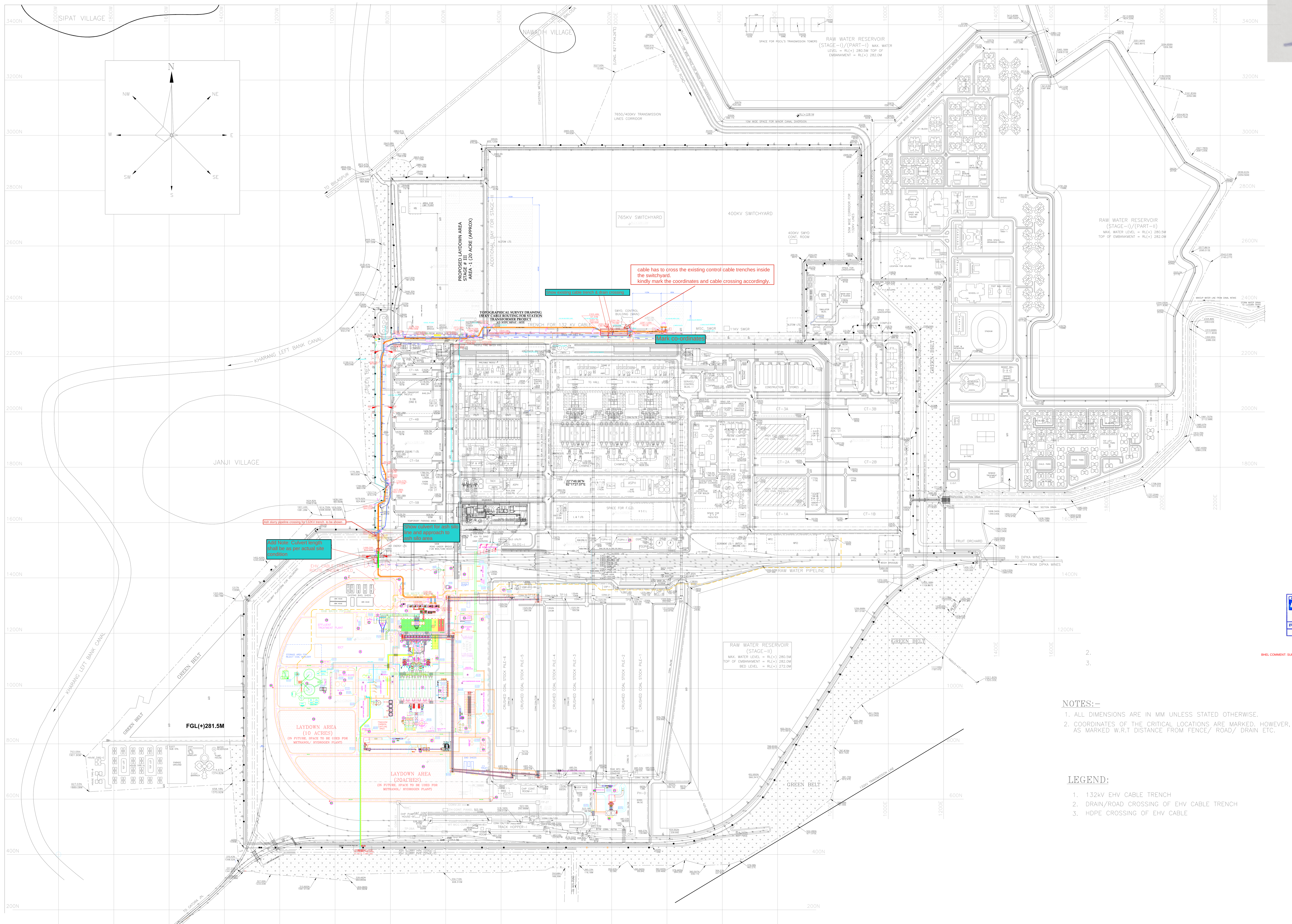
ड्राइंग संख्या/ DRAWING NO. TB-435-316-002 (132)

शीट SHEET 02 OF 02 पुनरीक्षण REV. 00

फार्मेट साइज़ A0 FORMAT SIZE A0

फर्स्ट एंगल प्रोजेक्शन/FIRST ANGLE PROJECTION

सभी माप मि मी मे है/ALL DIMENSIONS ARE IN MM



Drawing is for reference purpose only.

निर्माण हेतु जारी
दिनांक 08.10.25

BHEL COMMENT: SUBJECT TO COMPLIANCE OF CUSTOMER COMMENTS.

NOTES:–

1. ALL DIMENSIONS ARE IN MM UNLESS STATED OTHERWISE.
2. COORDINATES OF THE CRITICAL LOCATIONS ARE MARKED. HOWEVER, TRENCH IS TO BE CONSTRUCTED AT SITE AS PER SITE SUITABILITY AS MARKED W.R.T DISTANCE FROM FENCE/ ROAD/ DRAIN ETC.

LEGEND:

1. 132kV EHV CABLE TRENCH
2. DRAIN/ROAD CROSSING OF EHV CABLE TRENCH
3. HDPE CROSSING OF EHV CABLE

NOTE:– SCAN QR CODE FOR CHECKING THE LATEST REV. STATUS OF DRAWING.

ग्राहक ड्राइंग संख्या CUSTOMER DRAWING NO.	8003-001-572-PVE-F-075
ग्राहक/CUSTOMER	एन टी पी सी लिमिटेड N T P C LIMITED
कार्य संख्या- JOB NO.	435
स्थिति STATUS	CONTRACT
परियोजना PROJECT	सीपत सुपर थर्मल पावर परियोजना, चरण–III (1X800 मेगावाट) SIPAT SUPER THERMAL POWER PROJECT, STAGE-III (1X800 MW)

भारत हेवी इलेक्ट्रिकल्स लिमिटेड
BHARAT HEAVY ELECTRICALS LTD
TRANSMISSION BUSINESS GROUP
नोएडा (उ॰प्र॰)/NOIDA (U.P.)

DEPT CODE: M

	नाम NAME	हस्ताक्षर SIGNATURE	दिनांक DATE
तैयारकर्ता/DRN	RD	-sd-	20.05.2025
डिजाइनकर्ता/DESN	RD	-sd-	20.05.2025
जांचकर्ता/CHD	RD	-sd-	20.05.2025
अनुमोदनकर्ता/APPD	SKS	-sd-	20.05.2025

पुनरीक्षण REV.	दिनांक DATE	परिवर्तितकर्ता ALTD	जांचकर्ता CHD	अनुमोदनकर्ता APPD
01	04.06.2025	RD	RD	SKS

DRAWING REVISED AS PER NTPC COMMENTS

शीर्षक/TITLE: 132kV CABLE ROUTING DIAGRAM FOR STATION TRANSFORMER

स्केल – SCALE– 1:100

ड्राइंग संख्या / DRAWING NO. 8003-001-572-PVE-F-075

शीट SHEET 01 OF 02 — पुनरीक्षण REV. 02

फॉर्मेट साइज A0 FORMAT SIZE A0

Remove this sheet-2 and provide separately.
Civil details to be provided separately.

cable trench detail must be submitted as separate drawing. to be removed from here.

Drawing is for reference purpose only.

Note: The color contrast to be used in this drawing in such a way to ensure clear visibility and readability.

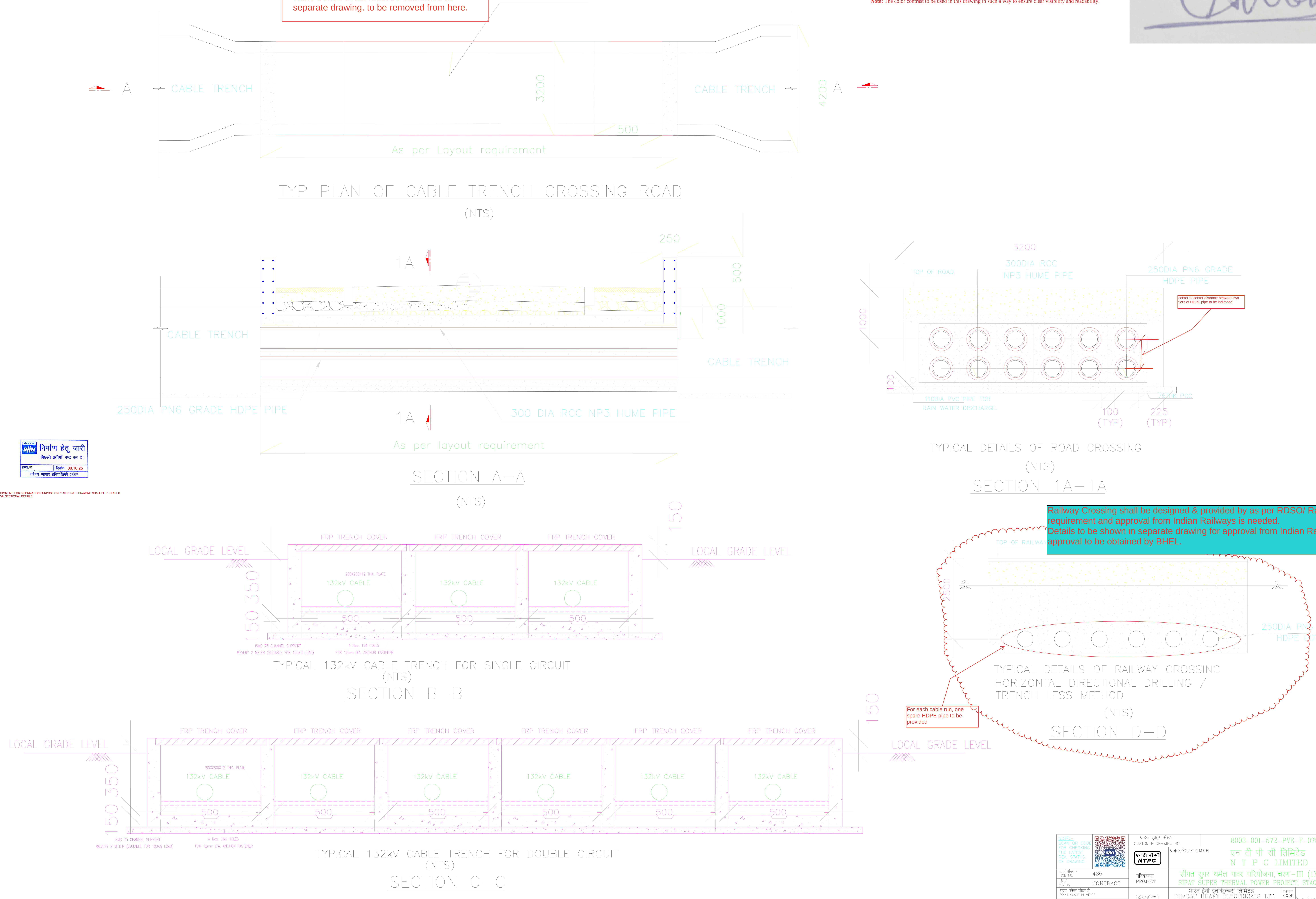
Railway Crossing shall be designed & provided by as per RDSO/ Railway requirement and approval from Indian Railways is needed.
Details to be shown in separate drawing for approval from Indian Railways and approval to be obtained by BHEL.

For each cable run, one spare HDPE pipe to be provided

center to center distance between two tiers of HDPE pipe to be indicated

BHEL COMMENT: FOR INFORMATION PURPOSE ONLY. SEPERATE DRAWING SHALL BE RELEASED FOR CIVIL SECTIONAL DETAILS.

निर्माण हेतु जारी
दिनांक 08.10.25



फर्स्ट ऐंगल प्रोजेक्शन/FIRST ANGLE PROJECTION
सभी माप मि मी में है/ALL DIMENSIONS ARE IN MM
PIPE CULVERT
CABLE TRENCH
3200
4200
500
A
As per Layout requirement
TYP PLAN OF CABLE TRENCH CROSSING ROAD
(NTS)
250
500
1000
1A
250DIA PN6 GRADE HDPE PIPE
300 DIA RCC NP3 HUME PIPE
As per layout requirement
SECTION A–A
(NTS)
3200
300DIA RCC NP3 HUME PIPE
TOP OF ROAD
250DIA PN6 GRADE HDPE PIPE
100 (TYP)
225 (TYP)
TYPICAL DETAILS OF ROAD CROSSING
(NTS)
SECTION 1A–1A
FRP TRENCH COVER
LOCAL GRADE LEVEL
132kV CABLE
500
150
350
TYPICAL 132kV CABLE TRENCH FOR SINGLE CIRCUIT
(NTS)
SECTION B–B
GL
TYPICAL DETAILS OF RAILWAY CROSSING
HORIZONTAL DIRECTIONAL DRILLING /
TRENCH LESS METHOD
(NTS)
SECTION D–D
TYPICAL 132kV CABLE TRENCH FOR DOUBLE CIRCUIT
(NTS)
SECTION C–C

ग्राहक ड्राइंग संख्या / CUSTOMER DRAWING NO. 8003-001-572-PVE-F-075

ग्राहक/CUSTOMER: एन टी पी सी लिमिटेड / N T P C LIMITED

परियोजना / PROJECT: सीपत सुपर थर्मल पावर परियोजना, चरण-III (1X800 मेगावाट) / SIPAT SUPER THERMAL POWER PROJECT, STAGE-III (1X800 MW)

CONTRACT

भारत हेवी इलेक्ट्रिकल्स लिमिटेड / BHARAT HEAVY ELECTRICALS LTD / TRANSMISSION BUSINESS GROUP / नोएडा (उ.प्र.)/NOIDA (U.P.)

शीर्षक/TITLE: 132kV CABLE ROUTING DIAGRAM FOR STATION TRANSFORMER

ड्राइंग संख्या / DRAWING NO. 8003-001-572-PVE-F-075

SUB-SECTION-B – 23

132KV CABLE & ACCESSORIES

CLAUSE NO.	TECHNICAL REQUIREMENTS	एनटीपीसी NTPC

132KV CABLE & ACCESSORIES

1.00.00 CODES AND STANDARDS

1.01.00 The design, manufacture, testing and performance of the cables supplied under this specification shall comply with the latest edition of the following Standards, Rules and Acts.

IEC Standards

IEC 60840	Power cables with extruded insulation and their accessories for rated voltages above 30kv (Um=36kv) upto 150 kV (Um=170kv) Test methods and requirements
IEC 60060	H.V.Test Techniques
IEC 885	Electrical test methods for Electric cables.
IEC 60228	Conductors of Insulated cables
IEC 60229	Tests on cable oversheath which have a special protective function and are applied by extrusion.
IEC 61462	Composite Insulators- Hollow insulators for use in outdoor and indoor electrical equipment - Definitions, test methods, acceptance criteria and design recommendations
IEC 60183	Guide to the selection of high voltage cables
IEC 60230	Impulse tests on cables and their accessories.
IEC 60270	High Voltage Test Techniques - Partial discharge measurements
IEC 60287	Electric cables - Calculations of the current ratings
IEC 60811	Common test methods for insulating and sheathing
Part-1 to 4	materials of electric cables
IEC 60885 Part-3	Electrical test methods for electric cables -Test methods for partial discharge measurements on lengths of extruded power cables.
ANSI/ IEEE Std	Guide Electrical safety and Sub- station grounding 80-1986

CLAUSE NO.	TECHNICAL REQUIREMENTS
	Indian Standards & Rules IS 5216 Guide for safety procedures and practice in electrical works. Indian Electricity Act 1910. Indian Electricity Rules 1956.
2.00.00	**GENERAL FEATURES**
2.01.00	Unless otherwise specified 132 KV cable shall conform to the standards specified above.
2.02.00	The design ambient air temperature for cable shall be 50 deg C, when laid in air. The design ambient ground temperature for cables shall be 40 deg C. Cables shall be installed in air, in built up concrete trenches and/or directly buried in soil.
3.00.00	**132 KV CABLE**
3.01.00	**GENERAL**
3.01.01	The cable shall confirm to IEC-60840. The cable shall consists of single core 800 sq.mm stranded copper compacted circular conductor, extruded semi conducting compound conductor screen, cross linked polyethylene (XLPE) dry cured insulation, extruded semi conducting compound insulation screen, bedding of swellable type water blocking semi conducting tape, copper wire screen with copper binder tape(as per requirement), aluminium or lead or lead alloy sheath and extruded PVC outersheath with overall graphite coating or overall extruded semiconducting layer
3.01.02	The conductor screen, insulation and semiconducting insulation screen shall be extruded in one operation, so as to obtain continuously smooth interfaces. The conductor screen and insulation screen shall be of semiconducting compound. The copper wire/tape screen together with aluminium or lead or lead alloy sheath shall be capable of withstanding the short circuit current of 31.5KA for one second. The Bidder shall furnish the supporting calculation for screen sizing.
3.01.03	The cable shall be suitable for use in solidly earthed system.
3.01.04	The cable shall be suitable for installation in air, in built up concrete trench and/or directly buried in soil with chances of flooding by water. The cable shall withstand all mechanical and thermal stresses under steady state and transient operating conditions.

CLAUSE NO.	TECHNICAL REQUIREMENTS
3.01.05	Repair to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are also not acceptable.
3.01.06	Cable ends shall be kept sealed by heat shrinkable PVC caps to prevent damage and ingress of moisture.
3.01.07	Each cable length shall be provided with a pulling socket eye which shall be fitted to the pulling end. Pulling socket eye shall be able to take the pulling force.
3.01.08	The Eccentricity of the core shall not exceed 10% and Ovality of the core shall not exceed 5%. The Eccentricity shall be calculated as $\mathbf{(t_{max} - t_{min})/t_{max} \leq 0.15}$ The Ovality shall be calculated as $\mathbf{(d_{max} - d_{min})/d_{max} \leq 0.05}$ where t_{max}/t_{min} are the maximum/minimum thickness of insulation and d_{max}/d_{min} are the maximum/minimum diameter of the core.
3.02.00	**CONDUCTOR** Conductor shall consist of plain annealed copper wires in accordance with IEC-60228 or equivalent and the shape shall be circular and very well compacted to facilitate a smooth interface between conductor screen(shield) and the insulation. The conductor shall have smooth surface with no intermediate joint.
3.03.00	**CONDUCTOR SCREEN (SHIELD)** Conductor screen shall consist of extruded semi-conducting compound applied over the conductor, which shall be firmly bonded to the inner surface of the insulation layer. The semi-conducting compound shall be free from any void and protrusion.
3.04.00	**INSULATION** Insulation shall be of extruded Cross Linked Polyethylene (XLPE). The insulation shall be free from any void and contaminant.
3.05.00	**INSULATION SCREEN(SHIELD)** Insulation screen shall consist of extruded semi-conducting compound and shall firmly be bonded to the insulation. The semi-conducting compound shall be free from any void and protrusion.
3.06.00	**BEDDING** Bedding shall consist of layer(s) of swellable semi conducting tape(s) to be applied over the extruded semi-conducting insulation screen with suitable overlap. Semiconducting swelling tape(s) shall also be provided over copper wire screen(if applicable).

CLAUSE NO.	TECHNICAL REQUIREMENTS
3.07.00	**METALLIC SHEATH** The metallic innersheath shall consist of aluminium or lead or lead alloy. The calculations for sizing and short circuit withstand capability of the metallic sheath, alongwith copper wire screen & copper binder tape(if applicable) shall be submitted during detailed design stage.
3.08.00	**OUTER SHEATH** Outer sheath shall consist of extruded black PVC compound, in accordance with IEC-60840.
3.09.00	**CABLE IDENTIFICATION/ MARKING** Atleast the following clear markings shall be provided over outer sheath of the cable at an interval of five metres throughout the length of the cable by embossing: Rated voltage Conductor size Type of insulation Manufacturer's name Year of manufacture Purchaser's name Sequential marking of length of cable in metres by embossing/printing at every meter. The embossing/printing shall be progressive, automatic, in line and marking shall be legible and indelible and incase of printing it should be done with the help a contact less printer.
4.00.00	**CABLE DRUMS**
4.01.00	Cables shall be supplied in steel drums of heavy construction.
4.02.00	The drum lengths to be supplied shall be advised to the contractor before commencement of manufacturing of the cable. The contractor shall supply the cables as per advised drum length within ±2 meter. The contractor shall be paid based on actual supplied length but shall not be paid for any excess lengths beyond +2m for each drum length supplied.
5.00.00	**CABLE ACCESSORIES** The termination and jointing kits shall be suitable for the cable and shall be complete with all accessories including crimping type cable lugs, jointing materials and consumables. Accessories offered shall be of proven design.
5.01.00	**Out Door Sealing Ends**

CLAUSE NO.	TECHNICAL REQUIREMENTS

The termination shall be suitable for outdoor installation in heavily polluted atmosphere and shall be made completely weather proof through cable sealing ends. Accessories shall consist of stress relief system comprising of premoulded material. The termination for open connection shall be housed in porcelain insulator/composite insulator to give high creepage resistance. The minimum nominal specific creepage distance shall be 25mm/kV. Each outdoor type sealing ends shall be supplied complete with mounting plate insulators to insulate the sealing end from supporting structures. Each sealing end shall be provided with two terminals, diametrically opposite each, suitable for bolting of the copper screen and/or metallic sheath of cable.

5.02.00 **Link Boxes**

5.02.01 Link boxes shall be suitable for outdoor installation in heavily polluted atmosphere and shall be made completely weather proof. There shall be one link box for each phase. The cable screen/sheath connections shall be bolted type. The connecting bar and disconnecting link shall be of copper. The arrangement shall be installed in a water tight box of min. 2mm thick CRCA steel having degree of protection as IP 55.

5.02.02 The cost of link boxes shall be deemed to be included in the supply price of 132KV cable outdoor sealing ends.

5.03.00 FRP TRENCH COVER

The FRP Trench cover shall be made of non biodegradable & non corrosive material/fillers, suitable designed for required strength. FRP trench cover shall be of medium duty type as per IS1726. Suitable locking & lifting features shall be provided for the FRP trench Cover. Further FRP trench cover shall be UV resistant type. Surface profile of the FRP trench cover shall be anti-skid type.
Erection of FRP trench covers shall be in the scope of contractor.

5.04.00 All accessories shall be suitable for the technical parameters as specified and shall be suitably derated to the site conditions.

6.00.00 CABLE /ACCESSORIES PARAMETERS

1	Type of Cables	Cross-linked polyethylene insulated
2	No. of Cores	Single.
3	Conductor size	800 sq. mm
4	Conductor material	Copper
5	Normal system voltage	132KV
6	Maximum system voltage	145kV
7	Fault current	Symmetrical short circuit 31.5kA r.m.s for 1 second
8	System frequency	50hz

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	9	Frequency variation	+/- 5%
	10	Rated continuous Current	570 Amp.
	11	Overload capacity	Nil
	12	Maximum allowable temperature for cable and accessories.	
	a)	At rated full load and at site conditions.	90 deg C
	b)	The conductor temperature after a short circuit for 1 second shall not exceed (with conductor temp. at inception of short circuit as 90 deg. C)	250 deg C
	13	Basic impulse insulation level (1.2/50 micro second wave)	650 kV (peak)
	14	Laying conditions	
	(a)	Built up Cable Trench.	500 mm centre to centre (typical)
	(b)	Earthing of screen	Bonded to earth at both ends.
	(c)	Ambient air temp.	50 deg. C
	(d)	Type of atmosphere	Heavily polluted
	(e)	Ground temperature	40 deg C
	(f)	Thermal resistivity of soil	150 degC.cm/watt
7.00.00	**INSTALLATION WORK AT SITE**		
7.01.00	Cable installation shall be carried out generally as per applicable standard/ manufacturer guidelines. Cable shall be laid in built up trench. Typical sectional drawing for 132 KV built up cable trench enclosed with this chapter shall be followed for preparing the detailed drawing by contractor. All necessary work like cable tagging, marking, dressing etc. as required shall be in contractor's scope.		
7.02.00	Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case shall the drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For unreeling the cable, the drum shall be mounted on suitable jacks or on		

CLAUSE NO.	TECHNICAL REQUIREMENTS
	cable wheels and shall be rolled slowly so that cable comes out from over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be kept sealed by heat shrinkable PVC caps to prevent damage and ingress of moisture.
7.03.00	While laying cable, ground rollers shall be used at every 2 meter interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangement. Pulling tension shall not exceed the values recommended by cable Manufacturer. Cable ends shall be kept sealed by heat shrinkable PVC caps to prevent damage and ingress of moisture. Selection of cable drums for each run shall be so planned so as to avoid straight through joints. Cable splices will not be allowed except where called for by the drawings or is unavoidable and permitted by the Project Manager. Care should be taken while laying the cables so as to avoid damage to cables.
7.04.00	Bending radii for cables shall be as per manufacturer's recommendations. Manufacturer's instructions shall be strictly adhered to and necessary conducting medium for checking healthiness of outersheath shall be applied.
7.05.00	Where cables cross roads/rail tracks underground, the cables shall be laid in HDPE pipes embedded in PCC in ground with a minimum cover of 1 metre. HDPE pipe shall also be provided where cables cross existing HT/LT cable trenches. The HDPE pipes and accessories shall be supplied, laid and encased in PCC by the employer. Ends of HDPE pipes shall be sealed properly after laying of cable.
7.06.00	In each cable run, extra length shall be kept at suitable point to enable two straight joints to be made, should the cable develop fault at a later stage.
7.07.00	Construction of buried cable trench shall include excavation, preparation of sieved sand bedding, riddled soil cover, supply and installation of concrete protective covers, back filling and compacting, supply and installation of route markers. Bidder shall furnish the details for burying the cable in ground.
7.08.00	RCC cable route markers and RCC joint markers shall be provided as required for buried cable trench. The voltage grade of cables shall be engraved on the marker. Location of underground cable joint shall be indicated with cable marker with an additional inscription "Cable Joint". The marker shall project 150 mm above ground and shall be provided at every change in direction. Top of cable marker/ joint marker shall be sloped to avoid accumulation of water/dust on marker.
7.09.00	Bidder shall ensure that the drawings, instructions and recommendations are correctly followed to avoid damage to the equipment.
7.10.00	Bidder shall carry out the bonding of screen at the both ends of terminal using the insulated conductor of required size with earth mat.
7.11.00	The bidder shall ensure that the cables and accessories supplied by him are installed in a neat workman-like manner such that it is levelled, properly aligned and

CLAUSE NO.	TECHNICAL REQUIREMENTS

well oriented. The tolerance shall be as established in the bidder's drawing and/or as stipulated by the Employer.

7.12.00 The cable termination work shall be carried out by an experienced cable jointer who shall have adequate experience in jointing and termination of 132kV or higher grade XLPE cables. The successful bidder shall submit, sufficiently in advance, the bio-data of the cable jointer giving the details of his qualification and experience for employer's approval.

8.00.00 TYPE, ROUTINE AND ACCEPTANCE TESTS

8.01.00 FOR 132 KV CABLES :

(a) All type tests on 132kV cables shall be carried out as per IEC 60840.

(b) Three (3) samples of one meter each shall be cut from the 132kV cable and individual weights of Copper Aluminium /lead, XLPE and PE materials shall be used for Price Adjustment formula as per Appendix-II to Contract Agreement (Section-VII) and clause no. 11 of GCC (Section-IV).

(c) All equipment/ systems to be supplied shall conform to type tests as per relevant standards and of proven type.

(d) The contractor shall carry out the type tests as listed in the technical specifications on the equipment mentioned therein. The Bidder shall indicate the charges for each of these type tests separately in the relevant schedule of BPS and the same shall be considered for the evaluation of the Bids. The type test charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the Owner's Engineer.

(e) The type tests shall be carried out in presence of the Owner's representative, for which minimum 15 days notice shall be given by the Contractor. The Contractor shall obtain the Owner's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.

CLAUSE NO.	TECHNICAL REQUIREMENTS
	(f) In case the contractor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering the type test reports to the owner for waival of conductance of such type test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test (s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The owner reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor. (g) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.
8.01.01	Routine tests and Acceptance tests shall be conducted on cables as per IEC 60840, QA table and other relevant standards.
8.01.02	The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and “No design Change”. Minor changes if any shall be highlighted on the endorsement sheet.
8.02.00	**FOR 132 KV CABLE ACCESSORIES:** (a) Type Test reports shall be furnished in accordance with standard IEC 60840/ IEC 61462 as applicable. (b) Routine tests and Acceptance tests on the accessories shall be conducted in accordance with standard IEC 60840/ IEC 61462. (c) All equipment to be supplied shall be of type tested design. During detailed engineering the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

CLAUSE NO.	TECHNICAL REQUIREMENTS
	(d) However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval. (e) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price. (f) The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.
8.03.00	**SITE TESTS:** Following site tests shall be carried out by the bidder and all the equipment required for the site tests shall be arranged by the bidder. a) HV test as per clause 15.2 IEC 60840. b) After completion of installation non metallic outer sheath shall be tested in accordance with clause- 5 IEC 60229. c) The insulation resistance of the cable shall be checked before & after the HV test on cable. d) The core resistance shall be measured and the value corrected in accordance with clause 5 of IEC 60228.

SECTION- 3

PROJECT DETAILS AND GENERAL SPECIFICATIONS

3.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipment and services covered under other sections of tender documents and are not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall prevail.

3.1 PROJECT DETAILS

	Particular	Details
a)	Customer	NTPC Limited
b)	Engineer/Consultant/ Inspector	---
c)	Project Title	765/400/132kV AIS Switchyard Extension at NTPC SIPAT STPP Stage-III (1 x 800 MW)
d)	Project Location	Place: Sipat District: Bilaspur State: Chhattisgarh
e)	Latitude & Longitude	**Latitudes and Longitudes of the site are as follows:** 22^0 - 05' to 22^0 - 09' (N) and 82^0 -16' to 82^0 - 18' (E) respectively
f)	Nearest Railway Station	Jairamnagar – At a distance of about 3 km on Nagpur-Raipur-Kolkata main line.
g)	Distance of project location from the Railway station	3 km (approx.)
h)	Nearest Major Town	Bilaspur city
i)	Distance of the town from the project site	20 km
j)	Nearest commercial airport	Bilaspur
k)	Distance of airport from the project site	20 km
	SITE CONDITIONS (for design purposes)	
a)	Design ambient temperature	50°C
b)	Maximum Relative humidity	80 %
c)	Height above mean sea level	Less than 1000 meters
d)	Pollution Severity	Heavily polluted
e)	Criteria for Wind Resistant design of structures and equipment	Standard Applicable - IS 875 (Part 3)

f)	Basic Wind speed "Vb" at ten meters above the mean ground level.	39 m/sec
g)	Category of terrain	Cat-2
h)	Risk Coefficient "K1"	1.06

3.1.1 **SYSTEM PARAMETERS:**

Sl.No.	Parameters	765 kV	400 kV	132 kV
1	Highest system voltage	800 kV rms	420 kV rms	145 kV rms
2	Lightning Impulse voltage	±2100 kVp	±1425kVp	±650 kVp
3	Switching impulse voltage	±1550 kVp	±1050kVp	NA
4	Power frequency withstand for 1 min (rms)	1150 kV(rms)	650 kV(rms)	275 kV(rms)
5	Max. fault level (1 sec.)	50 kA	63 kA	31.5 kA
6	Minimum creepage distance	20000 mm	10500 mm	3625 mm

3.1.2 **AUXILIARY POWER:**

Sl.No.	Nominal Connection Voltage	Variations in Voltage	Frequency	Phase	Neutral
1	415V	±10%	50 (+3% -5%)	3Phase, 4 Wire	Solidly Earthed
2	240V	±10%	50 (+3% -5%)	1 phase	Solidly Earthed

Combined variation of voltage and frequency shall be + 10%. Design fault level of 415V system shall be restricted to 50kA rms for 1 second.

The operational limits for variation of DC voltage are (+) 10% to (-) 15%.

3.1.3 The various minimum heights of the AIS switchyard shall be as given below from plinth level:

Voltage	Equipment /1st Level	2nd Level	3rd Level	Peak
765kV	14000mm	27000mm	40000mm	8000mm
400kV	8000mm	16000mm	23000mm	8500mm
132kV	4600mm	8500mm	12500mm	5200mm

The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or support insulators to the bottom of the equipment structure, where it rests on the foundation pad shall be 2550mm.

The minimum height of intermediate gantry tower for 765 & 400kV wherever required shall be 29 m & 25 m respectively and the peak (s) shall be of 8 m & 8.5 m respectively. The gantry width for 765 & 400kV AIS shall be minimum 54 m & 27m or as required to meet the specified clearances.

3.1.4 The minimum clearances for 765, 400 & 132kV switchyards shall be as given below:

Sl. No.	Parameters	765 kV	400 kV	132 kV
1	Phase to earth clearance	4900 mm	3500 mm	1300 mm
2	Phase to phase clearance	7600 mm	4000 mm	1300 mm
3	Section clearance	10300 mm	6500 mm	4000 mm

3.2 INSTRUCTION TO BIDDERS:

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

The bidders shall furnish catalogues, engineering data, technical information, design documents, drawings etc fully in conformity with the technical specification.

The supplier should be approved by Employer. If not, it is the responsibility of the vendor to be assessed and approved Employer, before placement of order by BHEL. Any cost involved in vendor assessment/approval must be borne by the vendor himself.

The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognized that the Bidder may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Purchaser. Sufficient amount of information for justifying such proposals shall be furnished to Purchaser alongwith the bid to enable the Purchaser to determine the acceptability of these proposals.

Wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood to be indicative of the function and quality desired and not restrictive. Other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.

Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/ or needed for erection, completion and safe operation of the equipment as required by applicable codes, though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the switchyard unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/parts of similar standard equipment under supply shall be inter-changeable with one another.

The bidder shall supply type tested (including special tests as per tech. specification) equipment and materials. The test reports shall be furnished by the bidder along with equipment/ material drawings. In the event of any discrepancy in the test reports, (i.e., if any test report is not acceptable due to any design/ manufacturing changes or due to non-compliance with the Technical Specification and/ or applicable standard), the tests shall be carried out without any additional cost implication to the BHEL. BHEL reserves the right to get any or all type/tests conducted/repeated.

3.3 CODES AND STANDARDS

In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well asof the locality where they will be installed, including the following :

a) Indian Electricity Act

b) Indian Electricity Rules

c) Indian Explosives Act

d) Indian Factories Act and State Factories Act

e) Indian Boiler Regulations (IBR)

f) Regulations of the Central Pollution Control Board, India

g) Regulations of the Ministry of Environment & Forest (MoEF), Government of India

h) Pollution Control Regulations of Department of Environment, Government of India

i) State Pollution Control Board.

(j.) Rules for Electrical installation by Tariff Advisory Committee (TAC).

(k.) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996

(l.) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998

(m.) Explosive Rules, 1983

(n.) Petroleum Act, 1984

(o.) Petroleum Rules, 1976,

(p.) Gas Cylinder Rules, 1981

(q.) Static and Mobile Pressure Vessels (Unified) Rules, 1981

(r.) Workmen's Compensation Act, 1923

(s.) Workmen's Compensation Rules, 1924

(t.) NTPC Safety Rules for Construction and Erection

(u.) NTPC Safety Policy

(v.) Any other statutory codes / standards / regulations, as may be applicable.

Unless covered otherwise in the specifications, the latest editions (as applicable as on date of bid opening: 03-March-2017), of the codes and standards given below shall also apply:

a) Bureau of Indian standards (BIS)

b) Japanese Industrial Standards (JIS)

c) American National Standards Institute (ANSI)

d) American Society of Testing and Materials (ASTM)

e) American Society of Mechanical Engineers (ASME)

f) American Petroleum Institute (API)

g) Standards of the Hydraulic Institute , U.S.A.

h) International Organization for Standardization (ISO)

i) Tubular Exchanger Manufacturer's Association (TEMA)

j) American Welding Society (AWS)

k) National Electrical Manufacturers Association (NEMA)

l) National Fire Protection Association (NFPA)

m) International Electro-Technical Commission (IEC)

n) Expansion Joint Manufacturers Association (EJMA)

o) Heat Exchange Institute (HEI)

p) IEEE standard

q) JEC standard

Other International/ National standards such as DIN, VDI, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English.

As regards highly standardized equipment such as Steam Turbine and Generator, National /International standards such as JIS, DIN, VDI, ISO, SEL, SEW, VDE, IEC & VGB shall also be considered as far as applicable for Design, Manufacturing and Testing of the respective equipment. However, for those of the above equipment not covered by these National / International standards, established and proven standards of manufacturers shall also be considered.

In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.

In case of any change in codes, standards & regulations between 03-March-2017 and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.

3.4 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

The 400 kV system is being designed to limit the power frequency over voltage of 1.5 p.u. and the switching surge over voltage to 2.5 p.u. In 400 kV system the initial value of temporary over voltage could be 2.0 p.u. for 1-2 cycles. All the equipment/materials covered in this specification shall perform all its function satisfactorily without undue strain, restrike etc. under such over voltage conditions.

All equipment shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation. All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow (not applicable for this project), short circuit etc for the equipment.

3.5 ENGINEERING DATA

3.5.1 Drawings

All drawings submitted by the supplier including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required. The dimensions required for installation and interconnections with other equipment and materials, clearances and spaces required for installation and interconnections between various portions of equipment and any other information specifically requested in the specifications.

Each drawing submitted by the bidder (including those of sub-vendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

After the approval of the drawings, further work by the bidder shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Purchaser, if so required.

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

All manufacturing, fabrication and execution of work in connection with the equipment/system prior to the approval of the drawings shall be at the bidder's risk. The bidder is expected not to make any changes in the design of the equipment /system, once they are approved by the Purchaser. However, if some changes are necessitated in the design of the equipment/system at a later date, the bidder may do so, but such changes shall promptly be brought to the notice of the Purchaser indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of

the Technical Specification. Approval of bidder's drawing or work by the Purchaser shall not relieve the bidder of any of his responsibilities and liabilities under the Contract.

All engineering data submitted by the contractor after final process including review and approval by the purchaser shall form part of the contract document and the entire work performed under these specifications shall be performed in strict conformity with technical specification, unless otherwise expressly requested by the purchaser in writing.

3.5.2 Bidder's Drawing Submission and Approval Procedure

The following procedure for submission and review/approval of the drawings, data reports, information, etc. shall be followed by the bidder:

a. All data/information furnished by Vendor in the form of drawings, documents, Catalogues or in any other form for Employer's information/interface and/or review and approval are referred by the general term "drawings".

b. The 'Master drawings list' indicating titles, Drawing Number, Date of submission and approval etc. shall be furnished by the bidder. This list shall be updated if required at suitable interval during detailed engineering.

c. All drawings (including those of sub-vendor) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The bidder shall furnish this format to his sub-vendor along with his purchase order for sub-vendor's compliance.

d. Contractor shall submit all the drawings in five (5) copies for review of Employer. Employer shall forward their comments within four (4) weeks of receipt of drawings.

e. Upon review of each drawings, depending on the correctness and completeness of the drawings, the same will be categorised and approval accorded in one of the following categories:

CATEGORY I	Approved
CATEGORY II	Approved, subject to incorporation of comments/modification as noted. Resubmit revised drawing incorporating the comments
CATEGORY III	Not approved. Resubmit revised drawings for Approval after incorporating comments/modifications as noted
CATEGORY IV	For information and records

f. Bidder shall resubmit the drawings approved under Category II, III within one (1) week of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision number enclosed in a triangle (e.g 1.2.3. etc.).

g. In case Bidder does not agree with any specific comment, he shall furnish the explanation for the same to Employer for consideration. In all such cases Bidder shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.

h. It is the responsibility of the Bidder to get all the drawings approved in the Category I or IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay

arising out of submission and modification of drawings shall not alter the contract completion schedule.

i. Bidder shall not make any changes in the portions of the drawing other than those commented. If changes are required to be made in the portions already approved, the Bidder shall resubmit the drawings identifying the changes (along with reasons for changes) for Employer's review and approval. **Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Employer shall review only such revised portion of documents.**

j. As Built Drawings

After final acceptance of individual equipment / system by the Employer, the Bidder will update all original drawings and documents for the equipment / system to "as built" conditions and submit no. of copies as per clause 3.5.5.

k. Approval of drawings will not in any way relieve the Bidder of his obligations of furnishing the equipment in accordance with the specification and shall not prevent subsequent rejection if such equipment is later found to be defective.

3.5.3 Erection Drawings.

a. Contractor shall furnish erection drawings for the guidance or commencement of erection or the first shipment, whichever is earlier. These shall generally comprise of fabrication/assembly drawings, various component/part details drawing, assembly, clearance data requirements, etc. The drawings shall contain details of components/ equipment with identification number, match marks, bill of materials, assembly procedures etc.

b. For all major equipment apart from above details, assembly sequence and instructions with check-lists shall be furnished in the form of erection manuals.

3.5.4 Instruction Manual

a. The Contractor shall submit to the Employer preliminary instruction manuals for all the equipments for review. The final instructions manuals incorporating Employer's comments and complete in all respect shall be submitted at least sixty (60) days before the first shipment of the equipment. The instruction manuals shall contain full details and drawings of all the equipments, the transportation, storage, installation, testing, commissioning, operation and maintenance procedures, etc. separately for each component/equipment along with log record format. These instruction manuals shall be submitted in five (5) copies for approval.

b. If after commissioning and initial operation of the plant, the instruction manuals require any modifications/additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted.

c. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall have sufficient details to enable the Employer to maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant/equipment, including erection, testing, commissioning, operation, maintenance dismantling and repair. Each manual shall also include a complete set of approved drawings together with performance/rating curves of the equipment and test certificates, wherever applicable. The contract shall not be

considered completed for purpose of taking over until such instructions and drawings have been supplied to the Employer.

d. A separate section of the manual shall be for each size/type of equipment and shall contain a detailed description of construction and operation, together will all relevant pamphlets.

e. The manuals shall include the following
a) List of spare parts along with their drawing and catalogues and procedure for ordering spares.
b) Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation.

f. Where applicable, fault location charts shall be included to facilitate finding the cause of mal-operation or break down.

g. A collection of the manufacturer's standard leaflets will not accepted to be taken as a compliance of this clause. The manual shall be specifically compiled for the concerned project.

The Instruction Manuals shall comprise of the following:

3.5.4.1 Erection Manuals

The erection manuals shall be submitted atleast three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum.

a) Erection strategy.

b) Sequence of erection.

c) Erection instructions.

d) Critical checks and permissible deviation/tolerances.

e) List of tool, tackles, heavy equipments like cranes, dozers, etc.

f) Bill of Material

g) Procedure for erection and General Safety procedures to followed during erection/installation.

h) Procedure for initial checking after erection.

i) Procedure for testing and acceptance norms.

j) Procedure / Check list for pre-commissioning activities.

k) Procedure / Check list for commissioning of the system.

l) Safety precautions to be followed in electrical supply distribution during erection.

3.5.4.2 Operation and Maintenance Manuals

a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side.

b) The arrangement and contents of O & M manuals shall be as follows :

1) Chapter 1 - Plant Description : To contain the following sections specific to the equipment/system supplied

(a) Description of operating principle of equipment / system with schematic drawing / layouts.

(b) Functional description of associated accessories / controls. Control interlock protection write up.

(c) Integrated operation of the equipment along-with the intended system. (This is to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers).

(d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment along-with its accessories and auxiliaries.

(e) Design data against which the plant performance will be compared.

(f) Master list of equipment, Technical specification of the equipment/ system and approved data sheets.

(g) Identification system adopted for the various components, (it will be of a simple process linked tagging system).

(h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume).

2) Chapter 2 - Plant Operation : To contain the following sections specific to the equipment supplied

(a) Protection logics provided for the equipment along-with brief philosophy behind the logic, Drawings etc.

(b) Limiting values of all protection settings.

(c) Various settings of annunciation/interlocks provided.

(d) Start-up and shut down procedure for equipment along-with the associated systems in step mode.

(e) Do's and Don'ts related to operation of the equipment.

(f) Safety precautions to be taken during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions.

(g) Parameters to be monitored with normal value and limiting values.

(h) Equipment isolating procedures.

(i) Trouble shooting with causes and remedial measures.

(j) Routine testing procedure to ascertain healthiness of the safety devices along-with schedule of testing.

(k) Routine Operational Checks, Recommended Logs and Records

(l) Change over schedule if more than one auxiliary for the same purpose is given.

(m) Preservation procedure on long shut down.

(n) System/plant commissioning procedure.

3) Chapter 3 - Plant Maintenance : To contain the following sections specific to the equipment supplied

(a) Exploded view of each of the equipments. Drawings along-with bill of materials including name, code no. & population.

(b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment.

(c) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc.

(d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc.

(e) Preventive Maintenance schedules linked with running hours/calendar period along-with checks to be carried out.

(f) Overhauling schedules linked with running hours/calendar period along-with checks to be done.

(g) Long term maintenance schedules

(h) Consumables list along-with the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling.

(i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be

carried daily, weekly, monthly & at longer intervals to ensure trouble free operation and quantity required for complete replacement.

(j) Tolerance for fitment of various components.

(k) Details of sub vendors with their part no. in case of bought out items.

(l) List of spare parts with their Part No, total population, life expediency & their interchangeability with already supplied spares to NTPC.

(m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares.

(n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares.

(o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied.

After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in table below. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer. If after the commissioning and initial operation of the plant, the instruction manuals (Erection and /or O &M manuals) require modifications/additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Employer for records and number of copies shall be as mentioned in table below:

S.No.	Description of Drgs/Docs	No. of Prints	No. of CD ROMs/DVDs/Portable Hard Disk
1	Erection Manual	4 Sets	2
2	Operation & Maintenance manual i) First Submission	1 Set	1
	ii) Final Submission	4 Sets	2

3.5.5 Final Submission of drawings and documents:

The Bidder shall furnish the following after approval of all drawings /documents and test reports:

a. List of drawings bearing the Employer's and Contractor's drawing number.
b. Six (6) bound sets along-with two (2) sets of CD-ROMs/ DVD/Portable hard disk of all final drawings/documents.
c. Bidder shall also furnish six (6) bound sets of all as-built drawings including the list of all as-built drawings bearing drawing numbers. The Contractor shall also furnish two (2) sets of CD-ROMs/ DVD/Portable hard disk of all as-built drawings as decided by the Employer.
d. The Bidder shall also furnish four (4) copies and two (2) sets of CD-ROMs/ DVD/Portable hard disk of instruction/ operations & maintenance manuals (after approval) for all the equipments.

3.5.6 TEST REPORTS

Two (2) copies of all test reports shall be supplied for approval before shipment of Equipment. The report shall indicate clearly the standard value specified for each test to facilitate checking of the reports. After final approval six (6) bound copies and two (2) sets of CD-ROMs/ DVD/Portable hard disk of all type and routine test reports shall be submitted to Employer.

3.6 MATERIAL /WORKMANSHIP

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

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

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

Whenever possible, all similar part of the works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the equipment supplied under the specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.
The equipment offered in the bid only shall be accepted for supply, with the minimum modifications as agreed/accepted.

3.7 PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE

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

SPACE HEATERS

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

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

supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

The heaters shall be suitably designed to prevent any contact between the heater wire and the air and shall consist of coiled resistance wire centered in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conducting and electrical insulation properties or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built into an envelope 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.

Control cubicles installed in air-conditioned area need not be provided with space heaters. These cubicles shall, however, have space heaters in case of storage of cubicles for long duration.

FUNGI STATIC VARNISH

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

Ventilation opening

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

Degree of Protection

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

a. Installed outdoor: IP- 55
b. Installed indoor in air conditioned area: IP-32
c. Installed in covered area: IP-52
d. Installed indoor in non air-conditioned area where possibility of entry of water is limited: IP-41.
e. For LT Switchgear (AC & DC distribution Boards) : IP-52

The degree of protection shall be in accordance with IS: 13947 (Part –I) / IEC-947 (Part-I) / IS 12063/IEC 529. Type test report for degree of protection test, on each type of the box shall be submitted for approval.

PRESERVATIVE SHOP COATING

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted as per the requirements covered in the relevant part of the Technical Specification.

Transformers and other electrical equipments, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Employer at a later date.

Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Bidder after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.

3.8 RATING PLATES, NAME PLATES AND LABELS

3.8.1 Each equipment shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer’s name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.

3.8.2 Such nameplates or labels shall be of white non-hygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back.

3.8.3 Each equipment shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Employer or as detailed in appropriate section of the technical specifications.

3.8.4 The rated current, extended current rating and rated thermal current shall be clearly indicated in the name plate in case of current transformer.

3.8.5 Rated voltage, voltage factor and intermediate voltage shall be clearly indicated on the nameplate in case of capacitor voltage transformer.

3.8.6 Each switch shall a clear inscription identifying its function. Switches shall also have a clear inscription of each position indication.

3.8.7 All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

3.8.8 All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.

3.9 GALVANISING:

3.9.1 All exposed ferrous parts shall be hot dip galvanised as per IS:2629 & IS:2633, Galvanising shall be uniform, clean, smooth continuous and free from acid spots. Should the galvanising of the sample be found defective, the entire batch of steel shall have to be re-galvanised at bidder’s cost.

3.9.2 The amount of zinc deposit over threaded portion of the bolts, nuts and screws shall not be less than 300 gms. per sq. meter of surface area. The amount of zinc deposit on washers shall not be less than 340 gms. per sq. meter of surface area or a minimum of 30 microns. The threads

shall have extra deposit of zinc which shall be removed by die cutting after the completion of galvanising. The removal of extra zinc shall be carefully done so that threads shall have the required deposits of zinc on them as specified.

3.10 PAINTING

Unless explicitly stated in relevant chapters of the specification, the painting of all electrical equipment shall be as follows:
Epoxy based with suitable additives. The thickness of finish coat shall be minimum 50 microns (minimum total DFT shall be 100 microns). However in case electrostatic process of painting is offered for any electrical equipment, minimum paint thickness of 50 microns shall be acceptable for finish coat. Paint shade shall be as per technical specification.

3.11 QUALITY ASSURANCE PROGRAMME

3.11.1 The Bidder shall adopt suitable quality assurance programme to ensure that the equipment and services under the scope of contract whether manufactured or performed within the Bidder's works or at his subcontractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS- 14001.

A quality assurance programme of the contractor shall generally cover the following:

i. His organisation structure for the management and implementation of the proposed quality assurance programme.
ii. Quality System Manual
iii. Design Control System
iv. Documentation Data Control System
v. Qualification data for Bidder's key Personnel.
vi. The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
vii. System for shop manufacturing and site erection controls including process controls and fabrication and assembly controls.
viii. Control of non-conforming items and system for corrective actions and resolution of deviations.
ix. Inspection and test procedure both for manufacture and field activities.
x. Control of calibration and testing of measuring testing equipments.
xi. System for Quality Audits.
xii. System for identification and appraisal of inspection status.
xiii. System for authorising release of manufactured product to the Employer.
xiv. System for handling storage and delivery.
xv. System for maintenance of records, and
xvi. Furnishing quality plans for manufacturing detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per format enclosed as Annexure-I.

3.12 GENERAL REQUIREMENTS - QUALITY ASSURANCE

3.12.1 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive

Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Bidder for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the Bidder's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder and will be submitted to Employer for approval.

3.12.2 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Bidder's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. E-mail in addition to hard copy, for review. Once the same is finalised, hard copies shall be submitted for approval. After approval the same shall be submitted in compiled form on CD ROM.

3.12.3 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed.

3.12.4 These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer/Authorised representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.

3.12.5 No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Dispatch Clearance Certificate (MDCC).

3.12.6 All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.

3.12.7 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer.

3.12.8 All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.

3.12.9 All brazers, welders and welding operators employed on any part of the contract either in Bidder's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.

3.12.10 Test results or qualification tests and specimen testing shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorised representative.

3.12.11 For all pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. Similarly, any other statutory requirements for the equipments/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding.

3.12.12 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

3.12.13 No welding shall be carried out on cast iron components for repair.

3.12.14 Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.

3.12.15 All non-destructive examination shall be performed in accordance with written procedures as per International Standards. The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job. In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 40mm shall be ultrasonically tested.

3.12.16 The Bidder shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI). All the subcontractor proposed by the Contractor for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Bidder and finalised with the Employer, shall be subject to Employer's approval. The Bidder’s proposal shall include vendor’s facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified subcontractors enclosed and shall be submitted to the Employer for approval within the period agreed at the time of pre-awards discussion and identified in "DR" category prior to any procurement. Such vendor approval shall not relieve the Bidder from any obligation, duty or responsibility under the contract.

3.12.17 For components/equipment procured by the Bidders for the purpose of the contract, after obtaining the written approval of the Employer, the Bidder’s purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the subcontractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor’s quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc.

3.12.18 Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Bidder’s or their sub-contractor’s quality management and control activities. The Bidder shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.

3.12.19 The Bidder shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Bidder shall carry out all tests/inspection required to establish that the items/equipments conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.

3.12.20 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Bidder in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.

3.12.21 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

3.12.22 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.

3.12.23 Environmental Stress Screening

All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the Bidder / sub – contractor should meet the following.

1. The Bidder / Sub – contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor / Sub – contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization.

Or

In case the Bidder / Sub – contractor do not have any established procedure to eliminate infant mortile components then two or 10% whichever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure.

<u>Elevated Temperature Test Cycle</u>

During the elevated temperature test which shall be for 48 hours, the ambient temperature shall be maintained at 50° C. The equipment shall be interconnected with devices and kept under energized conditions so as to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service.

During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature at 50° C.

In case of any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement.

Burn In Test Cycle

The test shall be conducted on all the panels fully assembled and wired including the panels having undergone the above mentioned elevated temperature test.

The period of Burn in Test Cycle shall be 120 hrs and process shall be similar to the elevated temperature test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems, the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.

During the Burn in Test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components / modules shall be monitored. The temperature rise inside the cubicle should not exceed 10° C above the ambient temperature.

The Bidder / Sub-contractor shall carry out routine test on 100% item at Bidder's / sub-contractor's works. The quantum of check / test for routine & acceptance test by employer shall be generally as per criteria / sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering stage.

3.13 QUALITY ASSURANCE DOCUMENTS

The Contractor shall be required to submit two hard copies and two sets on CDROM of the following Quality Assurance Documents as identified in respective quality plan with tick (∨) mark.

Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing.

The final quality document will be compiled and issued at the final assembly place of equipment before dispatch. However CD-Rom may be issued not later than three weeks.

3.13.1 Typical contents of Quality Assurance Document are as below:-

i) Quality Plan,
ii) Material mill test reports on components as specified by the specification and approved Quality Plans.
iii) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.

iv) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
v) Heat Treatment Certificate/Record (Time- temperature Chart)
vi) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure).
vii) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.
viii) Certificate of Conformance (COC) whoever applicable.
ix) MDCC

3.13.2 Before dispatch/ commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

i) If the result of the review carried out by the Inspector of the Quality document (or applicable section) is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.
ii) If the quality document is unsatisfactory, the Supplier shall endeavour to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.
iii) If a decision is made for dispatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than 3 weeks after the dispatch of equipment.

3.14 TRANSMISSION OF QUALITY DOCUMENTS

As a general rule, two hard copies of the quality document and Two CD ROMs shall be issued to the Employer on release of QA Documentation by Inspector. One set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Site.
For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 3 weeks after the date of the last delivery similarly as stated above.

3.15 INSPECTION, TESTING & INSPECTION CERTIFICATE

3.15.1 The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.

3.15.2 The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or

erection and if part of the works is being manufactured or assembled on other premises or works, the Bidder shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Bidder's own premises or works.

3.15.3 The Bidder shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Bidder's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the Bidder may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.

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

3.15.5 When the factory tests have been completed at the Bidder's or subcontractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Bidder from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.

3.15.6 In all cases where the contract provides for tests whether at the premises or works of the Bidder or any sub-contractor, the Bidder, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Bidder and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.

3.15.7 The inspection by Project Manager / Inspector 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.

3.15.8 To facilitate advance planning of inspection in addition to giving inspection notice, the Bidder shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

3.15.9 All inspection, measuring and test equipments used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Bidder shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked

specifically, the contractor shall re-calibrate the measuring/test equipments in the presence of Project Manager / Inspector.

3.16 PACKAGING & TRANSPORTATION

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Bidder shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Bidder shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting despatch of equipment. Before despatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & preassembly to bare minimum. The Employer's Inspector shall have right to insist for completion of works in shops before despatch of materials for transportation.

3.17 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

3.17.1 The material of clamps and connectors shall be Aluminium alloy casting conforming to designation A6 of IS:617 for connecting to equipment terminals and conductors of aluminium. In case the terminals are of copper, the same clamps/connectors shall be used with 2mm thick bimetallic liner.

3.17.2 The material of clamps and connectors shall be Galvanised mild steel for connecting to shield wire.

3.17.3 Bolts, nuts and plain washers shall be hot dip galvanised mild steel for sizes M12 and above. For sizes below M12, they shall be electro-galvanised mild steel. The spring washers shall be electro-galvanised mild steel.

3.17.4 All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be rounded off to meet specified corona and radio interference requirements.

3.17.5 They shall have same current rating as that of the connected equipment. All current carrying parts shall be at least 10 mm thick. The connectors shall be manufactured to have minimum contact resistance.

3.17.6 Flexible connectors, braids or laminated strips shall be made up of copper/aluminium.

3.17.7 Current rating and size of terminal/conductor for which connector is suitable shall be put on a suitable sticker on each component which should last atleast till erection time.

3.18 SPACERS

3.18.1 Spacers shall conform to IS: 10162. They shall be of non-magnetic material except nuts and bolts, which shall be of hot dip galvanised mild steel.

3.18.2 Spacers shall generally meet the requirements of clamps and connectors as specified above. Its design shall take care of fixing and removing during installation and maintenance.

3.18.3 In addition to the type tests as per IS: 10162, clamp slip test should have been conducted. In this test the sample shall be installed on test span of twin/quad bundle string at a tension of 44.2kN (4500 kg). One of the clamps when subjected to a longitudinal pull of 2.5kN (250 kg) parallel to the axis of conductor shall not slip, i.e. permanent displacement between conductor and clamp after test shall not exceed 1.0 mm. This test should have been performed on all other clamps of the sample.

3.19 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS, AND DISC INSULATORS

3.19.1 Bushings shall be manufactured and tested in accordance with IS: 2099 & IEC: 60137 while hollow column insulators shall be manufactured and tested in accordance with IEC62155/IS 5284. The support insulators shall be manufactured and tested as per IS: 2544/IEC 60168/IEC 60273. The insulators shall also conform to IEC 60815 as applicable having alternate long and short sheds.
Support insulators/ bushings/ hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

3.19.2 Porcelain used shall be homogenous, 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.

3.19.3 Glazing of the porcelain shall be uniform brown in colour, free form blisters, burns and other similar defects.

3.19.4 The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall be lead to deterioration. All ferrous parts shall be hot dip galvanised.

3.19.5 Post type insulators shall consist of a porcelain part permanently secured in metal base to be mounted on supporting structures. They shall be capable of being mounted upright. They shall be designed to withstand all shocks to which they may be subjected to during operation of the associated equipment.

3.19.6 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps, 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.

3.19.7 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued, 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.

3.19.8 In accordance with the requirement stipulated elsewhere, bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests and acceptance test/sample test in accordance with relevant standards.

3.20 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT.

3.20.1 All types of control cabinets, junction boxes, marshaling boxes, lighting panels, terminal boxes, operating mechanism boxes, Kiosks etc. shall generally conform to IS:5039, IS:8623 and IEC:60439 as applicable.

3.20.2 They shall be of Stainless steel or Aluminium. The thickness of Stainless steel shall be minimum 1 mm. The thickness of aluminium shall be minimum 3 mm and shall provide rigidity. Top of the boxes shall be sloped towards the rear of the box.

3.20.3 BAY MARSHALLING BOX

Bay Marshaling Box located at a convenient location to receive and distribute cables shall be provided as required. It shall meet all the requirements as specified for cabinets/boxes.

It shall have three separate distinct compartments for following purposes:

- To receive two incoming 415V, three phase, AC supplies controlled by 100A four pole MCBs with auto changeover provision, and to distribute five (5) three phase ac supplies controlled by 32A four pole MCBs. It shall also be provided with 63A, 3 phase 4 pin industrial grade receptacle with rotary switch.

- To receive three phase incoming from first compartment and to distribute ten (10) single phase ac supplies controlled by 16A two pole MCBs.

- 150 nos. terminal blocks in vertical formation for interlocking facility.

3.20.4 AUXILIARY SWITCH

The auxiliary switch shall conform of following type tests:

a) Electrical endurance test - A minimum of 1000 operations for 2A. D.C. with a time constant greater than or equal to 20 milliseconds with a subsequent examination of mV drop/ visual defects/ temperature rise test.
b) Mechanical endurance test - A minimum of 5000 operations with a subsequent checking of contact pressure test/ visual examination
c) Heat run test on contacts
d) IR/HV test, etc.

3.21 CABLE GLANDS AND LUGS/FERRULES

3.21.1 Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.

3.21.2 Cable lugs/ferrules for power cables shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. The cable lugs for control cables shall be provided with insulating

sleeve and shall suit the type of terminals provided on the equipments. Cable lugs and ferrule shall conform to DIN standards.

3.22 CONDUITS, PIPES AND ACCESSORIES

3.22.1 The bidder shall supply and install all rigid conduits, mild steel pipes, flexible conduits, hume pipes, etc. including all necessary sundry materials, such as tees, elbows, check nuts, bushing reduces, enlargers, wooden plugs, coupling caps, nipples, gland sealing fittings, pull boxes, etc.

3.22.2 The size of the conduit/pipe shall be selected to limit the fill to a maximum of 40%. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed in an approved manner to prevent damage to threaded portions and en- trance of moisture and foreign materials.

3.22.3 PVC conduits shall be of high impact, heavy gauge (at least class 2) conduit conforming to BS-4607.

3.22.4 The outer surface of the steel conduits shall be coated with hot-dip zinc and chromate conversion coatings. The inner surface shall have silicone epoxy ester coating for easy cable pulling. Mild steel pipes shall be hot-dip galvanized. All rigid conduits/pipes shall be of a reputed make.

3.22.5 The hume pipes and accessories shall be of reinforced concrete conforming to class NP2 of IS-458. All tests on hume pipes shall be conducted as per IS-458.

3.22.6 Flexible conduits shall be of heat-resistant lead coated steel, water-leak, fire and rust proof.

3.23 MOTORS

The voltage level for motors shall be as follows:

a) Upto 0.2 KW	: Single phase 240V AC / 3 phase 415V AC
b) Above 0.2 KW and upto 200 KW	: 3 phase, 415V AC
c) Above 200 KW and upto 1500 KW	: 3 phase, 3.3 kV AC
d) Above 1500 KW	: 11 kV

The bidder may adopt 415V/3.3 KV for the drives rated in the range of 160-210 KW.

The voltage rating of the drives indicated above is for basic guideline.

3.23.1 All motors shall conform to IEC-60034-5 / IS Standard and with principal dimensions in accordance with IEC 60072-1 (1991), IEC 60072-2 (1990) and IEC 60072-3 (1994).

3.23.2 All equipment shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification

3.23.3 Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment.

3.23.4 Degree of Protection

Degree of protection for various enclosures as per IEC60034-05 shall be as follows:

Indoor motors - IP 54
Outdoor motors - IP 55
Cable box-indoor area - IP 54
Cable box-Outdoor area - IP 55

3.23.5 Type:

AC Motors:

a) Squirrel cage induction motor suitable for direct-on-line starting.
b) Continuous duty LT motors upto 200 KW Output rating (at 50 deg.C ambient temperature), shall be Premium Efficiency class-IE3, conforming to IS 12615, or IEC:60034-30.
c) Crane duty motors shall be squirrel cage Induction motor as per the requirement.
d) Motor operating through variable frequency drives shall be suitable for inverter duty. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable.

DC Motors Shunt wound

3.24 AUXILIARY SWITCH

The auxiliary switch shall conform of following type tests:

a) Electrical endurance test - A minimum of 1000 operations for 2A. D.C. with a time constant greater than or equal to 20 milliseconds with a subsequent examination of mV drop/ visual defects/ temperature rise test.
b) Mechanical endurance test - A minimum of 5000 operations with a subsequent checking of contact pressure test/ visual examination
c) Heat run test on contacts
d) IR/HV test, etc.

3.25 LAMPS AND SOCKETS

3.25.1 Lamps:
All incandescent lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

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

3.25.3 Hand Lamp:

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

3.26 SWITCHES & FUSES:

Each control panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with switch-fuse units. Selection of the main and sub-circuit fuse ratings shall be such as to ensure selective

clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

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

All control switches shall be of rotary type. Toggle/piano switches shall not be accepted.

3.27 TYPE, ROUTINE & ACCEPTANCE TESTS:

3.27.1 TYPE TEST REQUIREMENTS FOR EQUIPMENTS OTHER THAN CIRCUIT BREAKER:

a) All equipments to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification. The validity period (counted from 02 May 2024) of reports shall be as per CEA Guidelines for the validity period of Type test(s) conducted on Major Electrical Equipment in power Transmission- May2020 (with latest amendments). These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a Client.

b) However if contractor is not able to submit report of the type test(s) conducted as per CEA Guidelines for the validity period of Type test(s) conducted on Major Electrical equipment in power Transmission-May2020 (with latest amendments) from 02 May 2024, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/ owners representative and submit the reports for approval.

c) All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

3.27.2 TYPE TEST REQUIREMENTS FOR CIRCUIT BREAKER:

a) The Contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The Bidder shall indicate the charges for each of these type tests separately in the relevant schedule of BPS and the same shall be considered for the evaluation of bids. The type test charges shall be paid as per the charges quoted for each of these type tests separately in the relevant schedule of BPS (Bid Proposal Sheet) & no qty variation is allowed. only for the test(s) conducted successfully under the contract and upon certification by the Employer's engineer.

b) The type tests shall be carried out in the presence of the Employer's representative, for which minimum 60 days' notice shall be given by the Contractor. The Contractor shall obtain the Employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set up, instrument to be used, procedure, acceptance norms, recording of various parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.

c) In case the Contractor has conducted such specified type test(s) according to the relevant standard and / or specification as per CEA Guidelines for the validity period (counted from 02

May 2024) of Type test(s) conducted on Major Electrical equipment in power Transmission-May2020 & with latest amendments, submit the type test reports to the Employer for waiver of conductance of such type test(s). These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a Client. The Employer reserves the right to waive conducting of any or all the specified type tests(s) under this contract. In case the type tests are waived, the type test charges shall not be payable to the Contractor.

However, if any type test report is found not meeting the specification requirements, bidder shall conduct all such type tests successfully according to relevant standards without any cost and delivery implication to BHEL.

3.27.2.1 Type tests to be conducted on AIS Circuit Breaker

a) Di-electric tests
b) Radio interference voltage test
c) Temperature rise test
d) short time withstand current, peak withstand test, short circuit test duties, short line fault test
e) Mechanical endurance
f) Out of phase making & breaking test
g) Line charging current breaking test
h) Corona test for 765kV only
i) IP: 55 test on each type of box
j) Seismic withstand test with structure for 765kV only
k) Test for reactor switching duty for 765kV CB only (applicable for Bus reactor CB)

3.28 CORONA AND RIV TESTS AND SEISMIC WITHSTAND TEST:

a) The corona and RIV tests shall conform to the requirements as per Annexure A.
b) The seismic withstand test for shall conform to requirements as per Annexure B.

3.29 Enclosures:

1. ANNEXURE- A - CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST
2. ANNEXURE- B - SEISMIC WITHSTAND TEST
3. ANNEXURE- I – MQP (NTPC format)
4. ANNEXURE- II – QUALITY ASSURANCE FOR SWITCHYARD

ANNEXURE – A

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST (For 765 & 400kV AIS only)

1.0 General:

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

2.0 Test Methods for RIV:

2.1 RIV tests shall be made according to measuring circuit as per International Special–committee on Radio Interference (CISPR) Publication 16 -1 (1993) Part – I. The measuring circuit shall preferably be tuned to frequency with 10 % of 0.5 MHz but other frequencies in the range of 0.5 MHZ to 2 MHz may be used, the measuring frequency being recorded. The result shall be in microvolts. Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107 – 1964 except otherwise noted herein. In measurement of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

2.2 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, 115% and 130% for the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 765 & 400KV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

3.0 Test Methods for visible Corona:

The purpose of this test is to determine the corona extinction voltage of the apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 130 % of RIV test voltage and maintained there for five minutes. In case corona inception does not take place at 130 %, the voltage level shall be raised till inception of corona or rated voltage whichever is lower. The voltage will then be decreased slowly until all visible corona disappears. The test procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which the visible corona (negative or positive polarity) disappears.

ANNEXURE – B

SEISMIC WITHSTAND TEST (for 765 & 400 kV AIS only)

a) The seismic withstand test on the complete equipment (except BPI) shall be carried out along with supporting structure.

b) The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the terminal pad of the equipment and at any other point as agreed by the owner. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the purchaser.

Clause No.	TECHNICAL REQUIREMENTS

Annexure – A

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1.0 **General**

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

2.0 **Test Levels**

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

3.0 **Test Methods for RIV:**

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

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

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

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85% , 100%, 115% and 130% for the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 420 KV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

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

Clause No.	TECHNICAL REQUIREMENTS
3.6	The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to the voltage read by the noise meter.
4.0	**Test Methods for visible Corona** The purpose of this test is to determine the corona extinction voltage of the apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 130 % of RIV test voltage and maintained there for five minutes. In case corona inception does not take place at 130 %, the voltage level shall be raised till inception of corona or rated voltage whichever is lower. The voltage will then be decreased slowly until all visible corona disappears. The test procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which the visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions at all voltage steps i.e. 85%,100%,115% and 130%.Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f / 5.6 or equivalent. The photographic procedure shall be such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connectors so as to show corona on bushing, insulators and all parts of energized connectors. The photographs shall be framed such that test object essentially fills the frame with no cut off.
4.1	For recording purposes, modern devices using UV recording methods such as image intensifier may also be used.
4.2	The test shall be recorded on each photograph. Additional photograph shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence.
4.3	In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of the test equipment and test object. Thes e four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by

Clause No.	TECHNICAL REQUIREMENTS
	purchaser's inspector after determining the best camera locations by trial energisation of test object at a voltage which results in corona.
4.4	The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.
4.5	However both tests shall be carried out with the same test set up and as little time duration between tests as possible. No modification or treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of the owner's engineer, if in his opinion it will not prejudice other test.
5.0	**Test Records:**
	In addition to the information previously mentioned and requirements specified as per CISPR or NEMA 107-1964 the following data shall be included in the test report-
a)	Background noise before and after the test
b)	Detailed procedure of application of test voltage
c)	Measurement of RIV levels expressed in microvolts at each level.
d)	Results and observations with regard to location and type of interference sources detected at each step.
e)	Test voltage shall be recorded when measured RIV passes through 100 micro volt in each direction.
f)	Onset and extinction of visible corona for each of the four tests required shall be recorded.

Clause No.	TECHNICAL REQUIREMENTS

Annexure – B

SEISMIC WITHSTAND TEST
(For 400kV Only)

The seismic withstand test on the complete equipment (except BPI) shall be carried out along with supporting structure.

The bidder shall arrange to transport the structure from his contractor's premises / owner's sites for purpose of seismic withstand test only.

The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the terminal pad of the equipment and at any other point as agreed by the owner. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the purchaser.

ANNEXURE-I

MFGR.'s LOGO	MANUFACTURER'S NAME AND ADDRESS	**MANUFACTURING QUALITY PLAN**		PROJECT : PACKAGE : CONTRACT NO. : MAIN-SUPPLIER:
		ITEM : SUB-SYSTEM:	QP NO.: REV.NO.: DATE: PAGE: …. OF….	

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C / N					M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	** 10.			11.

		LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** **M:** MANUFACTURER/SUB-SUPPLIER C**:** MAIN SUPPLIER, **N**: NTPC **P:** PERFORM **W**: WITNESS AND **V:** VERIFICATION. AS APPROPRIATE, **CHP:** NTPC SHALL IDENTIFY IN COLUM "N" AS ' W"		DOC. NO.: REV…… CAT…..	
MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER		FOR NTPC USE	REVIEWED BY	APPROVED BY / APPROVAL SEAL
SIGNATURE					

FORMAT NO.: QS-01-QAI-P-09/F1-R1 **1/1** **ENGG. DIV./QA&I**

EPC PACKAGE FOR TALCHER THERMAL POWER PROJECT STAGE-III (2X660 MW)			

ANNEXURE-II

ENDORSEMENT SHEET FOR QP

REFERENCE / *STANDARD* / FIELD QUALITY PLAN (RQP / SQP/*RFQP/SFQP*)

TO BE FILLED IN BY SUPPLIER AT TIME OF SUBMISSION		To be filled in by NTPC
PROJECT NAME		*REVIEW & ENDORSEMENT BY NTPC* **PROJECT SPECIFIC QP NUMBER ALLOTTED**
CONTRACT NO.:		**QP NO.:**
MAIN SUPPLIER		
MANUFACTURER WORKS & ADDRESS	M/S	**REV. NO.: DATE:**
ITEM /EQUIPMENT / SYSTEM/ SUB-SYSTEM DETAILS i.e. MODEL TYPE / SIZE /RATING etc.		** The RQP/SQP/RFQP/SFQP once endorsed for a particular contract shall remain valid even though the original QP may have expired or revised, unless / otherwise mutually agreed with the supplier. ①
APPROVED QP NO.: RQP/SQP/RFQP/SFQP	0000-999-QV - - REV. NO.: DATED**: **	
Confirmation by Main Supplier (TICK WHICHEVER APPLICABLE)		*(TICK APPLICABLE)*
***I. That the item/ component is identical to that considered for QP approval.* OR.**		**The QP is endorsed for this project without any change**
***II. That there are minor changes in the item/ component with respect to that considered for QP approval, however the same do not affect the contents of QP.* OR**		
III. That there are minor changes in the item/ component with respect to that considered for QP approval, however the same affect the QP slightly, as indicated below / in attached sheet.		**The QP is endorsed for this project with changes as indicated.**
		DISTRIBUTION OF ENDORSEMENT OF **A) RQP/SQP:** *1. MAIN SUPPLIER (WITH A COPY OF QP)* *2. MANUFACTURER* *3. RIO* *4. CQA-SPL* *5. CQA-O/C* **B) RFQP/SFQP:** *1. MAIN SUPPLIER (with a copy of QP)* *2. MANUFACTURER* *3. NTPC FQA (with a copy of QP)* *4. NTPC Erection (with a copy of QP)* *5. CQA-SPL* *6. CQA-O/C*
SIGN.: (Main Supplier) DATE	***SIGN.: (Manufacturer) DATE:***	**NTPC (Reviewed /Approved by/ Date & Seal)**

Bharat Heavy Electricals Limited

Project: 765/400/132kV AIS Switchyard Extn. at NTPC SIPAT STPP Stage-III (1x800 MW)
Customer: NTPC Limited
Technical Specification: 132kV XLPE Cable with accessories
Document No. TB-435-316-TS-002 Rev 00

Contents

Annexure-A: Compliance Certificate of Technical Specification

The bidder shall confirm compliance to the following by signing and stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.

2. There are no deviation(s) with respect to specification other than those furnished in the schedule of deviations.

3. Only those technical submittals which are specifically asked for in Notice Inviting Tender (NIT) to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of technical offer.

4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.

5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ' of the specification shall not be considered (i.e., technical description & quantities as per the specification shall prevail).

Date: Bidder's Stamp &
Signature

Annexure-B: Deviation/ Change Request of Technical Specification

Bidder shall list out all technical potential deviation/ change request (s) along with clause with respect to technical specifications.

Sl. no.	Page no.	Clause no.	Deviation(s)	Reason(s)/ Justification(s)

Any deviation not specifically brought out in this section shall not be admissible for any commercial implication at later stage. Except to the technical deviations listed in this schedule, bidder's offer shall be considered in full compliance to the tender specifications irrespective of any such deviation indicated / taken elsewhere in the submitted offer.

Date: Bidder's Stamp & Signature

Annexure-C: Technical Checklist

Sl. No.	Particulars	Confirmation by Bidder	
1	**Technical Qualifying Requirement**		
1.1	The bidder to furnish relevant documents for meeting the qualifying requirement. Performance certificates (if required as per tender) shall be submitted in English. Translated pages should be attested by the ultimate customer, if attested only by the bidder, it shall be notarized.	Confirmed	Yes/ No
1.2	The bid shall be submitted by the Manufacturer of 132kV XLPE cable & accessories in case of Indian Manufacturer, however agent may submit the technical offer in case of foreign manufacturer. The bidder's scope includes supply and services such as -Unloading and installation, -Testing, commissioning and handing over	Confirmed	Yes/ No
1.3	All the documents shall be submitted in English. Translated pages should be attested by the ultimate customer, if attested only by the bidder it shall be notarized.	Confirmed	Yes/ No
2	**Un-priced BOQ**		
2.1	Confirm that all items have been quoted separately. (If any item has not been quoted, the same shall be specifically brought out with technical reasons thereof)	Confirmed	Yes/ No
2.2	Any other supply/ service required for the execution for the complete work of 132kV XLPE cable & accessories is deemed to be included in the offer, whether specifically mentioned in the BOQ or not if it is included in technical specification. Bidder to submit list of items along with their respective quantities required for completeness of 132kV XLPE cable & accessories.	Confirmed (List of items is attached)	Yes/ No
2.3	Confirm that the consumables (list to be enclosed by bidder during contract stage) with shelf life of two years shall be supplied before erection after specific clearance by BHEL/NTPC.	Confirmed	Yes/ No
2.4	Supply of All the testing instruments & devices required for successful testing and commissioning of 132kV XLPE cable system at site till handing over shall be under bidder's scope.	Confirmed	Yes/ No
2.5	All tools & tackles, special tools, slings and plants shall be in bidder's scope.	Confirmed (List of items is	Yes/ No

		attached)	
2.6	Installation and fixing of materials required for earthing for complete route of XLPE cable and its end termination shall be in bidder's scope. The earth grid connection shall not be available at all points in route and, hence provisions of independent earthing including rod electrode etc. shall be deemed to be included in bidder's scope.	Confirmed	Yes/ No
2.7	The associated activities including cutting, drilling, welding, painting and fabrication etc. including minor civil works required for completion of 132kV XLPE cable work shall be in bidder's scope.	Confirmed	Yes/ No
2.8	Materials required for repair and maintenance of cables during/ after installation, if required shall be arranged by bidder to make it good to the satisfaction of BHEL/ Customer.	Confirmed	Yes/ No
2.9	Tools & tackles, testing instruments for termination/ jointing, tools for termination, scaffolding for support and making platform at elevated position, arrangement for controlled environment, crane/ hydra for lifting, heating arrangement etc. to complete termination and jointing work complete in all respect shall be bidder's scope.	Confirmed	Yes/ No
2.10	Cable accessories damaged during installation, testing & commissioning shall be made good/ repaired/ replaced by bidder to the satisfaction of BHEL/ Customer.	Confirmed	Yes/ No
3	**Technical**		
3.1	Bidder may please be noted that the exact cable length shall be decided after joint route survey during site visit and making precise measurements at contract stage. Manufacturing cable cut length and drum length shall be determined with consultation & approval with BHEL/ NTPC. -The Payment of cables length for supply shall be as per approved quantities by BHEL/ NTPC. -The Payment of cables length installation will be as per actual measurement at site which shall also include cable terminations. -The exact length may vary by -20% to +20% at contract stage based on actual measurement at site and calculations submitted by the bidder. However, Individual quantity of other items may vary to any extent and may get deleted during contract/ execution stage.	Confirmed	Yes/ No
3.3	Bidder shall submit following design calculations, (i) Insulation dimensions including thickness of inner/ outer sheath and semi-conducting layers. (ii) Verification of thermal withstand capacity of XLPE cables for short circuit current. (iii) Conductor, conductor sheath, insulation and structure losses. (iv) Temperature rise (v) Cooling and anti-condensation behavior. (vi) Voltage gradient calculations for operating voltage, highest system voltage and for transient voltage.	Confirmed	Yes/ No

	(vii) Supporting steel structure design and calculations. (viii) Mechanical forces and stresses induced in cable conductor and metallic sheath to prove the mechanical strength.		
3.4	Further to above, bidder shall also submit the following design calculations, (i) Design calculations of 132kV XLPE cables (conductor & sheath) to withstand short circuit current for 1 sec. (ii) Design calculations for thermal withstanding capacity for short circuit current (conductor & sheath). (iii) Calculation indicating that the 800sqmm copper (equivalent) conductor single phase 132kV XLPE cable is capable to carry 1000A continuous current. (iv) Calculations of cable for following, - Screen/ sheath voltage under full load condition, - Screen/ sheath voltage during an external three phase symmetrical through-fault (v) Calculations for screen/ sheath voltage/ current and the recommended method for metallic screen bonding and screen sizing shall be designed in such a manner so that it can carry the earth fault current level of the system, considering system is solidly grounded.	Confirmed	Yes/ No
4	**Technical Deviations**		
4.1	Confirm that the Complete systems have been offered as per the requirements of Technical Specification and Technical Deviation sheet has been submitted. Deviations mentioned elsewhere in the bid will not be considered.	Confirmed	Yes/No
5	**Type Testing**		
5.1	Bidder shall ensure that the equipment (132kV XLPE Cable & its Accessories) being procured should have valid type test certificates as specified in IS/ IEC standards (e.g. IEC 60840) (amended up to date) at any independent laboratory/ NABL accredited laboratory of respective country. The validity of type test reports shall be 10 years as on techno-commercial bid opening date.	Confirmed	Yes/No
5.2	The complete type test certificates and data sheets for cables and its accessories shall be furnished by bidder. If the tests conducted are not to the satisfaction of BHEL/ consultant/ customer, the tests shall be re-conducted by bidder without any commercial implication to BHEL. Further, in case, any of type tests have not been conducted on the offered design or there has been a change in the design after the type tests, the requisite tests shall be conducted by bidder on the offered design by bidder without any commercial implication to BHEL.	Confirmed	Yes/No
6	**Quality Plan**		

6.1	The successful bidder shall submit Quality Assurance Plan for 132kV XLPE Cable & its Accessories etc. including in-process inspection methods, tests, records, etc. for BHEL/ consultant/ customer approval. Customer hold points will also be included in the plan, which shall be mutually agreed by the BHEL/ consultant/ customer. In case bidder has reference Quality Assurance Plan agreed with BHEL/ consultant/ customer, same shall be submitted for specific project to BHEL/ consultant/customer approval. There shall be no commercial implication to BHEL/ consultant/ customer on account of Quality Plan approval.	Confirmed	Yes/No
7	**Field Testing & Commissioning**		
7.1	Bidder shall also submit site acceptance testing (SAT) procedures and get them approved from BHEL/ consultant/ customer before carrying out the site testing. Following site test as per IEC 62067, if applicable shall be conducted after laying of cable and installation of accessories. - DC voltage test of the over sheath - AC voltage test of the insulation - Partial discharge measurement test, if applicable	Confirmed	Yes/No

Date: Bidder's Stamp &
Signature

Annexure-D: Guaranteed Technical Particulates

Sl. No.	Particulars	Details to be provided by Bidder
A	**132kV XLPE Insulated Power Cables**	
1	Manufacturer's name & country of origin	
2	Standard according to which Cable is manufactured and tested	
3	Type	
4	No. of phases per circuit	
5	No. of cables per phase	
6	No. of core per cable	
7	Rated voltage*	
8	Highest system voltage*	
9	Rated continuous current*	
10	Rated short-time withstand current for 1 sec.* a) for conductor b) for metallic sheath	
11	Electrical Stresses (A.C. Voltage) Short circuit forces* a) On conductor i) Average ii) Maximum b) On Inner Semi-conductor layer i) Average ii) Maximum c) On outer semi-conductor layer i) Average ii) Maximum	
12	Rated frequency (Hz)	
13	Insulation level* (a) One Minute Power Frequency withstand voltage kVrms (b) 1.2/50 micro second lightning impulse withstand voltage, kVpeak (c) 250/2500 micro second switching impulse withstand voltage kVpeak	
14	Temperatures* a) Max. Temperature rise over ambient temperature of 50 deg C. b) Maximum permissible operating conductor temperature c) Maximum permissible conductor temp. during short circuit	

	d) Heating time constant when cable is switched on i) From zero load (cold condition) to a load of continuous current and corresponding conductor temperature. ii)From zero load (cold condition) to a load of maximum continuous current (offered by bidder) to attain 90 0C temperature, keeping the load constant.	
15	17. Conductor details (a) Type (b) Material and shape (c) Material Cross-sectional area (mm2) (d) Conductor diameter (mm) (e) Weight of conductor (kg/m) (f) Current density in conductor (A/mm2) (g) Conductivity of conductor (mho) (h) Ultimate tensile strength of conductor (i) Max. short-circuit current rating & duration KA/sec. (j) Impedance of conductor per meter ohm	
16	Conductor shielding a) Material b) Thickness, mm c) Max. size of protrusion, µm d) Electric stress level, kV/mm i) Maximum ii) Average	
17	a) Material b) Thickness mm c) Relative permittivity - d) Min. resistivity, Ω-cm e) Max. moisture content, ppm f) Max. size of void, µm g) Max. size of contaminant (Black metal and coloured impurity),µm h) Dielectric loss angle (at rated voltages at 200C & 900C) i) Outer dia of insulation mm	
18	Insulation shielding a) Material b) Thickness, mm c) Max. size of protrusion, µm d) Electric stress level, kV/mm	
19	Bedding (cushion layer) a) Material b) Total thickness, mm	
20	Inner sheath a) Material -	

	b) Type c) Thickness, mm d) Maximum short circuit current rating & duration, kA/sec. e) Sheath induced voltage, V f) Type of earthing g) Metallic sheath outer dia, mm h) Mutual inductance between conductor and sheath.	
21	Outer sheath a) Material b) Type c) Thickness, mm d) Colour e) Oxygen index f) Carbon black contents for PE	
22	Cable outside diameter, mm	
23	Cable weight, Kg/m	
24	Inductive reactance per phase per meter at 200 C, ohms	
25	Capacitance per phase per meter at 20 deg C & 50 Hz, Micro Farad	
26	Effective AC resistance per phase per metre, ohms	
27	Surge impedance, Ω	
28	DC resistance at 20 deg C, ohms	
29	Max. safe continuous current at ambient temperatures varying from 2.00 C to 50oC	
30	Charging current & power a) Maximum charging current per phase, A/km b) Maximum charging current per circuit, A/km c) Maximum charging power per circuit, kVA/km	
31	Cable insulation resistance, MΩ	
32	Cable burn through time at rated short circuit current, sec	
33	Corona Extinction voltage, kV	
34	Radio interference at 266 kVrms, micro volts	
35	Protrusion, Micron a) Conductor shielding b) Insulation shielding	
35	Cable test particulars a) AC high voltage test, kV/min. b) AC high voltage long time withstand test, kV/Min. c) Impulse voltage withstand test, kVpeak d) Partial discharge test, kV/pC e) Voltage test on outer sheath, kV/Min. f) Impulse voltage test on outer sheath, kVpeak	

	g) Max. Pulling tension, Kg h) Max. permissible side wall pressure, Kg/m i) Min. bending radius, m j) Max. symmetrical short circuit current, kA/sec k) Max. phase to earth short circuit current, kA/Sec l) Current carrying capacity at 500C,900C i) In flat formation, A m) Whether the cable is tested for pre-qualifying tests as per IEC 62067	
A	**132 kV Cable Accessories**	
A.1	**Outdoor Termination**	
1	Name and country of manufacturer	
2	Type	
3	Insulating medium	
4	Type of interface	
5	Material and colour of the bushing	
6	Bushing particulars • Make • Type • Voltage class • 1-minute power frequency withstand voltage, kVrms • Lightning impulse withstand voltage, kVpeak • Switching impulse withstand voltage, kVpeak • Flash over values - Dry, kV - Wet, kV •Puncture values, kV •Creepage distance, mm • Compression strength, kg/cm2 • Cantilever strength, kg-m • Pressure differential withstand capacity of conical insulators	
7	Is terminal type tested, if yes, to which standard	
8	Overall dimensions of termination, mm	
9	Connecting clamps i) Current rating, kA ii) Overall dimensions, kA	
A.2	**Disconnecting Link**	
1	Material and size	
2	Continuous current rating, A	
3	Momentary current rating, kA	
A.3	**Earthing Devices**	

1	Earthing conductor - Material & size - Continuous current rating, A - Momentary current rating, kA	
2	Link box - Material - Size & weight - Protection code	
3	LA (SVL) - Type - Rated voltage, kV - Voltage limiting range - Fault current rating for 1 sec, kA - Lightning impulse voltage withstand capacity, kVpeak - Power frequency withstand voltage, kVrms - Momentary current rating, kA - Continuous current rating, A	
A.4	**Cable drums**	
1	a) Flange diameter, mm b) Drum diameter & width, mm c) Drum weight, Kg d) Drum material e) Spindle hole dia,, mm	
A.5	**Cleats, Clamps, Bolts and Nuts**	
1	i) Material/composition of material ii) Min. tensile strength of bolts, kg/cm iii)Proof load at nuts, kg	
A.6	**Bonding Cable**	
	i) Material ii) Size iii) Type of bonding iv) Current carrying capacity	

Annexure- XIV

HSE CONDITIONS

at a GLANCE (for bidders)

Health Safety and Environment Management

Transmission Business Group, Noida

DOCUMENT CONTROL			
Document number:	TBG/HSE/NIT-01		
Issue number:	00	Issue date:	08.01.2020
Revision number:	01	Revision date :	22.10.2021

	Prepared by	Checked by	Approved and Issued for use by
Name	Sanjeev Sharma	Arvind Kumar Pandey	Anindya Chakraborty
Designation	Addl. Engineer	Engineer	Adl. General Manager
Signature	संजीव शर्मा	अरविन्द	अनिन्द्य चक्रवर्ती
Date	22.10.2021	22.10.2021	22.10.2021

Doc. copy issue no. :		Doc. copy issue date :	
Issued to :	Name	Designation	Signature
Issued by :	Name	Designation	Signature

BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS GROUP

BHEL TBG through its long experience and policy, has developed a culture to consider wellbeing of the society, protection of environment and occupational health and safety of its workers first. TBG has also a culture of transparency in all its business activities. In line to this culture, this NIT annexure is prepared as a peeping window in to the TBG HSE requirements which need to be 100% complied by the successful bidders while executing the contract. Interested bidders should go through these HSE conditions:

1. BHEL HSE Policy

In BHEL, Health, Safety and Environment (HSE) responsibilities are driven by our commitment to protect our employees and people we work with, community and environment. BHEL believes in zero tolerance for unsafe work/non-conformance to safety and in minimizing environmental footprint associated with all its business activities. We commit to continually improve our HSE performance by:

- Developing safety and sustainability culture through active leadership and by ensuring availability of required resources.
- Ensuring compliance with applicable legislation, regulations and BHEL systems.
- Taking up activities for conservation of resources and adopting sound waste management by following Reduce/Recycle/Reuse approach.
- Continually identifying, assessing and managing environmental impacts and Occupational Health & Safety risks of all activities, products and services adopting approach based on elimination/ substitution/reduction/control.
- Incorporating appropriate Occupational Health, Safety and Environment criteria into business decisions, design of products & systems and for selection of plants, technologies and services.
- Imparting appropriate structured training to all persons at workplace and promoting awareness amongst customers, contractors and suppliers on HSE issues.
- Reviewing periodically this policy and HSE Management Systems to ensure its relevance, appropriateness and effectiveness.
- Communicating this policy within BHEL and making it available to interested parties.

Atul Sobti
Chairman & Managing Director

June 5, 2018

Creating BHEL of tomorrow

2. Legal Compliances:

a. Statutory Provisions: All the sub-contractors are to comply with client specific rules and procedures, the National legislations and codes, in particular the following or their revised versions:

Srl. No	Acts/Rules Name	Srl. No	Acts/Rules Name
1	The Factories Act 1948, Amendment Act 1947	11	Contractor labour Act, 1970 (Regulation and abolition)
2	The Environment Act 1986	12	Provident fund Act, 1952
3	Workmen's Compensation Act, 1923	13	Payment of gratuity Act, 1972
4	Building and Other Construction Workers (Regulation of employment and condition of service) Act, 1996	14	Indian Explosives Act and the explosives Rules 2008
5	Buildings and Other Construction Workers Welfare Act, 1996	15	The Gas Cylinder Rules, 2016, Static and Mobile Pressure Vessels (Unfired) Rules 2016
6	Payment of wages Act, 2017 Equal remuneration Act,	16	The Indian Electricity Act 2003 and Indian Electricity Rules 2005
7	Minimum wages Act.1948	17	The Atomic Energy Act, 2015
8	Employers liability Act, 1938	18	The atomic energy (Radiation Protection) Rules. 2004
9	Industrial dispute Act, 1947	19	National Fire Protection Association (NFPA),
10	maternity benefit amendment act 2017	20	National Building Code of India 2016 etc.

b. Indian Standard (IS) Codes related to HSE

All the sub-contractors are to comply with client specific rules and procedures, the National legislations and codes in particular the following or their revised versions:

Srl	IS Code	Applies on
1	IS: 4081 -1986	Safety code for Blasting and Related Drilling operations
2	IS: 3764 -1992	Safety code for excavation work
3	IS: 5121 -1969	Safety code for pilling and other deep foundations

4	IS: 2750 -1964	Specification for steel scaffoldings
5	IS: 3696 (Part-I)-1987	Safety code for scaffolds and Ladders: Part- I Scaffolds
6	IS: 3696 (Part-II) -1991	Safety code for scaffolds and Ladders: Part –II Ladders
7	IS: 4082 -1977	Recommendations on stacking and storage of construction materials at site (First revision)
8	IS: 4130-1976	Safety code for demolition of building (First revision)
9	IS: 4912-1978	Safety requirements for floor and wall openings, railings and toe boards (First revision)
10	IS: 5916- 1970	Safety code for constructions involving use of hot bituminous materials
11	IS: 7205 -1974	Safety code for erection of structural steel work
12	IS: 7969 -1975	Safety code for handling and storage of building materials
13	IS: 8989 -1978	Safety code for erection of concrete framed structures
14	IS: 7293 -1974	Safety code for working with construction machinery
15	IS: 2212 -1991	Pipe lines –Identification –Colour code
16	IS: 5216 -1982	Recommendations on safety procedures &practices in Electrical works (Part -I &II)
17	IS: 875 -1964	Code of practice for structural safety of buildings and loading standards
18	IS: 10386 -1983	General aspects Part-1 -1983, Part-2 -1982, Part-6 -1983, Part-10 -1983- Amenities, Protective clothing and equipment, construction, storage, handling, detection and Safety measures for gases, chemicals and flammable liquids
19	IS: 10500-2012	Drinking water (Specification)
20	IS: 10291 -1982	Code of dress in civil engineering works
21	IS: 2925-1984	Safety helmets
22	IS: 1179-1967	Welding helmets
23	IS: 7524 -1979 (Part-I)	Safety goggles
24	IS: 9167 -1979	Ear muff /Ear plugs
25	IS: 6994 -1973 (Part-I)	Canvas hand gloves, Cotton hand gloves, Chrome leather gloves
26	IS: 4770 -1991	Rubber hand gloves tested for 15,000 volts
27	IS: 3521 -1999	Full body safety harness
28	IS: 11057 -1984	Specification for Industrial safety nets
29	IS: 13415 -1992	Protective Barriers in & around buildings (Code of safety)

30	IS: 13416 -1992	Preventive measures against Hazards at work places-Recommendations part-I Falling materials hazards Prevention part-I
31	IS: 13416 -1992	Preventive measures against Hazards at work places-Recommendations part-II Fall Prevention
32	IS: 15298 -2011 (Part 1&2)	Personal Protective Equipment -Safety shoes
33	IS: 12254 -1993	Poly vinyl chloride (PVC) industrial boots
34	IS: 5557:2004	Industrial and Protective Rubber knee and Ankle boots
35	IS: 2878 -2004	Co2 Type fire extinguisher
36	IS: 2171 -1999	Dry chemical powder fire extinguisher
37	IS: 13849 – 1993	Fire extinguisher for ABC fires
38	IS: 10204-2001	Mechanical Foam type extinguisher (Foam used shall conform to IS: 4989 -1974 and Co2 cartridge shall conform to IS: 4947 -1985)
39	IS: 3786 -1983	Methods for computation of Frequency rate and Severity rates for Industrial injuries and classification of Industrial accidents (First revision)

c. The Sub-contractors need to

- Attend HSE familiarization program at TBG-HQ with his site management team. This will be a half day long awareness session on HSE requirements and compliances which the agency is supposed to fulfil during contract execution at site. The session shall be taken by TBG HSE department on intimation by TBSM.
- Request for issuance of Form-V in their name from customer on behalf of BHEL
- Get the Labour license registration from concerned Labour office.
- Get the BOCW Registration done along with the labour license.
- Get their labourers registered under BOCW for benefits provided by the office.
- Maintain Seven registers of labours as per BOCW requirement.
- Ensure payment of wages to labours not less than the current minimum wages applicable in the premises.
- Ensure PF deduction of labourers and submission of proof to BHEL office (Wage sheet, ECR & Challan copies) duly signed.
- Submit Labour Payment Certificate by 10th of Every month.
- File timely returns, get renewals done and submit a copy to BHEL office.

- Get Workmen's Compensation policy before the start of work, covering all the labourers and staff,
  - Policy should clearly mention the project name and location,
  - should be as per labour class and wage.
  - Should cover all the height workers with clear mention of Max. height.
  - Policy should be submitted to BHEL office and renewal before expiry.
- Issue employment card to every worker.

3. Labour Welfare and Medical Facilities

a. Labour Welfare

1. Declaration of normal working hours and weekly off day, Payment day & intervals
2. Paid rest days & holidays.
3. Payment of overtime @ twice the normal wage rate.
4. No labour shall be allowed overtime >12 hrs/week, limited to 48 hrs/month.
5. Rest and lunch area.
6. Separate Male/Female Toilets and Lavatories, clearly marked in local Language and provided with signage.
7. Cold and clean drinking water facility suitable to strength and near workplace
8. Creche for children of female workers as per BOCW requirements
9. Arranging labour accommodation in hygienic environment with the facilities of Water (Drinking, Sanitation), washing and bathing area, toilets in sufficient nos., clean and safe camps and surrounding, access road, well illuminated camp and roads, mode of contact, transport facility, first aid centre, 24x7 Security etc.
10. Cooking and eating place to be maintained in hygienic condition
11. General awareness of health and hygiene.

b. Medical facilities and Health centres

- Availability of first aid box at every work location and agency office, with contents as per BOCW requirement.
- Emergency vehicle (four wheeler) at work place
- Availability of stretchers in emergency vehicle and in office.
- Trained first aider
- Medical check-up for all the supervisors and workers including cooks, at the time of induction and annually thereafter.
- Tetanus Vaccination for all in every six months.
- Identification and tie-up with nearby reputed hospital(s) and display of their contact number in Emergency contact list.

4. House Keeping & Storage

Housekeeping is a continuous process and is the part of work. Agencies shall maintain safe and presentable housekeeping all the time in their respective areas, common work locations and passage areas. Roads, passages, staircases, entrance/exit gates shall always be maintained obstruction free. No material shall be left or stacked at the roof edges. Agency shall make arrangements to remove scraps on regular basis and dispose them at a space provided by customer, clearly fenced and marked by the sub-contractor as **"SCRAP YARD"**. Suitable arrangement like dedicated housekeeping team and tractor/hydra should be identified for this work.

Construction materials like shuttering materials, staging materials, cables, re-bars, cements bags, earthing flats and rods, FF pipes, surplus soil etc should be stored/stacked properly such that it should neither pose threat to safety of man nor should obstruct the free movement of man and machineries.

Every sub-contractor should have separate and well maintained storage area for his own materials, T&Ps, PPEs and BHEL issued materials. Consumables like diesel, cotton, grease, oil, paint, admixtures and other fire potential materials should be stored separately with suitable firefighting facility.

Fire capacity of store area to be assessed and accordingly fire extinguishers shall be planned suiting the class and capacity of fire. Sand heaps may also be stacked in open store yards suitably to use in case of fires.

5. Site Safety

a. Induction and others safety trainings

Every sub-contractor shall make arrangement to provide induction training as per BHEL and/or customer requirement on a pre-approved and fixed module to all its new inductees irrespective of class or grade of appointment/hire. He shall also arrange the required facilities for induction training such as board, marker, dummy, posters/banners with all the mandatory PPEs.
Sub-contractor shall also arrange for periodic trainings on fire-fighting, first aid, CPR, importance and use of PPEs, electrical safety, hot work safety, Height work safety, confined space, deep excavations and barricading, concreting work safety etc.

b. Appointment of Safety Officer/Supervisor

Every sub-contractor shall appoint at least one full time qualified safety officer having qualification and experience as specified in Schedule-VIII of BOCW Act-1996. He shall not be assigned any duty/work other than assisting in upliftment of safety practices. He shall perform his duties in accordance with the requirements of Schedule-VIII of BOCW-1996. He shall ensure daily TBT, induction training, health check-up and other such compliances as per HSEP-14 on regular basis. In case of non-appointment, agency shall be penalized as per provisions in clause no. 7.0 of HSEP-14 (HSE Plan for Site Operations (subcontractors))

c. Safety organisation, Safety committees and meetings

Safety officer shall report directly to the head of the projects of the sub-contractor management. There shall be some appointed or nominated safety stewards from each sub-group like shuttering, bar-bending, concreting, brick work, material handling, structure erection, cable laying, pipe work, maintenance, batching plant, housekeeping etc.

A safety committee shall be formed including members from different agencies, BHEL and customer covering at-least 50% participation from workers. Safety committee shall meet on weekly basis or as may be decided by customer, outcomes shall be complied as committed.

d. Personal Protective Equipments.

Unless mentioned otherwise, there will be three mandatory PPEs- Safety shoes, Safety Helmet and Reflective jackets conforming to relevant IS codes as mentioned above.
Every person entering in the project premises shall use above mandatory PPEs.
There will be other PPEs too based on the work requirement like:
Twin lanyard full body harness, fall arresters and life lines for height workers,
Face shield for welders and grinders, Induction helmets and Electrical resistant shoes with FRP/PVC toe for electricians and commissioning engineers, Gum boots for concrete workers and manual excavators, Goggle for gas cutters and grinders, Aprons for welders, shoulder pads for material handlers, Hand gloves – Leather for binders/welders/grinders, certified Rubber gloves

for electricians, PVC for concrete/cement handlers, cotton-housekeeping team/brick coolies/erectors, cable laying men and other material handlers. Dust mask for cement handlers.

e. Material Handling

BHEL as a policy discourages continuous manual handling. Material handling contributes a major portion in the project and hence proper means (mechanical/ electrical powered) should be deployed appropriately for this work. Cranes/Faranas/hydras should not be used for material transportation for long distances(>100m), if such movement is un-avoidable, it must be accompanied by a trained signal man. Long materials should be guided by tagline. Roads for material movement should be free from obstructions. Lifting appliances must be in good condition and must have test/inspection certificates.
Lifting tackles like- D-shackles, chains, ropes, slings, belts shall be periodically inspected and shall have valid test certificate and/or third party inspection certificates.
Painted/galvanized structures/materials to be lifted by adequate capacity nylon belts only.
If a machine undergoes a major maintenance, fresh TPI shall be required before use. Hydraulic/pneumatic machines shall be free from leakages. Daily checklist to be filled and witnessed by the concerned supervisor before start of the work.

f. Vehicle/Machinery Documents and other safety requirements

- Crawler mounted boom cranes/Tyre mounted telescopic cranes/tower cranes
  1. Valid third party inspection certificate.
  2. Valid Insurance policy
  3. Registration Certificate (if applicable)
  4. Valid Pollution under control (PUC) (if applicable)
  5. Fitness certificate from RTO (if applicable)
  6. Operator's valid license, experience and/or competence certificate.
  7. Swing horn
  8. Reverse horn
  9. Boom aviation light
  10. Approved Load chart (inside cabin)
  11. Fire extinguisher (inside cabin)
  12. First aid kit (inside cabin)
  13. Boom angle indicator
  14. Hook Latch
  15. Reflector strips on around cabin and on boom

- Loader backhoe (JCB), crawler excavators (Poclain), Hydra,
  1. Valid third party inspection certificate.
  2. Valid Insurance policy
  3. Registration Certificate (if applicable)
  4. Valid Pollution under control (PUC) (if applicable)

5. Fitness certificate from RTO (if applicable)
6. Operator's valid commercial license, experience and/or competence certificate.
7. Reverse horn
8. Approved Load chart (inside cabin) (Hydra)
9. Fire extinguisher (inside cabin)
10. First aid kit (inside cabin)
11. Hook Latch (Hydra)
12. Reflector strips on around cabin and on boom

- Tipper, Transit mixtures (TM), Self-loading concrete mixture (Ajax Fiori), Tractors
    1. Valid third party inspection certificate.
    2. Valid Insurance policy
    3. Registration Certificate
    4. Valid Pollution under control (PUC)
    5. Fitness certificate from RTO
    6. Operator's valid commercial Heavy license, experience and/or competence certificate.
    7. Reverse horn
    8. Fire extinguisher (inside cabin)
    9. First aid kit (inside cabin)
    10. Reflector strips on around cabin and on body

Note: 1. Tractors may be allowed with Light Commercial/non-commercial license on customer's consent.

- Cars, Taxis, scooters, motor cycles and other public carriers
    - Valid 2/4 wheeler license (as applicable- commercial/non-commercial)
    - Registration Challan
    - Valid Insurance
    - Pollution under control

g. Man-lifts (Cherry pickers), Scissors Lifts

1. Trained operator with experience/competence certificate and license
2. Valid third party inspection certificate.
3. Valid Insurance policy
4. Registration Certificate (if applicable)
5. Valid Pollution under control (PUC) (if applicable)
6. Swing horn
7. Reverse horn
8. Boom aviation light
9. Fire extinguisher (inside cabin)
10. First aid kit (inside cabin)
11. Reflector strips on around cabin and on boom

Note:

1. No one shall ride man-lift bucket without safety belt, safety shoes, helmet and reflective jacket.
2. Not more than 3 persons at a time will board in bucket of man-lift (without any heavy materials) including operator.
3. Operator will not leave the machine while persons are elevated and working.
4. No one other than the authorised operator will operate the man lifts/Scissors lifts.

h. Excavation

Prior permission/clearance from customer is a must for excavations in areas where underground service services such as gas/water/oil/chemical/electrical lines may be routed. Due precautions shall be taken during excavation in such area. Excavations near water bodies (ponds/canals etc.) shall be done with sand/soil bags ready to plug water from accidental damaged/burst of edges. All the excavations shall be done by either step cutting (min. 600mm step at every 1.5m depth) or slope cutting at 1:2(X:Y axis) (or greater depending upon the soil condition). Where step cutting/slope cutting is not possible due to space constraints, shoring/shuttering or sheet piling to be used to check collapse of soil.

Excavated soil shall be stacked away from edge of the pit, at-least 1.5 meters or half of the depth whichever is higher. Height of the stack shall not exceed 2m in height.

Ramps shall be provided for access of the workers in large pits and ladder of metal/good built for small pits. Ladders shall be of sufficient length protruding at least 1m above the ground level.

Pumps of adequate capacity shall be available for pumping out of water. No lone worker shall be allowed to work in any excavation. Overloaded vehicle shall not be allowed near excavated pits.

i. Bar bending and Binding

Bar bending machine shall be installed under shed/roof. It shall be properly earthed and maintained for operation. Housekeeping of the area shall be team's responsibility on daily basis. All be bar benders shall be given hand gloves (leather/cotton) in addition to mandatory PPEs. Scrap shall be segregated and moved to scrap yard on regular basis. Bar bending station shall be located away from Main plying roads/passages. The station shall be well illuminated, shall have a maintained first aid kit and potable water. Station shall be located in such a way that the movement of the material be minimised.

j. Concreting

No electric vibrators shall be allowed to use. All the concrete workers shall be issued gum boots, safety helmets, reflective jackets and PVC hand gloves. Free fall of concrete from chute shall not exceed 1m in height. Heavy machineries/ vehicles shall be kept at least 2m away from the edge. Emergency vehicle shall be available near concreting work. Late night works shall be avoided, if it is unavoidable, a prior permission from BHEL/Customer is mandatory.

k. Welding, Gas Cutting & other hot works

Welding: Only experienced welders should be deployed for welding jobs. Welders shall be provided with apron, hand gloves, arm pads, leg pads, face shield and safety shoes. Welding leads shall be joint less and insulated. Power input point shall be fully covered at machine.

Gas cutting: If LPG is being used, domestic cylinder is strictly prohibited inside the project premises, (not allowed for site kitchen too). Hose pipes shall be in good condition without cracks, cuts, punctures or joints. Ends should be clamped with worm clamps. Dial gauges shall be of good quality and duly calibrated. Flash back arresters is a must for both oxygen/acetylene or LPG/Oxygen combination. Cylinders shall be stored, transported and used in vertical position only. When not in use, they shall be capped. Empty and filled cylinders to be stored separately with distinct marking.
Cylinders shall neither be rolled on the ground nor thrown during loading/unloading.

Grinding: Grinder shall be given clear glass face shield, apron, safety shoes, ear muffs and hand gloves. Grinder machines shall have wheel guard. Plug tops to be used for power connection preferably three wire type. Only trained persons shall be allowed to use grinders, abrasive cutters. Electrical connection shall be free from cuts, joints etc.

l. Erection & Height Work

Only trained filters and experienced helpers shall be engaged in erection work. Step bolts of lattice towers shall be checked for full tightness with spring washers before use. Height pass shall be issued to the identified group of erectors who have passed medical test and have working experience at height. Name of such workers shall be displayed at appropriate place. These workers only shall be allowed to work at height. Height work shall not be permitted in high wind/bad weather condition, during raining or in night/dark.

m. Electrical Safety

BHEL usually provided single point power source and sub-contractors draw power from there. Otherwise agencies make their own arrangement for construction power like DG sets etc. Sub-contractors shall submit their load requirement (amperage & phase) to BHEL before start of work. Accordingly, they shall make arrangements to draw power and distribution arrangements too in a safe way. MCCBs and HRC fuses to be put in circuit for short circuit and overload protections and RCCBs of 30mA sensitivity to be put at each distribution panel for human safety. Earthing pits shall be installed at each distribution point and maintained below three Ohm resistivity which shall be inspected randomly. The distribution points shall be clean, free from vegetation and water logging, easily accessible and covered/protected from three sides and top for rain. Earthing of DBs shall be done by 25x3mm GI flats connected from proper earth pits. Insulation mat, PVC Sheet/Wooden plank to be placed before DBs as platform. DB Sheds shall be legibly marked with name of agency, contact no of electrician and SLD of that DB. Only industrial plugs and sockets shall be allowed. Three wire (Phase, neutral and earth) system shall be used for tools, lights and machineries and two wire power draw shall be strictly prohibited. PTW and LOTO system shall be maintained to work on LT system. Name and contact no of authorised electricians who will be responsible of electrical power facility maintenance shall be submitted to BHEL by Agencies. Unauthorised sharing of power from one agency to other is strictly prohibited. Electricians shall use standard PPEs and insulated tools only. Standard and tested/certified discharge rods to be used in the areas where there is a possibility

of residual current or induction charge. The induction rod to be connected to the earth first and removed in the last. Induction helmets only to be used in the charged area. Electricians to be provided with electrical resistant safety shoes having FRP/PVC toe.

n. Dust Gases and fumes

Sub-contractor shall make arrangements to avoid accumulation of dust fumes and gases. Cement handlers inside store or at batching plant and gravel spreader shall be given effective nose masks and jaggery (at least 200g per person per day). DG sets and other machineries like cranes excavators etc. shall have valid and effective PUC certificate and shall have maintained engine with silencer. No IC engine operated machine shall be used in confined and covered area like hall, sheds, store etc. where accumulation due to lack of ventilation can increase to harmful levels. Dedicated arrangements (tanker or tractor with sprinkler) shall be made by the sub-contractors (individual or jointly) to continuously subside the dusts arising out of the movement of the vehicles roads/passages. Welding activities near roof accumulates harmful gases. Welders in such positions shall be provided with effective masks conforming to IS standards.

o. Vehicular Traffic

Speed limits defined within the premises shall strictly be followed by the drivers/commuters of construction as well as other vehicles.
Every construction machinery, man-lift shall display the name, contact no and passport size photograph of the authorised operator (There can be one or more authorised operators).
No one other than operator and co-operator shall sit inside the cabin of any construction machine while it is working.
Construction machineries (tractor, trucks, tippers, JCBs, hydra, Fassi cranes etc. shall never be used as mode of public transport. Machineries like Ajax Fiori and hydra shall not be driven in back direction except for small distances. No overloaded vehicle shall be permitted entry in the project premises.
Over speeding shall be reported and driver/operator shall be barred from entry or shall be penalised.
Drunken drivers shall be barred from entry in the project.
Carrying harmful weapons like knives (>6”), guns etc. shall permanently disqualify the person from entry in project premises.

p. Barricading and floor openings

Every pit deeper than 4 feet (1.2m) shall be barricaded immediately after excavation and will remain barricaded till backfilling.

Pits/trenches drains near roads, passages whether temporary or permanent shall be hard barricaded and well illuminated. Roof edges and openings shall be strictly hard barricaded and illuminated. Height works like masonry works, structure erection, erection by cranes, Lattice tower/beam erection areas shall be barricaded to restrict entry. Areas under charging/commissioning shall be barricaded and caution boards shall be displayed on newly charged areas.

q. Scaffold & Ladder

No bamboo/wooden scaffold shall be allowed to be used. Only tubular steel scaffolds with couplers conforming to the relevant IS codes shall be allowed with base plates. Standard steel or wooden planks to be used as platforms and no packing materials shall be used. All the platforms shall be built with provisions of **top rail at 1m height, mid rail at 0.5m height and toe boards of min 6" height** at floor level. Minimum width of platform shall be 900mm and if wheel barrow is to be used then 1200mm. Means of access to be provided in the form of ladders, ramps or staircase. Multilevel work platforms or those platforms having passage underneath shall be provided with safety net, screen or canopy at each level for protection from falling objects. Platforms shall be free from concrete, debris or other materials. Platforms shall not extend out of the putlogs and shall be secured and fastened. Decking shall be made non-skidding.
Scaffolds under erection shall be tagged **"RED"**, under repair/maintenance/inspection shall be tagged **"YELLOW"** and ready for use shall be tagged **"GREEN"**

Only metal ladders in the construction site and FRP ladders in charged areas shall be allowed. Ladders made from packing materials shall not be used. Ladders shall be securely fixed at bottom, top and long ladders at middle points too at an interval not more than 2400mm and must have a landing at every 6m. Inclination angle should be approximately 1:4 (X:Y) or 75deg. Ladder must extend at least 1m above the platform/access area. Gap between two rungs shall not exceed 300mm. Portable ladder should not be more than 4m in length. Minimum width of the ladder shall not be less than 300mm.

Use of Mobile aluminium scaffold is preferably advisable for erection of transformers/reactors.

r. Illumination

The sub-contractor shall ensure that the areas such as work stations, buildings, batching plants, passages/roads, stores, rest areas, power sources, staircases etc. are illuminated sufficiently to make safe work conditions at site and shall not be less than the relevant IS standards. Excavations/ below ground level structures near passages/roads shall also be sufficiently illuminated.

s. Safety banners/posters, caution boards

Sub-contractors shall display boards and banners in sufficient quantity having safety signs, slogans, important messages, pictures, cautions at prominent locations to promote safety and spread awareness for important precautions such as "Deep Excavation Ahead", Speed Limit", "Charged Area", "Do not operate", "Hard hat area", "No smoking Zone" etc. Boards containing messages of Emergency contacts, First aid facility, rates of minimum wages, working hours, rest day etc. should be displayed at specific areas.

t. Waste management and disposal

Sub-contractor shall make suitable and effective arrangement to remove waste material from site on regular basis and store them in an identified and safe location. Disposal of wastes shall also be done as per manufacturer's instructions or as per the guidelines laid by legal authorities. Re-bars, Cement bags, packing material (wooden/metal/plastic/paper), paint, oil, grease, cables (armour, sheathing, insulation), civil debris, metal chips, GI sheet scraps, batteries etc. are the common waste materials. Sub-contractor

shall arrange disposal of the hazardous wastes/materials in conformance to the legal and contractual requirements only.

u. Inspection of PPEs, T&Ps, Machineries and lifting appliances

All the PPEs, T&P and lifting appliances purchased newly by sub-contractors shall have test certificates which shall be submitted to BHEL office periodically or on demand. There shall be at least monthly joint inspection schedule for inspection of healthiness of all the PPEs, T&Ps and lifting appliances. All the lifting appliances shall be tested and examined by a competent person before taking into use for the first time or after it has undergone any alterations or repairs liable to affect its strength or stability

and also once at least in every twelve months. To confirm quality of the PPEs as per the relevant IS codes, BHEL may ask sub-contractors to get any or all types of PPEs tested through NABL approved lab as per relevant IS codes. At any stage, the 100% cost of such tests shall be in the scope of respective sub-contractors.

v. Cable Laying

Sub-contractor shall ensure cable trenches free from water, mud, debris, snakes, Scorpios, lizards before start of the work in trenches. Cable drum rollers shall be used to pull cables out of drums to avoid twisting of cables. Hand gloves, Safety shoes/gum boots, reflective jackets, safety helmets shall be provided to the workers. Cable laying area shall be well illuminated.

w. Fire Protection

Every sub-contractor has to maintain their working area, store and office area free from bushes. Stacking of flammable materials like wood, paper, plastic, paint, oil, grease, fuel, cotton, gases etc. at isolated place disconnected from other storage and office areas. Adequate arrangements of firefighting means like suitable extinguishers, fire/water buckets, water tanks, sand dunes etc. shall be made by the agency depending upon the fire capacity assessed or as per MSDS. Fire drills and trainings on how to operate fire extinguishers and how to react in case of fire breakouts shall be the part of regular training program. Guards and store persons must be a regular participant of such training programs. A list of trained firefighting persons and periodicity of such training programs shall be submitted to BHEL by every agency and same to be adhered. Sufficient number of fire extinguishers with suitable class shall be placed at such locations where there can be fire hazard like stores, pantry, office, DG set, electrical distribution panels etc.

x. Fencing of exposed rotating parts

Exposed rotating parts poses great threat to the person in vicinity. Such parts need to be fenced/covered. Guards are mandatory of grinders, abrasive cutters. Flywheels of the engines of heavy machines, Diesel engines, DG sets need to be covered. Electric winch machines, pulleys, chains, shafts, exhaust fans at reachable height, table fans, need to be caged/fenced. Such fencing/guard shall not be removed while machinery is in operation.

y. Emergency preparedness response plan and periodic mock drills.

Sub-contractor shall comply JSA (Job Safety Analysis) and arrange to mitigate the effects of identified possible hazards. He shall also define following in response to emergency preparedness:
An emergency assembly point and put a board of the same with information to all in induction training.
Have facility of ambulance or tie-up with nearest hospital for service in minimum possible time (Max-30min) if there is not ambulance inside the premises.
Ensure availability of emergency vehicle with driver all the time at site during work.
Conduct mock-drills on possible risks like electrocution, fall from height, fire, heat stroke etc., record responses and take photographs to submit in BHEL office. Stretchers availability in emergency vehicle or at work place should be well accessible. Provide fire extinguishers of right type at right place in right quantity with information to all. Display emergency contact nos. to various risk locations and at office, service building or at major work locations. Provide first aid training by doctors for and display names of such trained first aiders and fire fighters. Rescue kit with trained staff or man lift or both to rescue a man hanging by safety belt at height. Provide running water tap near chemical storage and handling points. Agencies shall follow emergency response plan prepared by BHEL in each area of work, store and office.

z. Safety reports & Reporting of accidents

BHEL will provide ''formats and checklists'' for the purpose of records/documents pertaining to the compliance of aforesaid clauses. Agencies shall be responsible for strict adherence and compliance for timely generation and fill-up of the checklists and reports. These shall be submitted on weekly and monthly basis as specified in the formats.

Agency shall also promote such an environment that the near misses, incidents and accidents are reported by every person, whosoever witnesses them. These shall help in analysing the trend and taking measures in reducing/stopping the accidents/incidents. Initial reporting can be in any form-by call, SMS, WhatsApp, e-mail, letter etc.
Major and fatal accidents or high potential incidents shall be investigated for route cause and outcomes shall be immediately implemented to check recurrences.

6. General conditions and penalty clauses

Following are the general conditions:

PPEs shall not only bear the ISI mark but also be conforming to the required standards, 100% compliance of the PPEs is mandatory.
Over speeding of vehicles shall attract penalty/notice and recurrence will attract debarring from entry into project premises.
Hiding of facts like incidents, accidents, fake/forged reports/certificates shall also attract penalty/ notice or both. Only approved third party agencies shall be allowed to inspect the machines, T&Ps. Reports shall directly be sent to BHEL/customers by the third parties.
Insurance and TPIs to be renewed before expiry. Machines, T&Ps shall not be allowed to work if renewal delayed. Continuity of WC policy to be maintained religiously by the respective agencies.

Agency shall submit the status report of his labour license, BOCW registration, WC Policy, insurance & TPI validity on monthly basis with list of machineries and T&Ps

Sub-contractors shall also maintain a buffer stock of all the PPEs in at least 20% excess to the present strength of the work force.

If construction power is not drawn as per the guidelines laid in clause no. 5(m), given above, BHEL may take-up this work at the risk and cost of the agency and/or may withhold a sum of min. Rs. 50,000/- (Rs. Fifty Thousand) or more as the site in-charge deems fit till the system is aligned as per aforesaid requirement.

Agencies shall be responsible for the compliance of the above requirements. Failure in one or more clauses/area shall attract a notice or monitory penalty or a combination of above.

Monitory penalty will be

- Rs. 1000/- per person/incident per day for non-conformity in above areas.
- A Major/severe accident shall attract a penalty of Rs. 2,00,000/- per head
- Fatality or permanent disability with total loss of earning capacity, if any, will attract a penalty of Rs. 5,00,000/- (Rs. Five Lakh).
- Further fatality/permanent disability shall attract double the last penalty imposed on the agency.
- Above penalties are exclusive of medical expenses of the victim or compensation to the family through insurance policy (WC Policy or group insurance).
- **Penalties imposed by customer shall be fully transferable to the sub-contractor. In the event of above cases, penalties shall be imposed whichever will be higher.**
- Evaluation of agency's performance on HSE compliance shall be done as per BHEL guide lines/system.

Revision History

Revision Date	Revision No.	Old Text	New Text	Reason	Revised by (with sign)
03.05.2019	00	N/A	Full Document	New Release	
12.10.2021	01	Nil	Attend HSE familiarization program at TBG-HQ with his site management team. This will be a half day long awareness session on HSE requirements and compliances which the agency is supposed to fulfil during contract execution at site. The session shall be taken by TBG HSE department on intimation by TBSM. (at page no. 4)	For better understanding of HSE requirements to agency. (HSE Review meeting dated 23.08.2021)	
12.10.2021	01	Edition	Inclusion of penalty provisions in case of non-deployment of safety person(page-7)	Introduction of HSEP-14	

-:End of Document:-

BANK GUARANTEE FOR PERFORMANCE SECURITY

Bank Guarantee No:

Date:

To

NAME

& ADDRESSES OF THE BENEFICIARY

Dear Sirs,

In consideration of the Bharat Heavy Electricals Limited [1] (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns) incorporated under the Companies Act, 1956 and having its registered office at BHEL House Siri Fort New Delhi-110049 through its Unit at BHEL, TBG, Noida having awarded to (Name of the Vendor / Contractor / Supplier) having its registered office at_____[2] hereinafter referred to as the 'Contractor/Supplier', which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns), a contract Ref No PO No……dated ……..[3] valued at Rs……[4] (Rupees ----------)/FC……(in words……..) for ……[5] (hereinafter called the 'Contract') and the Contractor having agreed to provide a Contract Performance Guarantee, equivalent to ……% (…. Percent) of the said value of the Contract to the Employer for the faithful performance of the Contract,

we, ……., (hereinafter referred to as the Bank), having registered/Head office at ……. and inter alia a branch at …… being the Guarantor under this Guarantee, hereby, irrevocably and unconditionally undertake to forthwith and immediately pay to the Employer a maximum amount Rs ---------- (Rupees ----------) without any demur, immediately on a demand from the Employer, .
Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. _____ _____.

We undertake to pay to the Employer any money so demanded notwithstanding any dispute or disputes raised by the Contractor/ Supplier in any suit or proceeding pending before any Court or Tribunal relating thereto our liability under this present being absolute and unequivocal.

The payment so made by us under this Guarantee shall be a valid discharge of our liability for payment thereunder and the contractors/supplier shall have no claim against us for making such payment.

We the ……bank further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract and that it shall continue to be enforceable till all the dues of the Employer under or by virtue of the said Contract have been fully paid and its claims satisfied or discharged.

We …….. BANK further agree with the Employer that the Employer shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Contract or to extend time of performance by the said Contractor/Supplier from time to time or to postpone for any time or from time to time any of the powers exercisable by the Employer against the said Contractor/Supplier and to forbear or enforce any of the terms and conditions relating to the said Agreement and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Contractor/Supplier or for any forbearance, act or omission on the part of the Employer or any indulgence by the Employer to the said Contractor/Supplier or by any such matter or thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.

The Bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Contractor and notwithstanding any security or other guarantee that the Employer may have in relation to the Contractor's liabilities.

This Guarantee shall remain in force upto and including…….. [6] and shall be extended from time to time for such period as may be desired by Employer.
This Guarantee shall not be determined or affected by liquidation or winding up, dissolution or change of constitution or insolvency of the Contractor/Supplier but shall in all respects and for all purposes be binding and operative until payment of all money payable to the Employer in terms thereof.

Unless a demand or claim under this guarantee is made on us in writing on or before the ……[7]we shall be discharged from all liabilities under this guarantee thereafter.

We …… BANK lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Employer in writing.
Notwithstanding anything to the contrary contained hereinabove:

a) The liability of the Bank under this Guarantee shall not exceed…… [8]
b) This Guarantee shall be valid up to ……[9]
c) Unless the Bank is served a written claim or demand on or before _____[10] all rights under this guarantee shall be forfeited and the Bank shall be relieved and discharged from all liabilities under this guarantee irrespective of whether or not the original bank guarantee is returned to the Bank.

We, _____ Bank, have power to issue this Guarantee under law and the undersigned as a duly authorized person has full powers to sign this Guarantee on behalf of the Bank.

For and on behalf of
(Name of the Bank)

Dated……..

Place of Issue…….

[1] *NAME AND ADDRESS OF EMPLOYER I.e Bharat Heavy Electricals Limited*

[2] *NAME AND ADDRESS OF THE VENDOR /CONTRACTOR / SUPPLIER.*

[3] *DETAILS ABOUT THE NOTICE OF AWARD/CONTRACT REFERENCE*

[4] *PROJECT/SUPPLY DETAILS*

[5] *BG AMOUNT IN FIGURES AND WORDS*

[6] *VALIDITY DATE*

[7] *DATE OF EXPIRY OF CLAIM PERIOD*

[8] *BG AMOUNT IN FIGURES AND WORDS.*

[9] *VALIDITY DATE*

[10] *DATE OF EXPIRY OF CLAIM PERIOD*

Note:

1. **Units are advised that expiry of claim period may be kept 2/3 months after validity date.**

2. **In Case of Bank Guarantees submitted by Foreign Vendors-**

   a. **From Nationalized/Public Sector / Private Sector/ Foreign Banks (BG issued by Branches in India)** can be accepted subject to the condition that the Bank Guarantee should be enforceable in the town/city or at nearest branch where the Unit is located i.e. Demand can be presented at the Branch located in the town/city or at nearest branch where the Unit is located.

   b. **From Foreign Banks (wherein Foreign Vendors intend to provide BG from local branch of the Vendor country's Bank)**

   b.1 In such cases, in the Tender Enquiry/ Contract itself, it may be clearly specified that Bank Guarantee issued by **any of the Consortium Banks only** will be accepted by BHEL. As such, Foreign Vendor needs to make necessary arrangements for issuance of Counter- Guarantee by Foreign Bank in favour of the Indian Bank (BHEL's Consortium Bank). It is advisable that all charges for issuance of Bank Guarantee/ counter- Guarantee should be borne by the Foreign Vendor. The tender stipulation should clearly specify these requirements.

   b.2 **In case, Foreign Vendors intend to provide BG from** Overseas Branch of our Consortium Bank (e.g. if a BG is to be issued by SBI Frankfurt), the same is acceptable. However, the procedure at **sl.no. b.1** will required to be followed.

   b.3 The BG issued may preferably be subject to Uniform Rules for Demand Guarantees (URDG) 758 (as amended from time to time). In case, of Foreign Vendors, the BG Format provided to them should clearly specify the same.

   b.4 The BG should clearly specify that the demand or other document can be presented in electronic form.

Sl.	Name of the bank	
1	State Bank of India	
2	Canara Bank	
3	Axis Bank	
4	Bank of Baroda	
5	Central Bank	
6	Citi Bank N.A.	
7	Deutsche Bank **	
8	Exim Bank	
9	Federal Bank Limited	
10	HDFC Bank Limited	
11	Hongkong and Shanghai Banking Corporation Ltd	
12	Indian Bank	
13	ICICI Bank Limited	
14	IDBI Bank Limited	
15	IndusInd Bank Limited	
16	Indian Overseas Bank	
17	Kotak Mahindra Bank Limited	
18	Punjab National Bank	
19	RBL Bank Ltd.	
20	Standard Chartered Bank	
21	Union Bank of India	
22	Yes Bank Limited	
	TOTAL	

भारतीय स्टेट बैंक
State Bank Of India

(17313) - CORPORATE ACCOUNTS GROUP NEW DELHI
4TH & 5TH FLOOR REDFORT CAPITAL PARSVNATH TOWERS,BHAI VEER SINGH MARG
GOLE MARKET NEW DELHI 110001
Tel: 11-23475566 Fax: 23475566 IFS Code : SBIN0017313

केवल 3 महीने के लिए वैध / VALID FOR 3 MONTHS ONLY

D	D	M	M	Y	Y	Y	Y

PAY

को या उनके आदेश पर OR ORDER

रुपये RUPEES

अदा करें ₹

Cancelled.

खा. सं.
A/c No.

30206227732

VALID UPTO ₹ 50 LACS AT NON-HOME BRANCH

CURRENT A/C

PREFIX:
0523500062

BHEL TRANSMISSION BUSINESS DIVISION

MULTI-CITY CHEQUE Payable at Par at All Branches of SBI

Please sign above

25-05-2019

⑈ 266265⑈ ⑆000256 2⑆ 000139⑈ 29

CIN No. U99999MH1970GAPO14629

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers
132, Dr. A. B. Road, Worli,
Mumba i 400 018
India
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

Cir. No. 22/DIV/CAB/05 07 June 2023

To Cable Division and Utilities/SEBS, listed of purchasing organisations

Sub: Correction in amendment to Price Variation Clause for MV and EHV Cables wef Apr 2023

IEEMA recently published amended Price Variation Clause for MV and EHV Cables wef Apr 2023 vide Cir. No. 07/DIV/CAB/05 and 06/DIV/CAB/05 dated 08 May 2023. After publishing IEEMA found some corrections to be done in the below factor tables:

For EHV Cables -
Table: 3d (SMIF): Variation factor for Copper in Lead + Cu wire construction (CuFpb)

For MV Cables -
Table: H4 (c) 3.3 KV (E) Unscreened arm
And note added for Table: H5 (a) & Table: H5 (b) as "Fillers added in above factors"

The corrected factor tables are attached and request to all stakeholders to replace these tables with earlier published factor tables.

All other factor tables and guidelines remains unchanged as per Cir No. 07/DIV/CAB/05 and 06/DIV/CAB/05 dated 08 May 2023.

Director
Encl.: corrected factor tables for amended PV clause for EHV Cables wef Apr 23.

HEAD OFFICE - DELHI
Rishyamook Building, First Floor, 85 A, Panchkuian Road, New Delhi 110001
P +91 11 2336 3013 / 14 • F +91 11 2336 3015 • E delhi@ieema.org • W www.ieema.org

ieema
your link to electricity

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers
132, Dr. A. B. Road, Worli,
Mumbai 400 018
India
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

Table 3d (SMIF) : Variation factor for Copper in Lead +Cu wire construction (CuFpb)												
Nominal Cross Sectional Area (in Sq. mm)	38/66 KV						64/110 kV					
SC Current in KA	31.5			40			31.5			40		
Duration in sec	1	2	3	1	2	3	1	2	3	1	2	3
185	1.762	2.531	3.196	2.235	3.325	4.163	1.637	2.383	3.048	2.087	3.177	4.015
240	1.719	2.509	3.174	2.213	3.304	4.141	1.565	2.359	3.024	2.063	3.153	3.991
300	1.692	2.555	1.566	2.258	3.262	4.100	1.538	2.428	1.488	2.111	3.104	3.942
400	1.646	2.525	3.211	2.215	3.347	4.068	1.484	2.360	3.044	2.059	3.183	3.907
500	1.584	2.463	3.147	2.154	3.281	4.135	1.438	2.324	3.011	2.022	3.140	3.993
630	1.551	2.432	3.111	2.122	3.239	4.118	1.390	2.281	2.956	1.962	3.087	3.949
800	1.475	2.363	3.035	2.057	3.179	4.035	1.308	2.188	2.868	1.883	3.015	3.869
1000	1.400	2.282	2.961	1.975	3.095	3.960	1.240	2.125	2.800	1.817	2.937	3.796
1200	1.228	2.109	2.786	1.800	2.928	3.782	1.160	2.050	2.729	1.740	2.861	3.724
1400	1.216	2.056	2.730	1.745	2.869	3.726	1.082	1.973	2.642	1.660	2.779	3.627
1600	1.095	1.975	2.652	1.669	2.784	3.662	0.988	1.873	2.542	1.563	2.678	3.541
1800	1.106	2.017	2.709	1.699	2.841	3.720	1.037	1.938	2.631	1.630	2.773	3.655
2000	0.976	1.861	2.535	1.549	2.670	3.539	0.909	1.769	2.450	1.466	2.585	3.451
2500	0.896	1.796	2.490	1.489	2.632	3.514	0.913	1.768	2.460	1.457	2.598	3.490

Table 3d (SMIF) : Variation factor for Copper in Lead +Cu wire construction (CuFpb)						
Nominal Cross Sectional Area (in Sq. mm)	76/132 kV					
SC Current in KA	31.5			40		
Duration in sec	1	2	3	1	2	3
185	1.562	2.290	2.955	1.994	3.085	3.922
240	1.488	2.265	2.930	1.969	3.059	3.897
300	1.472	2.395	1.466	2.049	3.061	3.898
400	1.414	2.292	2.977	1.983	3.110	3.970
500	1.364	2.238	2.918	1.941	3.055	3.938
630	1.299	2.187	2.860	1.875	2.996	3.866
800	1.215	2.104	2.776	1.797	2.924	3.783
1000	1.152	2.036	2.716	1.729	2.849	3.712
1200	1.062	1.945	2.627	1.641	2.761	3.622
1400	0.975	1.854	2.539	1.555	2.676	3.549
1600	0.924	1.797	2.479	1.491	2.612	3.468
1800	0.977	1.857	2.554	1.546	2.695	3.572
2000	0.853	1.717	2.395	1.414	2.536	3.385
2500	0.809	1.664	2.359	1.351	2.505	3.379

HEAD OFFICE - DELHI
Rishyamook Building, First Floor, 85 A, Panchkuian Road, New Delhi 110001
P +91 11 2336 3013 / 14 • F +91 11 2336 3015 • E delhi@ieema.org • W www.ieema.org

ieema
your link to electricity

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers
132, Dr. A. B. Road, Worli,
Mumbai 400 018
India
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

Table 3d (SMIF) : Variation factor for Copper in Lead +Cu wire construction (CuFpb)												
Nominal Cross Sectional Area (in Sq. mm)	127/220 kV											
SC Current in KA	31.5			40			50			63		
Duration in sec	1	2	3	1	2	3	1	2	3	1	2	3
400	1.053	1.937	2.613	1.623	2.751	3.621	2.362	-	-	-	-	-
500	0.973	1.849	2.536	1.543	2.662	3.512	2.305	3.666	-	3.157	-	-
630	0.942	1.820	2.495	1.506	2.632	3.482	2.276	3.619	4.697	3.116	4.834	-
800	0.909	1.775	2.460	1.465	2.596	3.458	2.249	3.597	4.640	3.077	4.803	6.134
1000	0.828	1.702	2.377	1.387	2.506	3.373	2.139	3.480	4.562	2.988	4.701	6.053
1200	0.717	1.577	2.251	1.266	2.382	3.258	2.033	3.419	4.477	2.888	4.620	5.944
1400	0.686	1.536	2.211	1.232	2.357	3.203	2.033	3.356	4.449	2.856	4.563	5.909
1600	0.680	1.457	2.117	1.140	2.267	3.124	1.921	3.276	4.340	2.769	4.493	5.836
1800	0.724	1.540	2.205	1.270	2.347	3.227	1.889	3.226	4.235	2.692	4.409	5.719
2000	0.529	1.317	1.996	1.049	2.109	2.968	1.795	3.154	4.215	2.643	4.371	5.667
2500	0.373	1.337	2.020	1.036	2.140	2.977	1.722	3.067	4.127	2.559	4.258	5.581

Table 3d (SMIF) : Variation factor for Copper in Lead +Cu wire construction (CuFpb)												
Nominal Cross Sectional Area (in Sq. mm)	220/400 kV											
SC Current in KA	31.5			40			50			63		
Duration in sec	1	2	3	1	2	3	1	2	3	1	2	3
630	0.870	1.756	2.455	1.443	2.581	3.465	2.137	3.501	4.568	3.003	4.761	6.687
800	0.862	1.734	2.425	1.414	2.566	3.448	2.120	3.500	4.532	2.993	4.720	6.483
1000	0.833	1.701	2.396	1.385	2.516	3.422	2.081	3.445	4.492	2.958	4.704	6.398
1200	0.750	1.611	2.312	1.299	2.447	3.326	2.015	3.389	4.427	2.882	4.613	6.316
1400	0.711	1.566	2.252	1.270	2.399	3.274	2.007	3.334	4.362	2.809	4.576	6.268
1600	0.697	1.472	2.165	1.178	2.302	3.176	1.880	3.259	4.318	2.757	4.499	6.186
1800	0.642	1.457	2.123	1.183	2.265	3.139	1.867	3.250	4.304	2.750	4.488	6.141
2000	0.488	1.360	2.048	1.089	2.158	3.042	1.800	3.141	4.167	2.633	4.364	6.058
2500	0.283	1.245	1.927	0.948	2.019	2.877	1.701	2.989	4.037	2.536	4.208	5.920

HEAD OFFICE - DELHI
Rishyamook Building, First Floor, 85 A, Panchkuian Road, New Delhi 110001
P +91 11 2336 3013 / 14 • F +91 11 2336 3015 • E delhi@ieema.org • W www.ieema.org

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers
132, Dr. A. B. Road, Worli,
Mumbai 400 018
India
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

IEEMA (PVC)/EHV CABLE/2019 (R-2) **Effective from: 01 Apr 2023**

Cir. No. 06/DIV/CAB/05 08 May 2023

To Cable Division and Utilities/SEBS, listed of purchasing organisations

Sub: Amendment to Price Variation Clause for EHV Cables (66 KV to 400 KV)

IEEMA EHV Cable PV formula is applicable from Sep 2019. With the coming demand for EHV cables; EHV Cable manufacturers' requested IEEMA to publish following missing factors from formula document of EHV Cable effective from Sep 2019; since some of the users were procuring such cables and demanding these factors and also for the correction in the SMIF factor for Copper Wire Metallic Screen for MV and EHV cables.

IEEMA Cable Technical committee discussed the subject in depth and IEEMA collected the variation factors and finalised in consensus. The average factors are tabled in annexure which are effective from 01 Apr 2023 and accordingly modified the formulae, attached with circular.

New evolved variation factors and corrections in formulae are as below:

1. Variation factors for EHV Cable (lead + Copper Screen)
   220 KV – 50 KA and 63 KA
   400 KV – 50 KA and 63 KA

2. IEEMA variation factors and **NEW** formula for a special construction of 66kV EHV Cable; Aluminium Conductor with PolyAl Sheath & Copper Screen with Aluminium wire armor

3. The formula for copper screen factor given in IEEMA EHV Cable PV clause for all formulae wef Sep 19 is for copper wires only and copper tape binder if provided, its area would be additional.

The SMIF, weight factor for Copper Wire Metallic Screen has been modified as under:

SMIF = (A x D x LF)/1000, where D = Density (= 8.89 for Cu), LF = Lay Factor (=1.07, for Copper Wire Metallic Screen and counter helix tape)

4. Considering the fluctuations in the prices; and as suggested by members IEEMA will be publishing a separate price for XLPE for EHV Cables (Above 66 KV) in IEEMA Cable price variation circular from 01 Apr 2023 onwards. This price will applicable for XLPE in all EHV Cable (Above 66 KV) formulae from 01 Apr 2023 onwards. And correction/change in existing "XLPE - HV Cable" being mentioned in IEEMA Price circulars with "XLPE - MV Cable" applicable for MV cables

5. For the better clarity and application of prices, it is also agreed upon to change/replace the existing PVC grades "CW 22" & "HR-11" being mentioned in IEEMA Price circulars with generic PVC names as under;

CW 22 to be changed to " PVC" &
HR 11 to be changed to " HR PVC"

HEAD OFFICE - DELHI
Rishyamook Building, First Floor, 85 A, Panchkuian Road, New Delhi 110001
P +91 11 2336 3013 / 14 • F +91 11 2336 3015 • E delhi@ieema.org • W www.ieema.org

ieema
your link to electricity

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers
132, Dr. A. B. Road, Worli,
Mumbai 400 018
India
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

IEEMA (PVC)/EHV CABLE/2019 (R-2) **Effective from: 01 Apr 2023**

As discussed and agreed in consensus, the understanding for above generic PVC grades is that " PVC" will be considered for PVC insulation and PVC sheath of General Purpose PVC insulated LV cables as per IS 1554 (I) suitable max conductor temperature of 70 ^{0}C, whereas " HRPVC" will be considered for Heat Resisting PVC insulation and Heat Resisting PVC sheath of HRPVC insulated LV Cables as per IS 1554 (I) and also for Heat Resisting PVC sheath of XLPE insulated LV cables as per IS 7098 (I) & Heat Resisting PVC sheath of XLPE insulated HT/EHV Cables as per IS 7098 (Part-2 and Part-3).

6. As suggested by stake holders and in consensus with IEEMA Cable Tech committee, prices of Steel for armouring for following thickness are published in IEEMA Cable PVC from 01 Jan 2023 and are effective/applicable from 01 Jan 2023.
Round wire 2.0 mm dia, Round wire 2.5 mm dia, Round wire 3.15 mm dia, Round wire 4.0 mm dia

We are enclosing amended price variation clause for EHV Cables (66 KV to 400 KV) along with applicable table of variation factors and additional table of variation factors which are effective from 01 Apr 2023. We recommend all stakeholders to incorporate these changes in all the contracts/tenders henceforth for settlement of price variation from 01 Apr 2023 onwards.

Director
Encl.: Amended PV clause for EHV Cables along with table of variation factors

HEAD OFFICE - DELHI
Rishyamook Building, First Floor, 85 A, Panchkuian Road, New Delhi 110001
P +91 11 2336 3013 / 14 • F +91 11 2336 3015 • E delhi@ieema.org • W www.ieema.org

ieema
your link to electricity

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers
132, Dr. A. B. Road, Worli,
Mumba i 400 018
India
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

IEEMA (PVC)/EHV CABLE/2019 (R-2) **Effective from: 01 Apr 2023**

Material Price Variation Clause for XLPE Insulated EHV Cables (66 kV to 400 KV)

The Price quoted/confirmed is based on the input cost of raw materials/components as on the date of quotation, and the same is deemed to be related to the prices of raw materials as specified in the price variation clause given below. In case of any variation in these prices, the price payable shall be subject to adjustment up or down in accordance with the formulae provided in this document.
Terms used in price variation formulae:

P Price payable as adjusted in accordance with above appropriate formula **(in Rs/Km)**
Po Price quoted/confirmed **(in Rs/Km)**

1) Conductor Metal

MIF Variation factor for Conductor
MIF2 Price of Respective Conductor Material as below (from a to b); this price is as applicable on **Two** months prior to the date of delivery.
MIF1 Price of Respective Conductor Material as below (from a to b); this price is as applicable on **One** month prior to the date of tendering.

a) ALUMINIUM (Conductor)

AIF Variation factor for Aluminium
AI Price of Aluminium; this price is as applicable on **Two** months prior to the date of delivery.
AIo Price of Aluminium; this price is as applicable on **One** month prior to the date of tendering.

b) COPPER (Conductor)

CuF Variation factor for copper
Cu Price of CC Copper rods. This price is as applicable on **Two** months prior to the date of delivery.
Cuo Price of CC copper rods. This price is as applicable on **One** month prior to the date of tendering.

2) XLPE Compound

XL3 Variation factor for XLPE Compound
XLFAl Variation factor for XLPE Compound for Aluminium Conductor Cable
XLFCu Variation factor for XLPE Compound for Copper Conductor Cable
CC Price of XLPE Compound. This price is as applicable on **Two** months prior to the date of delivery.
Cco Price of XLPE Compound. This price is as applicable on **One** month prior to the date of tendering.

3) Polymer Compound / PVC Compound

XL5 Variation factor for Polymer Compound / PVC Compound
CCFAl Variation factor for Polymer Compound / PVC Compound for Aluminium Conductor Cable
CCFCu Variation factor for Polymer Compound / PVC Compound for Copper Conductor Cable
POC Price of Polymer Compound / PVC Compound. This price is as applicable on **Two** months prior to the date of delivery.
POCo Price of Polymer Compound / PVC Compound. This price is as applicable on **One** month prior to the date of tendering.

ieema
your link to electricity

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers
132, Dr. A. B. Road, Worli,
Mumba i 400 018
India
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

4) Metallic Screen / Sheath

SMIF Variation factor for Sheath/Screen material

SMIF2 Price of Respective Sheath/Screen Material as below (from a to d); this price is as applicable on **Two** months prior to the date of delivery.

SMIF1 Price of Respective Sheath/Screen Material as below (from a to d); this price is as applicable on **One** month prior to the date of tendering.

a) COPPER (Screen) : In Copper Wire Screen + PolyAl Construction

CuFc Variation factor for copper screen

Cu Price of CC copper rods. This price is as applicable on **Two** months prior to the date of delivery.

Cuo Price of CC copper rods. This price is as applicable on **One** month prior to the date of tendering.

b) COPPER (Screen) : In Lead Sheath Construction

CuFpb Variation factor for copper screen

Cu Price of CC copper rods. This price is as applicable on **Two** months prior to the date of delivery.

Cuo Price of CC copper rods. This price is as applicable on **One** month prior to the date of tendering.

c) LEAD : In Lead Sheath Construction

PbF Variation factor for Lead

Pb Price of Pig lead (99.97%). This price is as applicable on **Two** months prior to the date of delivery.

Pbo Price of Pig lead (99.97%). This price is as applicable on **One** month days prior to the date of tendering.

d) Corrugated Aluminium Sheath

AlFs Variation factor for corrugated Aluminium sheath

Al Price of Aluminiujm. This price is as applicable on **Two** months prior to the date of delivery.

Alo Price of Aluminium). This price is as applicable on **One** month prior to the date of tendering.

The above prices and indices are as published by IEEMA vide Circular reference IEEMA(PVC)/CABLE(R-1)/--/-- prevailing as on 1st working day of the month i.e. one month prior to the date of tendering.

The date of delivery is the date on which the cable is notified as being ready for inspection/dispatch (in the absence of such notification, the date of manufacturer's dispatch note is to be considered as the date of delivery) or the contracted delivery date (including any agreed extension thereto), whichever is earlier.

Notes

(a) All prices of raw materials are exclusive of GST amount.
(b) All prices excluding Aluminium & Copper are as on first working day of the month.
(c) The details of prices are as under:

1. Price of Aluminium is LME average Cash SELLER Settlement price of Primary Aluminium in US$ per MT as published by London Metal Bulletin (LME) including Premium for Aluminium Ingot in US$ per MT is converted in Indian Rs./MT
2. Price of CC copper rods (in Rs/MT) is ex-works price as quoted by the primary producer.
3. Price of Pig lead (in Rs/MT) is ex-works price as quoted by the primary producer.
4. Price of Polymer Compound (in Rs/MT) is the ex-work price, as quoted by the manufacturer/s
5. Price of XLPE Compound (in Rs/MT) is the ex-works price, as quoted by the manufacturer/s
6. Price of PVC Compound (in Rs/MT) is the ex-works price, as quoted by the manufacturer/s

ieema
your link to electricity

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers
132, Dr. A. B. Road, Worli,
Mumba i 400 018
India
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

PV Formulae

a) For Aluminium /copper Conductor XLPE insulated copper wire screen + polyal PE/PVC sheathed cables

P = Po + MIF (MIF2 – MIF1) + XL3 (CC-Cco) + SMIF (SMIF2-SMIF1) + XL5 (POC - POCo)

Table references:-
Table 1 (MIF) : Aluminium Conductor AlF / Copper Conductor CuF
Table 2 (XL3) : Aluminium Conductor XLFAl / Copper Conductor XLFCu
Table 3a (SMIF) : Copper Wire Screen in Copper Wire Screen + Polyal Construction (CUFc)
Table 4 (XL5) : Aluminium Conductor CCFAl / Copper Conductor CCFCu

Note:
For cases where Short Circuit Current through Screen/Sheath is required & is not available in the Reference Tables, in that case Screen/Sheath area as approved by the customer in Datasheet / Short Circuit Current calculation of Screen/Sheath shall be used to derive SMIF as below:

If A= Area of Metallic Screen in Approved Datasheet / Calculation Sheet

D= Density= 8.89 for Cu. & 2.703 for Al; LF = Lay Factor (=1.07, for Copper Wire Metallic Screen and counter helix tape)
SMIF = (A x D x LF)/1000

b) For Aluminium /Copper Conductor XLPE insulated copper wire screen +Lead metallic sheathed PE/PVC sheathed cables

P = Po + MIF (MIF2 – MIF1) + XL3 (CC-Cco) + $SMIF_{Pbf}$ (SMIF2-SMIF1) + $SMIF_{CuFpb}$ (SMIF2-SMIF1) + XL5 (POC - POCco)
Table references :-
Table 1 (MIF) : Aluminium Conductor AlF / Copper Conductor CuF
Table 2 (XL3) : Aluminium Conductor XLFAl / Copper Conductor XLFCu
Table 3c (SMIF) : Lead in Lead Sheath Construction PbF
Table 3d (SMIF) : Copper wire screen in Lead Sheath Construction CuFpb
Table 4 (XL5) : Aluminium Conductor CCFAl / Copper Conductor CCFCu

Note:
For cases where Short Circuit Current through Screen/Sheath is required & is not available in the Reference Tables, in that case Screen/Sheath area as approved by the customer in Datasheet / Short Circuit Current calculation of Screen/Sheath shall be used to derive SMIF as below:

If A= Area of Metallic Screen in Approved Datasheet / Calculation Sheet
D= Density= 8.89 for Cu. & 2.703 for Al; LF = Lay Factor (=1.07, for Copper Wire Metallic Screen and counter helix tape)
SMIF = (A x D x LF)/1000

ieema
your link to electricity

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers
132, Dr. A. B. Road, Worli,
Mumba i 400 018
India
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

c) For Aluminium /Copper Conductor XLPE insulated Corrugated Aluminium metallic sheathed PE/PVC sheathed cables

P = Po + MIF (MIF2 – MIF1) + XL3 (CC-Cco) + SMIF (SMIF2-SMIF1) + XL5 (POC - POCco)

Table references:-
Table 1 (MIF) : Aluminium Conductor AlF / Copper Conductor CuF
Table 2 (XL3) : Aluminium Conductor XLFAl / Copper Conductor XLFCu
Table 3b (SMIF) : Corrugated Aluminium in CAS Construction AIFs
Table 4 (XL5) : Aluminium Conductor CCFAl / Copper Conductor CCFCu

Note:
For cases where Short Circuit Current through Screen/Sheath is required & is not available in the Reference Tables, in that case Screen/Sheath area as approved by the customer in Datasheet / Short Circuit Current calculation of Screen/Sheath shall be used to derive SMIF as below:

If A= Area of Metallic Screen in Approved Datasheet / Calculation Sheet

D= Density= 2.703 for Al;
SMIF = (A x D)/1000

d) For Aluminium /copper Conductor XLPE insulated copper wire screen + polyal PE/PVC sheathed cables with Aluminium Armouring (66 KV Cable)

P = Po + MIF (MIF2 – MIF1) + XL3 (CC-Cco) + SMIF (SMIF2-SMIF1) + XL5 (POC - POCo) + ALA (Al – Alo)

Table references:-
Table 1 (MIF) : Aluminium Conductor AlF / Copper Conductor CuF
Table 2 (XL3) : Aluminium Conductor XLFAl / Copper Conductor XLFCu
Table 3a (SMIF) : Copper Wire Screen in Copper Wire Screen + Polyal Construction (CUFc)
Table 4 (XL5) : Aluminium Conductor CCFAl / Copper Conductor CCFCu
Table 5 (ALA) : Aluminium factor ALA

Note:
For cases where Short Circuit Current through Screen/Sheath is required & is not available in the Reference Tables, in that case Screen/Sheath area as approved by the customer in Datasheet / Short Circuit Current calculation of Screen/Sheath shall be used to derive SMIF as below:

If A= Area of Metallic Screen in Approved Datasheet / Calculation Sheet
D= Density= 8.89 for Cu. & 2.703 for Al; LF = Lay Factor (=1.07, for Copper Wire Metallic Screen and counter helix tape) **SMIF = (A x D x LF)/1000**

Authorised Signatory

HEAD OFFICE - DELHI
Rishyamook Building, First Floor, 85 A, Panchkuian Road, New Delhi 110001
P +91 11 2336 3013 / 14 • F +91 11 2336 3015 • E delhi@ieema.org • W www.ieema.org

ieema
your link to electricity

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers
132, Dr. A. B. Road, Worli,
Mumba i 400 018
India
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

IEEMA (PVC)/EHV CABLE/2019 (R-2) **Effective from: 01 Apr 2023**

TABLE 1 MIF

VARIATION FACTOR FOR ALUMINIUM & COPPER CONDUCTOR (AIF & CuF)

EHV CABLES WITH ALUMINIUM & COPPER CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm.)	ALUMINIUM FACTORS (AIF)		COPPER FACTORS (CuF)	
	1 core	3 core	1 core	3 core
95	0.274	0.821	0.901	2.700
120	0.346	1.036	1.138	3.407
150	0.425	1.279	1.398	4.207
185	0.533	1.605	1.753	5.279
225	0.655	1.965	2.154	6.463
240	0.703	2.099	2.312	6.904
300	0.879	2.635	2.891	8.667
400	1.126	-	3.703	-
500	1.418	-	4.664	-
630	1.828	-	6.012	-
800	2.340	-	7.696	-
1000	2.951	-	9.706	-
1200	3.562	-	11.619	-
1400	4.154	-	13.578	-
1600	4.741	-	15.509	-
1800	5.352	-	17.346	-
2000	5.922	-	19.430	-
2500	7.176	-	24.287	-

Table 2 : XL3 (For XLPE Compound Factor)

Nominal Cross Sectional Area (in Sq. mm.)	XLPE Factor for Armoured/ Unarmoured Cable with AL /CU Conductor (XLFAl/XLFCu)				
	38/66 KV	64/110 kV	76/132 kV	127/220 kV	220/400 kV
185	1.072	1.814	2.332	-	-
240	1.259	2.057	2.562	-	-
300	1.345	2.175	2.570	-	-
400	1.467	2.345	2.761	5.283	-
500	1.597	2.463	2.966	5.596	-
630	1.743	2.663	3.193	5.751	7.170
800	1.963	2.940	3.504	5.970	7.247
1000	2.135	3.172	3.769	6.349	7.351
1200	2.370	3.487	4.127	6.805	7.549
1400	2.514	3.684	4.357	6.907	7.898
1600	2.657	3.967	4.567	7.196	8.219
1800	2.815	4.177	4.798	7.471	8.523
2000	2.939	4.347	4.989	7.737	8.816
2500	3.262	4.784	5.473	8.357	9.534

Note : XLPE factors include Semicons for Conductor & Insulation screen (based on IS 7098 (Part-3)) Proposed
For 3 core cables for 66 kV and sizes up to 300 sq.mm XLPE factors will be multiplied by 3

HEAD OFFICE - DELHI
Rishyamook Building, First Floor, 85 A, Panchkuian Road, New Delhi 110001
P +91 11 2336 3013 / 14 • F +91 11 2336 3015 • E delhi@ieema.org • W www.ieema.org

ieema
your link to electricity

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers
132, Dr. A. B. Road, Worli,
Mumba i 400 018
India
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

Table 4 : XL5 (For Polymer Compound Factor)					
Nominal Cross Sectional Area (in Sq. mm.)	Polymer Factor for Armoured/ Unarmoured Cable with AL /CU Conductor (CCFAl/CCFCu)				
	38/66 KV	64/110 kV	76/132 kV	127/220 kV	220/400 kV
185	0.447	0.624	0.710	-	-
240	0.540	0.707	0.805	-	-
300	0.585	0.747	0.832	-	-
400	0.646	0.857	0.917	1.789	-
500	0.710	0.881	1.140	1.848	-
630	0.792	1.115	1.223	1.887	2.326
800	0.867	1.177	1.287	1.932	2.365
1000	1.092	1.266	1.366	2.008	2.405
1200	1.185	1.365	1.442	2.103	2.561
1400	1.267	1.417	1.499	2.212	2.644
1600	1.312	1.488	1.545	2.278	2.708
1800	1.380	1.534	1.597	2.343	2.768
2000	1.422	1.576	1.640	2.396	2.839
2500	1.527	1.680	1.741	2.531	3.063

Note : For PVC Factor the above factor will be multiplied by 1.58

Table 3a (SMIF) Variation factor for Copper screen in CU wire + polyal construction (CuFc)			
Short Circuit capacity of Metallic screen	(CuFc)	Short Circuit capacity of Metallic screen	(CuFc)
31.5 kA for 1 sec	2.104	50 kA for 1 sec	3.232
31.5 kA for 2 sec	2.963	50 kA for 2 sec	4.585
31.5 kA for 3 sec	3.614	50 kA for 3 sec	5.571
40 kA for 1 sec	2.660	63 kA for 1 sec	4.071
40 kA for 2 sec	3.752	63 kA for 2 sec	5.758
40 kA for 3 sec	4.579	63 kA for 3 sec	7.233

ieema
your link to electricity

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers
132, Dr. A. B. Road, Worli,
Mumba i 400 018
India
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

Table 3b (SMIF) : Variation factor for Aluminium in Corr Al construction (AIFs)												
Nominal Cross Sectional Area (in Sq. mm)	**38/66 KV**						**64/110 kV**					
SC Current in KA	**31.5**			**40**			**31.5**			**40**		
Duration in sec	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
185	1.100	1.381	1.628	1.259	1.729	2.138	1.079	1.385	1.677	1.213	1.795	2.094
240	1.110	1.398	1.708	1.220	1.708	2.078	1.186	1.472	1.745	1.322	1.745	2.116
300	1.167	1.508	1.887	1.482	1.774	2.157	1.183	1.461	0.908	1.483	1.816	2.137
400	1.190	1.656	2.027	1.529	2.195	2.173	1.207	1.676	2.050	1.547	2.134	2.300
500	1.206	1.696	2.085	1.526	2.139	2.621	1.255	1.689	2.045	1.530	2.122	2.585
630	1.219	1.712	2.083	1.492	2.120	2.580	1.369	1.685	2.007	1.538	2.138	2.536
800	1.279	1.760	2.141	1.490	2.138	2.601	1.503	1.651	2.001	1.561	2.080	2.539
1000	1.426	1.777	2.127	1.533	2.125	2.599	1.647	1.669	2.054	1.647	2.098	2.539
1200	1.531	1.792	2.185	1.535	2.117	2.582	1.819	1.819	2.020	1.819	2.073	2.557
1400	1.730	1.781	2.186	1.730	2.168	2.544	2.055	2.055	2.080	2.055	2.104	2.546
1600	1.890	1.890	2.189	1.890	2.193	2.536	2.261	2.261	2.261	2.261	2.261	2.576
1800	2.068	1.974	2.198	2.068	2.186	2.495	2.389	2.389	2.389	2.389	2.389	2.522
2000	2.234	2.159	2.258	2.234	2.280	2.669	2.623	2.623	2.623	2.623	2.623	2.679
2500	2.611	2.611	2.611	2.611	2.611	2.744	2.971	2.971	2.971	2.971	2.971	2.971

Table 3b (SMIF) : Variation factor for Aluminium in Corr Al construction (AIFs)						
Nominal Cross Sectional Area (in Sq. mm)	**76/132 kV**					
SC Current in KA	**31.5**			**40**		
Duration in sec	**1**	**2**	**3**	**1**	**2**	**3**
185	1.098	1.354	1.740	1.227	1.740	2.133
240	1.236	1.404	1.703	1.272	1.736	2.142
300	1.237	1.522	0.834	1.494	1.734	2.138
400	1.304	1.698	2.037	1.553	2.109	2.171
500	1.404	1.665	2.045	1.522	2.098	2.545
630	1.519	1.650	2.032	1.587	2.107	2.578
800	1.652	1.712	2.039	1.691	2.067	2.519
1000	1.813	1.813	2.029	1.792	2.088	2.566
1200	1.972	2.068	2.060	1.994	2.115	2.543
1400	2.193	2.193	2.193	2.216	2.238	2.555
1600	2.355	2.355	2.355	2.355	2.355	2.581
1800	2.519	2.519	2.519	2.519	2.519	2.556
2000	2.788	2.788	2.788	2.788	2.788	2.788
2500	3.077	3.077	3.077	3.077	3.077	3.077

ieema
your link to electricity

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers
132, Dr. A. B. Road, Worli,
Mumba i 400 018
India
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

Table 3b (SMIF) : Variation factor for Aluminium in Corr Al construction (AIFs)												
Nominal Cross Sectional Area (in Sq. mm)	**127/220 kV**											
SC Current in KA	**31.5**			**40**			**50**			**63**		
Duration in sec	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
400	2.096	2.049	2.149	2.096	2.198	2.502	2.164	-	-	-	-	-
500	2.206	2.124	2.206	2.206	2.219	2.551	2.175	2.513	-	2.476	-	-
630	2.268	2.185	2.268	2.268	2.282	2.537	2.221	2.675	3.328	2.481	3.450	-
800	2.357	2.270	2.326	2.357	2.371	2.574	2.231	2.745	3.382	2.554	3.461	4.356
1000	2.619	2.497	2.546	2.619	2.634	2.679	2.445	2.827	3.368	2.658	3.478	4.291
1200	2.845	2.826	2.779	2.845	2.869	2.923	2.490	2.884	3.379	2.754	3.485	4.239
1400	2.983	2.929	2.872	2.983	2.999	3.018	2.533	2.897	3.390	2.754	3.520	4.243
1600	3.156	3.101	3.008	3.156	3.183	3.156	2.662	3.101	3.393	2.951	3.526	4.284
1800	3.241	3.263	3.241	3.241	3.263	3.191	2.710	3.149	3.438	2.999	3.526	4.274
2000	3.517	3.545	3.517	3.517	3.545	3.517	2.795	3.182	3.482	3.028	3.572	4.179
2500	3.796	3.836	3.796	3.796	3.836	3.796	3.242	3.385	3.708	3.242	3.781	4.192

Table 3b (SMIF) : Variation factor for Aluminium in Corr Al construction (AIFs)												
Nominal Cross Sectional Area (in Sq. mm)	**220/400 kV**											
SC Current in KA	**31.5**			**40**			**50**			**63**		
Duration in sec	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
630	2.823	2.844	2.823	2.823	2.879	2.845	-	-	-	-	-	-
800	2.955	2.991	2.955	2.955	2.991	2.955	-	-	-	-	-	-
1000	3.031	3.053	3.031	3.031	3.053	3.031	2.896	2.915	3.131	2.896	3.167	-
1200	3.217	3.240	3.217	3.217	3.240	3.217	3.054	3.073	3.182	3.054	3.210	4.041
1400	3.486	3.511	3.486	3.486	3.511	3.486	3.122	3.132	3.221	3.122	3.263	4.118
1600	3.589	3.614	3.589	3.589	3.614	3.589	3.334	3.344	3.334	3.334	3.334	4.057
1800	3.693	3.719	3.693	3.693	3.719	3.693	3.729	3.729	3.729	3.729	3.729	4.088
2000	3.998	4.041	3.998	3.998	4.041	3.998	3.734	3.745	3.745	3.734	3.734	4.110
2500	4.229	4.273	4.229	4.229	4.273	4.229	3.903	3.903	3.903	3.903	3.903	4.204

HEAD OFFICE - DELHI
Rishyamook Building, First Floor, 85 A, Panchkuian Road, New Delhi 110001
P +91 11 2336 3013 / 14 • F +91 11 2336 3015 • E delhi@ieema.org • W www.ieema.org

ieema
your link to electricity

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers
132, Dr. A. B. Road, Worli,
Mumba i 400 018
India
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

IEEMA (PVC)/EHV CABLE/2019 (R-2) **Effective from: 01 Apr 2023**

Table 3c (SMIF) : Variation factor for Lead in Lead +Cu wire construction (PbF)												
Nominal Cross Sectional Area (in Sq. mm)	38/66 KV						64/110 kV					
SC Current in KA	31.5			40			31.5			40		
Duration in sec	1	2	3	1	2	3	1	2	3	1	2	3
185	3.101	3.101	3.101	3.101	3.101	3.101	4.279	4.279	4.279	4.279	4.279	4.279
240	3.544	3.268	3.268	3.268	3.268	3.268	4.770	4.463	4.463	4.463	4.463	4.463
300	3.784	3.600	3.600	3.790	3.600	3.600	5.045	4.850	4.850	5.045	4.850	4.850
400	4.120	4.120	4.120	4.120	4.120	3.838	5.423	5.423	5.423	5.423	5.423	5.112
500	4.592	4.592	4.592	4.592	4.592	4.592	5.749	5.749	5.749	5.749	5.749	5.749
630	4.881	4.881	4.881	4.881	4.881	4.881	6.184	6.184	6.184	6.184	6.184	6.184
800	5.494	5.494	5.494	5.494	5.494	5.494	6.853	6.853	6.853	6.853	6.853	6.853
1000	6.100	6.100	6.100	6.100	6.100	6.100	7.381	7.381	7.381	7.381	7.381	7.381
1200	7.516	7.516	7.516	7.516	7.516	7.516	8.069	8.069	8.069	8.069	8.069	8.069
1400	7.950	7.950	7.950	7.950	7.950	7.950	8.746	8.746	8.746	8.746	8.746	8.746
1600	8.584	8.584	8.584	8.584	8.584	8.584	9.602	9.602	9.602	9.602	9.602	9.602
1800	9.096	9.096	9.096	9.096	9.096	9.096	9.930	9.930	9.930	9.930	9.930	9.930
2000	9.550	9.550	9.550	9.550	9.550	9.550	10.443	10.443	10.443	10.443	10.443	10.443
2500	10.976	10.976	10.976	10.976	10.976	10.976	11.379	11.379	11.379	11.379	11.379	11.379

Table 3c (SMIF) : Variation factor for Lead in Lead +Cu wire construction (PbF)						
Nominal Cross Sectional Area (in Sq. mm)	76/132 kV					
SC Current in KA	31.5			40		
Duration in sec	1	2	3	1	2	3
185	5.001	5.001	5.001	5.001	5.001	5.001
240	5.440	5.193	5.193	5.193	5.193	5.193
300	5.525	5.194	5.194	5.525	5.194	5.194
400	6.042	6.042	6.042	6.042	6.042	5.706
500	6.470	6.470	6.470	6.470	6.470	6.470
630	6.933	6.933	6.933	6.933	6.933	6.933
800	7.638	7.638	7.638	7.638	7.638	7.638
1000	8.186	8.186	8.186	8.186	8.186	8.186
1200	8.910	8.910	8.910	8.910	8.910	8.910
1400	9.710	9.710	9.710	9.710	9.710	9.710
1600	10.225	10.225	10.225	10.225	10.225	10.225
1800	10.630	10.630	10.630	10.630	10.630	10.630
2000	10.895	10.895	10.895	10.895	10.895	10.895
2500	12.260	12.260	12.260	12.260	12.260	12.260

HEAD OFFICE - DELHI
Rishyamook Building, First Floor, 85 A, Panchkuian Road, New Delhi 110001
P +91 11 2336 3013 / 14 • F +91 11 2336 3015 • E delhi@ieema.org • W www.ieema.org

ieema
your link to electricity

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers
132, Dr. A. B. Road, Worli,
Mumba i 400 018
India
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

Table 3c (SMIF) : Variation factor for Lead in Lead +Cu wire construction (PbF)												
Nominal Cross Sectional Area (in Sq. mm)	**127/220 kV**											
SC Current in KA	**31.5**			**40**			**50**			**63**		
Duration in sec	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
400	9.088	9.088	9.088	9.088	9.088	9.078	9.329	9.432	9.432	9.432	9.432	9.432
500	9.862	9.862	9.862	9.862	9.862	9.862	10.034	10.034	10.117	10.034	10.117	10.117
630	10.130	10.130	10.130	10.130	10.130	10.130	10.294	10.294	10.294	10.294	10.294	10.286
800	10.454	10.454	10.454	10.454	10.454	10.454	10.648	10.648	10.648	10.648	10.648	10.648
1000	11.081	11.081	11.081	11.081	11.081	11.081	11.440	11.440	11.440	11.440	11.440	11.440
1200	12.074	12.074	12.074	12.074	12.074	12.074	12.334	12.334	12.334	12.334	12.334	12.334
1400	12.368	12.368	12.368	12.368	12.368	12.368	12.656	12.656	12.656	12.656	12.656	12.656
1600	13.154	13.154	13.154	13.154	13.154	13.154	13.451	13.451	13.451	13.451	13.451	13.451
1800	13.514	13.514	13.514	13.514	13.514	13.514	13.799	13.799	13.799	13.799	13.799	13.799
2000	14.337	14.337	14.337	14.337	14.337	14.337	14.662	14.662	14.662	14.662	14.662	14.662
2500	15.640	15.640	15.640	15.640	15.640	15.640	15.638	15.638	15.638	15.638	15.638	15.638

Table 3c (SMIF) : Variation factor for Lead in Lead +Cu wire construction (PbF)												
Nominal Cross Sectional Area (in Sq. mm)	**220/400 kV**											
SC Current in KA	**31.5**			**40**			**50**			**63**		
Duration in sec	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
630	11.596	11.596	11.596	11.596	11.596	11.596	11.761	11.799	11.828	11.792	11.828	12.015
800	11.784	11.784	11.784	11.784	11.784	11.784	11.979	12.016	12.046	12.009	12.046	12.221
1000	12.016	12.016	12.016	12.016	12.016	12.016	12.349	12.386	12.415	12.379	12.415	12.461
1200	12.794	12.794	12.794	12.794	12.794	12.794	13.080	13.119	13.150	13.112	13.150	13.284
1400	13.196	13.196	13.196	13.196	13.196	13.196	13.702	13.702	13.702	13.702	13.702	13.702
1600	14.011	14.011	14.011	14.011	14.011	14.011	14.361	14.401	14.433	14.394	14.433	14.529
1800	14.372	14.010	14.010	14.010	14.010	14.010	14.909	14.909	14.909	14.909	14.909	14.909
2000	15.189	15.189	15.189	15.189	15.189	15.189	15.512	15.553	15.586	15.546	15.586	15.734
2500	16.551	16.551	16.551	16.551	16.715	16.551	16.858	16.901	16.935	16.893	17.099	17.143

HEAD OFFICE - DELHI
Rishyamook Building, First Floor, 85 A, Panchkuian Road, New Delhi 110001
P +91 11 2336 3013 / 14 • F +91 11 2336 3015 • E delhi@ieema.org • W www.ieema.org

ieema
your link to electricity

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers
132, Dr. A. B. Road, Worli,
Mumba i 400 018
India
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

IEEMA (PVC)/EHV CABLE/2019 (R-2) **Effective from: 01 Apr 2023**

Table 3d (SMIF) : Variation factor for Copper in Lead +Cu wire construction (CuFpb)												
Nominal Cross Sectional Area (in Sq. mm)	38/66 KV						64/110 kV					
SC Current in KA	31.5			40			31.5			40		
Duration in sec	1	2	3	1	2	3	1	2	3	1	2	3
185	1.762	2.555	3.566	2.258	3.347	4.163	1.637	2.428	3.048	2.111	3.183	4.015
240	1.719	2.531	3.211	2.235	3.325	4.141	1.565	2.383	3.044	2.087	3.177	3.993
300	1.692	2.525	3.196	2.215	3.304	4.135	1.538	2.360	3.024	2.063	3.153	3.991
400	1.646	2.509	3.174	2.213	3.281	4.118	1.484	2.359	3.011	2.059	3.140	3.949
500	1.584										3.104	3.942
630	1.551										3.087	3.907
800	1.475										3.015	3.869
1000	1.400										2.937	3.796
1200	1.228										2.861	3.724
1400	1.216										2.779	3.655
1600	1.106										2.773	3.627
1800	1.095	1.975	2.652	1.669	2.784	3.662	0.988	1.873	2.460	1.563	2.678	3.541
2000	0.976	1.861	2.535	1.549	2.670	3.539	0.913	1.769	2.450	1.466	2.598	3.490
2500	0.896	1.796	2.490	1.489	2.632	3.514	0.909	1.768	1.488	1.457	2.585	3.451

Superseded by Circular No. 22/DIV/ CAB/05 (Correction in amendment to Price Variation Clause for MV and EHV Cables wef April' 2023.

Table 3d (SMIF) : Variation factor for Copper in Lead +Cu wire construction (CuFpb)						
Nominal Cross Sectional Area (in Sq. mm)	76/132 kV					
SC Current in KA	31.5			40		
Duration in sec	1	2	3	1	2	3
185	1.562	2.395	2.977	2.049	3.110	3.970
240	1.488	2.292	2.955	1.994	3.085	3.938
300						3.922
400						3.898
500						3.897
630						3.866
800						3.783
1000						3.712
1200						3.622
1400						3.572
1600	0.975	1.854	2.479	1.546	2.676	3.549
1800	0.924	1.797	2.395	1.491	2.612	3.468
2000	0.853	1.717	2.359	1.414	2.536	3.385
2500	0.809	1.664	1.466	1.351	2.505	3.379

Superseded by Circular No. 22/DIV/ CAB/05 (Correction in amendment to Price Variation Clause for MV and EHV Cables wef April' 2023.

ieema
your link to electricity

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers
132, Dr. A. B. Road, Worli,
Mumba i 400 018
India
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

IEEMA (PVC)/EHV CABLE/2019 (R-2) **Effective from: 01 Apr 2023**

Table 3d (SMIF) : Variation factor for Copper in Lead +Cu wire construction (CuFpb)												
Nominal Cross Sectional Area (in Sq. mm)	127/220 kV											
SC Current in KA	31.5			40			50			63		
Duration in sec	1	2	3	1	2	3	1	2	3	1	2	3
400	1.053	1.937	2.613	1.623	2.751	3.621	2.362	-	-	-	-	-
500	0.973										-	-
630	0.942										4.834	-
800	0.909										4.803	6.134
1000	0.828										4.701	6.053
1200	0.724										4.620	5.944
1400	0.717										4.563	5.909
1600	0.686										4.493	5.836
1800	0.680										4.409	5.719
2000	0.529	1.337	2.020	1.049	2.140	2.977	1.795	3.154	4.215	2.643	4.371	5.667
2500	0.373	1.317	1.996	1.036	2.109	2.968	1.722	3.067	4.127	2.559	4.258	5.581

Superseded by Circular No. 22/DIV/ CAB/05 (Correction in amendment to Price Variation Clause for MV and EHV Cables wef April' 2023.

Table 3d (SMIF) : Variation factor for Copper in Lead +Cu wire construction (CuFpb)												
Nominal Cross Sectional Area (in Sq. mm)	220/400 kV											
SC Current in KA	31.5			40			50			63		
Duration in sec	1	2	3	1	2	3	1	2	3	1	2	3
630	0.870										4.761	6.687
800	0.862										4.720	6.483
1000	0.833										4.704	6.398
1200	0.750										4.613	6.316
1400	0.711										4.576	6.268
1600	0.697										4.499	6.186
1800	0.642										4.488	6.141
2000	0.488										4.364	6.058
2500	0.283	1.245	1.927	0.948	2.019	2.877	1.701	2.989	4.037	2.536	4.208	5.920

Superseded by Circular No. 22/DIV/ CAB/05 (Correction in amendment to Price Variation Clause for MV and EHV Cables wef April' 2023.

ieema
your link to electricity

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers
132, Dr. A. B. Road, Worli,
Mumba i 400 018
India
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

Table 5	
Variation factor for Armour for 66KV Poly Al construction cables	
Variation factor for Aluminium in Aluminium Armoured construction (ALA)	
Nominal Cross Sectional Area (in Sq. mm)	**66KV**
185	0.812
240	0.835
300	0.868
400	0.991
500	1.228
630	1.281
800	1.379
1000	1.513
1200	2.064
1400	2.167
1600	2.256
1800	2.361
2000	2.403
2500	2.630