



BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT
NOIDA

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CUSTOMER	SJVN Arun-3 Power Development Company (P) Ltd. (SAPDC)					
Consultant	SJVN Ltd					

PROJECT 4x225MW Arun-3 (HEP), Nepal

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Remarks: Bidder to note that data and details of Guaranteed Technical Particulars & Design documents shall not be reviewed during Technical Evaluation/ Review, hence compliance of Guaranteed Technical Particulars in line with Technical Specification shall be bidder's responsibility.

1	Rev	Date	Altered	Checked	Approved	Annexure BOQ & Annexure_TQR revised
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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 and installation/ laying, termination, jointing, dressing, testing at site & commissioning complete with all materials, support structures including hardware, accessories, commissioning spares & maintenance spares, consumables, special spanners, tools & tackles, any specific required ancillary services & mandatory spares etc. including demonstration at site for the equipment (400kV XLPE Cable & its Accessories) complete in all respect for efficient & trouble-free working mentioned under this specification.

Hence, the electrical scope of work under this requisition shall include but not be limited to basic and detailed engineering, as required, manufacturing, supply, transportation, inspection at manufacturer's work, installation/ laying, commissioning including site testing along with necessary equipment, 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 (*400KV XLPE Cable & its Accessories*). This constitutes minimum technical parameters for the above item as specified by the BHEL/ Customer. The offered equipment (400KV XLPE Cable & its Accessories) shall also comply with the Section-2 (Equipment Specification Under Scope of Supplies) of this specification and Section-3 (Project Details and General technical requirements for all equipment under the Project)

The specification comprises of following sections:

Section-1	:	Scope, Project Specific Technical Requirements & Bill of Quantities
Section-2	:	Equipment Specification under scope of Supplies
Section-3	:	Project Details & General Technical Requirements (For All Equipment under the Project)
Section-4	:	Check List
Annexures		Annexure A- Schedule of Technical Deviations Annexure B- Compliance Certificate to Technical Specification Annexure C- Quality Assurance Test Requirement Formats Annexure D- Checklist for QAP Annexure E- Quality and Inspection Formats Annexure F- Export Worthy Packing Annexure_Drawings – Relevant Drawings of the Project

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
2. Section-1
3. Section-2
4. Section-3

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 (400KV XLPE Cable & its Accessories) is required for the following project:

Name of the Customer:	SJVN Arun-3 Power Development Company (P) Ltd. (SAPDC)
Consultant :	SJVN Ltd
Name of Main Contractor:	Bharat Heavy Electricals Limited
Name of the Project:	4x225MW Arun-3 (HEP), Nepal

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

2. CODES & STANDARDS

The design, manufacture and testing of the various equipment covered under this specification shall comply with the requirements of the latest edition of the relevant IEC/IS/IEEE/ISO standards only. Preference for latest IEC standards for particular equipment / system shall be governed over IEEE/ IS/ ISO standards. Further rules, guidelines and standard laid down by international/ national agency shall be applicable in this specification.

3. SPECIFIC TECHNICAL REQUIREMENTS

Technical requirements for the equipment (400KV XLPE Cable & its Accessories) shall be as per SECTION-2. Specific requirement is follows:

Sl. No.	Technical Parameters	Unit	Particulars
1	Equipment		400KV XLPE Cable & its Accessories
A	Cable Construction		
1	Cable		COPPER CONDUCTOR, XLPE Insulated
2	Cores		1 core
3	Conductor size		500 Sq.mm (Minimum)
4	Rated fault level of conductor	kArms	50 for 1sec
5	Rated earth fault level for insulation metallic screen	kArms	50 for 1sec
6	Rated continuous current at Nominal Voltage (400kV)	A (rms)	450
7	Cable laying		Flat / trefoil formation in ventilation cum cable tunnel
8	400kV System Earthing		Solidly Grounded
B	System Parameters		Please refer Clause 17.3.2 of Section-2

Notes:

4. **BILL OF QUANTITIES:** Please refer ANNEXURE_BOQ

1. Quantities for supply and services for the equipment (400KV XLPE Cable & its Accessories) shall be as per ANNEXURE- BOQ. However, any item/ 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 visiting site & making precise measurements at contract stage. This shall be bidder's responsibility for accuracy of cable length measurement. Manufacturing lengths and drum length shall be determined with consultation & approval with BHEL/ Customer/ Consultant.
 - a. The Payment of cables length for supply shall be as per approved quantities by BHEL/ Customer/ consultant.
 - b. The Payment of cables length installation will be as per actual measurement at site which shall also include cable terminations.
 - c. Overall contract value may vary by $\pm 20\%$ at contract stage.

5. **TECHNICAL QUALIFYING REQUIREMENT:** Please refer document: Annexure_TQR

6. **FUNCTIONAL GUARANTEE REQUIREMENT**

The bidder has to consider the functional guaranteed value for the 400kV EHV XLPE Cable as per following: -

a) Min accepted Guarantee for the Total Losses (Copper Losses + Dielectric Losses etc.):

GUARANTEED LOSS – 113kW FOR 4550 Meter (AT RATED CURRENT 450A)

b) Evaluation, Penalty and Rejection Criteria

- i. **Penalty on Guarantee (INR) :** 2,50,000 per kW@@
- ii. **Rejection :** >10% of guaranteed losses quoted by the bidder

Location to demonstrate Guarantee: At Works

Rectification to Meet Guarantee: At Works**

Liquidated Damages shall be levied for short fall @ Rs.2,50,000/- per KW.

Penalty shall be imposed on Total losses which shall be calculated as Total measured length of 400kV EHV XLPE Cable laid multiplied by per kW loss per meter length respectively.

** The Contractor shall have to make good and meet the guarantees in case of shortfall in test values vis-à-vis guaranteed values. Two month, will be given to the Contractor for the same for rectification and re-demonstration.

@@ Penalty shall be imposed on Total losses which shall be calculated as Total measured length of XLPE Cable laid multiplied by per kW loss per meter length respectively.

7. OTHER GENERAL REQUIREMENTS

The other general requirements for the equipment (400KV XLPE Cable & its Accessories) shall be as follows,

1. Schedule

- a. Bidder shall submit detailed bar chart indicating all the milestones from engineering till manufacturing/ testing, dispatch to site, installation, testing and commissioning.
- b. Bidder to submit list of consumables with shelf life of less than two years. It shall be supplied before erection after clearance from BHEL/ Customer/ Consultant.

2. Store

- a. Open 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/ Customer/ Consultant. Bidder to submit requirement of closed store during technical bid.
- b. Office facilities & accommodation for bidder's staff along with conveyance, transportation of all special tools & plants, testing kits etc. shall be in bidder's scope.

3. Installation of cable trays, cable rack assembly along with Earthing

- a. The cables shall be laid in cable trays fixed on cable racks assembly in cable tunnel (underground / surface as applicable) / trestle / trench, as per site requirement. Cable

racks assembly in cable trench/ trestle shall be supplied and fixed by BHEL based on detailed input design and drawing provided by bidder. These details shall be furnished during tender stage. Installation and fixing of earthing grid with suitable size of GI flats shall be done by BHEL, however, earthing of cable system including earthing cable shall be in bidder's scope.

- b. It may also be noted that earth grid connection shall not be available at all points in route and, hence provisions of independent earthing etc. shall be deemed to be included in bidder's scope.
- c. The required drilling, fabrication and minor civil works required for completion of cable laying work shall be in bidder's scope.

4. Termination and Jointing

- a. Tools & tackles, testing instruments/ kits required for carrying out termination/ jointing works shall be bidder's scope.
- b. Any cable or accessories damaged during installation, testing & commissioning shall be made good/ repaired/ replaced by bidder to the satisfaction of BHEL/ Customer.

5. Site Testing & Commissioning

- a. Bidder shall depute its qualified testing & commissioning engineer including supply of all testing instruments/ kits (DC test for outer sheath and HV test).
- b. Bidder shall submit complete methodology for conduction of site tests for further approval of BHEL/ Customer/ Consultant.

6. Construction supply

For construction purpose, the necessary power supply at site shall be provided by BHEL at one point only, however supply requirements for testing etc. shall be arranged by bidder only.

7. Site Supervisor and Jointer

- a. Termination/ jointing of cables shall be done by skilled and experienced jointer certified by OEM of the joints/ end terminations and duly approved by Engineer-in charge.
- b. Provision of site supervisor and skilled technician, qualified jointer etc. along with tools & tackles, testing instruments/ kits etc. shall be deemed to be included in bidder's scope.

8. Manuals – Required receipt, storage, installation, testing, commissioning manuals covering all equipment of EM works shall be supplied by bidder as per project requirement.

- c. Storage and preservation manual
- d. Safety manual
- e. Erection Manual
- f. Testing and commissioning manual
- g. Operation & Maintenance manual
- h. Long term storage manual for Generator Transformer
- i. Long term storage manual for boxed up component / equipment.
- j. Repair process / procedure manual for equipment / system

9. Additional Inputs to be furnished by bidder

Bidder to submit special tools, tackles, slings, testing instrument etc. required for handling, pulling, laying, installation, testing and commissioning of 400 kV cables, accessories and

cable support systems, shall be arranged by the Contractor.

Erection, testing and commissioning tools/tackles and testing instruments, to be arranged by the Contractor, shall include but not limited to the following:

- a) Special tools required for laying, installation and dismantling of the 400kV cables, accessories and cable support systems.
- b) The HVAC testing kit and partial discharge measurement equipment for field tests.
- c) Any additional requirement of erection tools, testing instrument etc. for erection, testing and commissioning shall be met by the Contractor without any extra cost to the Employer.

- 10. Bidder to note that different bays may be commissioned different point of time, and hence bidder shall be required to deploy the resources multiple times at site in line with site requirement.
- 11. Bidder shall dispatch the consumables just before the start of the work at site and only after specific clearance from BHEL/ Customer.
- 12. Any special tools and tackles required to complete the cable installation/ laying, termination, testing and commissioning etc. shall be included in the offer. However, general tools and tackles for laying of cables shall be provided by BHEL.
- 13. 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.
- 14. Availability of Spare Parts And Maintenance Supports - Bidder shall ensure the availability of spare parts and maintenance support services for the equipment (400KV XLPE Cable & its Accessories) at least for 15 years from the date of supply. Bidder/ OEM shall give a notice of at least one year to the BHEL/ Customer before phasing out the products/spares to enable the owner for placement of order for spares and services.

8. TYPE, ROUTINE, ACCEPTANCE & FIELD TEST:

8.1. TYPE TESTING FOR 400KV XLPE CABLE

The contractor shall carry out type tests for the respective Equipment (400KV XLPE Cable & its Accessories). The charges for each of these type tests shall be indicated separately in the respective price schedules and the same shall be considered for the evaluation of the bids. The owner reserves the right to waive conducting of any or all of the specified type tests on submission of type test certificates from Govt. approved labs/ accredited laboratories conducted on similar equipment during last **five (5) years** from the date of bid opening (dated **09 February 2018**), in which case the type test charges shall not be payable for the type tests which are waived. The type test charges shall be paid only for the test(s) actually conducted successfully under this contract.

8.2. TYPE TESTING FOR CABLE ACCESSORIES

The contractor shall only submit the certificates from Govt. approved labs/ accredited laboratories of the type tests for the respective equipment (400KV XLPE cable Accessories) which should have been carried out within last five (5) years from the date of bid opening i.e. dated 09 February 2018. 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. In case the contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening i.e. dated 09 February 2018, or in case the type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct the test without any financial implication to BHEL / Customer.

8.3. REPETITION OF TYPE TEST

Type tests shall be carried out to prove the general qualities and design of the 400kV XLPE cable. The charges for each of these type tests shall be indicated separately in the respective price schedules and the same shall be considered for the evaluation of the bids.

The BHEL / Owner reserves the right to waive conducting of any or all of the specified type tests on submission of type test certificates from Govt. approved labs/ accredited laboratories conducted on similar equipment during last five (5) years from the date of bid opening (dated 09 February 2018), in which case the type test charges shall not be payable for the type tests which are waived.

The type test charges shall be paid only for the test(s) actually conducted successfully under this contract.

<u>Sr.No.</u>	<u>Description of Test</u>
1	Check on insulation thickness as per IEC 60811 (check of cable construction)
2	Tan δ measurement.
3	Partial discharge test after complete assembly of end terminations - At ambient temperature - At high temperature (90°C)
4	Cable bending test followed by partial discharge test at ambient temperature.
5	Switching impulse voltage withstand test as per IEC 60230/62067
6	Lightning Impulse voltage withstand tests followed by power frequency voltage test as per IEC 62067/6023
7	Ageing treatment as per IEC 60811
8	Tests for determining the mechanical properties of XLPE insulation and outer sheath (PE) before and after ageing.
9	Heat cycle voltage test as per IEC 62067

10	Flame retardant test on outer sheath (Test under fire condition)
11	Insulation shrinkage test
12	Measurement of resistivity of semi-conducting screens as per IEC 62067.
13	Conditioning & mechanical test as per IEC 60811
14	Pressure test at high temperatures on over sheaths
15	Hot set test for XLPE insulation.
16	Measurement of carbon black contents in PE outer sheath.
17	Water penetration test. hardness of outer sheath
18	Measurement of hardness of outer sheath
19	Abrasion test on outer sheath.
20	Heat shock test on outer sheath.
21	Oil resistant test for outer sheath.

8.4. Field Testing & Commissioning

1. Bidder shall carry out the installation, field testing and commissioning of the equipment (400KV XLPE Cable & its Accessories). Further appropriate test and commissioning reports and as-built documentation as necessary be submitted.
2. Field testing and commissioning of the equipment (400KV XLPE Cable & its Accessories) shall be done by Bidder/OEM only.
3. Bidder shall also submit site acceptance testing (SAT) procedures and get them approved from BHEL/ Customer before carrying out the site testing at site.
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. **Testing instruments required for field testing is in the scope of bidder.** Special tools & tackles for site testing kits for testing & commissioning shall be in bidder's scope, however, it shall be brought at site on returnable basis only.
6. All the general and special tools & tackles, testing instruments/ kits required for carrying out termination/ jointing works shall be bidder's scope. it shall be brought at site on returnable basis only.

8.5. PERFORMANCE TESTING

If nothing unusual has been observed in load run and load rejection tests, the test service period of 72 hours shall follow. During this test service period, the unit must operate continuously at rated condition without any interruption except of those beyond the control of the Contractor. However, such interrupted period shall not be counted for in the test service period. There should be one-month reliability run of the complete unit reckoned from the date of taking over by employer. During reliability run, machine shall be operated by employer and any problem observed during this run shall be attended by the contractor including replacement of components and providing requisite manpower.

8.6. General Note for type, routine, acceptance & field tests

- Type, Routine and acceptance tests as listed in relevant standard and equipment

specifications section -2 shall be conducted.

- The equipment (400KV XLPE Cable & its Accessories) shall be subject to inspection by BHEL & Customer or it's authorized representative at bidder/manufacturers' works. Hence, Bidder shall furnish all necessary information concerning the supply to BHEL/ Customer.
- 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.
- Bidder shall give at least 2 weeks' advance notice to BHEL/ Customer, 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.
- Bidder shall also furnish factory acceptance test (FAT) from manufacturers for BHEL/ customer approval.
- During fabrication/manufacturing or assembly, the equipment shall be subject to inspection by BHEL/SAPDC/SJVN or by an agency authorized by the owner to assess the progress of work as well as to ascertain that only quality raw material is used.
- Materials used for construction of major & important sub-assemblies shall be thoroughly shop tested and inspected by the Contractor at his own expense prior to dispatch. Shop test shall comprise of routine test & type tests (if applicable) as per the relevant section of the Technical Specification.

9. DRAWINGS & DOCUMENTATION

9.1. Documents to be submitted along technical bid

1. Bidder shall furnish following document / calculations of cable for following during tendering stage itself for information purpose. The same shall be reviewed and commented during contract stage only. (Bidder to note, deviations if any needs to be submitted in schedule of technical deviation only. Deviations submitted elsewhere in bid document / in any calculations shall not be considered.)

Sr	Name of Documents	
1	SCHEDULE OF GUARANTEED TECHNICAL PARTICULAR (as per attached format)	
2	Detailed Cross Section Drawing of Cable.	
3	List of Type Test Report	Details of Test object, test name, Test Lab, Report number & report date.
4	Requirement of Earthing & Bonding	
5	Calculation for Rated short circuit capacity for metallic sheath.	
6	Calculation for Rated short circuit capacity for Conductor.	
7	Calculation for Maximum & Average Electrical Stress on Conductor, Conductor screen	

	semiconductor layer, Insulation screen semi-conductor layer & Insulation	
8	Calculation for Screen/ sheath voltage under full load condition	
9	Calculation for Screen/ sheath voltage during an external three phase symmetrical through-fault.	
10	Details of System being offered for (section-2 clause 17.1.1.2) "Control, monitoring and related items and services Co-ordination and provision of necessary contacts and/or ports for integration with plant SCADA system."	
11	Suggested Cable Trench arrangement for 400kV XLPE Cable.	
12	Any other calculation / design document as applicable in line with technical specification and / or relevant section of IEEE / IS etc	

- 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 400KV system is solidly grounded.

9.2. Drawings / documents required for engineering manufacturing clearance

The drawings/ documents, as follows shall be used for providing engineering manufacturing clearance of the equipment (400KV XLPE Cable & its Accessories) and furthermore, it shall be used for delay analysis, if any from bidder. The schedule for submission and resubmission shall be in line with details provided in section-3. The successful bidder is required to submit drawings and documents that shall cover but not limited to the following:

LOT-1

Sl.	Description of Drawing
1	Cable Cross Section Drawings with Guaranteed Technical particulars
2	Type Test Report of Cable
3	Bonding / Earthing Cable Cross Section Drawings with Guaranteed Technical particulars
4	Design Calculations including cable sizing
5	Earthing / sheath voltage limitation study (Voltage Gradient)
6	Temperature rise calculations & Heat Losses
7	Sizing calculation & short circuit withstand capabilities of metallic sheath.
8	Cable Cutting & Cable Drum Schedule
9	OGA Drawing with Guaranteed Technical Particulars of Cable Drum
10	Quality Assurance Plan & Inspection Test Schedule of HV Cable

LOT-2

Sl.	Description of Drawing
1	OGA Drawing with Guaranteed Technical particulars of Termination Kits
2	OGA Drawing with Guaranteed Technical particulars of Straight Through Joints
3	OGA Drawing with Guaranteed Technical particulars of Link Box
4	Type Test Report of Cable Termination, Jointing Kit & Link Box
5	Quality Assurance Plan & Inspection Test Schedule of HV cable accessories

In addition to above, following documents are to be submitted during detailed engineering stage as per project requirement.

1	Cable Laying Technique criteria (Flat / Trefoil)
2	Loading Distribution on Foundation / Bracket
3	OGA / Cable Layout (Plan & Section) for Cable installation
4	Foundation / Clamp / Brackets drawings for cable laying
5	Arrangement of XLPE Cable Trench in Cable Tunnel
6	Cable Termination Arrangement
7	Sheath Earthing / Cable Earthing Arrangement including accessories
8	Cable Laying & handling Procedure document
9	XLPE Testing Procedure document
10	Component wise weight schedule, lifting arrangement & safety arrangement
11	All Electrical & Control Drawings such as Electrical Panels OGA, Cable Block & Termination Diagram, Schematic Diagram, JB/MB/Kiosk Diagram etc. in respect of XLPE
12	Erection Procedure documents along with all the drawings pertaining to this section
13	Technical Datasheet & Catalogue of every component used under this chapter.
14	Any other document required to meet technical requirement in line with relevant IS/ IEC code / technical specification.

10. QUALITY PLAN

The successful bidder shall submit Quality Assurance Plan in line with reference QAP attached in Section-2 for the equipment (400KV XLPE Cable & its Accessories) etc. with in-process inspection methods, tests, records, etc. for BHEL/ Customer approval. Customer hold points will also be included in the plan, which shall be mutually agreed by the BHEL/ Customer. In case bidder has reference Quality Assurance Plan agreed with BHEL/ Customer, same shall be submitted for specific project to BHEL/ Customer approval. There shall be no commercial implication to BHEL/ Customer 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 (400KV XLPE Cable & its 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 (400KV XLPE Cable & its Accessories) shall be deemed to be included in bidder's scope.

- a) During fabrication/manufacturing or assembly, the equipment shall be subject to inspection by BHEL/SJVN/SAPDC or by an agency authorized by the owner to assess the progress of work as well as to ascertain that only quality raw material is used.

Note-Inspection and testing shall be done as per of section-3 of technical specification. However, any other test not mentioned but required as per relevant IEC/IS shall also be performed.

11. DEFECT LIABILITY AND LATENT DEFECT:

Please refer techno-commercial terms and condition of tender enquiry. However, the minimum defect liability period shall be Twenty-Four months (24) months from the date of completion of the facilities (or any part thereof) or eighteen (18) months from the date of operational acceptance/taking over of the facilities (or any part thereof), of respective unit/ common auxiliary whichever period concludes earlier. Please refer relevant paragraph of Section-3 of technical specification for details.

12. PACKING AND DISPATCH

1. Cables & Accessories shall be packed in Export-Worthy / Sea Worthy Packing (Refer Annexure-F). 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 to IS:7098 (Part-3)
 - 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 reel, 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 IS 1554 (Part-1) for PVC insulated or IS 7098 (Part-2) for XLPE insulated cables.
 - f. Sequential length mark shall be provided at each metre along with the above markings.
 5. Cables shall be supplied in drum lengths of 350meters unless otherwise specified. However exact drum lengths shall be finalised during order execution. Due consideration shall be given to the route length & proposed screen bonding scheme to finalise drum lengths. A tolerance of +3% shall be permissible for each drum. However overall tolerance on each size of cable shall be limited to +2%.
 6. 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.
 7. 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 1 year).
 8. The packing, marking and documentation within and outside the packages shall comply strictly with such special requirements as shall be expressly provided for in the Contract and, subject to any subsequent instruction ordered by the Employer consistent with the requirements of the Contract as per relevant Clause of Section 2 & Section-3.

13. DEFINITIONS USED

The following expressions hereunder and elsewhere in the technical specification used and their grammatical variations shall unless repugnant to the subject or context thereof, have the following meanings hereunder respectively assigned to them, namely:

1. Battery Limit: The demarcated area within which the Unit is to be located.
2. Bid/Bidding Documents: The totality of the documents comprising the Bidding Document for the notice inviting tender.

14. 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,

GIS:	Gas Insulated Switchgear
DC:	Direct Current
HV:	High Voltage
EHV:	Extra High Voltage
kV:	Kilovolt
Hz:	Hertz
IP:	Ingress Protection
SAT:	Site Acceptance Testing
OEM:	Original Equipment Manufacturer
PE:	Poly Ethylene
BHEL:	Bharat Heavy Electricals Limited
QAP:	Quality Assurance Plan
BOQ:	Bill of Quantities
BIS:	Bureau of Indian Standards
BS:	British Standard
EPR:	Ethylene Propylene Rubber
FR:	Flame Retardant
HR PVC:	Heat Resistant Polyvinyl Chloride
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
PVC:	Polyvinyl Chloride
UV:	Ultra Violet
XLPE:	Cross-linked Polyethylene

15. **LIST OF DOCUMENTS/ DRAWINGS:** Please refer **Annexure_Drawings**

Route.1

The Manufacturer of 400kV XLPE cable shall have designed, manufactured, type tested at least the minimum specified quantity of all equipment covered under the scope of this contract (ie 4550 meter of 400kV XLPE Cable) of at least the rating as specified herein under or higher in last 20 years and supplied equipment should be in successful operation for at least 2 years in last 10 years as on Scheduled Date# in Power Plant or Sub-stations or Industrial Complex etc.

Minimum rating required for criteria of the 400kV XLPE Cables (450A) should be **400kV Class, 270 A** (i.e 60% of rated current) in the current project requirement.

Remark –

Originally scheduled date of technical bid opening of this Tender.

Route.2

Alternatively, the manufacturer, who have established manufacturing and testing facilities in India based on technological support of collaborator and not meeting the requirement stipulated in (Route.1) above, can also be considered provided that,

a) Min. 400kV grade XLPE insulated Cable of at least 270 A rating must have been **manufactured & PQ tested as per IEC/IS standard** from the works where the cable is manufactured AND is ready to conduct the Type Tests before supply of the Cable.

AND

b) The collaborator meets the requirements stipulated in (Route.1) above. A valid collaboration agreement for technology transfer / license to design, manufacture, test and supply 400kV XLPE Cable shall be submitted."

21/11
30/07/2021

30/07-2021

30/07/21 30/07/21



Section-2

ARUN-III HEP

400kV XLPE CABLES

17.1 SCOPE OF WORK

Scope of work under this section covers the provision of labour, tools, plants, materials and performance of work necessary for the design, engineering, manufacture, quality assurance, quality control, shop assembly, testing, packaging & delivery, in plant transportation at site, erection / installation, testing, pre commissioning, successful commissioning, performance and acceptance testing, handing over to Employer as per the specifications hereunder, complete with all auxiliaries, accessories, spare parts and warranting a trouble free safe operation of the installation. The scope of work covered under this section shall be read in conjunction with General Technical specifications, Section-3

17.1.1 Detail scope of work

The scope of work shall be a comprehensive functional system complete in every respect including but not be limited to following:

17.1.1.1 400 kV XLPE cable

- i. Thirteen (13) nos. - single-phase, 400-kV, copper conductor, XLPE cables (including one spare cable of the longest length) for the interconnection of 400kV GIS Adaptor in transformer Hall to 400kV GIS in Pot Head Yard, each complete with all necessary auxiliary equipment and hardware. The tentative length of cable will be 4550 Meter.
- ii. Twenty (24) nos. – cable sealing end (SF6 to XLPE) suitable for terminating the cable for interconnection with GIS complete with all necessary fittings, accessories and hardware.
- iii. One (1) set of sealing arrangement for sealing the one (1) spare cable at both ends.

Remark - 1. Unloading of material at Store shall be provided by BHEL. 2. Closed & Open store shall be provided by BHEL including security of material.

- iv. One (1) set of bonding arrangement for the connection of the cable sheath to the grounding system.
- v. One (1) Lot of cable support system including cable trays / hangers, fixtures, hardware etc. for supporting all the cables along the entire length of cable.

The length mentioned is for evaluation of bid purpose only. The final length shall be decided after jointly with successful bidder as per the latest layout arrangement of power project.

17.1.1.2 Control, monitoring and related items and services

Co-ordination and provision of necessary contacts and/or ports for integration with plant SCADA system.

17.1.1.3 Common Supplies and services

- i. Drawings, documents and design calculations as per clause 17.6.
- ii. Shop, assembly, inspection & tests as per clause no. 17.7.
- iii. Packaging, handling and site storage as per clause no. 17.8.
- iv. Delivery, installation and commissioning as per clause no. 17.9.
- v. Tools and instruments as per clause no. 17.10.
- vi. Spare parts as per clause no. 17.11
- vii. Field/touch-up painting including all painting materials.

17.1.1.4 Completeness of System

Any other item (s) not mentioned specifically but necessary for the satisfactory completion of scope of work defined above, as per accepted standard (s)/best international practice.

17.2 STANDARDS & REGULATIONS

The design, manufacture and testing of the various equipment covered under this specification shall comply with the requirements of the latest edition of the relevant IEC/IS/IEEE/ISO standards only. Preference for latest IEC standards for particular equipment / system shall be governed over IEEE/ IS/ ISO standards. Further rules, guide lines and standard laid down by international/ national agency shall be applicable in this specification.

The relevant abstract (in soft / hard copy) of all referred standards shall be provided free of cost during engineering stage for facilitating review/ approval of submitted drawing/documents.

17.3 PARAMETERS& GUARANTEES

17.3.1 Layout and General Arrangement

For the interconnection between 400kV GIS adaptor in Transformer Hall and the 400 kV GIS in Pot Head Yard, Twelve (12) nos. of single-phase 400 kV XLPE cables shall be provided. The laying of cable shall be in cable cum ventilation tunnel in flat/trefoil formation.

In addition, one single-phase 400 kV XLPE cable shall be provided and shall be laid with sufficient slack as spare cable with a total length equal to that of the longest cable used for connection. The spare cable will be laid in such a way that it can be pulled to any termination position without disturbing the other Twelve [12] cable lengths.

The spare cable length will be laid without termination, with suitable sealing at both ends.

The spare end terminations will be stored separately and will be used whenever spare length is required to be put into service depending on shelf life. The laying of spare cable shall be designed so as to be used in any equipment without cutting and without exceeding the specified bending radius.

17.3.2 Type and Rating

Sr.No.	Particulars	Unit	Value/Remarks
1	Rated System Voltage	kV	400
2	Highest System Voltage	kV	420
3	Number of Phases	Nos	3
4	System Frequency	Hz	50±5%
5	System Earthing		Solidly Grounded
6	Rated normal current at nominal voltage (400kV)	A (rms)	450 A

7	Rated Peak withstand current	kA	125
8	System fault current for one second	kA	50
9	Rated withstand voltage to earth of cable and cable sealing s		
	- 60 minute power frequency	kV	440
	- Lighting impulse	kVp	1425 (1.2/50)
	- Switching impulse	kVp	1050 (250/2500)
10	Nominal Cross section area of conductor	mm ²	500
11	Type of Conductor		Copper
12	Internal Semiconductor		XLPE semi-conductor shield
13	Insulation		XLPE
14	External Semiconductor		XLPE semi-conductor shield
15	Metallic Sheath		Corrugated/Aluminum/ Corrugated copper/ Welded aluminum/laminated aluminum
16	Outer sheath		PE with HFRR Layer
17	Creepage distance for termination	Mm/kV	25
18	Max permissible operating temperature of the conductor at rated continuous current	°C	90
19	Short Circuit Temperature	°C	250
20	Daily Load	Hours	24
21	Sheath voltage under full load condition to	V	180 (Max)

	ground		
22	Laying Method		Flat/trefoil formation in cable tunnel
23	Design Ambient Temp	°C	40
24	Min ambient Temp	°C	-4

17.3.3 Operating conditions

Normal operation shall be defined as operation with operating parameters within the following ranges:

Grid parameter	Normal range
Voltage	90 % to 110 % of rated value
Frequency	47.5 Hz to 52.5 Hz

17.3.4 Performance Guarantee

17.3.5.1 The bidder shall guarantee the following parameters of 400kV cables and the same shall be supported by calculations submitted along with the bid. The values of these parameters shall be indicated in the Guaranteed and other Technical Particulars.

- i) Power loss in conductor and in metallic sheath from GIS adapter bushing termination upto GIS termination in Pot Head Yard per length of 400kV single core 500mm² cables while carrying continuous rated current.
- ii) Dielectric power loss from GIS adapter bushing termination upto GIS termination in Pot Head Yard per length of 400kV single core 500mm² cables, while carrying continuous rated current.
- iii) The temperature rise for conductor and insulation/sheath while carrying continuously rated current
 - a) For conductor
 - b) For cable insulation / sheath
- iv) DC resistance of conductor at 20⁰ C (Firm value without tolerance).
- v) Skin Effect Factor.

- 17.3.5.2 The total losses listed in the Guaranteed and other Technical Particulars by the bidder shall be the losses in KW basis of 420 kV cables by considering cumulative length of 4550 meter.. The calculation in support of stated value of guaranteed total power losses for conductor, sheath and dielectric shall be submitted along with the bid.
- 17.3.5.3 The losses indicated in the Guaranteed and other Technical Particulars shall be firm. To verify the actual losses, the actual DC resistance shall be measured to calculate the AC resistance of the cable, using factors as given in IEC 60287. Further, the actual loss angle (dielectric loss) and other parameters shall also be measured during testing. The actual losses may then be determined based on these measured/ calculated values. If the actual calculated losses are found to be more than the values guaranteed, penalty will be imposed on the Contractor at the rate of Rs. 250000 for each kW and its fraction of excess in losses for actual length of cable.
- 17.3.5.4 The Employer reserves the right to reject the cable if the actual calculated losses exceed >10% of the guaranteed losses quoted by the bidder
- 17.3.5.5 Minimum accepted Guarantee for the Total Losses (Copper Losses + Dielectric Losses etc.): 113 kW for 4550 meter (at rated current 450A)
- 17.3.5.6 The Contractor shall have to make good and meet the guarantees in case of shortfall in test values vis-à-vis guaranteed values. One month, will be given to the Contractor for the same for rectification and re-demonstration at works. Delay on account of Rectification process shall not affect the overall project schedule. Imposition of penalty on account delay due to rectification shall be governed by respective clauses of Contract.

17.4 DESIGN AND CONSTRUCTION

17.4.1 Design considerations

The cables shall be capable of carrying the specified rated current continuously without exceeding the specified temperature limitations. Sheath voltage under full load condition shall not exceed 180V to ground at termination. Sheath shall be solidly grounded at the switchgear end. The charging current of the cable shall be as low as

possible.

The 400 kV systems will be solidly grounded. Cables will be protected from over voltages caused by lightning strikes or switching surges by means of station type lightning arresters located in the pot yard.

The manufactured length of each cable shall be the responsibility of the contractor who shall determine exact requirements to enable installation of the cables from terminal to terminal without resorting to cable splices and other corrective measures in order to ensure a satisfactory installation.

Contractor shall satisfy itself before commencing manufacture as to the exact lengths of cables required.

Additional cable lengths required for test samples shall be provided by the contractor

17.4.1.1 Mechanical Aspects

Design of 400 kV XLPE Insulated Power Cable systems shall be such that a life expectancy minimum of 35 years is achievable.

The 400kV XLPE Insulated Power cables for all the circuits shall be installed in the same tunnel, which is naturally ventilated and/or forced ventilation cooling is envisaged.

Each 400kV XLPE Insulated Power Cable of single core 500 mm²size shall be supplied in single length. The exact length of each cable shall be finalized during detailed design stage. The cable joints between end terminals shall not be permitted at initial stage.

Laying arrangement of 400 kV XLPE Insulated Power cables shall be such as to achieve optimum space saving, neat and logical arrangement when laid in horizontal snaking formation. The routine inspections and possible repairs for all elements shall be accessible without removing support structures.

The 400kV cables shall be securely supported for the entire length with suitable cable cleats to maintain continuous equal space between the cables laid in horizontal snaking formation.

Cables shall be supported on suitable cable supporting arrangement of galvanized steel in such a way so as to avoid development of any type of stress in the cable. The laying of cables shall be in a horizontal snaking formation to absorb the thermal expansion and contraction of the cables. Necessary calculations in this regard shall be furnished during design stage.

The ambient temperature at project site varies between (+) 4°C to (+) 35°C. The relative humidity varies between 35% to about 100%. These conditions along with the other climatic and high altitude parameters, as specified in other

All the accessories shall be identical allowing for interchangeability within and between the accessories.

The cable system shall withstand the electro mechanical forces due to short circuit and earth fault currents including superimposed seismic forces.

All accessories of power cables shall be capable of withstanding the specified seismic forces along with short circuit forces.

17.4.1.2 Electrical Aspects

The 400kV cables and accessories shall be suitable for bi-directional flow of power, under isolated/parallel operation with other circuits of the system and connected to grid system according to loading cycle of Arun-3 H.E. Project, Nepal.

All lengths of 400kV cables and accessories shall be capable of continuous operation at the maximum rated current without exceeding the maximum conductor temperature as specified in Clause 17.3.2 of this specification.

Thermal rating for all current carrying parts of the cable system shall be suitable for the normal rated current and for the rated symmetrical short circuit current of 50 kA for duration of 1second. If the maximum short circuit time be extended, the $I^2 t$ value shall remain constant where I =Short circuit current in Ampere and t =duration of short circuit in seconds.

The contours of energized metal parts of the 400 kV cable end terminations shall be such as to eliminate areas/points of high electrostatic flux concentrations. Surfaces shall be smooth with no projection or irregularities, which may cause visible corona. No corona shall be visible in complete darkness when the accessories are subjected to the specified tests.

Metal cleats and spacers/saddles for the 400 kV cables and other metal parts, which are subject to eddy currents induced by the cable current, shall be appropriately earthed and shall be of non-magnetic material.

17.4.1.3 Seismic Design criteria

The cable end terminals and supporting structures shall be designed for operation in seismic zone four for earthquake resistance. The seismic forces due to the horizontal and vertical accelerations may be assumed to act non-concurrently. The coefficients for horizontal acceleration as 0.24 g and vertical acceleration as 0.16 g shall be used for design purposes. The seismic forces shall be equal to static loads corresponding to the weight of the parts / accessories multiplied by the acceleration coefficients.

The supporting structures for 400 kV cables and accessories shall be strong enough to withstand all the forces in normal operation and in abnormal conditions with forces superimposed due to occurrence of earthquake. The design calculations for cable accessories and support structures by simulating the site parameters shall be furnished by the Contractor during detailed design stage.

To prevent the movement of cable accessories during earthquake, suitable devices shall be provided for fixing the assemblies to the foundations. The bidder shall include necessary bolts and fittings for embedding in the concrete foundations in the scope of supply.

17.4.2 General Requirements

The cable shall conform to IEC-62067. The cable shall consist of 400kV Grade single core 500sq.mm Compacted Circular copper conductor, XLPE dry cured insulation, extruded semi conducting compound insulation screen, bedding of swellable type water blocking semi conducting tape(s), copper wire screen with copper binder tape (as per requirement), laminated or extruded aluminium metallic sheath and extruded flame retardant Polyethylene (P E) outer sheath.

The conductor screen, insulation and insulation screen shall be extruded in one operation of triple extrusion process, so as to obtain continuously smooth interfaces between the insulation and screens.

The copper wire/tape screen and laminated/extruded aluminum metallic sheath shall be capable of withstanding the short circuit current of 50 kA for one second.

The cable shall be suitable for use in solidly earthed system.

Technical specification provides flexibility for bidder to choose the type of metallic sheets (corrugated aluminium sheets or flat aluminium / Copper / Lead alloy sheets with or without copper wired scheme, wire shield cable or Cu laminated cable etc) for XLPE cable fulfilling following conditions:- (1.) Metallic sheet shall be designed for fault level of 50kA for 1 Sec. (2.) Act as / Provide for Radial water barrier.

The cable shall be suitable for installation in underground tunnels and in concrete trenches in surface pothead yard, with restricted air circulation. The cable shall be capable to withstand all mechanical and thermal stresses under steady state and transient operating conditions.

Repair to the new cables shall not be accepted. Pimples, fish eye, blow holes etc. are also not acceptable.

Cable ends shall be sealed by heat shrinkable PVC/metal caps with pulling eye to prevent damage and ingress of moisture.

The Eccentricity of the core shall not exceed 10% and Ovality of the core shall not exceed 5%.

The Eccentricity shall be calculated as $(t_{\max} - t_{\min})/t_{\max} \leq 0.10$

The Ovality shall be calculated as $(d_{\max} - d_{\min})/d_{\max} \leq 0.05$

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.

17.4.3 Conductor

The conductor shall consist of plain annealed copper stranded wires in accordance with IEC-60228 or equivalent and the shape shall be circular, round and very well compacted to facilitate a smooth interface between conductor screen (shield) and the insulation. For segmented conductor, each segment shall be isolated with a separator tape & cabled together with a semi-conducting binder tape. The total cross-sectional area of copper conductor shall be 500mm². The conductor strand shall have smooth surface with no intermediate joint.

17.4.3.1 Conductor Screen(Shield)

Conductor screen shall consist of extruded cross-linked 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 which may deteriorate the cable's electrical performance for the specified voltage class. The material of conductor screen shall have the maximum resistivity of 1000 ohm-m.

17.4.4 Insulation

Insulation material shall be of extruded Cross Linked Polyethylene (XLPE). The insulation shall be free from any harmful void and contaminant which may deteriorate the cable electrical performance for the specified voltage class. The average thickness of insulation shall not be less than the nominal value guaranteed in the technical particulars. The minimum thickness of insulation at any point shall not be less than 95% of the guaranteed value.

17.4.4.1 Insulation Screen(Shield)

Insulation screen shall consist of extruded cross-linked semi-conducting compound and shall firmly be bonded to the insulation. The semi-conducting compound shall be free from any void and protrusion.

17.4.5 Bedding ##

Bedding shall consist of layer(s) of semi conducting tape(s) to absorb the thermal expansion and contraction of the extruded layers during operation with swelling compound to form water protection barrier 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.

17.4.6 Metallic Sheath

The metallic inner sheath shall consist of extruded or laminated aluminium tape/lead in accordance with relevant IEC or equivalent standards. The inner sheath shall be suitable to carry short circuit current of 50kA for one second. The calculations for sizing and short circuit withstand capability of the metallic sheath, along with copper wire screen & copper binder tape, shall be submitted during detailed design stage. The average thickness of sheath shall not be less than the nominal value specified in guaranteed technical particulars. However, the minimum thickness at any point shall not fall below 95% of the nominal value

17.4.7 Outer Sheath

Outer sheath shall consist of extruded black and flame retardant PE compound, in accordance with relevant IEC/IS. The average thickness shall not be less than the nominal value specified in the guaranteed technical particulars. However, the minimum thickness at any point shall not be less than 95% of the specified value.

17.5 AUXILIARY SYSTEMS AND MISCELLANEOUS COMPONENTS

17.5.1 Cable Identification/ Marking

At least the following clear markings shall be provided over outer sheath of the cable at an interval of one meter throughout the length of the cable by embossing:

- i. Rated voltage
- ii. Conductor size
- iii. Type of insulation
- iv. Manufacturer's name
- v. Year of manufacture
- vi. Employer's name
- vii. Sequential marking of length of cable in meters by embossing/printing.

The embossing/printing shall be progressive, automatic, in line and marking shall be legible and indelible.

17.5.2 Cable Identification Tags

In order to identify the phases and circuits, the identification tags shall be provided at each end of the cable as well as at an interval of 100m in the cable length for each phase and circuit number.

17.5.3 Cable Lengths And Cable Drums

The Cables shall be supplied in steel drums of heavy construction. The Cable drums shall be supplied with definite cable lengths to be decided during detailed engineering. Cable drums with shorter/longer lengths shall not be accepted.

17.5.4 Cable Accessories

17.5.4.1 Cable Terminations / Sealing Ends

The termination/sealing ends shall be located inside the underground transformer in one end to GIS adapter and other end to GIS at Pot Head Yard. The Bidder shall co-ordinate with the GIS Contractor in this regard, so that there shall be no mis match during installation/erection of the cables.

Each termination/sealing end shall be complete with all fittings, supporting structures, earthing, accessories, consumables etc. as required for erection, testing and commissioning.

The housing of the indoor termination/ sealing end shall be of epoxy/porcelain insulator type suitable for use with 400 kV GIS and shall have sufficient strength against mechanical, electrical and thermal stresses.

The 400kV cable Contractor shall supply all the required fittings, supporting structures, accessories and consumables in order to connect the termination assembly of cables to GIS.

The design and manufacturing of the termination assembly shall be done in latest standards. The Contractor shall coordinate with the Contractor of GIS to complete the termination work.

The cable termination sealing ends shall be suitably double earthed with the earth mat risers, provided by the Employer, in the vicinity of the equipment.

17.5.5 DISCONNECTING LINK BOX (Cable Covering Protective Unit -CCPU)

The cable screen/metallic sheath connections with grounding system shall be bolted type. The connecting bar and disconnecting link shall be of copper. The arrangement shall be installed in a watertight box having degree of protection of IP 55. Disconnecting links shall be provided to sealing ends to facilitate periodical checking of the integrity of the outer sheath.

The terminal end shall have suitable type of disconnecting link box known as Cable Covering Protective Unit (CCPU) to disconnect the earthing circuit during testing with sheath voltage limiter. The GIS adapter side terminal end shall have disconnecting link box (CCPU) for direct earthing.

The disconnecting link box shall be mounted on galvanized supporting steel structure and provided for each circuit individually. The protective device (sheath voltage limiter) shall be of non-liner resistor type and shall be made of zinc oxide compound.

17.5.6 Bonding Cable

Bonding cable shall be used for earthing the metallic sheath of 400kV Cable and as an earth continuity wire, equalizing earth level between disconnecting links. Construction and materials of bonding cable shall comply with relevant IEC or equivalent standards and the cross-sectional area shall be chosen so as to withstand the short circuit rating of the cable system. The calculations for selecting the size of bonding cable shall be furnished by the Contractor during detailed design stage.

17.5.7 Termination/ Sealing End Supporting Structure

Supporting structure for indoor termination/sealing end shall consist of galvanized steel members. The supporting structure shall be designed and supplied, complete in all respects, with all necessary embedments, hardware, earthing materials etc. The

zinc coating shall be uniform, clean, smooth and free from spangle as possible. All galvanizing shall comply with the requirements of the relevant IEC / IS Standards.

17.5.7 Cable Racks Supports and Accessories

The 400 kV cables from the Transformer Hall to 400KV GIS shall be supported on supports of galvanized steel. The cable supports shall be designed and supplied complete in all respects with necessary embedments, hardware, Cable spacers, stainless steel blocks/ saddles to snaking the cable, cable earthing materials etc. The Cable support system shall be designed to withstand the static and dynamic loads of required no. of cables laid on each rack. All galvanizing shall comply with the requirements of the relevant IEC/IS standards. The provision for one cable rack for future requirement shall be made in the cable support system to be supplied under this package.

Design of support structure at both side of termination end of 400kV XLPE cable are also in bidders scope.

17.3.1 400 KV Cable Cleats

Each cable shall be clamped with single way aluminum cleats at each support. The material of cleats shall be aluminum alloy in accordance with relevant IEC / IS or equivalent standards and the cable cleat shall be designed for the type, rating and diameter of cable to be cleated, as required.

17.5.9 Foundations & Fixtures

If required, foundations of the equipment shall be prepared by the Employer on the basis of data supplied by the Contractor. All bracket supports, fixtures / inserts etc. necessary for proper erection of embedded parts shall be supplied by the Contractor. The Contractor shall depute to project site his authorized person (s) for supervision of work of providing of embedments etc. wherever required & shall ensure the correctness of the same. Employer shall not be responsible for correctness of embedments. If during erection, any change is required in the embedments, the same shall be done by Contractor at his cost.

17.5.10 Painting

Before dispatch, the surface of all material, to be painted, shall be cleaned, filed, if necessary, and painted with suitable priming coat. The cable supporting system members, which shall be inaccessible after installation, shall be finally painted at works before dispatch. All other cable supporting members shall be finally painted at site by the Contractor after installation. Necessary quantity of paint for this purpose shall be supplied by the Contractor.

Painting shall be applied to clean surface free from dust, oil, moisture and other foreign materials. The details of equipments/members to be painted shall be supplied by the Contractor.

The Contractor shall apply one (1) coat of finish paint to the metal surface of & associated equipment at site, which is already painted with one (1) coat of finish paint and rust preventive paints at the manufacture's works. The supplier shall also perform repair and finish coating on parts of shop-coated equipment which get damaged during transportation or installation work.

17.6 DRAWINGS, DOCUMENTS AND DESIGN CALCULATIONS

17.6.1 Drawings and documents

After award of contract, the contractor shall furnish all drawings, documents, design calculations, data, manuals & other necessary literature, pertaining to equipment offered by them & so specified under various clauses, in accordance with Technical Specification and relevant IEC & International codes.

. A comprehensive list of all such drawings/documents planned to be submitted for reference/approval shall be provided beforehand for approval .

The list of drawings & documents to be furnished for approval / reference shall not be limited to the following:-

- i) Drawings, documents, design calculations literatures, manuals etc.
- ii) Drawings, documents, design calculations, literatures, manuals
- iii) Detailed quality assurance plan, giving complete specifications of the materials and specifications relating to inspection and testing of materials and finished components.
- iv) All drawings having bearing on civil foundations, equipments foundation details and loads
- v) Arrangement, installation, foundation, plan, section, detailing of main equipment and sub-assemblies including control & instrumentation system.

- vi) All Electrical, Hydraulic & Control Drawings such as Electrical Panels OGA, Cable Block & Termination Diagram, Schematic Diagram, JB/MB/Kiosk Diagram etc. in respect of this section.
- vii) All manufacturing drawings not specifically covered under approval/reference category shall be submitted for record and facilitate inspection of the component in the shop and assembly at site.
- viii) Detailed drawing of cable drum, disconnecting link boxes with and without SVL.
- ix) Any other drawings, documents, design calculations, literatures, manuals etc. not covered anywhere in the specification, but required to be furnished for approval / reference of employer for suitability of design to fulfill the scope of work.

17.7 SHOP ASSEMBLY, INSPECTION AND TESTS

All Type, Acceptance and Routine tests on Cables, Accessories and support systems shall be carried out as per specification and relevant standards. The Type tests, Routine tests and Acceptance tests on 400 kV Cables and Accessories shall be carried out as per IEC 62067, Technical specifications and other relevant standards.

17.7.1 Type Test

The Type tests as listed in **Schedule VI** shall fall under Category –I. These are to be conducted to demonstrate that the cables and accessories offered meet the requirement of specifications.

17.7.2 Routine Tests

The following Routine tests shall be conducted on samples of manufactured cables and on components of accessories in order to verify that the finished products meet the requirements of specifications.

- a) Conductor examination
- b) Measurement of electrical resistance of conductor
- c) Measurement of thickness of XLPE insulation and over sheath
- d) Measurement of thickness of metallic sheath
- e) Measurement of diameter
- f) Hot set test for XLPE insulation
- g) Measurement of capacitance
- h) Lightning impulse voltage test followed by a power frequency Voltage test

- i) Water penetration test
- j) Determination of losses .

The following Routine tests shall be carried out on all finished cables and associated accessories before dispatch at the manufacture's works:

- a) Check of dimensions
- b) Conductor resistance and capacitance test
- c) AC high voltage test as per relevant IEC/IS
- d) Partial discharge test as per relevant IEC/IS
- e) Electrical Tests on outer sheath as per relevant IEC/IS

17.8 PACKAGING, HANDLING AND SITE STORAGE

Seaworthy / Export worthy packing is included in bidder's scope.

Immediately after the completion of tests at works cable ends shall be sealed by heat shrinkable PVC/metal caps with pulling eye both ends of the cables to prevent the ingress of moisture, dirt and insects. Each length of cable shall be supplied on a seaworthy robust steel drum.

Drums or parts of drums made from ferrous metals shall be treated with suitable rust preventive finish or coating to avoid rusting, during transit or storage.

Cable accessories, cable support systems and other associated items shall be packed in robust wooden or suitable cases. Hydrophobic materials shall be duly protected from sea water or rain during transportation and storage.

The bonding cable shall be supplied on wooden/steel drum.

Shipping dimensions of cable drums shall be as large as practicable but within transport limitations as specified elsewhere in the Bidding Document.

The construction of cable drums shall be suitable for convenient handling of drums during loading/unloading, in transit and storage & laying at site. The cable drums shall be suitable for wheel mounting.

The Contractor shall indicate the methods of storage of cable drums and accessories at site during the detailed design stage.

A label shall be attached to each reel, giving the Employer's order number, length of cable, size of conductor, thickness of insulation, cable designation in accordance with these specifications, shipping weight dimensions as well as project particulars.

The Contractor shall indicate the methods of storage of cable drums and accessories at site during the detailed design stage.

17.9 SITE INSTALLATION AND COMMISSIONING

17.9.1 Installation procedure

The Contractor shall follow the construction methodology and installation procedure recommended by the cable manufacturer and shall arrange all the necessary erection tools/devices required for installation of cables such as cable rollers, cable pullers, motorized winches, power packs, two-way communications and safety devices etc., as per manufacturer's standard practices for installation of the cables.

17.9.2 Field Tests

Following tests shall be conducted after laying of cables and installation of accessories in accordance with relevant IEC or equivalent standards:

- a) High voltage AC resonant type Test / UOo voltage for 24 hours.
- b) Partial discharge measurement test
- c) DC Voltage test of the oversheath.

17.9.3 Performance Testing

If nothing unusual has been observed in load run and load rejection tests, the test service period of 72 hours shall follow. During this test service period, the unit must operate continuously at rated condition without any interruption except of those beyond the control of the Contractor. However, such interrupted period shall not be counted for in the test service period. There should be one month reliability run of the complete unit reckoned from the date of taking over by employer. During reliability run, machine shall be operated by employer and any problem observed during this run shall be attended by the contractor including replacement of components and providing requisite manpower.

17.10 TOOLS AND INSTRUMENTS

All special tools, tackles, slings, testing instrument etc. required for handling, pulling, laying, installation, testing and commissioning of 400 kV cables, accessories and cable support systems, shall be arranged by the Contractor. Erection, testing and commissioning tools/tackles and testing instruments, to be arranged by the Contractor, shall include but not limited to the following:

- a) Special tools required for laying, installation and dismantling of the 400kV cables, accessories and cable support systems.
- b) The HVAC testing kit and partial discharge measurement equipment for field tests.

- c) Any additional requirement of erection tools, testing instrument etc. for erection, testing and commissioning shall be met by the Contractor without any extra cost to the Employer.

17.11 SPARE PARTS

The spare parts are meant for use by the Employer during operation and maintenance stage and shall not be used as erection spares required during installation.

17.11.1 Mandatory Spare Parts

The Contractor shall supply the mandatory spare parts as per Bid Price Schedule

17.11.2 Recommended Spare Parts

The Contractor shall furnish the list of recommended spare parts at Schedule-IV.

420kV XLPE Cables: Schedule of documents

INDEX

Sr. No.	Schedules for 400kV cables	Page. No.
i.	deleted	
ii.	Schedule of Guaranteed Technical Particulars	3
iii.	deleted	
iv.	Schedule of Recommended Spares	11
v.	deleted	
vi.	Schedule of Type Test	13
vii.	deleted	

SCHEDULE-II

SCHEDULE OF GUARANTEED TECHNICAL PARTICULAR

Sr. No.	Description	Unit		Bidder to Specify
A.	400 kV Cables			
1	Manufacturer's name & Country of origin			
2	Standards 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 cores per cable			
7	Rated Voltage*	kV		
8	Highest system voltage*	kV		
9	Rated continuous current*	A		
10	Rated short-time current withstand capacity for 1 second			
a)	For conductor*	kA		
b)	For metallic sheath	kA		
11	Electrical stresses (AC Voltage) Short circuit forces*			
a)	On conductor			
i)	Average	kV/mm		
ii)	maximum	kV/mm		
b)	On conductor screen semi-conductor layer			
i)	Average	kV/mm		
ii)	Maximum	kV/mm		
c)	On insulation screen semi-conductor layer			
i)	Average	kV/mm		
ii)	Maximum	kV/mm		
d)	Insulation			
i)	Average	kV/mm		
ii)	Maximum	kV/mm		
12	Rated frequency	Hz		
13	Insulation level*			
a)	One minute Power Frequency withstand voltage	kV (rms)		
b)	1.2/50 micro-second lightning impulse withstand voltage	kV (peak)		

c)	250/2500 micro-second Switching impulse withstand voltage	kV (peak)		
14	Temperature*			
a)	Max. temperature rise over ambient temperature of the conductor at rated load	°C		
c)	Heating time constant when cable is switched on			
d)	Maximum permissible operating conductor temp. at 10% continuous over load			
i)	From zero load (cold condition) to a load of continuous current and corresponding conductor temperature	Seconds		
ii)	From zero load (cold condition) to a load of maximum continuous current to attain 90°C temperature, keeping the load constant	Seconds		
15	Power losses*			
a)	Guaranteed Power loss in conductor in each cable length of 350m at rated voltage and current	W		
b)	Guaranteed Dielectric power loss in each cable length of 350m at rated voltage and current	W		
c)	Guaranteed power loss in metallic sheath in each cable length of 350m at rated voltage and current	W		
d)	Guaranteed total power loss in each cable length of 350m at rated voltage and current (a+b+c)	W		
e)	Maximum permissible iron losses in supporting structures	W		
16	Maximum total power losses per meter*	W		
17	Conductor details			
a)	Type			
b)	Material and shape			
c)	Cross-sectional area	mm ²		
d)	No. of strands/Diameter of each strand	No./mm		
e)	Weight of copper in cable	Kg/m		
f)	Current density in conductor	A/mm ²		
g)	Conductivity of conductor	Mho/m		
h)	Ultimate tensile strength of conductor	N/mm ²		
i)	Maximum short-circuit current rating & duration	kA/sec.		
j)	Impedance of conductor per meter	Ω		
k)	Resistance per meter	Ω		

i)	DC at 20°C			
ii)	AC at 20°C	Ω		
18	Conductor screening			
a)	Material			
b)	Thickness	mm		
c)	Maximum size of protrusion	μm		
d)	Electric stress level			
	i) Maximum	kV/mm		
	ii) Average	kV/mm		
e)	Maximum resistivity*	$\Omega\text{-m}$		
19	Insulation details			
a)	Material			
b)	Thickness	mm		
c)	Relative permittivity			
d)	Dielectric loss angle (at rated voltages at 20°C & 90°C)			
e)	Insulation resistance constant	$\Omega\text{-cm}$		
f)	Elongation	%		
g)	Tensile strength	N/mm ²		
h)	Thermal resistance between conductor and sheath	km/W		
i)	Thermal resistance of outer sheath	km/W		
20	Insulation screening			
a)	Material			
b)	Thickness	mm		
c)	Maximum size of protrusion	μm		
d)	Electric stress level			
i)	Maximum	kV/mm		
ii)	Average	kV/mm		
e)	Maximum resistivity*	$\Omega\text{-m}$		
21	Bedding (cushion layer)			
a)	Material			
b)	Total Thickness	mm		
22	Metallic 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)	Diameter of cable over Metallic sheath	mm		
h)	Mutual inductance between conductor and sheath	mH/km		
i)	Resistance per meter			
	a) DC at 20° C	Ω /m		
	b) AC at 20° C	Ω /km		
23	Outer sheath			
a)	Material			
b)	Type			
c)	Thickness	mm		
d)	Colour			
e)	Oxygen index			
f)	Carbon black contents for PE	%		
24	Overall diameter of cable	mm		
25	Cable weight	Kg/m		
26	Inductive reactance per phase per meter at 20°C	Ω		
27	Capacitance per phase per meter at 20°C & 50Hz	μ F		
28	Effective AC resistance per phase per meter	Ω		
29	Surge impedance	Ω		
30	DC resistance at 20°C	Ω /km		
31	Maximum safe continuous current at ambient temperatures varying from (+)4°C to(+) 35° C	A		
32	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		
34	Cable burn through time at rated short circuit current	Sec.		
35	Corona Extinction voltage	kV		
36	Radio interference at 266 kV (rms)	μ V		
37	Skin effect factor*			
B.	400 kV Cable Accessories			
1	Indoor Termination			
a)	Name and country of manufacture			
b)	Type			
c)	Insulation medium			
d)	Type of interface			

e)	Is terminal type tested, if yes, to which standard?			
f)	Overall dimensions (LxBxH)	mm		
g)	Overall weight	Kg		
h)	Current rating			
i)	Normal	A		
ii)	Short circuit	kA		
2. a)	Disconnecting Link (CCPU)			
i)	Material and size			
ii)	Continuous current rating	A		
iii)	Momentary current rating	kA		
b)	Earthing Devices			
i)	Earthing conductor			
-	Material & size			
-	Continuous current rating	A		
-	Momentary current rating	kA		
ii)	CCPU Cable link Box			
-	Material			
-	Size & weight			
-	Protection code			
iii)	Technical particulars of LA (SVL)			
-	Type			
-	Rated voltage	kV		
-	Voltage limiting range			
-	Fault current rating for 1 second	kA		
-	Lightning impulse voltage withstand capacity	kV (peak)		
-	Power frequency withstand voltage	kV(rms)		
-	Momentary current rating	kA		
-	Continuous current rating	A		
-	Residual voltage	V		
3	Cable drums			
a)	Flange diameter	mm		
b)	Drum diameter & width	mm		
c)	Drum weight	Kg		
d)	Drum material			
e)	Spindle hole diameter	mm		
5	Supporting Structures			
a)	Cable Supporting Arrangement			
i)	Manufacturer's name			

ii)	Material			
iii)	Whether magnetic or non-magnetic			
iv)	Minimum yield point			
v)	Maximum span between the supports	M		
vi)	Maximum temperature rise under steady state condition at maximum continuous rated current	°C		
vii)	Maximum potential rise in the event of short-circuit	V		
b)	Terminal End Supporting Structure			
i)	Material/ Composition of material			
ii)	Reference standard			
iii)	Minimum guaranteed yield point			
iv)	Ultimate tensile strength			
v)	Base dimensions			
vi)	Weight & size of each member of supporting structures	Kg		
c)	Saddles, cleats, clamps, bolts and nuts			
i)	Material/composition of material			
ii)	Minimum tensile strength of bolts	kg/sq.cm		
iii)	Proof load at nuts			
iv)	Minimum creepage distance of porcelain bushing	mm /kV		
v)	Maximum permissible pressure of Oil gas in outdoor termination			
vi)	Designed pressure of Oil gas for outdoor termination			
vii)	Max. permissible pressure of SF6 gas in indoor termination			
viii)	Designed pressure of SF6 gas in indoor termination			
ix)	Permissible tension for outdoor termination	Kg/mm ²		
x)	Permissible tension for indoor termination	Kg/mm ²		
6	Bonding Cable			
i)	Material			
ii)	Size	mm ²		
iii)	Type of bonding			
iv)	Current carrying capacity	A		
C.	Other Information			
1	Details of interface			

a)	Max. force at interface			
	- Tensile			
	- Compressive			
b)	Tolerance on positioning of flanges			
c)	Earthing arrangement			
2	Minimum recommended clearance			
a)	Between the cable	mm		
b)	Between the racks	mm		
3	Details of cable end sealing, cable clamping arrangement etc.			
4	Details of cable handling, laying and pulling device			
5	Weight and dimensions of shipping packages			
a)	Name and shipping weight of the heaviest package of cable drums etc.	kg		
b)	Name and dimensions (LxBxH) of the largest package	m		
c)	Shipping weight of all special cable laying, handling devices, wrenches and tools etc.			
d)	Shipping weight and dimensions of each XLPE cable end termination	m		
e)	Maximum length of 400kV, single phase, single core of 1200mm ² copper conductor XLPE insulated power cable which can be supplied in single length			
f)	Standard length	m		
6	Designed life of cable	Years		
7	Cable loading			
i)	Continuous over loading at one go			
ii)	Total hours of emergency to which cable can be loaded during its life			
8	Any other item/information not covered above			

Date:

Place:

Signature of Bidder

Name:

Status

Whether authorized attorney

Of tendering company

Name of Tendering Company

SCHEDULE-IV

SCHEDULE OF RECOMMENDED SPARES

Sr.No.	Description	Unit	Quantity

Date:

Place:

Signature of Bidder

Name:

Status

Whether authorized attorney

Of tendering company

Name of Tendering Company

SCHEDULE-VI
SCHEDULE OF TYPE TEST

Sr.No.	Description of Test
1	Check on insulation thickness as per IEC 60811 (check of cable construction)
2	Tan δ measurement.
3	Partial discharge test after complete assembly of end terminations - At ambient temperature - At high temperature (90°C) -
4	Cable bending test followed by partial discharge test at ambient temperature.
5	Switching impulse voltage withstand test as per IEC 60230/62067
6	Lightning Impulse voltage withstand tests followed by power frequency voltage test as per IEC 62067/6023
7	Ageing treatment as per IEC 60811
8	Tests for determining the mechanical properties of XLPE insulation and outer sheath (PE) before and after ageing
9	Heat cycle voltage test as per IEC 62067
10	Flame retardant test on outer sheath (Test under fire condition)
11	Insulation shrinkage test
12	Measurement of resistivity of semi-conducting screens as per IEC 62067.
13	Conditioning & mechanical test as per IEC 60811
14	Pressure test at high temperatures on over sheaths
15	Hot set test for XLPE insulation.
16	Measurement of carbon black contents in PE outer sheath.
17	Water penetration test. hardness of outer sheath
18	Measurement of hardness of outer sheath

19	Abrasion test on outer sheath.
20	Heat shock test on outer sheath.
21	Oil resistant test for outer sheath.

Date:

Place:

Signature of Bidder

Name:

Status

Whether authorized attorney

Of tendering company

Name of Tendering Company

Bill of Quantity of Supply and Spare Items for 400kV XLPE Cable of Arun 3 HEP Project - Rev 1				Date 19 July 2021		
Sno	Short Description	Detailed BOQ	Long Description	Unit	Qty	Remark
	CABLE					
1.01	SUPPLY- HIGH VOLTAGE POWER CABLE : XLPE INSULATED, COPPER (PLAIN) CONDUCTOR, PE WITH HFFR LAYER OUTER SHEATH 230/400KV SINGLE CORE, 500 SQMM SIZE	400 kV, 1Cx500sqmm, Copper Conductor, XLPE cables	XLPE, Copper conductor cable shall be complete in all respects and comprising of following but not limited to, 1. The cable construction shall as per technical specification. 2. The exact cable length shall be decided after visiting site & making precise measurements at contract stage. Manufacturing lengths and drum length shall be determined with consultation & approval with BHEL/ Customer/ Consultant. 3. Bidder shall furnish calculations of cable 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 system is solidly grounded. 5. Any other item/(s) required to complete the supply in all respects but not limited to above shall be in bidder's scope.	Meter	6000	Estimated qty for 12+1 (Spare) circuit length. The interconnection of "400kV GIS Adaptor" in transformer Hall to "400kV GIS" in Pot Head Yard
1.02	SUPPLY- HIGH VOLTAGE POWER CABLE : BONDING CABLE FOR EARTHING THE METALLIC SHEATH OF THE EHV CABLE	Bonding cable suitable for earthing/ bonding of metallic sheath of 400kV XLPE Cable.	1. Bidder shall submit the calculations for sizing of earthing/ bonding cable in such a manner that it can carry the earth fault current level of the system. 2. Any other item/(s) lugs/ connectors and other accessories required to complete the supply	Meter	100	Earthing arrangement between Cable to Link box will be covered in this scope. (ref. Section-2 Clause 17.5.6). Construction and materials of bonding cable shall comply with relevant IEC or equivalent standards and the cross-sectional area shall be chosen so as to withstand the short circuit rating of the cable system. The calculations for selecting the size of bonding cable shall be furnished by the Bidder during detailed design stage.
1.03	SUPPLY- HIGH VOLTAGE POWER CABLE : EARTH CONTINUITY CONDUCTOR	Earth continuity conductor between end terminations	1. Bidder shall submit the calculations for sizing of earthing/ bonding cable in such a manner that it can carry the earth fault current level of the system. 2. Any other item/(s) lugs/ connectors and other accessories required to complete the supply	Meter	1850	This shall be used as an earth continuity wire / equalizing earth level between disconnecting links / Link Box. (ref. Section-2 Clause 17.5.6). Earthing arrangement after Link box will be covered in this scope. Construction and materials of bonding cable shall comply with relevant IEC or equivalent standards and the cross-sectional area shall be chosen so as to withstand the short circuit rating of the cable system. The calculations for selecting the size of bonding cable shall be furnished by the Bidder during detailed design stage.
	CABLE ACCESSORIES					
2.01	SUPPLY- HIGH VOLTAGE POWER CABLE : INDOOR/ OUTDOOR TERMINATION KIT FOR GIS END SUITABLE FOR 230/400KV, 500 SQMM SIZE	Cable Sealing end (SF6 to XLPE) - Suitable for termination of 400 kV, 1Cx500sqmm, Copper Conductor, XLPE cables for interconnection with GIS module, complete with all necessary fittings, accessories, hardware, Bonding & grounding system (excluding bonding cable and other items already covered in BOQ).	Cable sealing end shall be complete in all respects and comprising of following but not limited to, 1. It shall be suitable for the size of conductor, insulation and voltage/ current ratings of the cable. 2. It shall also be complete with all necessary fittings, accessories, hardware, Bonding & grounding system (excluding bonding cable and other items already covered in BOQ). 3. Any other item/(s) such as weather shields/ sealing ends, Cu lugs/ connector suitable for size of conductor, Non-magnetic glands/ dummy glands, hardware and other accessories required to complete the supply in all respects but not limited to above shall be in bidder's scope.	Nos	24	The interfaces between 400kV XLPE Cable to SF6 Bushing Module shall conform to IEC standards. Cable to SF6 Bushing Module shall be of the plug-in type with dry-type or fluid-filled terminations.
2.02	SUPPLY- HIGH VOLTAGE POWER CABLE : INDOOR/ OUTDOOR TERMINATION KIT FOR SPARE EHV CABLE FOR 230/400KV, 500 SQMM SIZE	Cable Sealing arrangement (SF6 to XLPE) - for sealing one spare 400 kV, 1Cx500sqmm, Copper Conductor, XLPE cables, complete with all necessary fittings, accessories, hardware, Bonding & grounding system (excluding bonding cable and other items already covered in BOQ).	Cable sealing end shall be complete in all respects and comprising of following but not limited to, 1. It shall be suitable for the size of conductor, insulation and voltage/ current ratings of the cable. 2. It shall also be complete with all necessary fittings, accessories, hardware, Bonding & grounding system (excluding bonding cable and other items already covered in BOQ). 3. Any other item/(s) such as weather shields/ sealing ends, Cu lugs/ connector suitable for size of conductor, Non-magnetic glands/ dummy glands, hardware and other accessories required to complete the supply in all respects but not limited to above shall be in bidder's scope.	Nos	2	Necessary provision to protect installed spare termination / sealing is to be provided.
2.03	SUPPLY- HIGH VOLTAGE POWER CABLE : 1 X 3 PHASE - DISCONNECTING LINK BOX WITH SVL(SHEATH VOLTAGE LIMITER SUITABLE/ COMPATIBLE FOR EHV CABLE SYSTEM WITH NECESSARY FITTINGS AND ACCESSORIES	1x3- PHASE DISCONNECTING LINK BOX WITH SVL - (Cable Covering Protective Unit -CCPU) with Sheath Voltage Limiter suitable for 400 kV, 3Rx1Cx500sqmm, Copper Conductor, XLPE cables along with installation of metallic screen bonding/ earthing cable along with accessories (excluding bonding cable and other items already covered in BOQ).	Any other item/(s) such as mounting structure and other accessories required to complete the supply in all respects but not limited to above shall be in bidder's scope. (1Set= 3Phase)	Nos	4	Please refer clause 17.5.5 of Section-2.
2.04	SUPPLY- HIGH VOLTAGE POWER CABLE : 1 X 3PHASE DISCONNECTING LINK BOX WITHOUT SVL(SHEATH VOLTAGE LIMITER) SUITABLE/ COMPATIBLE FOR FOR EHV CABLE SYSTEM WITH NECESSARY FITTINGS AND ACCESSORIES	1x3- PHASE DISCONNECTING LINK BOX WITHOUT SVL - (Cable Covering Protective Unit -CCPU) without Sheath Voltage Limiter suitable for 400 kV, 3Rx1Cx500sqmm, Copper Conductor, XLPE cables along with installation of metallic screen bonding/ earthing cable along with accessories (excluding bonding cable and other items already covered in BOQ).	Any other item/(s) such as mounting structure and other accessories required to complete the supply in all respects but not limited to above shall be in bidder's scope. (1Set= 3Phase)	Nos	4	
2.05	SUPPLY- HIGH VOLTAGE POWER CABLE : 1 PHASE - DISCONNECTING LINK BOX WITH SVL(SHEATH VOLTAGE LIMITER SUITABLE/ COMPATIBLE FOR EHV CABLE SYSTEM WITH NECESSARY FITTINGS AND ACCESSORIES	1- PHASE LINK BOX WITH SVL - DISCONNECTING LINK BOX (Cable Covering Protective Unit -CCPU) with Sheath Voltage Limiter suitable for 400 kV, 1Cx500sqmm, Copper Conductor, XLPE cables, along with installation of metallic screen bonding/ earthing cable along with accessories (excluding bonding cable and other items already covered in BOQ).	Any other item/(s) such as mounting structure and other accessories required to complete the supply in all respects but not limited to above shall be in bidder's scope. (1Set= 1Phase)	Nos	1	
2.06	SUPPLY- HIGH VOLTAGE POWER CABLE : 1 X 3 PHASE - CROSS BONDING LINK BOX WITH SVL(SHEATH VOLTAGE LIMITER SUITABLE/ COMPATIBLE FOR EHV CABLE SYSTEM WITH NECESSARY FITTINGS AND ACCESSORIES	1x3- PHASE CROSS BONDING LINK BOX WITH SVL - Link Box with Sheath Voltage Limiter suitable for Cross Bonding arrangement of 400 kV, 3Rx1Cx500sqmm, Copper Conductor, XLPE cables, complete with all necessary fittings, accessories, hardware, Bonding & grounding system.	Any other item/(s) such as mounting structure and other accessories required to complete the supply in all respects but not limited to above shall be in bidder's scope. (1Set= 3Phase)	Nos	1	

Bill of Quantity of Supply and Spare Items for 400kV XLPE Cable of Arun 3 HEP Project - Rev 1				Date 19 July 2021		
Sno	Short Description	Detailed BOQ	Long Description	Unit	Qty	Remark
2.07	SUPPLY- HIGH VOLTAGE POWER CABLE : CABLE SUPPORT STRUCTURE FOR CABLE SEALING END SUITABLE/ COMPATIBLE FOR FOR CABLE SYSTEM	Supporting Structure for cable termination end / cable sealing End etc ,including necessary cable trays / hangers, fixtures, hardware etc as applicable.	Supply of all structural materials including hardware for both ends required to complete the work in all respects shall be in bidder's scope.	MT	5	
2.08	SUPPLY- HIGH VOLTAGE POWER CABLE : SINGLE CLAMPS, NON-MAGNETIC SUITABLE/ COMPATIBLE FOR FOR CABLE SYSTEM	Non-magnetic Clamps suitable for installation of 400 kV, 1Cx500sqmm, Copper Conductor, XLPE cables, in flat formation, complete with necessary fittings / accessories & mounting hardware.	1. Clamps shall be fixed at the distance of 1.5 meters on circuit cables. 2. Any other item/(s) such as mounting/ fixing hardware and other accessories required to complete the supply in all respects but not limited to above shall be in bidder's scope.	Nos	4000	Suitable for spacing upto 1.5 meter between clamp to clamp
2.09	SUPPLY- HIGH VOLTAGE POWER CABLE : TREFOIL CLAMPS, NON-MAGNETIC SUITABLE/ COMPATIBLE FOR CABLE SYSTEM	Non-magnetic Trefoil Clamps suitable for installation of 400 kV, 3Rx1Cx500sqmm, Copper Conductor, XLPE cables, in Trefoil formation, complete with necessary fittings / accessories & mounting hardware.	1. Clamps shall be fixed at the distance of 1.5 meters on circuit cables. 2. Any other item/(s) such as mounting/ fixing hardware and other accessories required to complete the supply in all respects but not limited to above shall be in bidder's scope.	Nos	100	Optional Item. Suitable for spacing upto 1.5 meter between clamp to clamp
2.1	SUPPLY- HIGH VOLTAGE POWER CABLE : SUPERVISION , CONTROL, MONITORING AND RELATED ITEMS	Control, monitoring and related items	Control, monitoring and related items shall be complete in all respects and comprising of following but not limited to, 1. Control, monitoring and related items as per clause no. 17.1.1.2, Co-ordination and provision of necessary contacts and/or ports for integration with plant SCADA system. 2. Any other item required for completion of work shall be included in biider's scope.	Lot	1	
2.11	SUPPLY- HIGH VOLTAGE POWER CABLE : CABLE IDENTIFICATION TAGS	Miscellaneous item including cable Identification Tags/ route marker etc.	This shall includes all items required for commisioning of cable system inclduing cable marker, cable identification tags and other items.	Lot	1	Cable Identification Tags, route marker. Other miscellaneous items and accessories are deemed included in the scope.
	MANDATORY SPARES					
3.01	SPARES- HIGH VOLTAGE POWER CABLE : XLPE INSULATED, COPPER (PLAIN) CONDUCTOR, PE WITH HFFR LAYER OUTER SHEATH 230/400KV SINGLE CORE, 500 SQMM SIZE	SPARES - 400 kV, 1Cx500sqmm, Copper Conductor, XLPE cables		meter	350	
3.02	SPARES- HIGH VOLTAGE POWER CABLE : INDOOR/ OUTDOOR TERMINATION KIT FOR GIS END SUITABLE FOR 230/400KV, 500 SQMM SIZE	SPARES - Cable Sealing end (SF6 to XLPE) - Suitable for termination of 400 kV, 1Cx500sqmm, Copper Conductor, XLPE cables for interconnection with GIS module, complete with all necessary fittings, accessories, hardware, Bonding & grounding system.		Nos	2	Suitable for terminating the 400kV XLPE, single phase cable for interconnection with GIS module. complete with all necessary fittings, accessories, hardware, Bonding & grounding system (excluding bonding cable).
3.03	SPARES- HIGH VOLTAGE POWER CABLE : COPPER (PLAIN) CONDUCTOR, STRAIGHT THROUGH JOINT SUITABLE FOR 230/400KV, 500 SQMM SIZE	SPARES - Straight through Joint Kit, suitable for 400 kV, 1Cx500sqmm, Copper Conductor, XLPE cables complete with all necessary fittings, accessories, hardware & Bonding arrangement for the connection of the cable sheath & armour.		Nos	2	
3.04	SPARES- HIGH VOLTAGE POWER CABLE : SURGE ARRESTOR (SHEATH VOLTAGE LIMITER) FOR 400KV XLPE CABLE	SPARES - Sheath Voltage Limiter		Nos	4	(3 Mandatory spare + 1 construction spare)
3.05	SPARES- HIGH VOLTAGE POWER CABLE : DISCONNECTING LINK BOX, Three Phase PHASE	SPARE - 1x3- PHASE DISCONNECTING LINK BOX WITH SVL - (Cable Covering Protective Unit -CCPU) with Sheath Voltage Limiter suitable for 400 kV, 3Rx1Cx500sqmm, Copper Conductor, XLPE cable.		No	2	
3.06	SPARES- HIGH VOLTAGE POWER CABLE : DISCONNECTING LINK BOX, SINGLE PHASE	SPARE - 1- PHASE LINK BOX WITH SVL - DISCONNECTING LINK BOX (Cable Covering Protective Unit -CCPU) with Sheath Voltage Limiter suitable for 400 kV, 1Cx500sqmm, Copper Conductor, XLPE cable		No	2	
3.07	SPARES- HIGH VOLTAGE POWER CABLE : BONDING CABLE FOR EARTHING THE METALLIC SHEATH OF THE EHV CABLE	SPARES - Bonding Cable / Earth Continuity Cable		meter	350	

Bill of Quantity of Services for 400kV XLPE Cable of Arun 3 HEP Project - Rev 1			
Sno	Description of Item	Quantity	Unit
4	SERVICES		
4.01	Site survey for route & length finalization of 400 kV, 1Cx500sqmm, Copper Conductor, XLPE cables The exact cable length shall be decided after visiting site & 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. (1 Lot = Complete requirement for package)	1	Lot
4.02	Installation of 400 kV, 1Cx500sqmm, Copper Conductor, XLPE cables complete in all respect including earthing , bonding arrangements and Earth Continuity Conductor. Scope includes installation of installation of clamp, route marker, cable marker & other miscellaneous cable accessories. Installation of XLPE, Cu conductor cable shall be completed in all respects and comprising of following but not limited to, 1. Laying of cables in flat / trefoil form with proper dressing by fixing trefoil clamps and/ or single form as required on support structure using trefoil/ single clamps on cable trays of cable trench/ rack assembly/ other structure assembly. The scope shall include includes snaking, dressing of cable etc. also. 2. Arrangement of special tools & tackles for smooth laying & installation on returnable basis. 3. All cable tags shall be supplied and fixed at the distance of 30m and in all bends/ as applicable in technical specification. 4. Any other service/(s) required to complete the work in all respects but not limited to above shall be in bidder's scope.	6000	Meter
4.03	Installation of Cable Accessories: Cable sealing end (SF6 to XLPE) suitable for termination of 400 kV, 1Cx500sqmm, Copper Conductor, XLPE cables for interconnection with GIS complete with all necessary fittings, accessories, hardware & Bonding arrangement for the connection of the cable sheath to the grounding system Termination of Cable Sealing End shall be completed in all respects and comprising of following but not limited to, 1. Termination suitable with Copper Cable in all respects. 2. Fixing of structure for support of termination including other fixing arrangements. 3. Termination/ jointing of cables shall be done by skilled and experienced jointer certified by OEM of the joints/ end terminations and duly approved by Engineer-in charge. 4. Any other service/(s) required to complete the work in all respects but not limited to above shall be in bidder's scope.	26	Nos
4.04	Installation of Cable Accessories: 1x3-PHASE DISCONNECTING LINK BOX WITH & WITHOUT SVL - (Cable Covering Protective Unit -CCPU) with Sheath Voltage Limiter suitable for 400 kV, 3Rx1Cx500sqmm, Copper Conductor, XLPE cables, along with installation of metallic screen bonding/ earthing cable along with accessories. Installation of link box shall be completed in all respects and comprising of following but not limited to, 1. Installation of link box along with installation of metallic screen bonding/ earthing cable along with accessories. 2. Installation of rod electrode/ pipe electrode or any other accessories for earthing shall also be in bidder's scope. 3. Any other service/(s) required to complete the work in all respects but not limited to above shall be in bidder's scope.	8	Nos
4.05	Installation of Cable Accessories: 1- PHASE LINK BOX WITH SLV - DISCONNECTING LINK BOX (Cable Covering Protective Unit -CCPU) with Sheath Voltage Limiter suitable for 400 kV, 1Cx500sqmm, Copper Conductor, XLPE cables, along with installation of metallic screen bonding/ earthing cable along with accessories. Installation of link box shall be completed in all respects and comprising of following but not limited to, 1. Installation of link box along with installation of metallic screen bonding/ earthing cable along with accessories. 2. Installation of rod electrode/ pipe electrode or any other accessories for earthing shall also be in bidder's scope. 3. Any other service/(s) required to complete the work in all respects but not limited to above shall be in bidder's scope.	1	Nos
4.06	Installation of Cable Accessories: 1x3-Phase CROSS BONDING LINK BOX WITH SVL - Link Box with Sheath Voltage Limiter suitable for Cross Bonding arrangement of 400 kV, 3Rx1Cx500sqmm, Copper Conductor, XLPE cables, complete with all necessary fittings, accessories, hardware, Bonding & grounding system. Installation of link box shall be completed in all respects and comprising of following but not limited to, 1. Installation of link box along with installation of metallic screen bonding/ earthing cable along with accessories. 2. Installation of rod electrode/ pipe electrode or any other accessories for earthing shall also be in bidder's scope. 3. Any other service/(s) required to complete the work in all respects but not limited to above shall be in bidder's scope.	1	Nos
4.07	Installation of Support structure: Support structure for Cable Termination/ Sealing End, including cable trays / hangers, fixtures, hardware etc as applicable. All structural works required to support and fix the end terminations including supply of mounting hardware, fixing hardware, grouting and other civil works required to complete the work shall be in bidder's scope.	5	MT

Bill of Quantity of Services for 400kV XLPE Cable of Arun 3 HEP Project - Rev 1			
Sno	Description of Item	Quantity	Unit
4.08	Installation and services for Control, monitoring and related items Installation of Control, monitoring and related items shall be complete in all respects and comprising of following but not limited to, 1. Control, monitoring and related items as per clause no. 17.1.1.2, Co-ordination and provision of necessary contacts and/or ports for integration with plant SCADA system. 2. Any other service required for completion of work shall be included in bidder's scope.	1	Lot
5	FIELD TESTING		
5.01	Field testing & commissioning 400kV XLPE, Cu conductor cable along with accessories - a) High voltage AC resonant type Test / Uo voltage for 24 hours as per clause no 16.3 of IEC 62067 (AC voltage test of the insulation)	1	Lot
5.02	Field testing & commissioning 400kV XLPE, Cu conductor cable along with accessories - b) Partial discharge measurement test	1	Lot
5.03	Field testing & commissioning 400kV XLPE, Cu conductor cable along with accessories - c) "DC Voltage test of the oversheath	1	Lot
6	TYPE TESTING		
6.01	Repetition of Type Test: Check on insulation thickness as per IEC 60811 (check of cable construction)	1	Lot
6.02	Repetition of Type Test: Tan δ measurement.	1	Lot
6.03	Repetition of Type Test: Partial discharge test after complete assembly of end terminations - At ambient temperature - At high temperature (90°C) -	1	Lot
6.04	Repetition of Type Test: Cable bending test followed by partial discharge test at ambient temperature.	1	Lot
6.05	Repetition of Type Test: Switching impulse voltage withstand test as per IEC 60230/62067	1	Lot
6.06	Repetition of Type Test: Lightning Impulse voltage withstand tests followed by power frequency voltage test as per IEC 62067/6023	1	Lot
6.07	Repetition of Type Test: Ageing treatment as per IEC 60811	1	Lot
6.08	Repetition of Type Test: Tests for determining the mechanical properties of XLPE insulation and outer sheath(PE) before and after ageing	1	Lot
6.09	Repetition of Type Test: Heat cycle voltage test as per IEC 62067.	1	Lot
6.1	Repetition of Type Test: Flame retardant test on outer sheath (Test under fire condition) .	1	Lot
6.11	Repetition of Type Test: Insulation shrinkage test .	1	Lot
6.12	Repetition of Type Test: Measurement of resistivity of semi-conducting screens as per IEC 62067.	1	Lot
6.13	Repetition of Type Test: Conditioning & mechanical test as per IEC 60811 .	1	Lot
6.14	Repetition of Type Test: Pressure test at high temperatures on over sheaths .	1	Lot
6.15	Repetition of Type Test: Hot set test for XLPE insulation.	1	Lot
6.16	Repetition of Type Test: Measurement of carbon black contents in PE outer sheath.	1	Lot
6.17	Repetition of Type Test: Water penetration test. hardness of outer sheath .	1	Lot
6.18	Repetition of Type Test: Measurement of hardness of outer sheath .	1	Lot
6.19	Repetition of Type Test: Abrasion test on outer sheath.	1	Lot
6.2	Repetition of Type Test: Heat shock test on outer sheath.	1	Lot
6.21	Repetition of Type Test: Oil resistant test for outer sheath.	1	Lot

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

Name of the Project:	4x225MW , Arun-3 HEP ,Nepal
Name of the Customer:	SAPDC
Name of Consultant :	SJVN

SJVN Arun-3 Power Development Company (P) Ltd. (SAPDC), a company promoted by SJVN Ltd., as a single shareholder company in Nepal having its registered office at Lokanthali, Kathmandu, Nepal has signed Project Development Agreement with Government of Nepal to plan, promote, organize & execute Arun-3 Hydroelectric Project (900 MW) in Sankhuwasabha District. of Nepal.

The bid prepared by the Bidder and all correspondence and documents related to the bid exchanged by the Bidder and the consultant/owner shall be written in the English, provided that any printed literature furnished by the Bidder may be written in another language, as long as such literature is accompanied by a translation in English, in which case, for purposes of interpretation of the bid, the translation shall govern.

3.2 Location & Land Availability:

The proposed project site is located at a distance of 50 km from Khandbari, the headquarters of Sankhuwa sabha District of Nepal. It is at about 240 km from Biratnagar and about 740 km from Kathmandu. The location details of the proposed project site are as indicated below:

- Latitude 27°30'N – 27° -35'N
- Longitude 87° -12'E – 88°-20'E
- Distance from Tumlingtar (domestic airport) town is.....About 68 km
- Distance of Kathmandu (international airport) from Tumlingtar.....About 660.km

3.3 Climatic Condition

A	Meteorological data		
1.1	Maximum ambient temperature	°C	35
1.2	Minimum ambient temperature	°C	4
1.3	Design ambient temperature	°C	40
1.4	Design minimum ambient temperature	°C	-4
1.5	Maximum Relative humidity	%	100
1.6	Maximum Relative humidity	%	35

3.4 Seismic Zone

The equipment shall be designed for operation in seismic zone IV for earthquake resistance. The equipment and each part of it shall be strong enough and sufficiently well connected to resist total operating stresses resulting from forces in normal operation, abnormal condition and forces superimposed due to occurrence of earthquakes of intensity which cause a ground acceleration of 0.16 g in vertical direction and 0.24 g in the other horizontal directions.

3.5 Transportation

Unless otherwise specified in the **Specification**, responsibility for arranging transportation of plant and equipment lies with the Contractor. The Contractor shall at its own risk and expense transport all plant and equipment to a destination specified in bid document. The contractor shall transport the contracted plant and equipment/ supplies through registered common carriers only.

The nearest major airport is at Kathmandu which is at a distance of 740km from Project Site. Biratnagar is connected to Kathmandu by Road.

The major nearest seaport for the trans-shipment of heavy equipment to Nepal is Kolkata. Other sea ports for imported equipment would be Mumbai or Chennai as convenient. The two sea ports Mumbai & Chennai are connected to Kolkata and Jogbani by rail as well as roads.

Railway transport is available from Kolkata and other locations of Indian Cities to the Nepal-India border only. The broad gauge line from Kolkata ends at Jogbani, Bihar. All rail freight for Nepal has to be unloaded there. The distance of Kolkata by rail route is about 800 km. From Jogbani, the road distance to the projects sites via Biratnagar is about 300km.

Road access to Arun-3 project from Kolkata to Jogbani is 600km; from Biratnagar to Project Area via Hile is 300km. Total distance to project area from Kolkata is 900km. Alternative route could be from Kolkata to Raxaul which is 800km, further from Birganj to Dhalkebar to Hile to Project Area which is 450km. Total distance Kolkata to Project Area is 1250km.

Local transportation, insurance and other services incidental to the delivery of facilities to be supplied from Employer's country (Schedule- 2 Items) shall be quoted separately.

3.6 Transport Limitation

The transport limitation by road from Jogbani to the project site is the governing factor for determining permissible package size and weight.

The existing roads allow the transport of the packages of the following size and weight.

Size (in mm) (l x b x h) - 9700 x 6000 x 6000*

Weight (Tonnes) - 70R

Heaviest package to be transported with suitable number of axle for safe transportation of consignment for 70R bridge capacity.

* Height from the ground.

3.7 Salient features of Project

The salient features of Arun-3 HEP are as follows:

A. POWER HOUSE COMPLEX

i. Power House Cavern	Underground on Left bank
ii. Installed capacity	900 MW
iii. No. of units	4
iv. Unit Capacity	225 MW
v. Size of Power House Cavern	179.50m (L) x 22.5m (W) x 49.5m(H)

B. UNDERGROUND TRANSFORMER CAVERN

i. Size	146.14m (L) x 16 m(W)x 23m(H)
ii. Transformer Type	Single Phase
iii. Number and rating	13 nos. (including 1 spare), 15.75/420/v3kV, 50Hz, 92MVA
iv. Transformer Hall level	El. 552 m

C. Switchyard & Transmission

i. Type of Switching	Gas Insulated Substation and Pothead Yard
ii. Size	207m (L) x 106m (W)
iii. Switchyard level	El. 557 m
iv. Transmission System	400kV Arun III HEP – Muzzafarpur via Dhalkebar D/c Quad Moose Lines with LILO of both circuits at Dhalkebar 400/220kV substation

3.7.1 SYSTEM PARAMETERS

1	Continuous current carrying capacity (rms) at 40° C ambient temperature.	2000A (min)
2	Short time current carrying Capacity	50kA for 1sec
3	Voltage	400KV/420kV (rms) (Nom/Max)
4	Frequency	50Hz
5	System neutral earthing	Effectively earthed
6	Insulation Level	
a	One minute Dry Power frequency Withstand Voltage (kV rms)	630
b	One minute Wet power frequency Withstand Voltage (rms)	630
7	Switching Impulse withstand(250/2500 microsec.) voltage (kV peak)	1050
8	Impulse Withstand Voltage of arrester housing with 1.2/50 micro sec wave.	1425 kVp
9	Creepage distance	25 (mm/kV)
10	Radio Interference voltage at 320kV	As per CEA guidelines

3.7.2 AUXILIARY POWER SUPPLY

3.7.2.1 AC power

Three-phase system with grounded neutral for feeding three-phase and one-phase consumers (connected between phase and neutral), 415/240V $\pm$ 10% and 50Hz , -5% to +3 %. All motors and other electrical apparatus should be designed to work continuously under, -5% to +3 % frequency variation and $\pm$ 10% voltage variation.

3.7.2.2 DC power

DC Systems, ungrounded, with earth fault detection 220V plus (+) 10% and minus (-) 20% for the supply of main control circuits for high and medium voltage switchgear, protection circuits and to other larger essentials loads. Other voltage systems eventually needed, shall be generated from the above systems by means of dc/dc converters, inverters etc.

3.7.2.3 Deleted

3.7.2.4 Cabling & wiring

Wiring within cubicles and equipment enclosures shall conform to requirements of this section unless otherwise specified. Control wiring shall be single / stranded copper subjected to prior approval by purchaser during detailed engineering and shall not be smaller than 2.5 Sq. mm, except as otherwise agreed by the purchaser.

All Distribution Boards, Control & Protection panels, Motor Control control panels etc. shall be supplied completely wired internally up to the terminal blocks ready to receive purchaser control cable.

All inter cubicle and inter panel wiring and connections between panels of same Distribution Board, Control & Protection panels, Motor Control panels including all bus wiring for AC and DC supplies shall be provided by the tenderer. Larger size wiring shall be used where needed for the current carrying capacity requirements.

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

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

Wiring shall terminate at terminal blocks at one side only. Where tap connections are required, they shall be made on terminal blocks. Wiring shall be neatly arranged and laid in wire ways accessible from the front door.

Engraved core identification ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire.

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

3.7.2.5 Power outlets

Power outlet for utilities such as electric drills, welding equipment etc., shall be provided in all floors of the powerhouse to enable repair and maintenance works to be done locally/ in-situ.

3.7.2.6 Terminal blocks

The terminal blocks shall be located to allow a neat and easy connection work and shall be safely accessible while the equipment is in service. Control circuits and power circuits shall be completely separated by use of divided or separate terminal blocks. Power terminal blocks shall be rated in accordance with applicable standards, and shall be provided with covers. Terminal blocks shall be 1100V grade and have continuous rating to carry the maximum expected current on the terminals.

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

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

The conducting part in contact with cable shall preferably be tinned or silver plated.

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

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

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

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

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

Wherever duplication of a terminal block is necessary it shall be achieved by solid bonding links.

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

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

3.7.2.7 Protection requirement

For short circuit and overload protection of power and control circuits, air circuit breakers, moulded case circuit breakers or MCBs shall be used. Outlets from AC (and DC) distribution panels are protected in their respective panels.

3.7.2.8 Switches, Lamps & Instruments

General

Control switches, indicating lamps and instruments shall be arranged so that all parts are readily accessible for servicing without the necessity to remove other devices, terminal blocks or excessive amount of wiring.

All control switches and indicating devices mounted in cabinets and enclosures shall be visible with the doors closed.

Identification nameplates shall be provided for all control switches, indicating instruments and lamps, in accordance with clause "Nameplates".

Instruments and controls shall be located so that their dials, indicators and nameplates are clearly readable. Data for all instruments to be provided, including type, size, scale range, electrical ratings, nameplate and name of manufacturer, shall be furnished. Steel panels shall be provided for group mounting of the instruments.

All instruments shall be of an approved type and shall match, insofar as practicable, the other instruments with which they are associated; their dial type, scaled markings and units, type of connection and mounting, shall be co-coordinated. All piping and tubing required for instruments shall be furnished and installed. All instruments and control switches shall be furnished with necessary auxiliaries, i.e. resistors, shunts etc.

3.7.2.9 Control and Selector switches

The switches and push buttons shall be provided with ample contact ratings, suitable cam or block arrangements necessary for the control functions on 230 V AC or 220V DC circuits. The control switches used in mimic diagrams shall be of discrepancy type with built in lamp indication.

Control and Selector switches shall be rotary type with escutcheon plates clearly marked to show the function and positions. The switches shall be of sturdy construction suitable for mounting on panel front.

Switches with shrouding of live parts and sealing of contacts against dust ingress shall be provided.

Circuit breaker control switches shall have three positions and shall be spring return to "NEUTRAL" from "CLOSE" and "TRIP" positions and shall have pistol grip handles. They shall have at least two (2) contacts closing in close position, and two (2) contacts closing in trip position unless specified otherwise.

Ammeter and voltmeter selector switches shall have four stay out position with adequate number of contacts for three phase 4 wire system. These shall have oval handles. Ammeter selector switches shall have make before break type contacts to prevent open circuiting of CT secondaries. Contacts of the switches shall be spring assisted and shall be of suitable material to give a long trouble free service.

3.7.2.10 Push buttons

Push-buttons shall be of spring return, push to actuate type. Their contacts shall be rated to make, continuously carry and break 10A at 230V AC and 0.5A at 220V DC.

All push buttons shall have one normally open and one normally closed contact, unless specified otherwise. The contact faces shall be of silver or silver alloy.

All push buttons shall be provided with integral escutcheon plates marked with its function. The colour of the button shall be as follows:

Green : Breaker Close
Red : Breaker Open
Black : For overload reset

3.7.2.11 Indicating and signaling lamps

Each indicating and signaling lamp shall have a removable cap, which can be inscribed with wording and shall not be affected with the heat of the lamp.

Indicating lamps are preferably of LED type & low watt consumption and shall be replaceable from the front of the panel. The indicating and signaling lamps shall be of the same size and type.

Lamps shall be provided with series resistors, preferably built-in the lamps assembly. The lamps shall have escutcheon plates marked with its function, wherever necessary.

Lamps shall have translucent lamp-covers of the following colours, as warranted by the application.

Red : ACB's/MCCB's close
Green : ACB's/MCCB's open
White : Auto trip
Amber : For all healthy conditions e.g. control supply
Voilet : Circuit breaker spring charged
Blue : For all alarm conditions (e.g. overload) Also for "SERVICE" & "TEST" positions indicators

Indication lamps should be located just above the associated push buttons/control switches. All indicating lamps shall be suitable for continuous operation at 90% to 110% of their rated voltage.

3.7.2.12 HRC Fuses

HRC-Fuses shall have visible operation indicators.

HRC-Fuses shall be mounted on fuses carriers, which are mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type of bases. In such cases one set of insulated fuse pulling handles shall be supplied with each switchgear.

HRC-Fuse rating shall be chosen by the tenderer depending upon the circuit requirements.

3.7.2.13 Indicating instruments and Meters

Instruments mounted on panels, shall be of the semi flush type back connected, matching pattern, shape, and of approved finish to present neat and fitting appearance consistent with functional requirements. Mechanical quantity measuring instruments which are directly mounted on equipment shall have circular dials and shall be properly supported and guarded against accidental injury/breakage. These shall be placed in convenient locations.

The instruments shall accurately measure and indicate the quantity under all conditions of operation with minimum instrument errors. Changes in ambient temperature within the range prevailing at site shall not affect the accuracy. Contact making instruments shall have contacts suitable for 240 V AC or 220 V DC circuits.

The reading scales on the dials shall be in metric units only and range shall be such that the normal operating values of the quantities are indicated in the middle 3rd of the scale. The dials pointer etc. shall be designed to facilitate accurate reading by minimizing parallax and glare from instrument window and by providing clear bold dial markings. The size of dial and length of the scales of the indicating instruments shall be large enough to suit the requirements. The scale plates of panel mounted indicating instruments shall have a permanent white mat finish with black graduations and the pointer shall also be of the black colour. Instruments mounted on panels shall be of flush type and shall be back connected. All instruments on a switchgear panel shall be of matching pattern, shape and finish so as to present a pleasing appearance consistent with the functional requirements.

All instruments shall conform to relevant International or national applicable standards. These shall be subjected to tests prior to dispatch. The instruments shall be shock, vibration and moisture proof. The electrical instruments shall withstand dielectric test of 2000 V RMS to ground for one (1) minute as per standards.

The coils of electrical instruments shall be designed for continuous operation at 110% of the full load current at instrument potential. The coil rating of the measuring instruments shall be coordinated with those of the associated instrument transformers (i.e. CTs, PTs, etc.) by the supplier. The VA burden of the instruments shall be as low as possible. The meters shall be of the first grade in respect of accuracy classification.

Energy meter shall be suitable for 3-phase, 4-wire unbalanced system and shall comply generally with the relevant standard. All instruments shall be tested in accordance with the requirements of relevant standards.

3.7.2.14 Integrating instruments

The Wh and VARh meters shall be of the semi-flush-mounted type. Each meter shall be connected to terminal blocks suitable for opening and short-circuiting for testing purposes. The meter cases shall be dust-tight and with removable covers. The meters shall be three-phase, three element, equipped with an impulse contact mechanism, potential free for remote metering purposes, and shall be suitable for continuous operation from secondary of potential transformers and from secondary of current transformers, with transformer ratios and connections indicated on the contract drawings.

The meters shall be provided with primary-rated, direct reading registers, with five or more digits and a suitable multiplier. The meters for the outgoing lines shall be of the two-way type and all meters shall have mechanism to prevent negative registration.

The meters shall have built in over-voltage protection and isolation according to IEC Publication 60521. The tolerance ambient temperature range of the meters shall be 0 to 45 degrees C.

The protection class of the Wh meters shall be 0.2 and the VARh meters 0.2 according to IEC Publication 60687.

3.7.2.15 Measuring converters

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

For the measuring converters the following minimum requirements shall be fulfilled:

Current transducers shall be single-phase, of accuracy class 0.5 or better. Voltage transducers shall be single-phase of accuracy class 0.5 or better. W and VAR transducers shall be two elements, three-phase. Accuracy class of the transducers shall be 0.5 or better.

3.7.2.16 Measuring transformers

All current and voltage transformers shall be completely encapsulated cast resin insulated type suitable for continuous operation at the temperature prevailing inside the switchgear enclosure, when the distribution board is operating at its rated condition and the outside ambient temperature is 40 deg.C.

All instrument transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit and momentary current ratings of the associated switchgear.

All instrument transformer shall have clear indelible polarity markings. All secondary terminals shall be wired to a separate terminal on an accessible terminal block where star-point formation and earthing shall be done.

All VTs shall have readily accessible HRC current limiting fuses on both primary and secondary sides. The class of insulation should be E or better.

The parameter & rating of CTs & PTs are minimum requirement & tentative only. Contactor shall submit the calculations for selection of CT/PT for approval to purchaser. Potential transformer secondary windings shall be rated 110 / V3 V Current transformer secondary windings shall have a rated current of 1A / 5A.

3.7.2.17 Nameplates and Labels

Each major and auxiliary item of equipment shall have a nameplate permanently affixed thereto, or as directed, showing in a legible and durable manner the serial number, name and address of the manufacture, rated capacity, speed, electrical characteristics, and other significant information, as applicable.

The module identification plate shall clearly give the feeder number and feeder designation wherever applicable. For single front switchboards, similar panel and board identification labels shall be provided at the rear also.

All name plates shall be of non rusting metal or 3-ply lamincoid with white engraved lettering on black back-ground, inscriptions and lettering sizes shall be as per their standard practice. Suitable plastic sticker labels shall be provided for easy identification of all equipment, located

inside the panel/module. These labels shall be positioned so as to be clearly visible and shall give the device number, as mentioned in the module wiring drawings.

3.7.2.18 Motors

All electric motors for driving various equipment shall conform to relevant standards viz. IEC, BS or IS as applicable. The motor rating, torque characteristics, speed etc. shall be selected to suit the duty requirements.

Type of starter for motors shall be duly approved by the purchaser during detailed engineering. The detailed design calculation for selection of type of starters is to be submitted for approval. The priority for type of starters shall be in the following order:

1. Variable frequency drive
2. Soft starter
3. Star delta/ auto –transformer
4. Direct on-line starter

The enclosure of each motor shall be of the type best suited for the service conditions of the motor. The motor insulation shall be resistant to moisture, oil or oil vapor and the motors in general shall be so designed as to suit the tropical climate. Varnished cambric or glass insulation class F shall be used for connection from the windings to the terminals.

The terminal box shall be closed conduit box type conveniently located, and shall have means for terminating the external wiring for outdoor use. The motor terminals shall be of the stud type totally enclosed. Eye bolts or lugs shall be provided for lifting.

Space heaters to avoid condensation shall also be provided. Special type of motors, not adequately covered by these specifications, shall be offered for any special application, but these shall be subject to the approval of purchaser.

3.7.2.19 Space heaters

Space heater shall be provided in the Distribution Boards, Control & Protection panels, Motor Control panels etc. The space heaters shall be suitable for continuous operation on 240V AC, 50 HZ single phase supply, and shall be automatically controlled by thermostats. Necessary isolating switches and fuses shall also be provided.

3.7.2.20 Auxiliary relay, contacts and devices

All relays and timers in protective circuits shall be flush mounted on panel front with connections from the inside. They shall have transparent dust tight covers removable from the front. All protective relays shall have a draw out construction for easy replacement from the front. They shall either have built-in test facilities, or shall be provided with necessary test blocks and test switches located immediately below each relay. The auxiliary relays and timers may be furnished in non-draw out cases.

All AC auxiliary relays shall be suitable for operation with VTs and CTs secondaries.

DC auxiliary relays shall be designed for 220V DC unless otherwise specified and shall operate satisfactorily between 80% and 110% of the rated voltage. Relays shall have adequate thermal capacity for continuous operation in circuits in which they are used.

All protective relays and timers shall have at least two potentially free output contacts. Relays shall have contacts as required for protection schemes. Contacts of relays and timers shall be silver faced and shall have a spring action. Adequate number of terminals shall be available on the relay cases for applicable relaying schemes.

Suitable number of auxiliary contacts or auxiliary relays shall be provided with each VCB's / ACB's for indication, remote indication, annunciation and automatic changeover and interlocking scheme.

All protective relays, auxiliary relays and timers shall be provided with hand reset operation indicators (flag) for analysing the cause of operation.

3.7.2.21 Welding & NDT

Preparation of base material

Members to be joined by welding may be cut to shape and size by mechanical means such as shearing, machining, grinding, or by gas or arc cutting, to suit the conditions. Edges shall be shaped according to ASME requirements. Design of welded joints and selection of weld filler metal shall be in accordance with approved standards and shall allow thorough penetration and good fusion of the weld with the base metal. The edges of surfaces to be welded shall be sound metal free of visible defects such as laminations or defects caused by cutting operation at least 30 mm back from the edge of the weld, and free from rust, oil, grease, and other foreign matter.

The establishment of welding procedures, welder's qualifications shall conform to the requirements of the ASME Boiler and Pressure Vessel Code Section VIII and IX. The approved copy of the WPS & WPQR in accordance with the ASME requirements shall be submitted to the purchaser for review and record.

3.7.2.22 Field welding

Filler material required for field-welded joints shall be furnished by the Contractor. The Contractor shall perform all welding work at site in accordance with the applicable WPS. Only qualified welders shall be used for undertaking welding as per the applicable WPS. NDT shall be performed as per the approved drawings.

Preparation for field welding

All cutting, chamfering, and other shaping of metals necessary for the field connection shall be done as far as possible in the shop. Adequate temporary bolted field connections shall be provided to hold the assemblies rigidly and in proper alignment during shop and field assembly.

To ensure proper alignment during field erection, a minimum of two dowels shall be provided for each field connection between subassemblies. The holes shall be drilled and the dowels fitted at shop assembly after the subassemblies have been satisfactorily aligned. All stipulations for welding, structural work and other, shall be applied to fieldwork as well as to shop work, except where otherwise stated.

3.7.2.23 Painting

All the equipment furnished and installed by the Contractor shall be completely painted for final use, with the exception of those parts or surfaces that are expressly designated as unpainted. Surfaces to be painted shall receive the preparatory treatment and required number of coats. The Contractor shall perform all painting work in the shop, before shipment, followed by a final coat of paint at site after installation as per the standard procedure.

All materials, supplies, and articles furnished shall be the standard products of recognized reputable manufacturers. Colour schedule of equipment supplied shall be finalized during detailed design stage.

3.7.2.24 Galvanization

All materials to be galvanized shall be of the full dimensions shown or specified and all punching, cutting, drilling, screw tapping and the removal of burrs shall be completed before the galvanizing process commences. All galvanizing shall be done by the hot dip process with smelter, not less than ninety eight percent (98%) of which must be pure zinc. No alternative process shall be used without the approval of the purchaser. No components shall be galvanized which are likely to come into subsequent contact with oil. Bolts shall be completely galvanized including the threads, but the threads shall be left uncoated in the case of nuts.

The zinc coating shall be uniform, clean, smooth and as free from spangle as possible. In the case of component parts the zinc coating shall weigh not less than 0.6 kg/m² over the area covered and be not less than 0.09mm in thickness. All galvanizing shall comply with the requirements of the relevant ASTM standards/Indian Standards. All galvanized parts shall be protected from injury to the zinc coating due to differential aeration and abrasion during the period of transit, storage and erection. Damaged areas of the coating shall be touched up with an approved zinc dust paint or other approved flake metallic compound.

3.7.2.25 Pumps

All pumps forming part of the generating units and other plant and equipment shall be of high performance requisite type (viz. centrifugal, rotary etc.) and rating, of reputed make, and shall be directly coupled to their driving motors. The pumps shall be of self-priming type and with proper sealing systems and protection.

The materials of construction of pumps in general shall suit the service conditions. The materials of construction of the pumps handling water, such as drainage & dewatering pumps, turbine top cover drainage pumps etc. shall be resistant to abrasive effects of silt in such water. The pumps shall operate quietly without undue noise and vibration in their full operating range of head and flow. They shall be easy to maintain.

3.7.2.26 Embedded parts, Anchor Bolts and Fasteners

All embedded anchor bolts, rods, pipes, welding plates and support plates shall be provided by contractor. Anchor bolts shall consist of a threaded steel rod installed inside a pipe sleeve to provide lateral adjustment after the sleeve is embedded. The threaded end of the rod shall be provided with two steel nuts and two steel washers to permit leveling and anchoring the equipment prior to grouting.

Approved types of expansion or chemical anchors shall be used where practicable for small equipment.

3.7.2.27 Rust Prevention and Protection during Transit:-

Bright steel parts including all machined surfaces shall be given a thick coat of tar or tallow or any other approved rust resisting paint in plain colour to prevent rusting during shipment and transport.

3.7.2.28 Civil Works

Civil foundations for equipment of the generating units and other plant and equipment will be prepared by the Purchaser in accordance with the basic design data to be supplied by the Contractor.

The Contractor shall provide design for foundations and install the concrete inserts/embedment; support steels and/or components for foundation /supports purpose, shall do any chipping / levelling works, denting / painting etc.

3.7.3 Erection, Testing, Commissioning and performance of Guarantee Tests

3.7.3.1 Testing and inspection

Materials used for construction of major & important sub-assemblies shall be thoroughly Lab / shop tested and inspected by the Contractor at his own expense prior to dispatch. Lab / Shop test shall comprise of routine test & type tests.

The shop tests and inspections shall be as spelt out in individual equipment specifications as dealt in succeeding sections but shall not be limited to the same. Any other tests and inspection not specifically listed but are otherwise considered essential and advisable shall also be conducted.

The Bidders shall furnish schedule of the lab / shop tests and inspections on materials and equipment. Important tests/inspections shall be subject to witness by the purchaser for which the Contractor shall give sufficient advance notice. In case purchaser is unable to witness shop tests/inspections, the Contractor shall be so intimated and the tests/inspections may then be carried out in the absence of the Purchaser.

Equipment on which tests and inspections have been duly witnessed and approved by the Purchaser may be dispatched by the Contractor. Equipment on which tests and inspections have not been witnessed by the purchaser shall be dispatched only after the shop tests and inspection Certificates have been approved by the Purchaser.

3.7.3.2 Dimensional Checks and Visual Inspection

Dimensional checks shall be performed on all major parts, components and partial assemblies, especially when close tolerances and fits are involved (tolerance of shafts, between stationary and moving parts, connecting dimensions for the assembly with other supplies, etc.). If the dimensional checks show discrepancies in measurement, which may affect the fit, assembly or dismantling of the respective part or component, the same have to be corrected correspondingly. Such correction or modification shall, however, in no way lead to sacrifices with respect to reliability of operation or inter-changeability, and shall be performed only after the agreement of the Owner has been obtained. If the correction or modification cannot be carried out in accordance with the terms mentioned above, the part or component concerned may be subject to rejection. Faulty machine parts or equipment shall by no means be delivered.

3.7.3.3 Functional Tests

Functional tests on partial assemblies and/or complete assemblies shall be carried out as much as possible already in the manufacturer's workshops. Such tests shall be performed as far as possible under operation-like conditions.

When requested by the Owner, the functional tests shall be repeated until full proof has been obtained that the functioning of the assemblies will comply with the requirements of the Contract Documents.

3.7.3.4 Erection, commissioning & field tests

The Contractor has to do all the work related to assembly, erection, testing and commissioning complete in all respects. All necessary tools, plants, labour, materials including consumables for performing installation, testing and pre-commissioning shall be provided by the Contractor.

The Contractor shall submit the necessary data/information, layout and foundation/support drawings well in advance. The Contractor shall provide and install the concrete inserts/embedment, support steels and/or components for foundation/supports purpose as per approved erection drawings and coordinate the activities with civil contractors to keep his activities in synchronism with civil work. All installation for foundation shall be verified and accepted by the Engineer.

The Contractor shall use anchor fasteners for installation of piping, fixtures, mountings, conduits, cabling, panels etc. Minor Chipping of concrete is permitted. However, taking support from reinforcement bars shall not be allowed.

3.7.3.5 Installation procedure

The Contractor shall submit six copies of all detailed programs and the procedures to be adopted for erection / installation, testing and commissioning well in advance, before start of erection activities/ installation.

The installation procedure shall also have a section "site quality assurance plan" containing erection data sheets / site protocols for various components. These sheets should specify site measurements/ inspections required to be made for ensuring proper installation.

3.7.3.6 Cable laying

Wiring between equipment enclosures shall be made with cables, laid in trenches and/or cable trays and in cable conduits. The Contractor shall submit for review to the Engineer a cable route layout-showing location of trenches, conduits and trays. All material for cable laying such as cable trays supports and fastening material shall be furnished and placed by the Contractor. Cables shall be properly fastened and marked where they enter enclosures by either cable clamps or nipples.

Cables in horizontal cable trays shall be fastened properly with clamps or plastic strips. Power and control cables shall be placed in separate trays or conduits. Cables shall be clearly marked at each terminal point and appropriate intermediate locations as per Standard.

Conduits shall be of heavy gauge rigid steel, hot-dip galvanized, cut square reamed, threaded and screwed tight at all joints.

Conduit entrances to pull boxes and switches shall have double lock nuts & insulating bushings. No running thread shall be used.

Flexible metallic conduit shall be used for connection to equipment, which are subject to vibration, and also for connection to level/limit/pressure switches.

3.7.3.7 Field inspection

The Contractor shall permit Engineer to perform inspections of the assembly which will include a complete verification of the assembly of all parts as to their levels, clearances, pertinent fits, alignments and quality of workmanship. The field supervisor of the Contractor shall provide Engineer with three (3) copies of all the clearances, tolerances and data of all pertinent fits, alignments and levels, so that the latter may repeat the Contractor's measurement, if desired.

Unless otherwise specified, any rejection based on the inspection will be reported to Contractor within fifteen (15) days.

3.7.3.8 Field tests

All field tests including tests during installation, pre-commissioning, commissioning, performance and field acceptance tests shall be conducted by the Contractor, in the presence of representative of the Employer. Procedure to be adopted for conducting these tests shall be submitted well in advance, before start of relevant testing, for approval of the Employer.

The equipment / system shall be deemed to be commissioned and ready for trial run only after successful operation for a test service period specified in sub clause "Performance Testing". In the event of any failure this period shall be repeated for any number of times till the successful operation as described above is achieved.

All test equipment and instruments shall be furnished by the Contractor and will remain the Contractor's property after the fulfillment of all field tests.

Any defects or leaks disclosed in the tests shall be duly mended/ repaired to meet the desired function and retested. All necessary materials and labour for performing all the above tests shall be provided by the Contractor.

The Contractor shall prepare written test certificates in a form agreed upon by the Contractor and Employer of all tests results and hand them over to the Employer in due time.

The design, location and approval tests of anchoring rings for the fixing of lifting apparatus necessary for assembly and dismantling of equipment and plant accessories shall be the responsibility of the Contractor.

3.7.3.9 Taking over of facilities

Taking over" means that the Facilities (or a specific part thereof where specified) have been completed operationally and structurally and put in a tight and clean condition, and that all work in respect of pre-commissioning of the Facilities or such specific part thereof has been completed and commissioning has been attained as per Technical Specifications. The contractor shall make formal request for taking over the facility to the EIC.

3.7.3.10 Operation acceptance

The operational acceptance by the Employer of the Facilities (or any part of the Facilities where the Contract provides for acceptance of the Facilities in parts), which certifies the Contractor's fulfillment of the Contract in respect of Functional Guarantees of the Facilities (or the relevant part thereof) in accordance with the provisions of Specification.

3.7.3.11 Consumables, oils and Lubricant

The Contractor shall deliver to the Owner all equipment complete with initial fill of fluids, grease or lubricants, transformer oil, Nitrogen, SF6 gas and other used gases in non returnable drums / containers and replace any quantity used up or lost during installation and testing.

The oil used for the lubrication and oil pressure systems for the turbine, governor, shutoff valve and generator shall be preferably of the same type.

Supply

The Contractor shall furnish the following:

- (i) All oil for initial filling of all equipment supplied, plus additional oil equivalent to the first filling requirement of one unit.
- (ii) Grease if required for initial filling of all of the equipment, plus 10% additional.
- (iii) Gases for initial filling of all equipment supplied, plus 10 % additional quantity.
- (iv) Flushing fluids to flush and clean all systems.

3.7.3.12 Deleted:

3.7.3.13 Submission of Drawings, Documents, Manual, software, Calculations, Safety Margin Details etc.

All drawings and documents shall be submitted to purchaser in hard form as well as in editable soft form. Bidder shall submit Ten (10) number hard copies of the documents & drawings to purchaser for reference / review / approval. A comprehensive list of all such drawings/documents planned to be submitted for reference/approval shall be provided beforehand to the purchaser.

Loading drawings

For all larger pieces of Works which, due to their dimensions and/or weight and transport limitations, will require special means for their transportation, the Contractor shall submit binding loading drawings indicating dimensions, weights, etc., of the respective pieces of Works and the necessary trailer for its transportation to the site.

Foundation drawings

If a piece of works requires its own foundation or needs a special area for installation, the contractor shall submit drawings indicating all pertinent dimensions, static and dynamic loads, etc. They shall include all essential details required for proper design and construction of the foundations and/or buildings.

In addition, they shall include openings, sleeves, slopes and the arrangement of any supporting structure, i.e. base-frames or other steel constructions for permanent fixing or erection purposes.

If conduits are to be installed in the foundations, the relevant information such as diameter, length, and purpose shall be indicated on the drawings.

Arrangement drawings

All arrangement drawings shall be drawn to scale. The General Arrangement Drawings shall show the physical arrangement of Works (constructions, machines, complete switchgears, control panels, instrument cubicles, etc.), civil constructions (buildings, rooms, foundations, ducts, etc.) and reserved areas (for pipes, cables, lines, etc.) in relation to each other and to

agreed co-ordinates and boundaries. Such drawings shall be prepared for the whole plot, for separate plots and for each building (building, hall, room, ducts and trenches, etc.).

Outline drawings

The Outline Drawing shall show all elements and the main dimensions of individual components where necessary in plan view, cross-section, side and top views. If reasonably possible such dimensions can be shown on Arrangement Drawings.

Design drawings

The Design Drawings shall include the shop drawings, assembly drawings, erection drawings, piping diagrams and piping arrangement drawings, etc., showing the dimensions, design and data of all constructions, apparatus and Works to be furnished under this Contract. The drawings shall - where applicable - substantially conform to the Contract Drawings and shall show:

- 3-D Assembly drawings for major components in hard and soft form.
- Details of manufacturing and treatment of major single work pieces specially manufactured for this Contract
- Assembly of the Works in plan and elevation with main dimensions Sub-assembly of the principal components of the Works with overall dimensions, adjustment and clearance tolerances, numbers of corresponding detail drawings
- Sub-assemblies in which the Contractor proposes to ship the Works
- All necessary details of the parts connecting to the Works supplied by others
- Location and sizes of auxiliary connections for oil, grease, water, air, electrical power etc.
- Location and size of the instruments and accessories provided
- Methods of lubrication and sealing
- Instructions for heat treatment, pressure tests, surface preparation and anticorrosive protection
- Full details of parts for which adjustment is provided or which are subject to wear
- Method and sequence of installation, field joints, erection and lifting devices, jacks, grout plugs, anchoring details, etc., if not shown on foundation drawings.

Installation drawings

The construction, mechanical, electrical and I & C Installation Drawings shall provide detailed information on the disposition of the various items of a system (e.g. lighting fixtures, socket outlets, connection boxes, transmitters, actuators, loudspeakers, telephones, pipes, valves, pumps, compressors, etc.) and of the piping and wiring respectively included in the installation or assembly. They shall be based on dimension drawings of cubicles, rooms, buildings or areas containing the Works.

Diagrams

Single-line diagrams

This is a simplified diagram of the essential electrical Works and their interconnections. Each circuit shall be represented by a single line only. It shall contain all required technical information of the Works represented, e.g. voltage, current, capacity, shortcircuit level, ratios,

voltage variations, positive and zero sequence impedances, measuring transformer and protection relay indices, interlocking, kind of switch drive, code designation, etc. as applicable.

Circuit diagrams

The Circuit Diagrams shall show the power circuits in all the phases with the main apparatus as well as the pilot circuits (measuring and control circuits). It shall show in full the functioning of part or all installations, Works or circuits with all required technical details.

Block diagrams

The Block Diagrams shall be used to show in a simplified manner the main inter - relationships between the elements of a system by means of symbols, block symbols and pictures without necessarily showing all the connections. The symbols used for the individual kinds of components, e.g. servomotors, computing modules, etc., shall clearly be explained on the diagram or on an attached legend.

Logic diagrams

The Logic or Functional Diagrams shall be used for representation of logic and sequence controls and interlocking by showing only binary logic elements and their effect on the various process equipment disregarding their electrical realisation. Logic function elements (AND, OR, NOR, NAND, STORAGE, etc.) shall be used for processing and combining binary signals.

Terminal diagrams

Such diagrams shall be prepared for any type of terminal box, marshalling rack, control cubicle, switchboard, etc., and shall show the terminals (properly numbered) and the internal and/or external conductors (wires or cables) connected to them.

The terminal diagram of each individual switchboard, terminal box, panel, etc., shall contain, but not be limited to the following information:

Protection co-ordination diagrams

These diagrams shall show in a graphical manner separately for each power supply circuit:

- A simplified single-line diagram of the circuit with technical data of all instrument transformers and relays
- Co-ordinated tripping curves of related protection devices
- Setting of the protection devices.

Emergency shutdown diagram

This diagram shall show the sequential steps and interdependencies during emergency closure.

Flow Charts

Flow charts shall be used for representing sequence of events for start / stop / shut down of the machine including associated equipment and auxiliaries.

Manuals

The following manuals covering all equipment of EM works shall be supplied as per the time schedule in both editable soft and hard form:-

Sr.No.	Manual Description
1.	Storage and preservation manual
2.	Safety manual
3.	Erection Manual
4.	Testing and commissioning manual
5.	Operation manual
6.	Maintenance manual
7.	Long term storage manual for Generator Transformer
8.	Long term storage manual for boxed up component / equipment.
9.	Repair process / procedure manual for equipment / system

As built drawing to be provided incorporating changes made during erection, testing and commissioning.

Drawing & Document Submission Schedule

Drawings & documents submission schedule of the EM package with the categorization (i.e. Approval / reference) & tentative submission date shall be submitted to purchaser.

Preliminary list of drawings under various categories have been prepared and appended at Section 1 of the Technical Specification.

3.8 DRAWINGS & DOCUMENTS TO BE SUBMITTED BY THE SUCCESSFUL BIDDER AFTER AWARD OF CONTRACT

One set of soft copies of all the approved drawings, documents including as built drawings shall be furnished by the Bidder to the Owner / Consultant in compact discs.

White prints or other non-reproducible drawings can be mailed folded. Blue prints shall generally not be used.

All drawings, prepared by the Bidder shall be as per IS: 696. Supplier's standard drawings are exempted from the above size limitation, unless his "standard" includes drawings of very large size or length. There shall be sufficient reference notes on the drawings to permit identification of all the drawings which are required for a proper understanding.

Bills of material and drawings shall be cross-referenced for easy identification.

All drawings shall be dimensioned in the metric system. Where drawings are usually made in the British (or other) system, they shall also have metric system dimensions in parentheses or below dimension line. Titles and written notations shall be in English. If the original is in another language it shall carry English translation. The translations will appear immediately on the drawings. Attached lists of translated words shall not be accepted.

Drawings and bills of material shall be identified by a numbering system to be mutually agreed later on. Any additional identification numbers or symbols that the Bidder selects to

use for his own purposes are permissible so long as Owner's number is the prime means of identification.

The scale of the drawing shall be shown clearly in the title block of the drawing. Wherever possible, scales of drawings shall be:-

1:1	1 : 2.5	1 : 5	1 : 10	1 : 20	1 : 25
1:50	1 : 100	1 : 200	1 : 300	1 : 500	
1: 1000	1 : 2000	1 : 5000			

All reproducible must be made from original drawings.

All revised drawing shall clearly indicate the number, date and subject to each revision. All the revisions carried out in the drawings shall be clearly identified and marked.

Drawing list shall be kept up-to-date, incorporating all new additions, cancellations and changes, and will be reissued periodically with Progress Report.

General arrangement drawings shall be submitted for approval to the Owner/ Consultant prior to the commencement of detail engineering by the Bidder. These drawings shall show to scale all major equipment including electrical equipment and building outlines and overall dimensions as well as tie-in dimensions and clearances shall be clearly indicated. Approved arrangement drawings shall be used as basis for design and preparation of detail drawing to be prepared by the Bidder. The Bidder shall furnish all the necessary drawings, data etc., of the plant/equipment with appropriate "Status" stamp in adequate no. of copies as indicated below:

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
				Prints	CDs
1	Drawings and Data Sheets	1	6	10	-
2	Drawings "As Built "	-	-	10	-
3	Type Test Reports	1	6	10	02
4	Erection Manuals	-	6	10	-
5	Operation and Maintenance Manuals	-	6	10	-
6	Manufacturing Quality Plan	1	6	10	-
7	Field Quality Plan	1	6	10	-
8	Inspection Test Reports	-	-	10	-

All instruction manuals / O&M Manual/"as built drawing": 10 copies each

3.8.1.1 QUALITY ASSURANCE PROGRAMME

The Bidder shall follow Quality Assurance Programme to ensure that the equipment and services under the scope of contract whether manufactured or performed at the Bidder's works or at his sub-vendor's premises or at the SAPDC's site or at any other place of work are in accordance with the technical specifications. Such programme shall be outlined by the Bidder and be submitted along with the bid. The QA programme shall be generally in line with IS/ISO- 9001 and generally cover the following:

- ORGANISATION STRUCTURE FOR THE MANAGEMENT AND IMPLEMENTATION OF THE
- PROPOSED QUALITY ASSURANCE PROGRAMME
- QUALITY SYSTEM MANUAL
- DESIGN CONTROL SYSTEMS
- DOCUMENTATION AND DATA CONTROL SYSTEMS
- QUALIFICATION/EXPERIENCE OF BIDDER'S KEY PERSONNEL.
- PROCEDURE FOR PURCHASE OF MATERIAL, PARTS, COMPONENTS AND SELECTION OF SUB-VENDOR'S SERVICES INCLUDING VENDOR ANALYSIS, SOURCE INSPECTION, INCOMING RAW-MATERIAL INSPECTION, VERIFICATION OF MATERIALS PURCHASED, ETC.
- SYSTEM FOR SHOP MANUFACTURING AND SITE ERECTION CONTROLS INCLUDING PROCESS, FABRICATION AND ASSEMBLY.
- CONTROL OF NON-CONFORMING ITEMS AND SYSTEM FOR CORRECTIVE ACTIONS AND
- RESOLUTION OF DEVIATIONS.
- CONTROL OF CALIBRATION AND TESTING OF MEASURING / TESTING EQUIPMENT.
- SYSTEM FOR QUALITY AUDITS.
- SYSTEM FOR IDENTIFICATION AND APPRAISAL OF INSPECTION STATUS.
- SYSTEM FOR AUTHORISING RELEASE OF MANUFACTURED PRODUCT TO THE PURCHASER.
- SYSTEM FOR TRANSPORTATION /DELIVERY, HANDLING, STORAGE AND PRESERVATION.
- SYSTEM FOR MAINTENANCE OF RECORDS.

GENERAL REQUIREMENTS - QUALITY ASSURANCE

All materials, components and equipment covered under scope and its technical specifications shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme agreed mutually.

Minimum Quality Assurance Test Requirement (QATR) to be followed during Manufacturing and Field erection indicating requirement of various tests / inspections, on major equipment / items, to be carried out as stipulated in technical specification and standards mentioned therein, are attached hereto and are part of bidding documents.

Clarification, if any, on these quality assurance test requirement, raised by bidder shall be discussed and resolved during pre-bid meeting.

After the award of contract, the contractor shall submit the detailed Manufacturing & Field Quality Assurance Plans for complete equipment / material during detailed engineering in the format attached hereto (format of quality plan F-060-02 issue 2.0 rev. 01, Total 1 Page) for

approval and acceptance by SAPDC/Consultant in line with technical specification, Quality Assurance – General & Test Requirements and detailed engineering.

Manufacturing Quality Assurance Plans shall detail out for all the components and equipment & various tests/inspection, to be carried out in conformity with relevant latest IEC/IS/ISO etc, quality practices and procedures to be followed by Contractor's / Subvendor's Quality Control Organization, the relevant reference documents, standards and acceptance norms etc. during all stages of material procurement, manufacture, assembly and final testing / factory acceptance tests.

The Field Quality Assurance Plans shall detail out the various tests/inspection to be carried out in conformity with relevant latest IEC/IS/ISO, quality practices and procedures etc. to be followed by the contractor's / sub-contractor's site Quality Control Organisation during various stages of site activities from receipt of material/equipment at site till final commissioning/ acceptance/handover.

All major items/ equipment/ components to be manufactured in house as well as procured from sub-vendors (Bought out Items, BOI) to be listed in the bid. Bidder shall submit Quality Assurance Plan submission schedule in the bid for above listed items in attached Format (duly filled in the format F-060-05 Issue 2.0 Rev. 00, Total 1 Page) in line with L2 Schedule.

For components / equipment / Bought out Items procured by the contractor for the purpose of the contract, the Contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the sub-vendors.

The quality plans called for from the sub-vendors shall detail out, during the various stages of manufacture and installation, the quality practices and procedures followed by the sub-vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc.

Such quality plans of the successful sub-vendors shall be finalized with the SAPDC/Consultant in line with requirement mentioned above and such approved Quality Plans shall form a part of the purchase order/contract between the contractor and his sub-vendor.

Within three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications and other related documents such as data sheet, drawings, quality plans and delivery conditions shall be furnished to the SAPDC/Consultant by contractor along with a report of the Purchase Orders placed, on the monthly basis, so far for the contract.

The Quality Plans shall be submitted on electronic media e.g. CD or E-mail in addition to hard copy, for review and approval of SAPDC/Consultant. After approval, the same shall be submitted in compiled form on CD-ROM by contractor.

For all spares, replacement items and additional similar items, the quality requirements/Quality Plans as agreed for the main equipment supply shall be applicable.

All material of construction shall be as per technical specification / approved drawings / GTP.

Contractor's Plant internal standards must be traceable to acceptable International / National standards & salient points of difference (if any) shall be clearly stated with submission of plant standards. The contractor shall furnish copies of reference documents, plant standards, acceptance norms, test and inspection procedure etc. as referred in Quality Plans along with Quality Plan to SAPDC/Consultant. These Quality Plans and reference documents/standards etc. will be subject to approval of SAPDC without which manufacturer shall not proceed. These documents shall form a part of the contract.

Tests on components and sub-assemblies shall be carried out at various stages of manufacturing, till the product undergoes the final tests in conformity with the relevant standards.

The Customer Hold Points (CHPs), identified in approved quality plan, i.e. testing checks which shall be carried out in the presence of the SAPDC, beyond which the work will not proceed without written consent of SAPDC's authorized representative.

The contractor / sub-vendor shall carry out routine test on 100% items at his works. The quantum of check / test for routine and acceptance test by SAPDC/Consultant 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.

The quantum of check when specified in percentage (%) / sampling basis shall be treated as per lot per sub-vendor. When the quantum of check is indicated to in whole no., then same quantum of check shall be applicable to each sub-vendor supplying the same equipment.

For sub-vendors identified during pre-award stage for submission of vendor details/ credentials (category "DR"), contractor shall submit documents in format F-060-01 after placement of award in the manner as specified as under prior to any procurement and within a month after placement of award or a period as agreed at the time of pre-award discussions.

The proposed sub-vendors should be registered vendors of the bidder and must have proven experience for successful operation for similar equipment / items / processes as mentioned elsewhere in technical specification.

Before assigning any portion of work to the sub-vendor, other than one specified and duly accepted in the contract, the contractor will take prior approval of BHEL/SAPDC.

Normally no request for change of sub-vendors or inclusion shall be entertained by SAPDC. But in exceptional circumstances, if the request for change of sub-vendors or inclusion is found reasonable and justified, then the same shall be entertained and the decision of SAPDC in this respect shall be final and binding. The time consumed for the change / inclusion of sub-vendors shall not be excluded from the stipulated time of the completion of the contract. This change shall not relieve the contractor from the responsibility to complete the work within stipulated time in any manner.

The contractor's proposal shall include sub-vendor's facilities established at the respective works, the process capability, process stabilization, Q.C. system followed, experience list etc. along with his own technical evaluation of sub-vendor. (Format F- 060-01 issue 2.0 rev. 01, Supplier / Sub-vendor Assessment Sheet, Total 14 pages).

However, whenever felt necessary, sub-vendor assessment will also be carried out by SAPDC/Consultant in accordance with the above procedure and by factory visits; for existing/proposed vendors/sub-vendors. This approval shall not relieve the contractor from any obligation, duty or responsibility under the contract & SAPDC shall not be responsible for any complications arising between the contractor and his subcontractor(s) / sub-vendor (s) and / or any other liabilities.

SAPDC/Consultant reserves the right to carry out quality audit and quality surveillance of the system and procedures of the contractor / or their sub-vendor. The contractor shall provide all necessary assistance to enable SAPDC/Consultant to carry out such details & surveillance including Quality Manuals, if required by SAPDC/Consultant.

All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirement of ASME section-VIII/IX or other International equivalent standard acceptable to SAPDC/Consultant. All welding/brazing procedures shall be submitted to SAPDC/Consultant/BHEL for review / verification prior to carrying out the welding/brazing. However, wherever required by the SAPDC/Consultant, tests shall be conducted in presence of SAPDC's authorized representative.

All Brazers, Welders and welding operators employed on any part of the contract either in Contractor/his sub-vendor's works or at site or elsewhere shall be qualified as per ASME section-VIII/IX or other equivalent International Standards acceptable to SAPDC/Consultant.

Unless otherwise proven and specifically agreed with SAPDC/Consultant, welding of dissimilar material and high alloy materials shall be carried out at shop only.

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 or Indian Society of non-destructive examination). NDT shall be recorded in a report, which include detail of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of correlation of the test report with the job.

All material used for equipment manufacture including castings and forgings, 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.

Contractor shall submit Field Welding Schedule for field welding activities like field welding location, numbers, welding procedure to be used, requirements, codes and NDT requirement along with all supporting documents, like welding procedures, heat treatment procedures,

NDT procedures, etc. to SAPDC/Consultant for review at least ninety days before schedule start of erection work at site.

Any other statutory requirements as applicable for the equipment / systems shall also be complied with.

The inspection calls (duly filled in the format F-060-06 Issue 2.0 Rev. 00, total 1 Page) shall be placed at least 06 weeks in advance for overseas inspections excluding India and 15 days in advance for inspections within India and Nepal.

Before submitting the inspection call to SAPDC for witnessing the Customer Hold Points (CHP's) and/or requesting SAPDC for issuance of Material Dispatch Clearance Certificate (MDCC) based on Test Certificate (TC) review / Certificate of Conformance (COC), the contractor shall ensure that all Drawings / documents / GTP / technical data sheet, relevant to respective CHP / MDCC requirement, has been duly approved /accepted / noted by SAPDC.

Contractor shall ensure readiness of offered equipment by all means, before raising such call to SAPDC to attend CHP inspections. In case, SAPDC engineer (s) on reaching at a place of inspection found that material is not ready for inspection due to whatsoever reason, the complete inspection expenditure of SAPDC engineer(s) as per actual shall be chargeable to the contractor.

Only calibrated testing & measuring instruments shall be used while performing tests during manufacturing and erection, testing & commissioning at site by the contractor. Copy of the calibration certificates will be submitted to SAPDC/Consultant by the contractor during inspection as an evidence.

Non-conformities observed during manufacturing, shop testing, handling, packaging, transportation, storage, preservation, erection, testing & commissioning are required to be intimated by the contractor (Format for reporting, F-060-04 issue 2.0 rev 01, Total 5 pages). The acceptance/rejection of the non-conformities will be at the discretion of SAPDC.

Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the acceptance of SAPDC. Action taken in accordance with decision of disposal of non-conformity for repair / rework / modification of the item / equipment and to prevent re-occurrence. The corrective and preventive action may involve modification of item / equipment, change in procedure and system etc. to achieve quality improvement at all stages and levels.

Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the SAPDC 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 Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings etc.

No material shall be dispatched from the manufacturer's works before the same is duly accepted, subsequent to pre dispatch/final inspection including verification of records of all

previous tests/inspection by SAPDC and duly authorised for Dispatch by issuance of Material Dispatch Clearance Certificate (MDCC).

The test reports of type tests conducted as per contract, in line with requirement stipulated in the technical specification / quality plan should be got accepted from SAPDC/Consultant before final inspection / issuance of MDCC.

All materials used or supplied shall be accompanied by valid and approved material certificates and tests and inspection reports. These certificates and reports shall indicate the heat numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it to ensure physical correlation and traceability of material vis-a-vis test certificate. Such identification no. shall remain same and verifiable for all stages of manufacturing and installation.

3.8.1.2 QA DOCUMENTATION

The contractor shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan.

Each QA Documentation shall have a project specific Cover Sheet bearing name and identification number of equipment including index of its contents with page control on each document. The QA Documentation file shall be progressively completed by the Contractor/sub-vendor 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 despatch. However CD-ROM may be issued not later than three weeks.

Before dispatch / commissioning of any equipment, the Contractor 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 Contractor will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

The contractor shall be required to submit copies of the following quality assurance documents in original duly reviewed and accepted by contractor along with the request letter for issuance of MDCC (Material Dispatch Clearance Certificate):

- QUALITY PLAN CHECK LIST.
- MATERIAL MILL TEST REPORTS ON COMPONENTS AS SPECIFIED IN QUALITY PLAN.
- SKETCHES AND DRAWINGS USED FOR INDICATING THE METHOD OF TRACEABILITY OF THE
- RADIOGRAPHS TO THE LOCATION ON THE EQUIPMENT.
- NON-DESTRUCTIVE EXAMINATION RESULTS REPORTS INCLUDING INTERPRETATION REPORTS.
- CALIBRATION CERTIFICATE OF ALL METERS & MEASURING INSTRUMENTS PROPOSED TO
- BE SUPPLIED AS PART OF RELEVANT BILLING BREAKUP ITEM.
- ROUTINE TEST REPORTS FOR TESTING REQUIRED AS PER APPLICABLE CODES AND
- STANDARDS REFERRED IN THE SPECIFICATIONS.
- INSPECTION REPORTS DULY SIGNED BY AUTHORIZED REPRESENTATIVE OF SAPDC AND

- CONTRACTOR FOR THE AGREED CUSTOMER HOLD POINTS.
- ALL THE ACCEPTED DEVIATIONS SHALL BE INCLUDED WITH COMPLETE TECHNICAL DETAILS.
- LIST OF BALANCE POINTS IF ANY.
- CERTIFICATES IN RESPECT OF CALIBRATION, WELDERS & BRAZERS QUALIFICATION ETC.
- COPY OF ALL REFERENCE DRAWINGS AND REFERENCE TECHNICAL DOCUMENTS
- ACCEPTANCE OF TYPE TEST REPORTS BY SAPDC/CONSULTANT.

Similarly, the Contractor shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/procedures, within 2 weeks after commissioning of individual system.

On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Consultant and other set to SAPDC. For the particular case of phased deliveries, the complete quality document to the SAPDC/Consultant shall be issued not later than 3 weeks after the date of the last delivery of equipment.

ASSOCIATED DOCUMENTS / FORMATS

- F-060-01 VENDOR / SUB-VENDOR ASSESSMENT SHEET
- F-060-02 QUALITY PLAN SUBMISSION BY CONTRACTOR.
- F-060-04 NON-CONFORMANCE REPORT (NCR)
- F-060-06 INSPECTION CALL REQUEST.

3.8.1.3 Safety

Safety of personnel

All equipment and services provided under this contract shall abide by international standards commonly accepted in the hydroelectric utility industry for safety of personnel whether involved with operation or maintenance.

Safety of operation

All equipment and services provided under this contract shall abide by commonly accepted standards for safety of operation.

The various system and sub-systems supplied under this contract shall be designed to follow and operate under a clear hierarchical structure:

- Plant control level,
- Unit control level,
- Functional control level, functional drive group level,
- Local drive level.

Each hierarchical control level shall perform its specific tasks and always depend on the subordinate lower control levels. In general, should a higher control level failure occur, the lower control level shall not be affected and shall be able to control the power plant with full safety.

The Contractor shall accordingly build into the "Electrical & Mechanical System" adequate levels of autonomy, independence, redundancy and functional distribution to insure that safety is maintained at all times.

3.8.1.4 Earthing

Earthing terminals for equipment of these specifications shall form part of equipment supplies. The contractor shall connect the earthing conductors to these terminals as required.

Risers from earthing bus shall be in the scope of purchaser. However, extension from these risers to the equipment shall be in the scope of supplier in the Power House, Transformer Hall, Switchyard and Butterfly Valve House.

However, overall earthing arrangement required for HT panel, LT panel, DG set, motor & motor control panels etc. at isolated location such as Dam Site, TRT Outfall area and Surge Shaft either by pit earthing or counter poise etc. shall be in the scope of supplier including civil works, design, material supply (for main earthing risers, interconnection, charcoal, salt, Bentonite etc.), erection, testing & commissioning etc.

A copper ground bus, sized to carry maximum short circuit current, shall run along the entire length of panel structure and shall have terminal connector at each end for connection to station ground grid (50 X 6 mm G.I. flat).

Tests

Each panel shall be completely assembled, wired, adjusted and tested at the factory prior to shipment. The test shall include wiring continuity tests, insulation tests and functional tests to ensure satisfactory operation and control of individual equipment.

Special Cables

Special cables for specific purpose, as required, shall be supplied and installed by the Bidder.

3.8.1.5 Completeness of the specification

Any fittings, accessories, equipment or any other things required for successful commissioning of Arun-III Hydro Electric Project, though may not have been specifically mentioned in the specification but are usually necessary for the completeness of the equipment shall be deemed to be included in the specification and shall be supplied by the contractor without any extra cost to the Employer.

3.8.1.6 Packaging and Shipment

The Contractor shall provide such packing of the Goods as it is required to prevent their damage or deterioration during transit to their final destination as indicated in the Contract. The packing shall be sufficient to withstand, without limitation, rough handling during transit and exposure to extreme temperatures, salt and precipitation during transit and open storage. Packing case size and weights shall take into consideration, where appropriate, the remoteness of the final destination of Goods and the absence of heavy handling facilities at all points in transit.

The packing, marking and documentation within and outside the packages shall comply strictly with such special requirements as shall be expressly provided for in the Contract and, subject to any subsequent instruction ordered by the Employer consistent with the requirements of the Contract.

After unpacking of Goods the packing material shall become the property of Employer

The contractor shall wrap, pack and crate all plant included in the work or part thereof, suitable for shipment to a tropical location, facilitating proper handling and protection from damage in rail, truck, ocean or air shipment as applicable. An approved drying agent, such as Silica Gel, shall be packed in containers or packages holding plant which may be adversely affected by moisture or excessive humidity.

All packing crates shall be clearly marked before shipping to indicate the contract number, shipping address, volume, weight, name, number and unit number of the contents, slinging and weight bearing points.

All plant parts shall be marked to facilitate erection. Each packing crate shall contain a packing list in a waterproof envelope. Parts shall be described and also identified by their numbered marking in the packing list.

Three copies of the packing list shall be forwarded to the purchaser prior to dispatch. The ownership of packaging materials shall be of Employer. All wooden packaging crates and steel support structures shall be dumped to the designated area within 5kms of the power house as per the direction of Engineer in charge.

The supplier shall be entirely responsible for the insurance, shipment, handling and transportation.

The equipment shall not be dispatched by the Bidder from the place of manufacture to the site until the dispatch instructions are issued by the Owner.

3.8.1.7 PACKAGING, HANDLING AND SITE STORAGE

The Contractor shall pack all the consignment in sea worthy packaging strong enough to withstand rough handling during transit. Machine surface shall be suitably protected against scratches, corrosion, shocks, impact etc. Packages shall be suitably and distinctly identified for type of handling and kind of storage.

Electronic equipment shall be packaged, shipped and stored in anti-static packing. All packages shall be stored indoor. Packages containing electronic equipment shall be stored in humidity controlled environment.

The Bidder shall indicate the number of packages of consignment together with the size (L x W x H) and weight for transporting the equipment in the Bidding Document.

3.9 SPECIAL INSTRUCTIONS TO BIDDERS

General

The Bidder shall base the equipment design on the information given in this specification. The equipment shall be complete in all respects. Any item which is not specifically mentioned herein but found essential for safe and efficient operation and maintenance and satisfactory performance of the system shall be deemed to have been included in the scope of the Bidder. It shall be presumed that the Bidder has studied the site, all the drawings, tender documents and is fully aware of the scope of work involved and the site conditions prevailing.

3.10 Codes and Standards

- a) All equipment, systems and works covered under this specification shall comply, in all respect, with requirements of applicable latest statutes and that of latest editions of codes and standards. Latest regulations and safety & environmental requirements as applicable in India / state of installation shall also be complied with.
- b) All codes and standards mentioned shall mean as relevant and applicable to a particular equipment / system.
- c) All other codes/standards not covered in Section 1 / Section 2 but required for the plant and system offered shall also be referred / followed by the Bidder. The Bidder, along with the bid, shall submit a comprehensive list of codes and standards to be followed for various equipment / system.
- d) In all cases where IBR does not govern, German, American, British, ISO or other international standards established to be equivalent or superior to the codes specified are also acceptable. In the event of any conflict between the requirements of equivalent codes and standards and the requirements of Indian standards / regulations, the latter will govern unless specified otherwise in the specifications.
- e) The Bidder shall be responsible to be in possession of all the specified Codes / Standards and ensure reference to the same before submitting the offer/ bid.
- f) Mandatory codes / local regulations to be followed for safety, design, fabrication and operation of the switchyard shall be, followed:
- g) If the equipment supplied does not conform to the codes and standards mentioned in this specification, but is manufactured to the Bidder's own standard, developed as a result of his experience, is also acceptable provided the same is found to be superior to the above mentioned codes and standards. The Bidder shall identify such equipment and shall also present sufficient data to the Owner / Consultant to support his design and to establish the superiority. The design may be accepted by Owner/ his Consultants only if the Purchase / his consultant is satisfied that sufficient experience exists with the design proposed.

- h) Design not meeting the stipulations of the codes and standards will not be acceptable.
- i) Apart from various codes and standards mentioned in Section 1/2, the Manufacturer shall comply with other requirements of codes and standards mentioned in this Specification for detailed design, manufacture, testing, erection, construction etc.

Control System	IEEE – 122 , 1992
Metering / Dosing pumps	API 675 – 1987 (Positive displacement pumps – controlled volume) API 676 – 1987 (Positive displacement pumps – Rotary).
Centrifugal pumps	API 610 – 1990, ASME PTC 8.2 – 1965
Gear Box	API 613 – 1993 & AGMA 420 & 421
Coupling	API 671 – 1993
Structural	IS 1893 – 1991, IS 875-1992 & IS 800 – 1991
Pressure Vessel	ASME Sec. VIII, Div. 1 – 1995
Piping	ANSI B 31.1-1995 / 31.3 – 1993, IBR
Valve	API
Instrument	ISA, API
Electrical	As per specification attached & relevant
	IS/IEC
Tanks	API 650- 1993
Electrodes	AWS, IS
Painting	IS Standards
Performances Tests	
Overload test of crane and hoists	IS 3177

3.11 Deviations and Assumptions

Bidders requested to carefully examine and understand the specifications and seek clarifications, if required, to ensure that they have understood the specifications. The Bidder's offer should not carry any sections like clarifications, interpretations and/or assumptions. In the event of conflict between the Technical Specifications and the condition of contract, the requirements as indicated in the technical specification shall govern, unless confirmed otherwise by the Owner in writing before the award of contract, based on written request from the bidder for such a clarification.

In the event of conflict between requirements of any two clauses of the specification documents, the more stringent requirements shall apply, unless otherwise confirmed by the Owner in writing before the award of this contract, based on a written request from the Bidder for such clarification.

The Bidders are advised that while making their Bid Proposals and quoting prices, all terms and conditions of bidding documents may appropriately be taken into consideration. Bidders are required to furnish a certificate indicating their full compliance to the terms and conditions of the bidding documents.

3.12 Limit of Contract

Equipment furnished shall be complete in all 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 respective specifications, unless included in the list of exclusions. All similar standard components/ parts of similar standard equipment provided shall be interchangeable with one another.

This review by the Owner's Engineer / Consultant may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicative of the accuracy of the information submitted. This review and/ or approval by the Engineer shall not be construed by the Bidder, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements specified under these specifications and documents.

3.13 Latent Defects

Notwithstanding the issue of the Take Over Certificate, the Contractor shall be responsible for making good with all possible speed any Latent Defect in any Works /equipment of the plant which appears at any time before the expiry of defect liability period. And shall remedy such defect at its own cost and expense. The latent defect liability period shall be a minimum of 5 years from the end of defect liability period. The defects to which this applies are defects in design, materials or workmanship or defects arising from any act or omission of the Contractor done or omitted prior to Take-over of the portion of the Plant affected by the defects or during the Warranty Period which a reasonable examination at the end of the Warranty Period would not have disclosed.

3.14 Defect Liability

- a) "Defect Liability Period" means the period of validity of the warranties given by the Contractor commencing at Completion of the Facilities or a part thereof, during which the Contractor is responsible for defects with respect to the Facilities (or the relevant part thereof as provided here.
- b) The Contractor warrants that all the facilities or any part thereof are new, unused, and of the most recent or current models, and that they incorporate all recent improvements in design and materials, unless provided otherwise in the Contract.
- c) The Contractor further warrants that the Plant and equipment shall be free from defects arising from any act or omission of the Contractor or arising from design, materials, and workmanship, under normal use in the conditions prevailing in the country of final destination.
- d) **The defect liability period shall be Twenty Four months (24) months from the date of completion of the facilities (or any part thereof) or eighteen (18) months from the date of**

operational acceptance/taking over of the facilities (or any part thereof), of respective unit/ common auxiliary whichever period concludes earlier.

e) If during the Defect Liability Period any defect should be found in the design, engineering, materials and workmanship of the Plant and equipment supplied or part thereof, the Contractor shall promptly, in consultation and agreement with the Employer regarding appropriate remedying of the defects, and at its cost, repair, replace or otherwise make good (as the Contractor shall, at its discretion, determine) such defect as well as any damage to the Facilities caused by such defect. The Contractor shall not be responsible for the repair, replacement or making good of any defect or of any damage to the Facilities arising out of or resulting from any of the following causes:

- (a) improper operation or maintenance of the Plant and equipment by the Employer
- (b) operation of the Facilities outside specifications provided in the Contract
- (c) normal wear and tear.

f) Upon receipt of notice the contractor shall within one week start the repair work.

g) The Employer shall give notice to the Contractor stating the nature of any such defects together with all available evidence thereof, promptly following the discovery thereof. The Employer shall afford all reasonable opportunity for the Contractor to inspect such defects.

h) Upon receipt of such notice, the Contractor shall, within the period specified in the specification, expeditiously repair or replace the defective Plant and equipment or parts thereof, at no cost to the Employer.

i) If the Contractor fails to commence the work necessary to remedy such defect or any damage to the Facilities caused by such defect within a reasonable time (which shall in no event be considered to be less than fifteen (15) days), the Employer may, following notice to the Contractor, proceed to do such work, and the reasonable costs incurred by the Employer in connection therewith shall be paid to the Employer by the Contractor or may be deducted by the Employer from any monies due the Contractor or claimed under the Performance Security.

j) If the repair, replacement or making good is of such a character that it may affect the efficiency of the Plant and equipment or any part thereof, the Employer may give to the Contractor a notice requiring that tests of the defective part of the Facilities shall be made by the Contractor immediately upon completion of such remedial work, whereupon the Contractor shall carry out such tests.

k) If such part fails the tests, the Contractor shall carry out further repair, replacement or making good (as the case may be) until that part of the Facilities passes such tests. The tests in Character shall in any case be not less than what has already been agreed by the Employer and the Contractor for the original equipment / part of the Facilities.

l) If the Plant and equipment or any part thereof cannot be used by reason of such defect and/or making good of such defect, the Defect Liability Period of the Facilities or such part, as the case may be, shall be extended by a period equal to the period during which the Facilities or such part cannot be used by the Employer because of any of the aforesaid reasons.

m) Upon correction of the defects in the Facilities or any part thereof by repair/replacement, such repair/replacement shall have the Defect Liability Period extended by a period of twelve (12) months from the time such replacement/repair of the

facilities or any part thereof subject to maximum time period of thirty six (36) months from the date of putting plant and equipment into use.

- n) The Contractor's obligations under this Clause shall not apply to
 - (i.) any materials that are supplied by the Employer are normally consumed in operation, or have a normal life shorter than the Defect Liability Period stated herein
 - (ii.) any designs, specifications or other data designed, supplied or specified by or on behalf of the Employer or any matters for which the Contractor has disclaimed responsibility herein .
 - (iii.) any other materials supplied or any other work executed by or on behalf of the Employer, except for the work executed by the Employer for remedy of defects in the work executed by the contractor as per provisions mentioned below.
- o) The Employer shall afford the Contractor all necessary access to the Facilities and the Site to enable the Contractor to perform its obligations under this Clause .The Contractor may, with the consent of the Employer, remove from the Site any Plant and Equipment or any part of the Facilities that are defective if the nature of the defect, and/or any damage to the Facilities caused by the defect, is such that repairs cannot be expeditiously carried out at the Site.
- p) Except as provided in (Defect Liability) and (Loss or Damage to property), the Contractor shall be under no liability whatsoever and howsoever arising, and whether under the Contract or at law, in respect of defects in the Facilities or any part thereof, the Plant and Equipment, design or engineering or work executed that appear after Operational acceptance or any part thereof, except where such defects are the result of the gross negligence, fraud, criminal or wilful action of the Contractor.
- q) **The contractor shall provide an extended warranty for a period of 36 months from the date of taking over of Facilities for the part repaired** (as envisaged in POINT NO (k)).

21. Loss of or Damage to property:

- a) The Contractor shall indemnify and hold harmless the Employer and its employees and officers from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and
- b) expenses of whatsoever nature, including attorney's fees and expenses, in respect of the death or injury of any person or loss of or damage to any property (other than the Facilities whether accepted or not), arising in connection with the supply and installation of the Facilities and by reason of the negligence of the Contractor or its Subcontractors, or their employees, officers or agents, except any injury, death or property damage caused by the negligence of the Employer, its contractors, employees, officers or agents.
- c) If any proceedings are brought or any claim is made against the Employer that might subject the Contractor to liability the Employer shall promptly give the Contractor a notice thereof and the Contractor may at its own expense and in the Employer's name conduct such proceedings or claim and any negotiations for the settlement of any such proceedings or claim.
- d) If the Contractor fails to notify the Employer within twenty-eight (28) days after receipt of such notice that it intends to conduct any such proceedings or claim, then the Employer shall be free to conduct the same on its own behalf. Unless the Contractor has so

failed to notify the Employer within the twenty-eight (28) day period, the Employer shall make no admission that may be prejudicial to the defense of any such proceedings or claim.

e) The Employer shall, at the Contractor's request, afford all available assistance to the Contractor in conducting such proceedings or claim, and shall be reimbursed by the Contractor for all reasonable expenses incurred in so doing.

f)The Employer shall indemnify and hold harmless the Contractor and its employees, officers and Subcontractors from any liability for loss of or damage to property of the Employer, other than the Facilities not yet taken over, that is caused by fire, explosion or any other perils, in excess of the amount recoverable from insurances procured under GCC Clause (Insurance), provided that such fire, explosion or other perils were not caused by any act or failure of the Contractor.

g) The party entitled to the benefit of an indemnity under this Clause shall take all reasonable measures to mitigate any loss or damage which has occurred. If the party fails to take such measures, the other party's liabilities shall be correspondingly reduced

3.15 Completion Schedule

The Bidder shall submit Time Bar chart indicating completion date of major activities such as submission of design data / calculations and drawings for approval, manufacturing of components / units, supply, inspection etc. without which the Tender shall not be considered. Time Bar Chart furnished shall afterwards form part of the contract and cannot be altered arbitrarily except Force Majeure conditions as may be agreed with the Owner.

3.16 Drawings & Documents for Owner's use and Archives

The Bidder shall submit all final drawings, documents, manuals for Owner's use and for reference / record required during course of operation and maintenance of the plant. Numbers of copies and their form (hard copy, electronic form, reproducible) to be submitted and the details of the documents, drawings, manual etc. to be furnished by the Bidder are described elsewhere in the specification.

Drawings, documents, calculation, data & Information to be submitted by the Bidder along with the offer:

Technical Data to be submitted with the Tender

- 1) List of performance tests proposed by the Bidder to demonstrate the guaranteed parameters for generator and other electrical equipment.
- 2) Specific energy consumption.
- 3) Type test certificates for major categories of equipment, issued by independent testing authority.
- 4) Guaranteed Technical Parameters.
- 5) Technical catalogues.
- 6) Manufacturing Quality Plan

Operation & Maintenance Manuals

Instruction manuals, presenting the basic categories of information for the operating and/or maintenance personnel, as detailed herein below shall be furnished by Bidder. The instruction manuals shall present the following basic categories of information in particular complete and comprehensive manner and prepared for the use by operating and/or maintenance personnel.

- i. Instructions for initial commissioning, short duration and long duration shut down.
- ii. Instruction for operation, routine inspection and maintenance including preventive maintenance.
- iii. Recommendation for inspection points, method of inspection and period of inspection.
- iv. Information on detection, cause and rectification of troubles and faults.
- v. Instructions on normal repairs and overhaul.
- vi. Complete parts list with proper and complete identification (Tag nos./Serial nos. as shown in the respective approved drawings) and ordering information for all

- replaceable parts. The identification details of equivalent and alternative makes for these spare parts which are not manufacturer's own product shall also be listed.
- vii. List of all special tools and tackle & spares and instructions for use of such tools and tackle & spares.
 - viii. One complete set of as built drawings of the entire systems.
 - ix. The information shall be organized in a logical and orderly sequence. A general description of equipment including significant technical characteristics shall be included to familiarize operating and maintenance personnel with the equipment. Such description and technical characteristics shall not differ from the approved data.
 - x. Necessary drawings, curves and other illustrations shall be included or copies of appropriate approved drawings shall be bound in the manuals. Tests, adjustment and calibration information, as appropriate, shall be included. Safety and other warning notices and installation, maintenance and operating cautions shall be emphasized.
 - xi. Write-up, figures, part list etc., shall be clearly legible. The manuals shall be prepared on good quality paper securely bound in durable folders.
 - xii. The instruction manuals shall be subject to Consultant's approval in the same fashion as that for drawings.
 - xiii. Instruction manual shall give step by step procedure for Erection, testing and commissioning
 - xiv. Operation, Maintenance and Repair Instruction manual shall also contain:
 - xv. List of spare parts with ordering specifications and manufacturer's catalogues
 - xvi. List of consumables, lubricants, chemicals with specifications, brand names and annual consumption figures.
 - xvii. Drawings relevant for erection, operation, maintenance and repair of the equipment.
 - xviii. Procedure for ordering spares.
 - xix. Maintenance Manual shall also include:
 - xx. Diagnostic trouble shooting / fault location charts
 - xxi. Tests for checking of proper functioning.

Drawings / documents for approval

Quality Control & Quality Assurance plan.

G.A. and Cross Sectional drawings of all equipment indicating weights, material of construction, bill of material, dimension, specification etc.

Final design calculations and assumptions.

Actual performance data and characteristic curves based on the testing at site.

Technical specification of all equipment, motors, for all system and all other accessories.

Final list of drawings.

As built drawings.

Miscellaneous

- i. General arrangement and cross sectional drawings of all major components with bill of material.
- ii. Foundation drawings, load data & design calculation for all equipment.

- iii. Erection drawings for all equipment and structures showing complete erection details.
- iv. Engineering and design calculations of installations and units.
- v. QAPs
- vi. Detailed procedures of shop testing of all the items applicable shall be submitted to the Owner/ Consultant for approval before conducting tests.
- vii. Following shop test certificates/test curves/data, shall be furnished.
 - Materials and components test certificates.
 - Performance test results and characteristic curves of all fans, pumps, and electric drive motors etc.
 - Non-destructive test results as applicable.
 - Reports and test certificates of shop tests.
 - Type test & routine test certificates.
- viii. Detailed quality assurance program along with quality plan shall be submitted.

Following data shall be furnished:-

- a) Technical data of all the plant, equipment, drive motors, instruments, panels, etc. shall be furnished.
- b) Following lists/tables / write ups shall be furnished, complete with tag nos. and brief specification. Proper numbering system as approved by Consultant/Owner shall be adopted.
 - i) Instrument schedule (with service, range, make of instrument).
 - ii) Flow element schedule.
 - iii) Valve schedule.
 - iv) Pipe schedule.
 - v) Cable schedule (Power & Control).
 - vi) Schedule of actuators (electric/pneumatic)

The scheduled dates for the submission of these as well as for, any data/information to be furnished by the Employer would be discussed and finalized at the time of award. The supplier shall also submit required no. of copies as mentioned in this specification of all drawings/design documents/test reports for approval by the Employer.

Note: The contractor may please note that all resubmissions must incorporate, all comments given in the submission by the Employer failing which the submission of documents is likely to be returned. Every revision shall be a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.

3.17 Workmanship and Quality Control

All moving parts of equipment, which can conceivably cause injury to the operator and otherwise authorized personnel within the vicinity of working area shall be suitably guarded and warning displays shall be put at prominent places.

The Bidder shall clearly indicate and identify the plans and procedures, which shall be followed in the design, manufacture and installation of plant and equipment to control and assure to the Owner of the desired quality.

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.

3.17.1 Equipment Mounting

All instruments, switches etc. mounted on the front face of the panels shall be of flush type.

All equipment shall be so mounted that removal and replacement may be accomplished individually without interruption of service to others.

All equipment inside the panel shall be so located that their terminals and adjustments are readily accessible for inspection and maintenance. Adequate ventilation shall be provided in enclosed panel.

Each of the LV switchboards shall be designed for 1.1 times the required rating as a spare capacity. Further all LV Switchboard shall be provided with 20 % spare modules of each rating and type of module.

3.18 Performance Test:

If nothing unusual has been observed in load run and load rejection tests, the test service period of 72 hours shall follow. During this test service period, the unit must operate continuously at rated condition without any interruption except of those beyond the control of the Contractor. However, such interrupted period shall not be counted for in the test service period. There should be one-month reliability run of the complete unit reckoned from the date of taking over by employer. During reliability run, machine shall be operated by employer and any problem observed during this run shall be attended by the contractor including replacement of components and providing requisite manpower.

3.18 Title Block :

Project	4x225MW Arun-3 (HEP),Nepal			
Customer	SJVN Arun-3 Power Development Company (P) Ltd. (SAPDC)			
Consultant	 SJVN Ltd			
	BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP NOIDA		Name	Sign
		Drawn		
		Checked		
		Approved		
Title	Drawing Number :			Rev

-----XXXX-----

Technical Checklist

Sl. No.	Particulars	Confirmation by Bidder	
1.0	Technical Qualifying Requirement		
1.1	The bidder to furnish relevant documents for meeting the qualifying requirement. 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
1.2	The bidder's scope includes supply and services such as - Installation, - Testing and commissioning.	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
2.0	Un-priced BOQ		
2.1	Bidder to confirm that all BOQ items have been quoted. Any item, which is not quoted, the same shall be specifically brought out in Schedule of technical deviation with technical reasons of thereof. However, it shall be discretion of BHEL/ Customer/ Consultant to take final decision on this regards.	Confirmed	Yes/ No
2.2	Any other item /service required for the execution for the complete work is deemed to be included in the offer, whether specifically mentioned in the specification or not. Hence, bidder shall bring out such requirements during tendering stage only. The bill of quantities included in the offer shall clearly reflect such additional items along with their respective quantities & unit prices. Bidder to attach list of item (s), if required, for completeness of work.	List of items required to be attached.	Yes/ No
2.3	The specification entails complete solution to 400kV HV cabling system and hence, scope includes supply of all materials and services i.e. cable installation, termination/ jointing, clamping, testing and commissioning of the cable system, point to point, necessary to execute the work to the satisfaction of BHEL/ Customer/ Consultant.	Confirmed	Yes/ No
2.4	Supply & installation of support structure and minor civil works for foundation for supporting the cable/ termination/ jointing etc. transformer cable box end is in bidder's scope. The supply of cable clamps for fixing of the cable on structure shall be bidder's scope. The required drilling, fabrication and minor civil works required for completion of cable laying work shall be in bidder's scope.	Confirmed. (Details are submitted)	Yes/ No

2.5	Bidder shall dispatch the consumables just before the start of the work at site and only after specific clearance from BHEL/ Customer.	Confirmed (List is attached)	Yes/ No
2.6	The cables shall be laid in cable trays fixed on cable racks assembly in cable trench/ tressle, as per site requirement. Cable racks assembly in cable trench/ tressle shall be supplied and fixed by BHEL based on detailed input design and drawing provided by bidder. These details shall be furnished during tender stage only. Installation and fixing of earthing grid with suitable size of flats shall be done by BHEL, however, earthing of cable system including earthing cable shall be in bidder's scope.	Confirmed	Yes/ No
2.7	All the general and special tools & tackles, testing instruments/ kits required for carrying out termination/ jointing works shall be bidder's scope.	Confirmed (List is attached)	Yes/ No
2.7	Any cable or accessories damaged during installation, testing & commissioning shall be made good/ repaired/ replaced by bidder to the satisfaction of BHEL/ Customer.	Confirmed (List is attached)	Yes/ No
3.0	Cable lengths		
3.1	Bidder may please be noted that The exact cable length shall be decided after visiting site & making precise measurements at contract stage. Manufacturing lengths and drum length shall be determined with consultation & approval with BHEL/ Customer/ Consultant.	Confirmed	Yes/ No
3.2	The Payment of cables length for supply shall be as per approved quantities by BHEL/ Customer/ consultant.	Confirmed	Yes/ No
3.3	The Payment of cables length installation will be as per actual measurement at site which shall also include cable terminations.	Confirmed	Yes/ No
4.0	Technical		
4.1	Compliance to technical specification	Confirmed	Yes/ No
4.2	Calculations		
4.2.1	Bidder will submit short circuit current calculation, continuous current rating calculation and sheath standing voltage calculation for justifying the size of cable in line with proposed laying conditions and customer requirements. Any other detailed calculations, if required/ envisaged during detailed engineering stage shall also be in bidder's scope.	Confirmed	Yes/ No
4.2.2	Bidder shall furnish calculations of cable for following during tendering stage only,	Confirmed	Yes/ No

	- Screen/ sheath voltage under full load condition, - Screen/ sheath voltage during an external three phase symmetrical through-fault.		
4.2.3	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 400kV system is solidly grounded.	Confirmed	Yes/ No
4.3	Technical deviations		
4.3.1	Confirm that the complete system has been offered as per the requirements of technical specification and in this regard, compliance certificate to technical specification is duly signed and sealed.	Confirmed	Yes/ No
4.3.2	If there is certain clarification/ deviations, same is to be filled, signed and sealed in the schedule of technical deviation and hence <u>deviations/ clarifications mentioned elsewhere in bid shall not be considered.</u>	Confirmed	Yes/ No
5.0	Schedule		
5.1	Bidder shall submit detailed bar chart indicating all the milestones from engineering till manufacturing/ testing, dispatch to site, installation, testing and commissioning.	Confirmed	Yes/ No
6.0	Store & Office Arrangement		
6.1	Open store & Closed store area shall be provided by BHEL, however, bidder shall provide their requirement of space in open 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/ Customer/ Consultant.	Confirmed	Yes/ No
6.2	Office facilities & accommodation for bidder's staff along with conveyance, transportation of all special tools & plants, testing kits etc. shall be in bidder's scope.	Confirmed	Yes/ No
6.3	For construction purpose, the necessary power supply at site shall be provided by BHEL at one point only, however supply requirements for testing etc. shall be arranged by bidder only.	Confirmed	Yes/ No
7.0	Site Supervisor and Jointers		
7.1	Termination/ jointing of cables shall be done by skilled and experienced jointer certified by OEM of the joints/ end terminations and duly approved by Engineer-in charge	Confirmed	Yes/ No
7.2	Provision of site supervisor and skilled technician, qualified	Confirmed	Yes/

	jointer etc. along with tools & tackles, testing instruments/ kits etc. shall be deemed to be included in bidder's scope.		No
7.3	Any special tools and tackles required to complete the cable installation/ laying, termination, testing and commissioning etc. shall be included in the offer. However, general tools and tackles for laying of cables shall be provided by BHEL.	Confirmed	Yes/ No
8.0	Site Test		
8.1	Special tools & tackles for site testing kits for testing & commissioning shall be in bidder's scope, however, it shall be brought at site on returnable basis only.	Confirmed	Yes/ No
8.2	All field tests including tests during installation, pre-commissioning, commissioning, field acceptance tests shall be conducted by the bidder, in presence of representative of the BHEL/ Customer. No separate site test will be conducted by BHEL/ Customer	Confirmed	Yes/ No
9.0	Type Test Requirements		
9.1	Compliance to Type Test Requirement	Confirmed	Yes/ No
9.2	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 without any extra cost and delivery impact to BHEL/ Customer.	Confirmed	Yes/ No

Date:

Bidder's Stamp & Signature

ANNEXURE - A
SCHEDULE OF TECHNICAL DEVIATIONS

Bidder shall list out all technical potential deviation/ change request (s) along with clause with respect to technical specifications.(To be provided in editable format along with signed copy)

Sno	Page No	Clause No.	Extract from Specification	Bidders Comment/Clarification
Bill of Quantity (Annexure 1)				
Section 1				
Section 2				
Section 3				

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-B:
COMPLIANCE CERTIFICATE OF TECHNICAL SPECIFICATION

The bidder shall confirm compliance to the following by signing/ 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 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 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 C

 संजयीएन SJVN Manufacturing Quality Assurance Test Requirements			
Project Name (MW): ARUN- III HEP (4X225 MW)		Doc. No.: QAI/A/M/EM/CB/02	Rev. No.: 02
Item Description: 400 KV XLPE Cable		Issue Date: 30.05.2016	Pages.: 2
Sr. No.	Component, Operation & Characteristics	Applicable Standard	Remark
1	2	3	4
A	400 KV XLPE Cable		
1	Incoming Material		
1.1	Copper Rod		
	Make, Type & Grade, Diameter, Resistivity, Tensile Strength, Purity, Surface finish	IEC 60228/ TS/ REL STD	V
1.2	XLPE Compound		
	Packing, Compound grade	IS 7098/ TS/ REL STD	V
1.3	Semi conducting compounds		
	Packing, Compound grade	TS/ REL STD	V
1.4	PVC Compound		
	Make, Type & Grade, Physical Appearance, Tensile Strength, Elongation at break	TS/ REL STD	V
1.5	Semi conducting binder tape		
	Make, Type & Grade, Appearance & type, Thickness, Volume Resistivity	TS/ REL STD	V
1.6	Water swellable semi conducting tape		
	Make, Type & Grade, Thickness, Swelling height (after 10 minute), Volume Resistivity	TS/ REL STD	V
1.7	Copper Woven SC Tape		
	Make, Type & Grade	TS/ REL STD	V
1.8	Aluminium Tape		
	Make, Type & Grade, Thickness, Tensile Strength, Elongation at break	TS/ REL STD	V
1.9	Bitument Compound		
	Softening Point, Specific density		
1.10.	Packing Drum		
	Material, Drum dimension, Surface finish, Preserve Paint		
2	In process Stage		
2.1	Wire Drawing & in-line annealing		
	Surface finish, diameter, Elongation (copper wires)	TS/REL STD	V
2.2	Stranding		
	No. of wires, diameter of wires, stranding lay, diameter of conductor,surface finish, conductor weight, ovality of conductor	TS/REL STD	V
2.3	Semi conducting tape over conductor		
	Material grade, Application of tape	TS/ REL STD	V
2.4	Core Extrusion/ Rewinding		
	Thickness of insulation, thickness of extruded semi conducting layers, surface finish, core dia, eccentricity & ovality, Tensile strength of insulation, elongation of insulation, hot set test on insulation	TS/ REL STD	V
2.5	Taping		
	Material grade, Application of tape	TS/ REL STD	V
2.6	Corrugated aluminium sheathing		
	Thickness of sheath, pitch of corrugation, height of corrugation, integrity of welding	TS/REL STD	V
2.7	Bitumen Coating & Taping		
	Bitumen application	TS/REL STD	V
2.8	Outer Sheath (Extrusion/ Rewinding)		
	Material & Type, Thickness, Surface finish, Outer conducting layer, Overall diameter, Marking on cable sheath, Cable length, Cable winding		
3	Final Inspection		
3.1	Type Test	IEC 62067/ TS/ DRG/ REL STD	W
3.2	Routine Tests		
	Conductor Examination, Measurement of Electrical Resistance of Conductor, Measurement of thickness of XLPE insulation and over sheath, Measurement of thickness of metallic sheath, Measurement of diameter, Hot set test for XLPE insulation, Measurement of Capacitance, Lighting impluse voltage test followed by a power frequency voltage test, Water penetration test, Performance test	IEC 62067/ TS/ DRG/ REL STD	W
	Measurement of actual Losses	TS/ DRG/ REL STD	W
	Dimensional check, Measurement of length of cable of each drum as per length approved by SJVN, Verification of no joints in cables,	TS/ DRG/ REL STD	W
	High Voltage Test, Partial Discharge test on XLPE Cables along with prefabricated accessories	IEC 62067/ TS/ DRG/ REL STD	W
	Conductor Resistance and Capacitance test, DC test on outer sheath, Electrical tests on outer sheath as per IEC 60229	IEC 62067/ IEC 60229TS/ DRG/ REL STD	W
B	Cable Racks		
	Dimesions, Galvanizing test, Mass of Zinc Coating, Thickness and uniformity of Coating, Adhesion test	IS 2629/ DRG/ TS/ REL STD	V
C	Cable Terminations, Sealing Ends, Cable Cleats, Tags, Disconnecting Link Box		
	Visual & Dimensional Verification, Finish & Smoothness	DRG/ TS/ REL STD	V
D	Termination/ Sealing End Supporting Structure		
	Visual & Dimensional Verification, Finish & Smoothness, Galvanizing Test, Thickness of Zinc Coating	DRG/ TS/ REL STD	V
LEGENDS			
TS: TECHNICAL SPECIFICATIONS		REL. TS/ DRG/ Rel STD.: RELEVANT STANDARD	
V: VERIFICATION OF REPORTS/TCs		DRG: DRAWING	
W: CUSTOMER HOLD POINT (CHP)			
NOTES			
1	Any test at any stage not covered in Quality Assurance Test Requirement (QATR), but part of technical specification of contract, shall also be carried out		
2	QATR shall be read in conjunction with General Quality Assurance Requirement given as part of Technical Specification		
3	Routine test on XLPE Cables shall be conducted on minimum samples as per the provision of IEC 62067		



Field Quality Assurance Test Requirements

Project Name (MW): Arun-III HEP (4X225 MW)	Doc. No.: QAI/A/F/EM/CB/02	Rev. No.: 02
Item Description: 400KV XLPE Cables	Issue Date: 30.05.2017	Pages.: 1

S.No.	Component, Operation & Characteristics	Applicable Standard	Remark
1	2	3	4
1	Material Received		
1.1	Visual check of Drum	TS/ DRG/ REL STD	W*
1.2	Check for Transit damage	TS/ DRG/ REL STD	W*
1.3	Cross check with packing list & SJVN's dispatch clearance	TS/ DRG/ REL STD	W*
2	Storage of Material		
2.1	Proper Placement of equipment as per the Instruction Manual.	TS/ DRG/ REL STD	W*
2.2	Ensure that no damage or rusting takes place during storage	TS/ DRG/ REL STD	W*
2.3	Ensure that all delicate Equipment are stored in protected area.	TS/ DRG/ REL STD	W*
3	Civil Works Pre Erection Activity		
3.1	Embedments		
3.1.1	Installation/fixing of embedments as per drawing	DRG/TS/Plant std	W*
3.1.2	Levelling & alignment before & after concreting	DRG/TS/Plant std	W*
3.2	Foundation		
3.2.1	Check for alignment & level before & after concreting	DRG/TS/Plant std	W*
3.2.2	Check for correctness of foundation	DRG/TS/Plant std	W*
3.3	Blockout		
3.3.1	Check for visual, dimensions & Co-ordinates of block out	DRG/TS/Plant std	W*
3	Erection Stage		
3.1	Verifying the location & spacing between support	TS/ DRG/ REL STD	W*
3.2	Verifying spacing between racks	TS/ DRG/ REL STD	W*
3.3	Earthing of racks and support	TS/ DRG/ REL STD	W*
3.4	The dimensions of the rack . Support and spacing between them	TS/ DRG/ REL STD	W*
4	Laying of cables as per drawing		
4.1	Clamping of cables with cleats at each support	TS/ DRG/ REL STD	W*
4.2	Alignment of cables	TS/ DRG/ REL STD	W*
4.3	Marking/ Identification of Cable Drums	TS/ DRG/ REL STD	W*
4.4	IR Value of Cables	TS/ DRG/ REL STD	W*
4.5	Cable Identification tag	TS/ DRG/ REL STD	W*
5	Commissioning Tests of Cables		
5.1	High Voltage AC & DC Withstand Test	TS/ DRG/ REL STD	W*
5.2	Partial Discharge Measurement Test	TS/ DRG/ REL STD	W*
6	Performance Test as per TS	TS	W*

LEGENDS

TS: TECHNICAL SPECIFICATIONS	REL. STD.: RELEVANT STANDARD
V: VERIFICATION OF REPORTS/TCs	DRG: DRAWING
W: CUSTOMER HOLD POINT	W*: WITNESS BY SAPDC/ MAIN CONTRACTOR

NOTES

1	Any test at any stage not covered in Quality Assurance Test Requirement (QATR), but part of technical specification of contract, shall also be carried out by Contractor/ firm.
2	QATR shall be read in conjunction with General Quality Assurance Requirement given as part of Technical Specification
3	Responsibility for witnessing (W*) at site shall be decided mutually at the time of finalization of FQAP as per the criticality of test.

**ELECTRO MECHANICAL PACKAGE FOR
ARUN-3 HYDRO ELECTRIC PROJECT 900 (4X225) MW**

**(CHECK LIST FOR DOCUMENT SUBMISSION BY BIDDER WITH REGARD TO QUALITY
ASSURANCE PROGRAMME)**

Bidder's Name and Address:

To,

Addl. General Manager
Electrical Contract Department,
SJVN Limited, SJVN Complex,
2nd floor, Shanhan,
Shimla- 171 006 (HP)

Dear Sirs,

We hereby confirm that, we will follow the Quality Assurance Programme (containing overall Quality Management and procedures), as provided in the bid documents and all relevant details/documents required to be submitted alongwith the bid as per the QATR has been enclosed as per details given herein under:

Sr.no.	Document Description	Submitted(Yes/No)
1.	Organization structure for the management and implementation of the proposed quality assurance programme.	
2.	Quality system manual.	
3.	Design control systems.	
4.	Documentation and Data control systems.	
5.	Qualification/experience of bidder's key personnel.	
6.	Procedure for purchase of material, parts, components and selection of sub-vendor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased, etc.	
7.	System for shop manufacturing and site erection controls including process, fabrication and assembly.	
8.	Control of non-conforming items and system for corrective actions and resolution of deviations.	
9.	Control of calibration and testing of measuring/testing equipment.	
10.	System for quality audit.	
11.	System for identification and appraisal of inspection status.	

Bid Document for EM Works of AHEP (4x225) 900MW No. SJVN/ECD/SAPDC/AHEP/EM/17	Section-VII (Attachments)	Page 254 of 258
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12.	System for authorizing release of manufactured product to the purchaser.	
13.	System for transportation /delivery, handling, storage and preservation.	
14.	System for maintenance of records.	

I hereby confirm that general Quality Assurance Requirements and Quality Assurance Test Requirements (QATRs) have been read in detail and same are *accepted/accepted with deviations mentioned in schedule for deviation.

Date: (Signature).....

Place : (Printed Name).....

(Designation)

(Common Seal).....

Note: Continuation sheets of like size and format may be used as per the Bidder's requirements and shall be annexed to this Schedule.

*strike whichever is not applicable

Bid Document for EM Works of AHEP (4x225) 900MW No. SJVN/ECD/SAPDC/AHEP/EM/17	Section-VII (Attachments)	Page 255 of 258
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Annexure –E

QA&I Formats

	SJVN	FORM NO.: F-060-01 PAGE: 1 of 14 ISSUE: 2.0 REV. 01 DATE: 30/06/2016
	FORM	

VENDOR / SUB-VENDOR ASSESSMENT SHEET

TO BE FILLED-IN BY SUPPLIER / SUB-VENDOR

NAME OF SUPPLIER / SUB-VENDOR IN FULL			
		REGISTERED OFFICE	FACTORY / WORKS
ADDRESS			
TELEPHONE NO.			
FAX NO.			
EMAIL ID			
PERSON(S) TO BE CONTACTED (NAME & DESIGNATION & MOBILE NO.)			
WEEKLY OFF			
SHIFT WORKING		Type of Company (Pl. Tick)	
OFFICE	WORKS	Pvt. Ltd.	Public Ltd.
ONE	ONE	☐	☐
☐	☐	Proprietary	Partnership
TWO	TWO	☐	☐
☐	☐	Public Sector	
THREE	THREE	☐	
☐	☐		
		Type of Industry (Pl. Tick)	
		MSME	Large Scale
		☐	☐
		Govt.	Contractor
		☐	☐

	SJVN	FORM NO.: F-060-01 PAGE: 2 of 14 ISSUE: 2.0 REV. 01 DATE: 30/06/2016
	FORM	

Sr. No.	Items / Services / Process for which Approval is desired for	Rating / Size & Type	Applicable Standards IS/DIN/BS/IEC Etc.

REGISTRATION DETAILS #			
PAN / TAN NO.	CENTRAL SALES TAX REG. NO.	STATE SALES TAX / TIN NO.	EXCISE DUTY REGISTRATION NO.
EXCISE CONTROL CODE NO.	SERVICE TAX REG. NO.	CATEGORY OF INDUSTRY	REGISTRATION NO. & VALIDITY DATE
		Micro ☐	
		Small ☐	
		Medium ☐	
		Large ☐	

	SJVN	FORM NO.: F-060-01 PAGE: 3 of 14 ISSUE: 2.0 REV. 01 DATE: 30/06/2016
	FORM	

A. ORGANISATIONAL SOUNDNESS						
Sr. No.	DESCRIPTION		DETAILS TO BE FURNISHED			
1.	Nature of Business (Strike whichever is not applicable)		Manufacturing Unit / Engineering Consultant / Agents / Distributors / Stockists / Dealers / Traders / Indian Subsidiary / EPC contractor / Channel Partner (Attach authorization certificate of principal) / Erection contractor / Other			
2#	Year of commencement of Business / Factory Establishment					
3.	Year of Commencement of Manufacture / Services					
4.	Total Area/Covered Area in Sq. m.		Total Area	Covered Area		
5.	Electric Power-Connected Load					
6#	Electric Power Standby Load & System					
7.	Details of Directors					
Sr. No.	Name	Designation	Qualification	Experience		
8.	Details of Employees					
Please attach copy of Company's Organization Chart (For Unit)						
Division Status	Graduate		Diploma	Skilled	Un-Skilled	Remarks
	Technical	Non-Technical				
Production						
Engineering & Quality Control						
Administration & Other Supporting activities.						

	SJVN	FORM NO.: F-060-01 PAGE: 4 of 14 ISSUE: 2.0 REV. 01 DATE: 30/06/2016
	FORM	

9. Brief Details of Product and Manufacturing Capability					
Sr. No.	Item & Material	Description (Type, Size Rating)	Annual Production for Last Three Years		
			I	II	III
10.#	Details of Foreign or Indigenous Collaborator				
Sr. No.	Product	Name & Address of Collaborator	Collaboration		
			Scope	Year	Valid up to
11#	Have your product been type tested by any external agency? If so, give details				
Sr. No.	Product	Test (Size / Type & class	Test Report No.	Next Due date	

	SJVN	FORM NO.: F-060-01 PAGE: 5 of 14 ISSUE: 2.0 REV. 01 DATE: 30/06/2016
	FORM	

12.#	Have you been approved by any Statutory agency / third party agency like LLOYD, ASME, NTPC, PGCIL, EIL, Railways etc. ? If so, indicate details and enclose copies of approval letters				
Sr. No.	Item / Material / Service / Process	Description (Size, Type & Class)	Agency	Date of approval	Next Due date
13.#	Indicate Approval / Certification by National / International Standards / Agencies applicable for the subject product.				
Sr. No.	Product	Codes / Standards	License No. & Date		
14.#	Reference List (Experience in Particular Type of Equipment / Service / Process). Please indicate since how many years similar type of item / equipment / service / process provided (please furnish documentary evidence).				
Sr. No.	Item / Material / Service / Process	Type & Capacity / Rating	Customer (End User with Address)	Date of Supply / Service provided	Under Operation since year / Month
#Note: Please furnish the performance feedback certificate for proposed item / equipment / process / service form end user in line with requirement stipulated in Technical Specification.					

	SJVN	FORM NO.: F-060-01 PAGE: 6 of 14 ISSUE: 2.0 REV. 01 DATE: 30/06/2016
	FORM	

15.#	Business Commenced with SAPDC/SJVN in past				
Sr. No.	Year	Name of Department / Project Dealt with	Item Supplied / Services Offered.		
16.A#	Machinery, Instrument & other Equipment Specific to Process & Product Facilities / service				
Sr. No.	Description of Machine	Capacity & Nos.	Location Shop	Make	Year of Manufg.
16.B#	Other General Facilities				
Sr. No.	Description of Machine	Capacity & Nos.	Location Shop	Make	Year of Manufg.
i	Material Handling Mobile Crane Fork Lift Over Head Cranes				
ii	Metal Cutting &				

	SJVN		FORM NO.: F-060-01		
	FORM		PAGE: 7 of 14 ISSUE: 2.0 REV. 01 DATE: 30/06/2016		

	Bending				
iii	Casting				
iv	Forging				
v	Fabrication				
vi	Welding				
vii	Machining				
viii	Heat Treatment				
ix	Sheet Metal				
x	Fettling & Cleaning, Sand Blasting, Shot Blasting & Pickling				
xi	Painting				
xii	Metal Coating				
xiii	Protection before packing				
xiv	Packing				
xv	Other				
17.#	If In-House Manufacturing Facilities not available, inform source of manufacturing details along with their facilities and experience				
Sr. No.	Process outsourced	Name of the company	Description of machine / Equipment	Remarks	
18. A#	Facilities for In-house Testing & Inspection				
Sr. No.	Description	Capacity & Nos.	Make & Year of Mfg.	Calibration Status	Approval Qualification

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18. B#	If In-house testing facilities are not available, indicate source of testing with relevant details.				
Sr. No.	Source of Testing	Description	Capacity & Nos.	Make & Year of Mfg.	Approval Qualification
Note: In case of outsourcing of major testing such as NDT, Electrical & Mechanical testing, no marks will be awarded. However, material composition testing by chemical method from NABL Lab shall not attract negative marking.					
18 C #	Details of any Government Laboratory facility available in area				
	Product related testing facility (type / Performance / Routine / Acceptance Test)				
19	Sources of Raw Material and Bought out Items				
Sr. No.	Description of Raw Material / Bought Out Items			Source	
20 #	Storage Area Availability				
	Storage for finished goods (Open / Close)				
	Raw Material storage and identification				

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21 #	Do you have in-house Design / R&D departments?	
22 #	Details of pending legal issues on contractual aspects with customers, if any.	
23 #	Please furnish details of Labour problems in the last three years, if any?	

B. FINANCIAL SOUNDNESS OF ORGANIZATION				
Financial Information for last Three Years (Please furnish copy of annual report)				
Sr. No.	Parameters	Year 20	Year 20	Year 20
1#	Please furnish annual turnover of the company. Growth in annual turnover w.r.t. previous years (%)			
2#	Please furnish Profit before tax (PBT) of the company. Growth in PBT w.r.t. previous years (%)			
3#	Please indicate the net worth (Net current assets – Net current liabilities) of the company?			
4#	Whether the vendor has been referred to BIFR / NCLT / any other similar Govt. agency.			
5#	Whether the supplier is a potentially sick company.			
6	Please mention current order book position, as on date in terms of Value and time			

C. QUALITY SYSTEM		
Sr. NO.	DESCRIPTION	Sub-vendor response (along with supporting document)
1*	Are you an ISO 9001 company? If yes, please furnish the certificate and what is your quality policy?	
2*	Is the company an ISO 14000 approved?	
3#	Is the company an OHSAS approved?	
4*	Have your company won any Quality award like Rajeev Gandhi National Quality Award, DMC Ramkrishna Bajaj National Quality Award, Golden Peacock National Quality Award etc? If yes provide documentary evidence.	
5*	Have you received appreciation letter from your customer. Please provide evidence.	
6	To whom your Q.C./Q.A. Chief reports to ? (Please furnish your organization structure)	
7*	If you have a written quality control manual/procedure, then please furnish the same.	

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7 (i) *	Incoming Material Control System (Furnish a copy of system and organization)	
7 (ii) *	Process Control: Are written procedure defining stage wise operations and functions on shop floor established and followed? (Furnish copy of work instruction and record of process control parameter)	
7 (iii) *	Manufacturing/Testing Procedure Qualification & Personnel Qualification (Procedure qualification specification & Record of personnel qualification (PQR) to be submitted).	
7 (IV) *	Are written Quality Control Instruction sheets prepared & properly used? (Please furnish evidence)	
7 (V) #	Are records generated during inspection maintained & available for review? (Please furnish evidence)	
7 (VI) *	Are quality control checks / procedure adequate to maintain desired quality level right from the incoming stage to final stage? Please furnish copy of such control checks / procedure.	
8.#	Documentation Control	
8 (i)	Does a system for clear and precise stipulation of responsibilities for documentation issue & change control exists?	
8 (ii)	Are changes made in writing?	
9*	Control of Inspection, measuring and testing equipment	
9 (i)	Are necessary gauges, testing and measuring equipment's, available and used?	
9 (ii)	Are testing and measuring equipment properly maintained?	
9 (iii)	Is recorded control on calibration of equipment available?	
10*	System of Identification & Traceability of materials, tools, jigs, fixtures & processed components, etc. (Copy of procedure to be submitted).	
11*	System of Storage / Preservation / Painting and Packing (copy of Procedure to be submitted)	
12*	Do you have written procedure for disposing off the non-conformities? If yes, please furnish the copy of the same also furnish three copies of NCR & CAPA.	
13*	Safety measures (Submit copy of safety system & record of accidents for last two years)	
14#	What type of Sampling Inspection Plan is used in your factory/company? Please furnish details.	
15	How good are you in keeping your dispatch commitments? Please give details of last ten deliveries stating details as below (Provide documentary evidence) Within delivery period:	

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	Delayed but accepted by user: Delayed but accepted with penalty:	
16 [#]	Have you ever been de-listed or put in under temporary suspension by any customer / contractor.	
D. AFTER SALES SERVICE		
Sr. NO.	DESCRIPTION	Sub-vendor response (along with supporting document)
1 [#]	For overcoming product deficiencies what are the analytical methods used at Customer's premises?	
2 [#]	What is the strength of your "after-sales service" team?	
3 [#]	What is the response time after receiving complaints from the customers? Provide evidence.	
4 [#]	Customer complaints handling system (Submit list of customer complaints & status for the last three years) Please furnish complete list of complaints attended to during last one year.	
5 [#]	How do you keep your "after-sales service" team updated?	
6 [#]	Provide certificate from 02 customers (end user) for satisfactory after sales services.	

Declaration by Director/ Partner/ Proprietor

I declare that the information furnished above and attached documents are correct to the best of my knowledge. I undertake to inform you at the earliest any change(s) in the details mentioned above.

Signature and Date

Name & Designation

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TO BE FILLED BY MAIN CONTRACTOR FOR SUB-VENDOR (MC)

Sr. No.	Parameters	Supplier response (along with supporting document)
1	Name and address of sub-vendor:	
2 (a)	Type of equipment / item / process / service for which approval is sought:	
2 (b)	Details of equipment / item / process / service for which approval is sought (i.e. Rating, capacity, type, size, weight, etc.):	
3	Experience of main contractor with sub-vendor:	
(a) [#]	Since how many years sub-vendor is registered with you for proposed type of equipment / item / process / services (furnish documentary evidence):	
4 [#]	Whether sub-vendor is meeting the qualification criteria indicated in the technical specification (furnish documentary evidence).	
5 [#]	Sub-vendor rating as per contractor's internal procedure in the scale 0-10 or 0-100% (furnish documentary evidence).	
6 [#]	Any dispute of main contractor with vendor during execution of last 05 contracts.	
7 [#]	Have you ever de-listed or put in temporary suspension the proposed sub-vendor? If yes, please provide the reason for same.	
8	Please indicate the reason for re-approving / re-listing the sub-vendor.	

I declare that the information furnished by Sub-vendor has been verified and found in order / minor changes which have been marked and initialed on this form itself / observed the following discrepancies.

(Signature & Designation)

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GUIDELINES TO SUPPLIERS FOR FILLING-UP VENDOR/SUPPLIER REGISTRATION FORM

- All columns are to be filled up properly in the space provided for. Wherever it is not applicable / not available, please mention "Not Applicable" / "Not Available". All pages of the form are to be signed along with seal by the authorized signatory.
- A separate sheet may be attached if the space provided is insufficient or additional information is to be given, Please put proper identification tag on the separately attached sheet.
- Any information / clarification required by SAPDC/ Consultant during evaluation must be given expeditiously.
- Please ensure that all required enclosures are attached with the filled up Vendor Registration Form.
- Marks shall be awarded on the basis of documentary evidences submitted by Vendor / sub-vendor wherever called in vendor / sub-vendor assessment form.
- Incomplete or incorrect forms will be rejected.
- Please fill up the check list given below and send along with the vendor registration forms to SAPDC/Consultant.
- In case any information found incorrect / false, the vendor shall be rejected / de-listed at any stage.
- Information with # marks is score able.
- Accepting or rejecting a vendor is sole discretion of SAPDC.
- Product catalogue / manual for the proposed item / equipment / process / service, if available, shall be submitted alongwith other documents.

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Furnish following information/Documents:-

Sr. No.	Description	Yes / No	Page No / Annexure
1	Latest audited annual account.		
2	Balance Sheet.		
3	Valid Income Tax Clearance Certificate.		
4	Details of Pending Arbitration cases.		
5	Details of pending disputes with Statutory Authorities.		
6	Organization chart		
7	Copy of Performance certificate (minimum 03)		
8	Copy of minimum three (03) completion certificates of similar work / service.		
9	Letter of approval from ASME / NTPC/ EIL / Railway / Lloyds / Power Grid etc. if any.		
10	ISO: 9001 certificate		
11	Quality Manual		
12	ISO: 14000 certificate		
13	OHSAS, ISO 18000 certificate		
14	Experience list		
15	Type test report & approval certificate		
16	Product Approval certificate from national / international agency.		
17	Quality award certificate		
18	Process and Personnel qualification certificates		
19	Copy of registration / enlistment with reputed / large organizations		
20	Detail of existing clients and details such as address, contact number and mail address.		
21	List of works / projects of similar nature executed with documentary evidences of works executed in last 02 years.		
22	Other documents mentioned elsewhere in vendor / sub-vendor assessment form.		

(Signature & Designation)

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	FORM	

	PROJECT NAME (MW)			MANUFACTURING / FIELD QUALITY ASSURANCE PLAN				CONTRACTOR NAME, ADDRESS & LOGO			
	ITEM DESCRIPTION			SUB-ITEM	QAP NO.	REV. NO	ISSUE DATE	SUB-CONTRACTOR NAME, ADDRESS & LOGO			
SR. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS
					M/C	S				M C S	
1	2	3	4	5	6	7	8	9	10	11	
LEGENDS											
M	MANUFACTURER		C	CONTRACTOR		S	SAPDC LTD.				
P	PERFORM		V	VERIFICATION OF RECORDS		W	WITNESS / CHP				
IR	INSPECTION REPORT		DRG	DRAWING		CHP	CUSTOMER HOLD POINT				
MA	MAJOR		MN	MINOR		CR	CRITICAL				
ME	MEASUREMENT		NDT	NON DESTRUCTIVE TESTING		HT	HEAT TREATMENT				
TR1	CERTIFICATE OF COMPLIANCE TO TS/STANDARD REQUIREMENT WITHOUT ANY CHECK LIST OF TESTS CARRIED OUT.		TR2	CERTIFICATE OF COMPLIANCE TO TS/STANDARD REQUIREMENT WITH CHECK LIST OF TESTS CARRIED OUT.		TR3	TEST REPORT/TEST CERTIFICATE WITH TEST RESULTS BASED ON SPECIFIC INSPECTION & TESTING AT MANUFACTURER FACILITY/NABL APPROVED LAB.				
NOTE: QAP SHALL BE READ IN CONJUNCTION WITH QUALITY ASSURANCE REQUIREMENT GIVEN AS PART OF TECHNICAL SPECIFICATION.											
MANUFACTURER / SUB-CONTRACTOR:			CONTRACTOR:		FOR SAPDC USE:		REFERENCE DOC NO. OF SJVN:				
PREPARED BY:		REVIEWED BY		REVIEWED & RECOMMENDED BY		REVIEWED BY		RECOMMENDED BY		APPROVED BY	
NAME, DESIGNATION & SIGNATURE		NAME, DESIGNATION & SIGNATURE		NAME, DESIGNATION & SIGNATURE		NAME & SIGNATURE		NAME & SIGNATURE		SIGNATURE & SEAL	

Prepared By:	Reviewed By:	Approved By:
		Process Owner



	SJVN	FORM NO.: F-060-04 PAGE: 2of 5 ISSUE: 2.0
	FORM	REV. 01 DATE: 28/06/2016

NON-CONFORMITY REPORT FOR MANUFACTURING, TRANSPORTATION, STORAGE & ERECTION STAGES	FOR SAPDC USE ONLY
	NC NO.
	Date:
	PAGE 2 of 5

STEPS TO PREVENT RECURRENCE (For Corrective Action):

ENCLOSURE SUBMITTED BY CONTRACTOR:-

☐ DRAWINGS/ DETAILS
 ☐ INSPECTION REPORT
 ☐ ROOT CAUSE ANALYSIS
 ☐ PROCEDURE OF DISPOSAL OF NCR
 ☐ ANY OTHER (Please specify)_____

DATE	NAME & DESIGN	SIG OF CONTRACTOR	SEAL
FINAL DISPOSITIONING BY SAPDC			Disposition Code
INCHARGE of RIO or FQA (In case of Minor)			
SAPDC (In case of Major)			

DATE	NAME & DESIG.	SIGNATURE
------	---------------	-----------

	SJVN	FORM NO.: F-060-04 PAGE: 3 of 5 ISSUE: 2.0
	FORM	REV. 01 DATE: 28/06/2016

NON-CONFORMITY REPORT FOR MANUFACTURING, TRANSPORTATION, STORAGE & ERECTION STAGES		FOR SAPDC USE ONLY
		NC NO.
		Date:
		PAGE 3 of 5
FOR SAPDC INTERNAL USE ONLY		
RECOMMENDATION of INCHARGE of RIO or FQA (In case of Major)/ CONCERNED SAPDC 's INSPECTION/ SITE ENGINEER (In case of Minor)		Disposition Code
DATE	NAME & DESIG.	SIGNATURE
RECOMMENDATION OF SAPDC CONCERNED ENGINEER		Disposition Code
DATE	NAME & DESIG.	SIGNATURE
GROUP HEAD		
DATE	NAME & DESIG.	SIGNATURE
RECOMMENDATION OF SAPDC (FOR MAJOR CATEGORY) (Comments of Engineering / Others deptt as applicable to be considered)		
DATE	NAME & DESIG.	SIGNATURE

	SJVN	FORM NO.: F-060-04 PAGE: 4 of 5 ISSUE: 2.0
	FORM	REV. 01 DATE: 28/06/2016

NON-CONFORMITY REPORT FOR MANUFACTURING, TRANSPORTATION, STORAGE & ERECTION STAGES		FOR SAPDC USE ONLY
		NC NO.
		Date:
		PAGE 4 of 5
PART B (Verification of Corrections of Non-Conformity) (Filled after Completion of corrections of Non-Conformity)		
ACTION TAKEN BY SUPPLIER/ CONTRACTOR (Attach Report of verification)		
DATE	NAME & DESIGN	SIG.OF SUPPLIER/ CONTRACTOR
SEAL		
VERIFICATION BY SAPDC'S SITE ENGINEER/ INSPECTION ENGINEER		
DATE	NAME & DESIG.	SIGNATURE
IN-CHARGE of RIO/ FQA		
DATE	NAME & DESIG.	SIGNATURE
COMMENTS OF SAPDC ENGINEER		
DATE	NAME & DESIG.	SIGNATURE
GROUP HEAD		
DATE	NAME & DESIG.	SIGNATURE
HOD		
DATE	NAME & DESIG.	SIGNATURE
HOD		
DATE	NAME & DESIG.	SIGNATURE
HOD		

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NON-CONFORMITY REPORT FOR MANUFACTURING, TRANSPORTATION, STORAGE & ERECTION STAGES	FOR SAPDC USE ONLY
	NC NO.
	Date:
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INSTRUCTIONS 'MAJOR' NONCONFORMITY IS DEFINED AS DEPARTURE FROM SPECIFICATION WHICH AFFECTS PERFORMANCE RELIABILITY. SAFETY INTERCHANGEABILITY. ERECTION, COMMISSIONING OR WORKING LIFE ALL OTHER NON-CONFORMITIES SHALL BE TREATED AS CATEGORY 'MINOR'. - ACCEPTANCE OF DISPOSITIONED NON-CONFORMANCE IS WITHOUT PREJUDICE TO SAPDC RIGHT TO CLAIM COMMERCIAL REBATE AND DOES NOT ABSOLVE CONTRACTUAL OBLIGATIONS. - OBTAINING APPROVAL OF STATUTORY AUTHORITY IF ANY W.R.T. ABOVE NON CONFORMANCE IS THE RESPONSIBILITY OF SUPPLIER/ CONTRACTOR. - DISPOSITIONING OF THIS NON-CONFORMANCE IS FOR THIS SPECIFIC CASE ONLY AND NOT TO BE REGARDED AS PRECEDENCE. DISPOSITION CODE THE NON-CONFORMANCE SHALL BE DISPOSITIONED AS UNDER BY SAPDC AND SUPPLIER. (GIVE CODE AT APPROPRIATE BOXES):- (01) NC-REJECTED (02) NC- CONDITIONALLY ACCEPTED (SPECIFY CONDITION) (03) NC-ACCEPTED AS-IT-IS (04) NC-ACCEPTED WITH REPAIR. NC NUMBER - THIS NO. SHALL BE ALLOTTED BY SAPDC AND SHALL HAVE SAPDC PROJECT NAME, PACKAGE, FOLLOWED BY RUNNING SERIAL NO. & ENTER TO NC REPORT BY RIO/ FQA/ CQAL
--

RESPONSIBILITIES OF CONTRACTOR - ASCERTAIN EXACT NATURE OF NON-CONFORMANCE AND ALONGWITH SUPPORTING DRAWING OF ITEMS/ EQUIPMENT ETC WITH WHICH NON-CONFORMANCE EXISTS. - IDENTIFY THE CAUSE OF NON CONFORMITY. - DECIDE ON CODE OF DISPOSING. - FINALISE THE CAUSE OF NON-CONFORMITY AND PROPOSE CORRECTIVE ACTION. - ENSURE AND CERTIFY THAT THE PRODUCT QUALITY PERFORMANCE, RELIABILITY AND WORKING LIFE IS NOT AFFECTED FOR MINOR NON-CONFORMITIES AND QUANTIFY THE EXTENT TO WHICH IT IS AFFECTED IN THE CASE OF CATEGORY 'MAJOR' NON-CONFORMITIES. - IMPLEMENT AGREED CORRECTIVE ACTION IN A TIME BOUND PROGRAMME AND PROVIDE FEEDBACK AS PER PART-B OF THE FORMAT

RESPONSIBILITIES OF RIO/ FQA - IDENTIFY THE PRODUCT APPROPRIATELY. - ANALYSE THE CAUSE OF NON-CONFORMITY AND PROPOSE RECOMMENDATION
--

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	FORM	PAGE: 1 of 1 ISSUE: 2.0 REV. 00 DATE: 30/06/2016

INSPECTION CALL REQUEST

Inspection Call No.		Date:				
Project:		Contract No. :				
Contractor/Supplier's Name & Address:		Sub-vendor/Sub-Supplier's Name & Address:				
Contact Person:		Contact Person:				
Telephone/Mobile No.:		Telephone/Mobile No.:				
Fax No.		Fax No.				
email ID:		email ID:				
Details of Equipment with Unit No.:						
Sr. No.	Equipment/Item Description and Sr. No.	Unit No.	BBU Ref.	QAP No. & Rev. No.	Relevant QAP Clause No.	Approved Drawing No. & Rev. No.
Status of Type Tests		Approved / Not Approved / Not Applicable		Place of Inspection:		
Proposed date of Inspection:				Anticipated Working Days Required		
Status of internal inspection by Vendor/sub-vendor		Completed		In-progress	Yet to be done	
Tentative date of completion of internal inspection in case inspection is in-progress/yet to be done:						
Note: Readiness status is to be submitted separately after completion of internal inspection by Manufacturer.						

Date:
Place:

Signature
Name
Designation
Department
Company

Annexure F - Export-Worthy Packing

1.0 SCOPE:

For export jobs, sea worthy packing capable of performing all necessary functions like prevention of damage to the contents, sufficient to support frequent handling and lengthy periods of outdoor storage in adverse weather conditions are required. Workmanship and material used shall meet the technical requirements and be in accordance with best commercial export packing practices. Vendor shall be responsible for the packing, however, it shall meet the minimum requirements specified herein. Equivalent or better packing methods may be deployed subject to approval of the purchaser. Vendor shall submit the packing procedure for its equipment for purchaser's approval during detailed engineering.

2.0 TECHNICAL SPECIFICATION OF WOOD:

The wood shall be Fir, Chir, Silver Oak (Grevillea Robusta) or chemically treated mango with moisture content not exceeding 50 %. The wood shall have flexural & compressive strength, stiffness, shock absorption and nail retention properties. The wood shall be free from common defects such as warp, bone, twist, knot, cracks, splits, end splits, bend, visible sign of infection and any kind of decay caused by insects, fungus etc. Surface cracks with a maximum depth of 3 mm are permissible. A continuous crack of any depth all along the length is not allowed.

The wood shall be chemically treated to provide protection against deterioration due to fungi and attack by termites, borers, marine organism and any other kind of infection. It shall be treated only after final processing like cutting, planing, joint grooving etc.

3.0 TYPE, DESIGN & DIMENSION OF WOODEN PACKING CASES:

3.1.1 PACKING OF EQUIPMENTS:

Various mechanical, electrical and C&I equipment e.g. pumps, motors, equipment skids, heat exchangers, control panels, switch gears, transformers etc. shall be wrapped in weather proof packing and then secured in wooden packing cases. The construction of wooden packing cases shall be as per details given below and also in figures 1 to 11.

3.1.1 BOTTOM FRAME:

The construction of bottom frame shall be as per fig. 2. The number of slides/runners for bottom frames shall be selected depending upon the weight and overall dimension of the load to be carried. The equipment shall be secured by fixing their base frame/plate with the help of bolt & nuts etc to the bottom frame of the wooden packing cases. The equipment not provided with the base frame/plate like

cylindrical vessels etc. to be secured to the bottom frame of the wooden case with 'C' clamps fabricated from steel channels/angle irons.

3.1.2 TOP FRAME:

The construction of top frame shall be as per fig. 3.

3.1.3 END PANELS:

The dimensions of the end and lateral panels shall be calculated according to overall dimensions of the items to be packed.

Diagonal braces shall be used for packing cases having height exceeding 500 mm. Detail of bracing shall be as per figure 5 to 8.

3.1.4 SLING PLATE:

To facilitate lifting of cases, longitudinal under slide boards shall be fixed. To avoid damage to the box while lifting sling plates shall be provided. Refer fig. 11.

3.1.5 ANGLE IRON CLEATS :

Angle iron cleats shall be used for strengthening the joints as indicated in fig. 10.

3.1.6 OTHER REQUIREMENTS:

The thickness of planks for top, bottom, side and end panels shall be at least 25 mm. Planks used for this purpose shall be joined with each other by tongue & groove joint. The groove dimension shall be such that tongue fits tightly into groove to make good joint.

Runners/slides, traverse bars etc. shall be of single length i.e. without any joint. Planks for sheathing, diagonal bracing etc shall also be of single length upto 2400 mm. For sizes larger than 2400 mm, proper jointing is permitted for planks for sheathing and diagonal bracing.

Each equipment to be individually covered with double polyethylene petticoat. Sheet thickness of polyethylene sheet shall not be less than 0.175 mm (175 microns). The sealing shall be such so as not to allow moisture inside.

The inner surface of 4 sides of shooks shall be nailed with bituminised water proof kraft paper. Wherever 2 pieces of kraft paper are used, the joint shall have an overlap of minimum 20mm.

All the inner sides of the box shall be nailed with bitumen coated hessian polyethylene kraft paper. For top frame it shall project on all sides by 100mm and shall be nailed on sides. Wherever 2 pieces of kraft paper are used, the joint shall have an overlap of minimum 20mm.

For delicate equipment like control panels, switchgears etc suitable cushioning material like rubberized coir shall be provided on their bottom support. The thickness of coir shall be 50 mm (minimum) and width 100 mm (minimum).

For control panels and switchgears, the gap between the panel and casing shall be filled with rubberized coir with distance between consecutive supports less than 500 mm (ref fig 15). For other equipment suitable support from sides of the casing to be provided.

Switchgear cubicles, control panels and control desks shall be packed and shipped in separate convenient sections. The components e.g. circuit breakers relays and instruments etc. which are removed from panels for shipping purpose shall be separately packed and shipped as per packing instructions in clause 3.2.

Packing case for control panels & switchgear panels shall be finally covered with GI sheet of minimum thickness of 0.4 mm.

Packing cases shall be bound at edges by nailing MS clamps/brackets at sufficient intervals. Further, heavier boxes shall be strapped with 'C' clamps (ref fig 4) fabricated from steel channels/angles and lighter boxes shall be strapped with hoop iron strips.

3.1.7 ALTERNATIVE PACKING CASES FOR CONTROL PANELS AND SWITCHGEARS

If required, for control and switchgear panels, construction of wooden packing cases may be provided as per fig 14 & 15 and as detailed below:

Thickness of planks for all sides, binding and jointing battens shall be atleast 25 mm. Width of planks shall be at least 125mm and that of binding and jointing planks shall be at least 100 mm.

Top frame shall be suitable so that it does not collapse due to sandwiching between slings while lifting. Longitudnal and traverse bars for the bottom wooden pallet to be suitably selected.

Diagonal bracings shall be as per clause 3.1.3 and All other requirements shall be as per clauses 3.1.4 to 3.1.6.

3.2 PACKING OF LOOSE ITEMS:

Loose mechanical, electrical and C&I items eg valves, fittings, pressure/temperature gauges/switches, circuit breakers, relays etc shall be individually wrapped using polyethylene sheets/U foam/thermocole sheets/air bubbled sheets depending upon the item and then packed in wooden boxes. The left out spaces and top of the boxes shall be filled with rubberized coir to get proper cushioning effect. Special attention is to be paid to relays, instruments etc for arresting the movement of their operating mechanisms during transportation.

The construction of wooden packing case shall be as per clause 3.1 retaining its all features concerning strength of box. The construction of wooden packing case for loose electrical and C&I items shall be as per fig. 16.

Inner surface of 6 sides of the box shall be lined with Bitumen coated hessian polyethylene kraft paper. Rubberized coir of min. 25 mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of the box.

Loose items such as Galvanised Steel Structure, Cable support racks, Cable Trays and GI Pipes etc. shall be individually wrapped using polyethylene sheets and further lots may be wrapped in Bitumen coated hessian cloth.

4.0 MOISTURE ABSORBER:

Silica gel is used for this purpose to protect contents over sufficiently long time from corrosion. Silica gel shall be of indicating type conforming to IS-304-1979 packed in cotton bags placed at different positions inside the packing for absorbing moisture and shall not come directly into contact with the equipment / material inside the package. The quantity of silica gel shall be enough for storage period of one (1) year, however, it shall not be less than 4 gms per litre volume of case subject to minimum of 400 gms per case.

5.0 INDICATION MARKS ON THE BOXES:

Markings shall be provided on the boxes indicating position of boxes for handling, storage and nature of consignment. For guidelines refer figure 12. The ink used for this purpose as well as for marking despatch instruction shall be indelible/nonwashable marking ink.

6.0 DESPATCH DETAILS:

External front and rear sides of the boxes to be planed for writing instructions.

Dispatch details such as consignor/consignee address, contract and case details, country of origin , port of delivery, stacking instructions shall be written on one of the side of boxes. An anodised aluminium plate shall be provided on one side of the boxes.

One copy of packing slip wrapped in polyethylene bag covered with aluminium packing slip holder to be nailed on the external surface of the box. One more copy of the packing slip wrapped in polyethylene bag to be kept inside the box at the prominent place.

7.0 INSPECTION:

There shall be a Customer Hold Point (CHP) for inspection of final assembly of packing. During above inspection, the records for Chemical Treatment shall be reviewed.

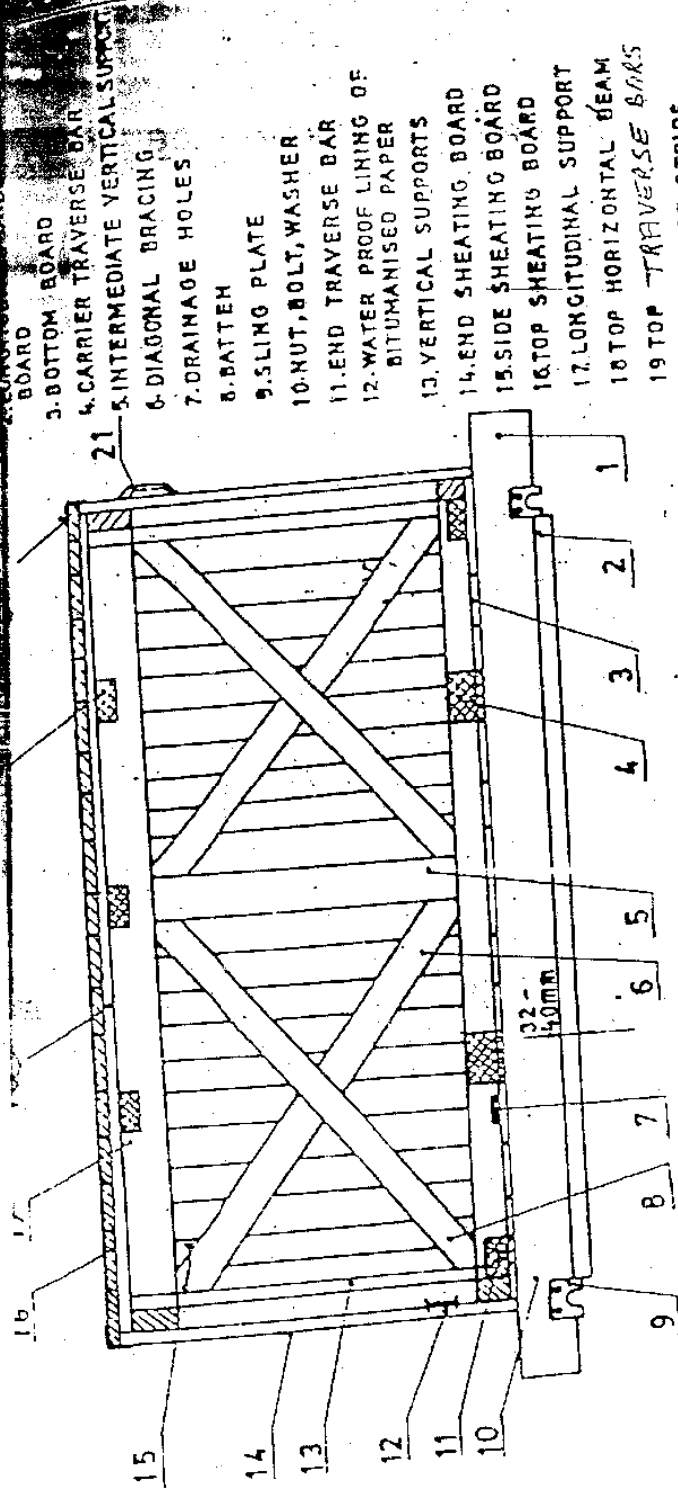


FIG. 1

NOMENCLATURE OF PARTS OF PACKING

CASIS

FIG. -1

BOTTOM FRAME ARRANGEMENTS

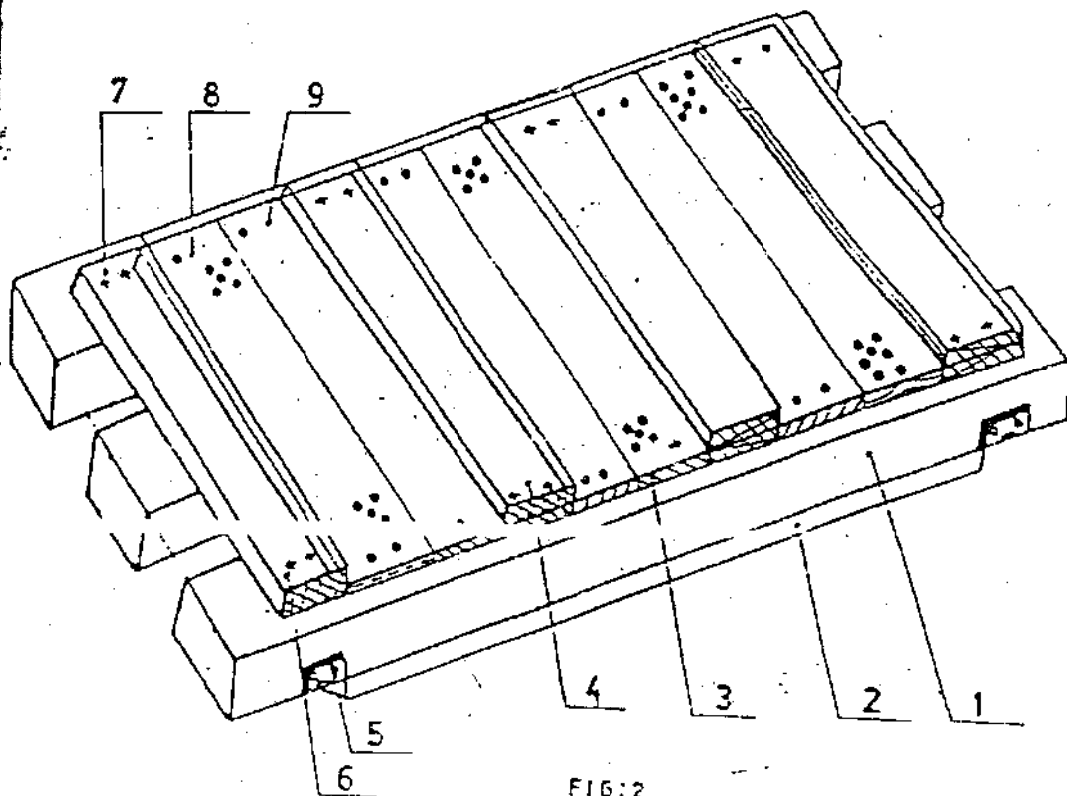


FIG:2

Nos. of slides : Minimum 2 Nos.

For length more than 1800 mm or
load more than 1000 kg, Nos. of
slides shall be minimum 3 Nos.

For dimensions of slides, refer Table 1

Cross section of end traverse bar; 100 X 100 mm.
(minimum)

1. SLIDE
2. UNDER SLIDE BOARD
3. BOTTOM BOARD
4. CARRIER TRAVERSE BAR
5. SLING PLATE
6. TRAVERSE BAR
7. BOLT, NUT & WASHER
8. DRAINAGE HOLES
9. NAILS

TOP FRAME ARRANGEMENT

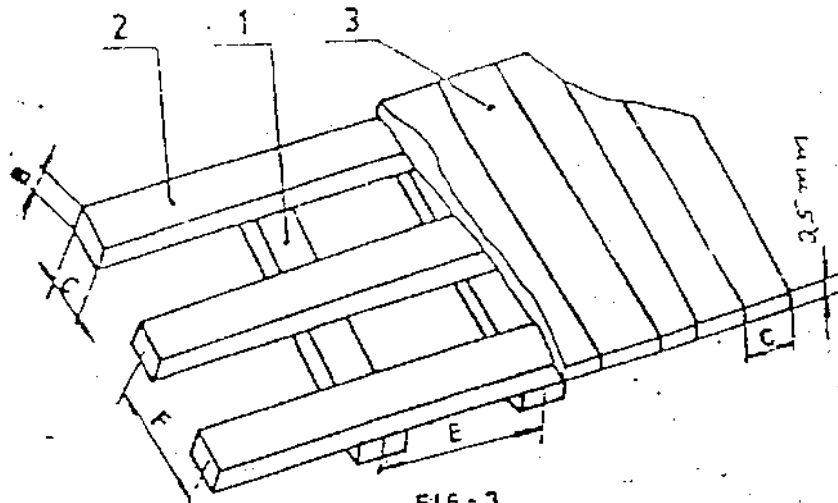


FIG-3

Dim F : 700 to 1000 mm
 Dim E : 500 to 900 mm
 B x C : 30 x 100 mm.

- 1 - Traverse Bars
- 2 - Horizontal Scans
- 3 - Top Board

ARRANGEMENT OF C-CLAMPS AROUND CASES

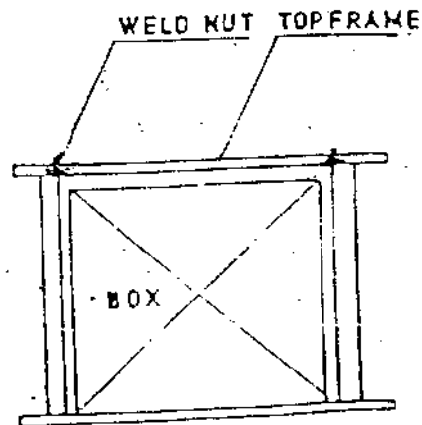
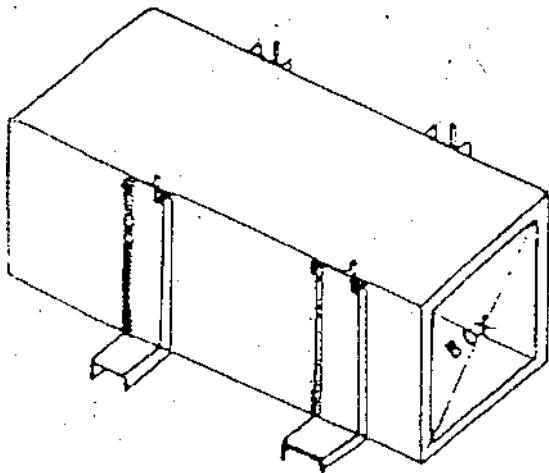


FIG-4

ARRANGEMENT OF DIAGONAL BRACING AND HORIZONTAL SUPPORT

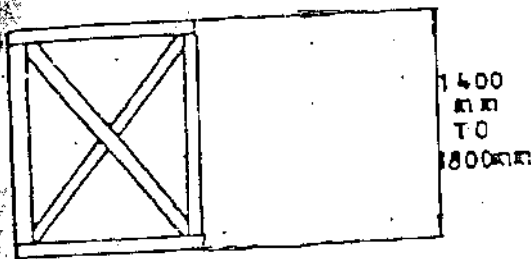


FIG: 6

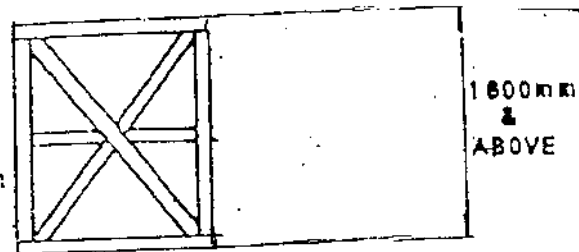


FIG: 8

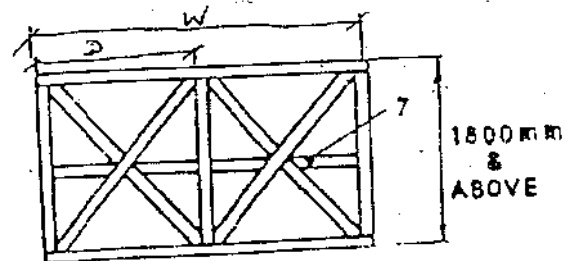


FIG: 9

7- Middle Horizontal Support

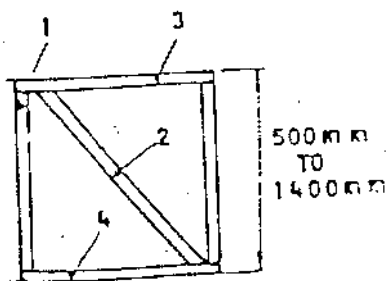


FIG: 5

- 1- Vertical Support
- 2- Diagonal Bracing
- 3- Upper Horizontal Support
- 4- Lower Horizontal Support

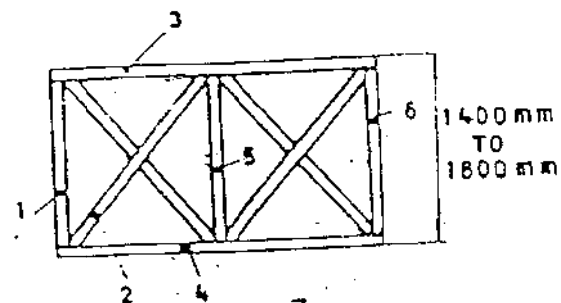
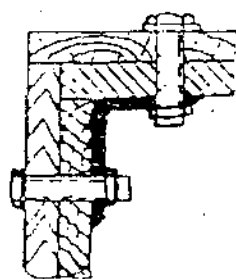
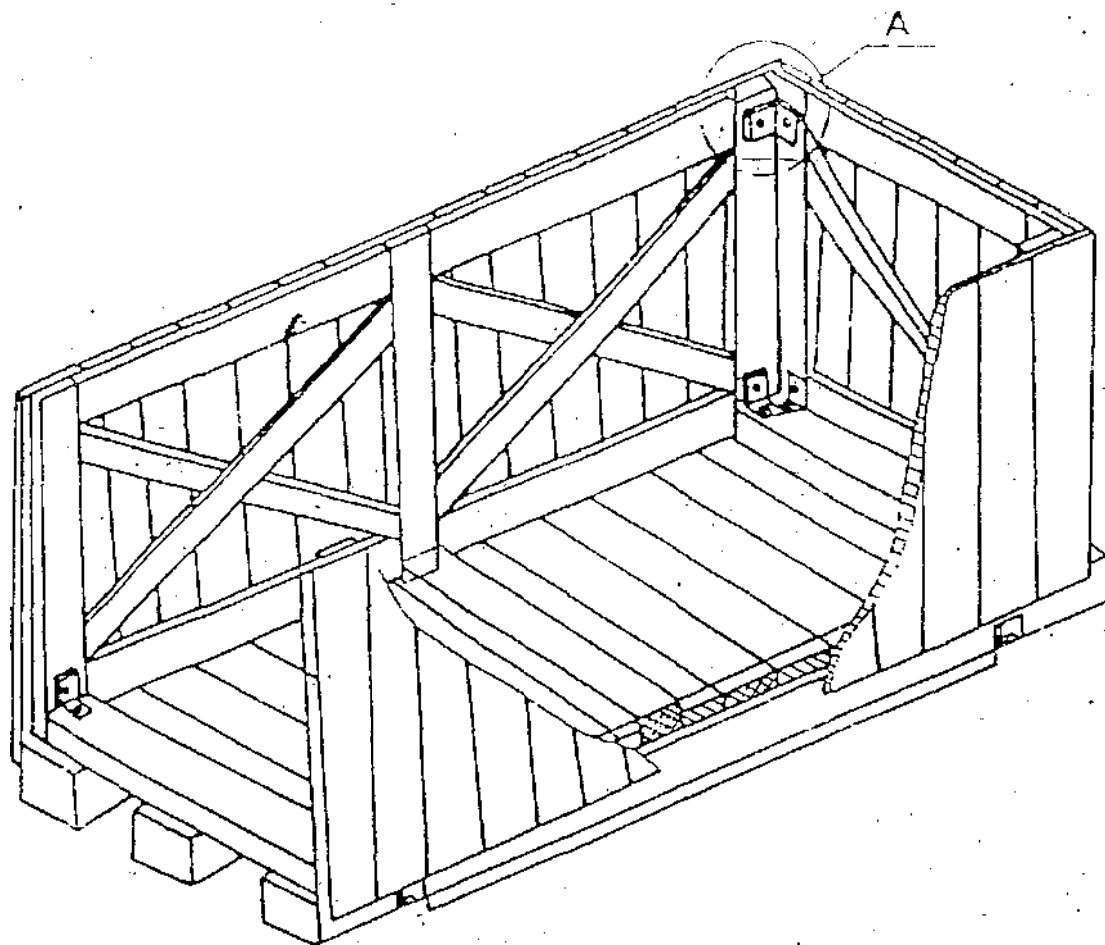


FIG: 7

- 1, 5, 6 - Vertical Support
- 2 - Diagonal Bracing
- 3 - Upper Horizontal Support
- 4 - Lower Horizontal Support

The dimensions of various items shall be as Table-2

ARRANGEMENT OF PACKING CASE



DETAIL-A

HOLE DIAMETER
MUST CONFORM
TO BOLT DIA

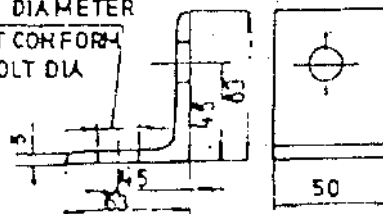


FIG:1D

ARRANGEMENT OF SLING - PLATE ON
CASES

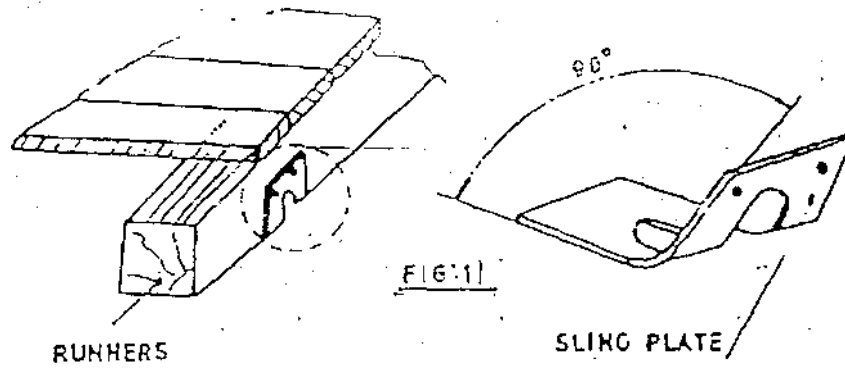


Table 1

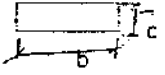
load	Length of Slides						
	600	800	1000	1200	1300	1500	2000
	Cross Section b x c						
							
500	50 x 100	50 x 100	50 x 100	50 x 100	75 x 100	75 x 100	100 x 100
800	50 x 100	50 x 100	75 x 100	75 x 100	75 x 100	75 x 100	100 x 100
1000	75 x 100	75 x 100	75 x 100	100 x 100	100 x 100	100 x 110	100 x 150
1500	75 x 100	75 x 100	100 x 100	100 x 100	100 x 100	100 x 150	100 x 150
2000	75 x 100	100 x 100	100 x 100	100 x 150	100 x 150	100 x 150	150 x 150
2500	75 x 100	100 x 100	100 x 150	100 x 150	100 x 150	150 x 150	150 x 150
3000	100 x 100	100 x 150	150 x 150	150 x 150	150 x 150	150 x 150	

Table 2

End and side Panels	Width of the panel W	Distance between longitudinal support DIM 'D'						
		600	800	1000	1200	1400	1600	1800
		Cross Section (b : c)						
Fig 5 to Fig 9	600 to 1200	30 x 100	30 x 100	30 x 100	30 x 130	30 x 130	30 x 130	30 x 130
	1201 to 1600	30 x 130	30 x 130	30 x 130	30 x 130	30 x 130	30 x 130	30 x 130
	1601 to 2000	30 x 130	30 x 130	30 x 130	30 x 130	30 x 130	30 x 130	30 x 130
	2001 to 3000	30 x 130	30 x 130	30 x 130	30 x 130	30 x 130	30 x 130	40 x 150
	3001 to 4000	30 x 130	30 x 130	40 x 150	40 x 150	40 x 150	40 x 150	40 x 150

INDICATION MARKS ON CASES

SL. NO.	INDICATION MARK	MEANING
1		TOP SIDE
2		KEEP AWAY FROM HEAT
3		SLINGING POSITION
4		FRAGILE MATERIAL. HANDLE WITH CARE
5		CENTRE OF GRAVITY
6		KEEP DRY

BHEL-PEM-DELHI-INDIA					
CONSIGNEE					
MATERIAL			MO. NO.		
CUSTOMER REF.			CASE NO.		
DESPATCH ADVICE NOTE NO.			NET WT -KGS	GROSS WT -KGS	
DIMENSIONS(MM) LXBXH					
SPECIAL INSTRUCTIONS	HANDLE WITH CARE - KEEP DRY DO NOT DROP - DO NOT TILT				

FIG-13: MARKING PLATE.

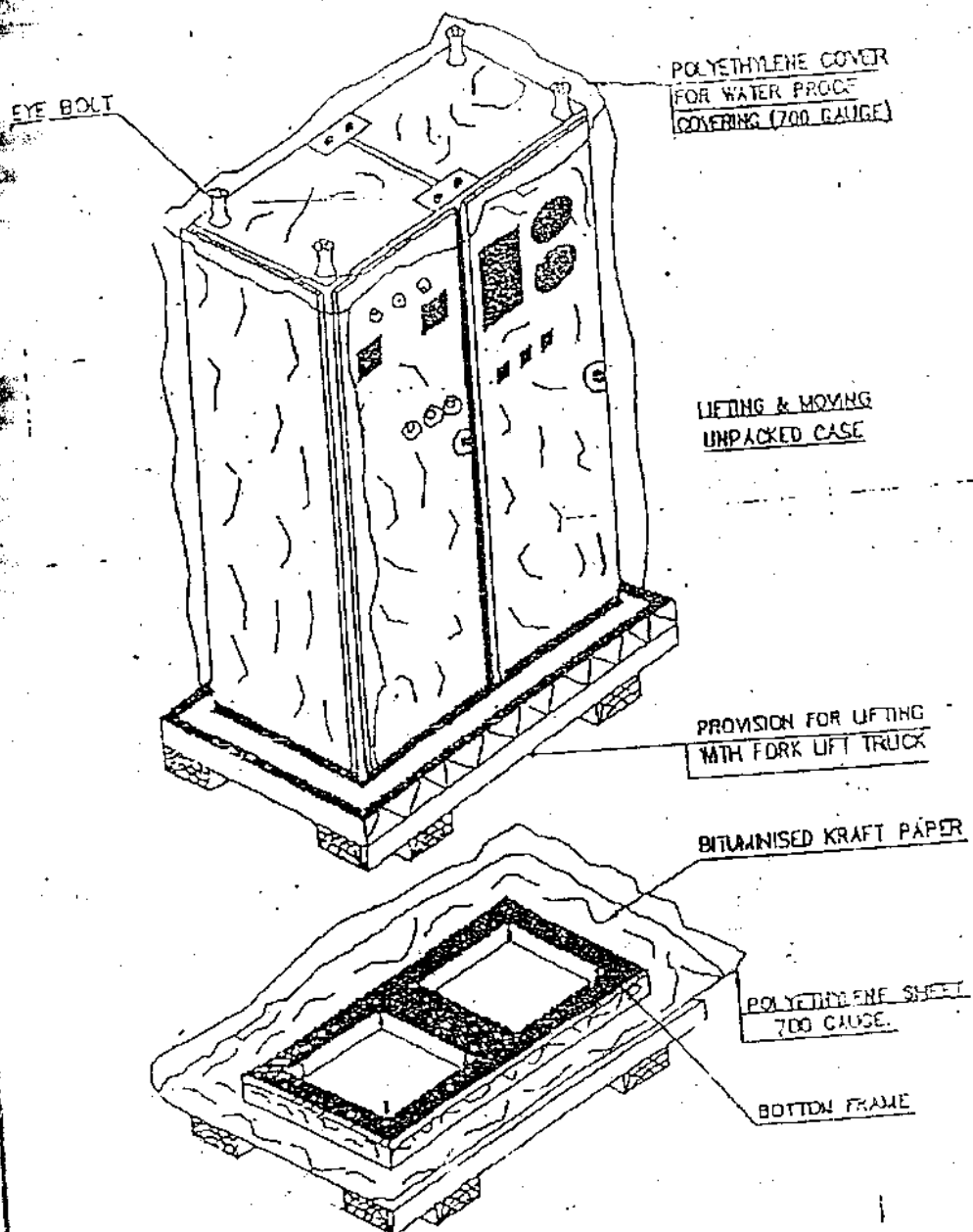


FIGURE-14

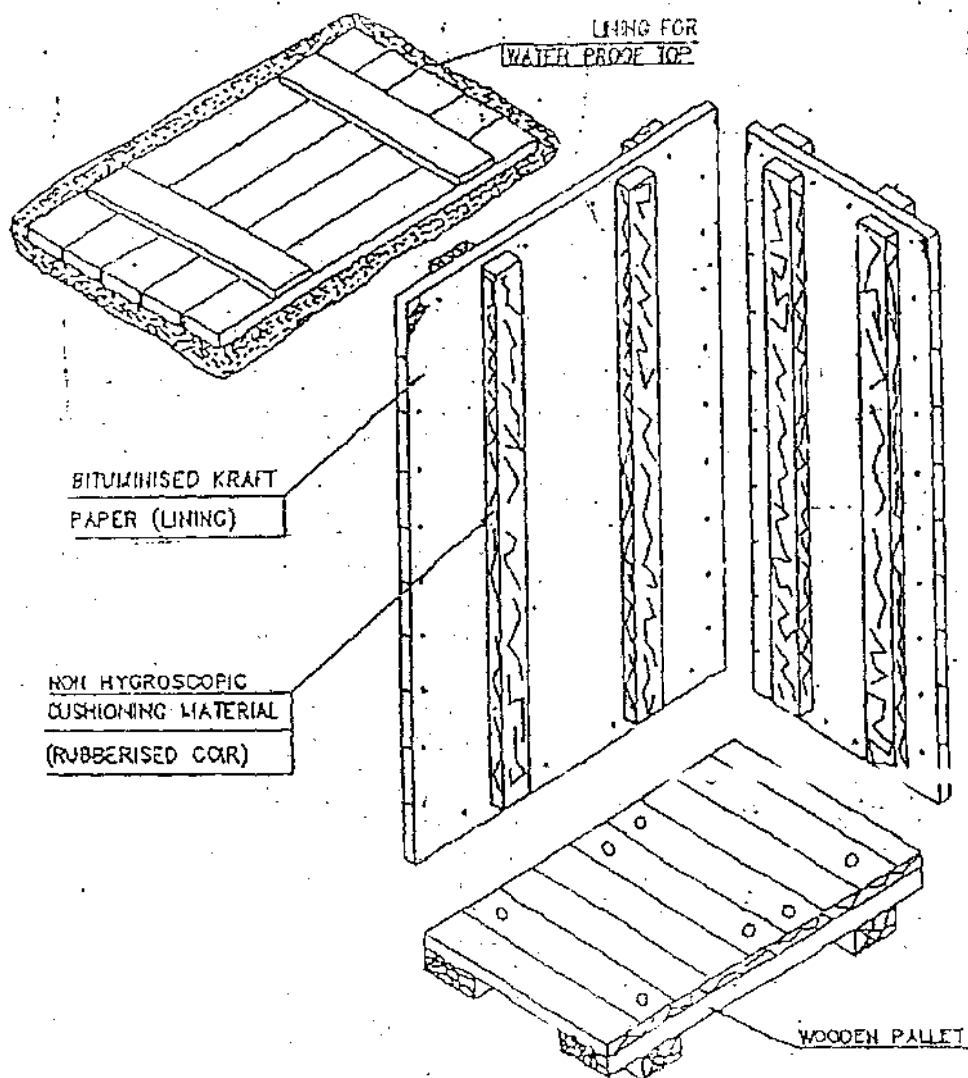


FIGURE-15

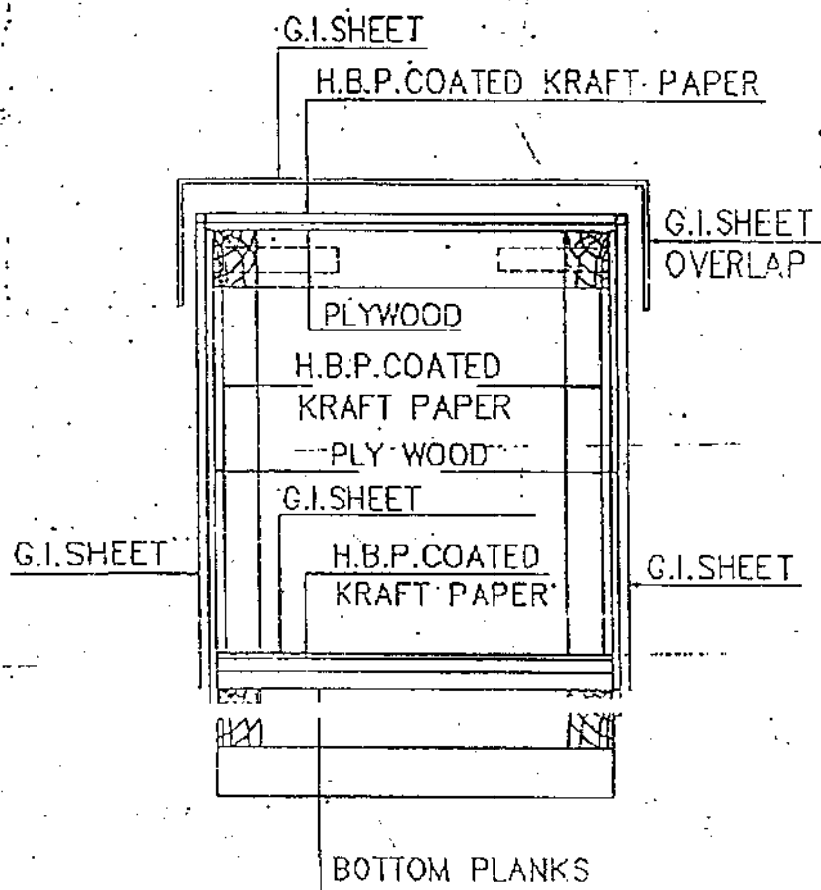
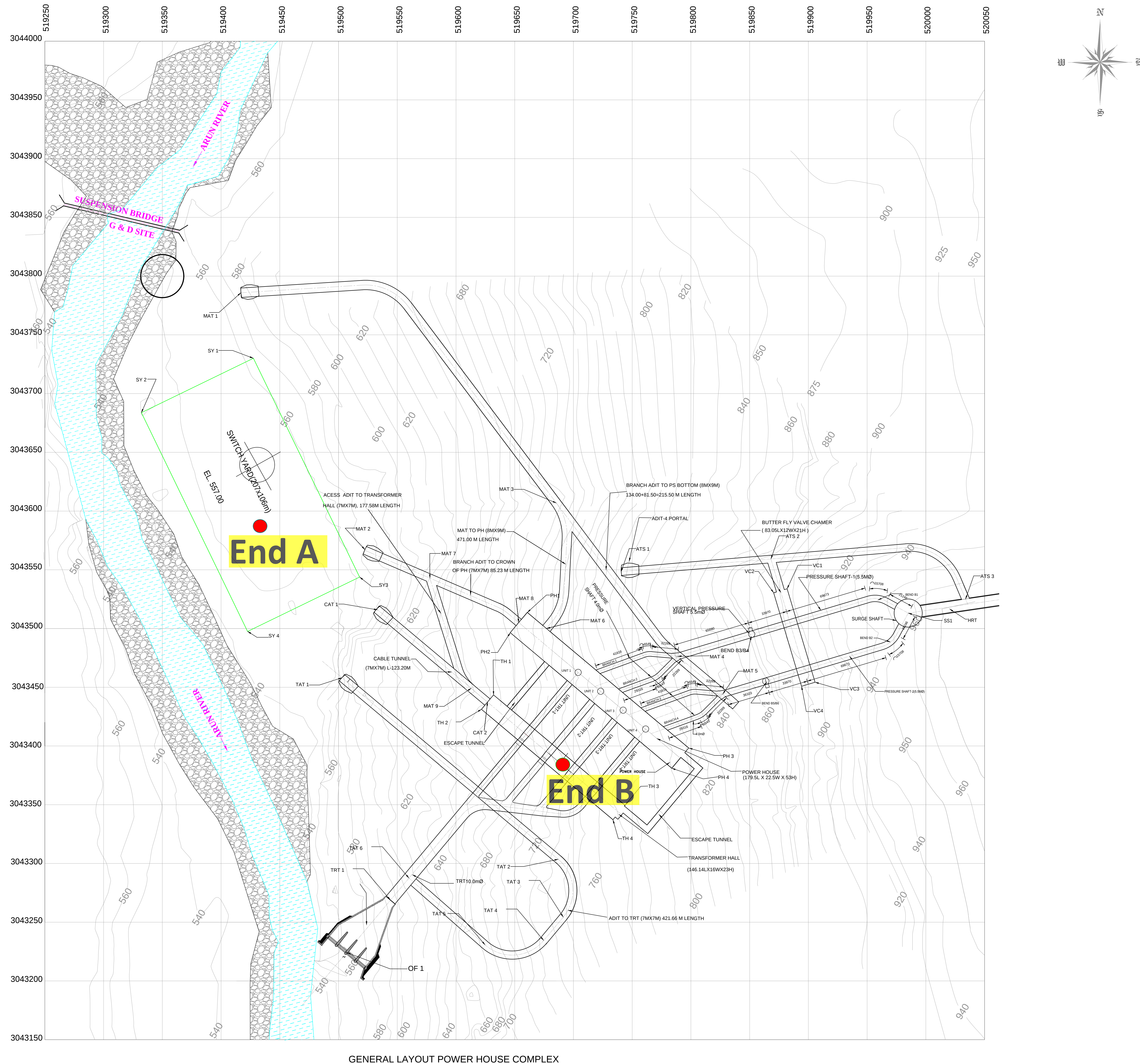


FIG-16 : CLOSED PACKING CASE WITH G.I.SHEET
SHOWING LAYERS OF PACKING MATERIALS.

CONSTRUCTION DRAWING					
NOTE:-					
1. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS OTHERWISE SPECIFIED.					
2. NO DIMENSION SHALL BE MEASURED FROM THE DRAWING. ONLY WRITTEN DIMENSIONS SHALL BE FOLLOWED.					
3. THIS DRAWING SHOWS THE GENERAL LAYOUT PLAN OF THE POWER HOUSE COMPLEX.					
CO-ORDINATES & ELEVATIONS OF IMPORTANT POINTS					
S.No.	DESCRIPTION	POINTS	EASTINGS	NORTHINGS	ELEVATION
1.	POWER HOUSE COMPLEX	MAT 1	519416.907	3043785.938	557.00
		MAT 2	519522.234	3043566.868	570.00
		MAT 3	519685.488	3043606.825	532.50
		MAT 4	519788.824	3043476.354	522.25
		MAT 5	519827.118	3043444.205	522.25
		MAT 6	519676.943	3043500.055	539.00
		MAT 7	519577.745	3043542.925	555.31
		MAT 8	519553.473	3043505.071	555.00
		MAT 9	519612.918	3043449.025	552.50
		CAT 1	519532.446	3043516.584	557.00
		CAT 2	519626.759	3043437.404	552.00
		PH 1	519660.700	3043513.687	539.00
		PH 2	519646.240	3043496.454	539.00
		PH 3	519798.182	3043398.271	539.00
		PH 4	519783.715	3043381.040	539.00
		TH 1	519631.961	3043443.485	552.00
		TH 2	519621.670	3043431.225	552.00
		TH 3	519743.929	3043349.492	552.00
		TH 4	519733.637	3043337.232	552.00
2.	TAIL RACE TUNNEL	TRT 1	519544.240	3043268.786	520.00
		TAT 1	519502.890	3043548.148	557.00
		TAT 2	519687.037	3043303.600	536.14
		TAT 3	519691.345	3043254.290	531.37
		TAT 4	519674.694	3043234.453	529.12
		TAT 5	519654.801	3043230.647	524.29
		TAT 6	519559.976	3043287.531	516.85
3.	OUTFALL	OF 1	519506.801	3043224.191	532.00
4.	VALVE CHAMBER	VC 1	519881.921	3043553.862	780.00
		VC 2	519870.423	3043530.429	780.00
		VC 3	519905.684	3043454.284	780.00
		VC 4	519894.186	3043450.851	780.00
5.	SURGE SHAFT	SS1	519985.000	3043513.141	779.96
		ATS1	519740.585	3043548.421	557.00
		ATS2	519868.100	3043559.178	557.00
		ATS3	520033.823	3043525.080	779.53
6.	SWITCH YARD	SY1	519427.546	3043730.041	557.00
		SY2	519332.186	3043683.753	557.00
		SY3	519517.939	3043543.820	557.00
		SY4	519422.580	3043497.532	557.00



S.No.	DESCRIPTION	POINTS	EASTINGS	NORTHINGS	ELEVATION
1.	SWITCH YARD	SY1	519456.419	3043702.499	557.00
		SY2	519380.269	3043677.981	557.00
		SY3	519605.452	3043550.197	557.00
		SY4	519443.580	3043520.277	557.00

REV.	DATE	ALTERED	REV. 06	DATE 22/06/21	ALTERED	REV. 05	DATE 28/05/21	ALTERED	ADDITIONAL INFORMATION : WO NO. :	PROJECT: ARUN-3 HYDRO ELECTRIC PROJECT (NEPAL) (4 x 225 MW)							
		CHD/APPD			CHD/APPD			CHD/APPD									
ZONE			ZONE	CURRENT REVISION INCORPORATES CHANGES AS PER EMAIL DATED 14 JUNE 2021 FROM M/S SJVN	ZONE	CURRENT REVISION INCORPORATES SOAK PIT AS PER SOAK PIT DOCUMENT REV-04 (TB-405-316-018)		STATUS OF DRAWING : 	CUSTOMER: SJVN ARUN-3 POWER DEVELOPMENT COMPANY PVT. LTD. (SAPDC LTD.)								
												DISTRIBUTION OF PRINTS : 	CONSULTANT: SJVN LTD. (A JOINT VENTURE OF GOVT OF INDIA AND GOVT OF HP)				
REV. 04	DATE 20/10/20	ALTERED CHD/APPD	REV. 03	DATE 10/03/20	ALTERED CHD/APPD	REV. 02	DATE 07/06/19	ALTERED CHD/APPD	REV. 01					DATE 30/03/19	ALTERED CHD/APPD		BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP NOIDA
ZONE	1. DETAILS OF THE REACTOR AND REACTOR CUM NGR AREA INCLUDED. 2. DISTANCE BETWEEN THE REACTORS OPTIMISED. 3. REPRESENTATION OF THE REACTOR UNLOADING INCLUDED. 4. RAILS REMOVED FROM THE MAIN ROAD.	ZONE	1. Building for Ventilation Room is now limited for catering to the requirement of GIS.	ZONE	1. Building for Inert Gas System included. 2. Common Ventilation Room for Power House and GIS Building included. 3. Cable Trench shown for the CAT to Switchyard. 4. The Layout of the Transformer Cavern shall be part of shown in "Cross Section and Plan of Transformer Cavern - 1 200 00 20558. 5. Comments marked on Rev-01 incorporated.	ZONE	Revised Switchyard Layout - Sketch - Drg No. SJVN/ED/Arun-III/EM-2017-04	DEPT. TBG CODE		SCALE NTS	CARD CODE	DRG.NO. TB-3-405-316-001					

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F

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FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

TB-3-405-316-001

DRG. NO.

6

5

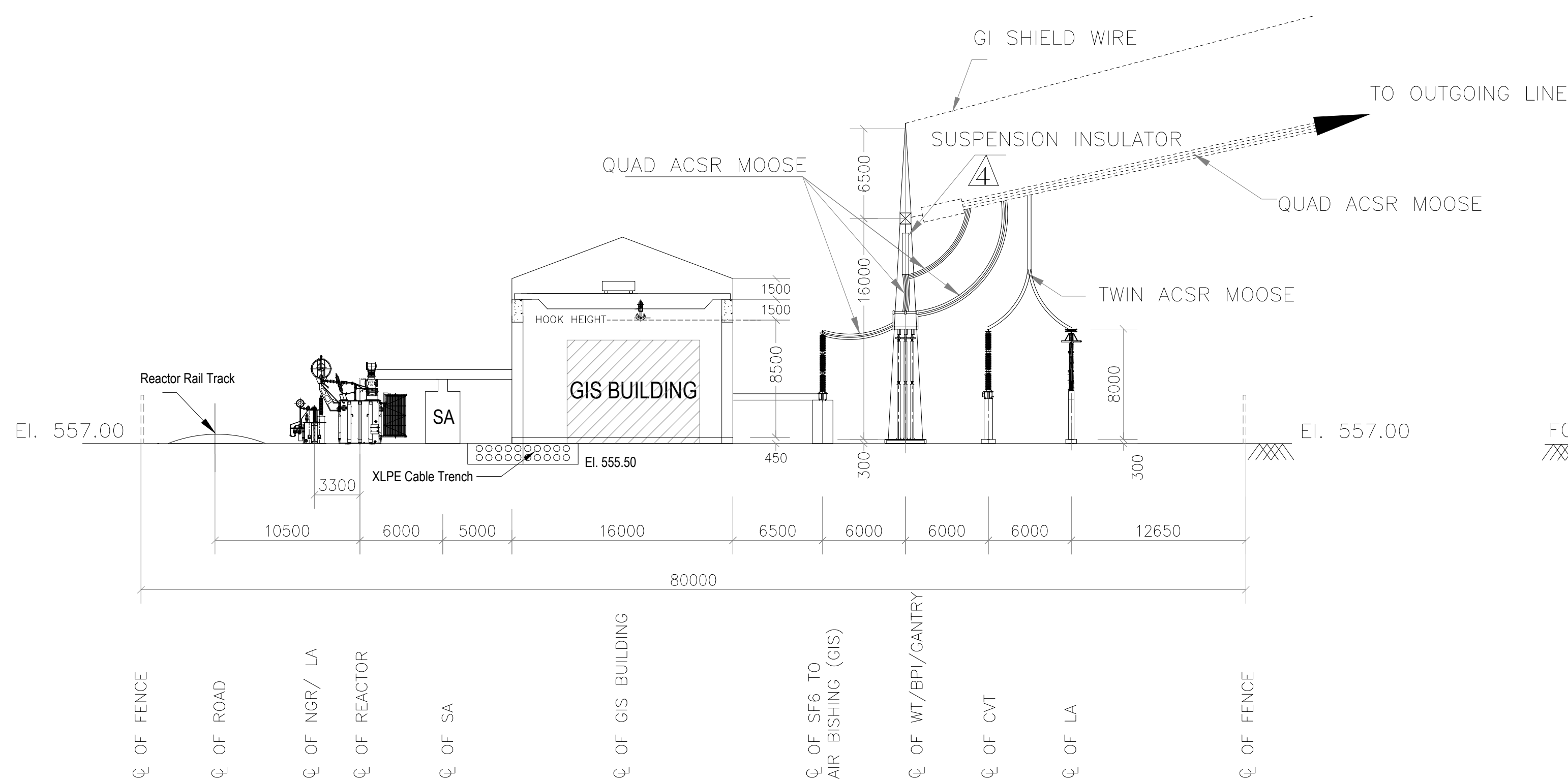
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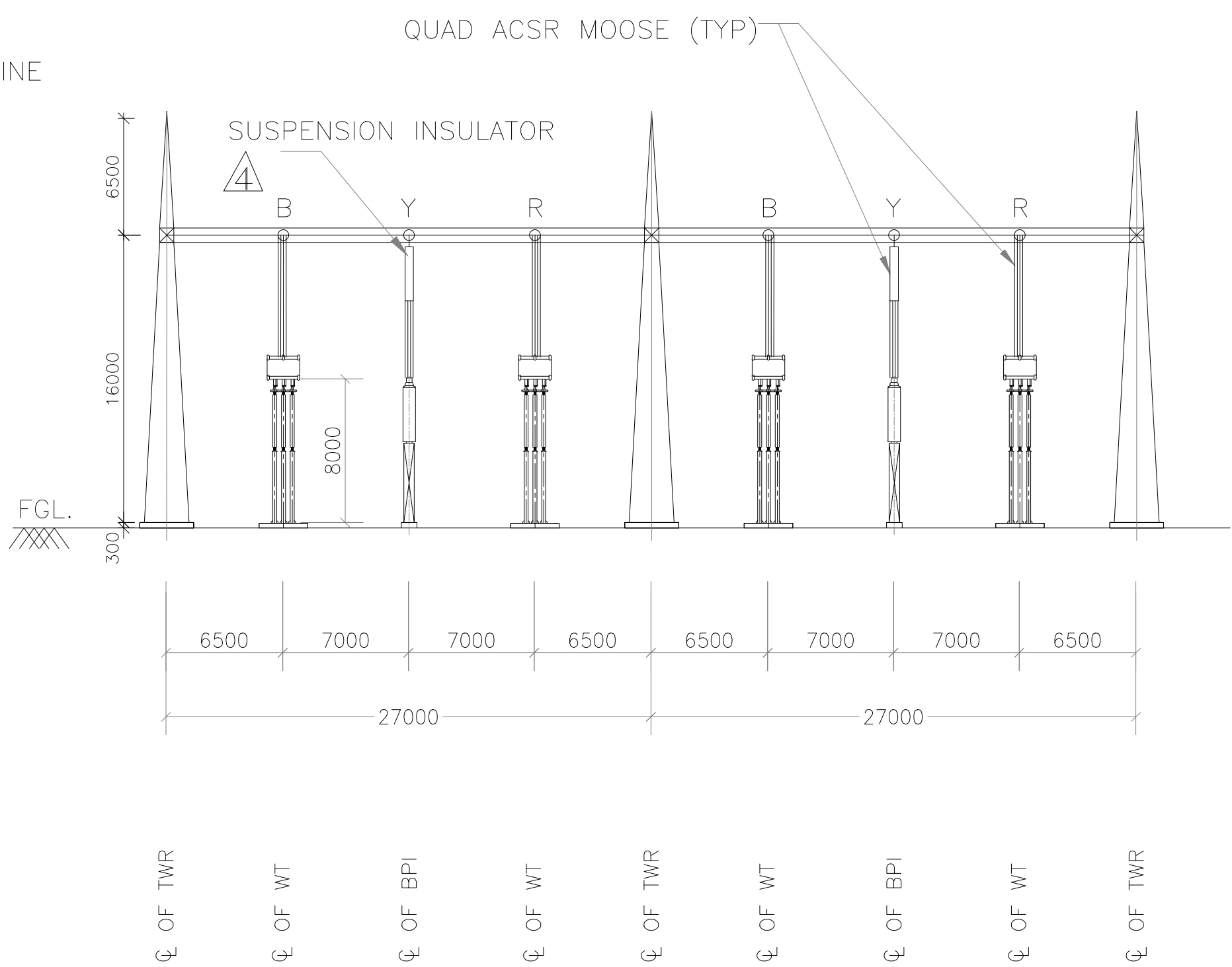
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End A.2



SECTION A-A



SECTION B-B

- ALL DIMENSIONS ARE IN MM. UNLESS OTHERWISE SPECIFIED.
- MINIMUM CLEARANCE TABLE
 - PHASE TO PHASE = 4000 MM.
 - PHASE TO EARTH = 3500 MM.
 - SECTIONAL CLEARANCE = 6500 MM
- LEVELS FOR SWITCHYARD ARE AS PER Revised Switchyard Layout - Sketch - Drg No. SJVN/ED/Arun-III/EM-2017-04
- ELEVATION OF SWITCHYARD AREA = 557.00 M.
- SYSTEM NOMINAL VOLTAGE = 400kV.
- SYSTEM HIGHEST VOLTAGE = 420kV.
- DOUBLE BUS-COUPLER HAS BEEN ADOPTED IN GIS.
- CONDUCTOR FOR 400KV SYSTEM WILL BE QUAD/TWIN MOOSE.
- ALL STRUCTURE/CONDUCTOR HEIGHTS ARE ABOVE PLINTH LEVEL. PLINTH LEVEL - 300 MM ABOVE F.G.L.
- ALL FLEXIBLE CONNECTIONS ARE WITH QUAD MOOSE/TWIN ACSR MOOSE CONDUCTOR WITH 450 MM SPACING.
- LOCATION OF WAVE TRAPS ARE INDICATIVE ONLY AND THE EXACT LOCATION WILL BE BASED ON PLCC REQUIREMENT. THE FDN. DESIGN SHALL BE PROVIDED BY BHEL.
- GIS/BUS DUCT LAYOUT IS TENTATIVE AND SHALL BE FINALIZED AFTER VENDOR FINALIZATION OF GIS.
- SWITCHGEAR ROOM AND GIS BUILDING LAYOUT SHALL BE SUBMITTED SEPARATELY.
- THE SCOPE OF BHEL SHALL BE LIMITED TO POINT OF CONNECTION OF OUTGOING LINE AT THE DEAD END GANTRY.
- THE DETAIL OF THE CABLE TERMINATION ON GT AND CABLE SUPPORT SYSTEM SHALL BE ADDED IN SUCCESSIVE REVISIONS.
- ROADS, FENCE AND GATE IS NOT IN BHEL'S SCOPE.
- OUTGOING STRINGING OF LINE CONDUCTOR & SHIELD WIRE ARE NOT IN BHEL SCOPE BUT CONNECTION OF EQUIPMENT TOWARDS LINE SIDE SHALL BE DONE BY BHEL..
- CONSTRUCTION OF FIRE RESISTANT WALL BETWEEN 400KV REACTOR UNITS ARE NOT IN BHEL SCOPE.
- PHASE SEQUENCE IS INDICATIVE & IT SHALL BE VERIFIED AT SITE DURING EXECUTION.
- THE DIMENSION OF THE XLPE CABLE TRENCH IS TENTATIVE AND SHALL BE FINALISED IN LINE WITH THE CABLE LAYING PHILOSOPHY OF THE EHV XLPE CABLE SUPPLIER.
- THE SWITCHGEAR BUILDING LAYOUT SHALL BE FURNISHED AS A SEPARATE DRAWING.
- DETAILS OF CABLE TRENCH - ROAD CROSSING ARRANGEMENT SHALL BE SHOWN IN CABLE TRENCH LAYOUT.
- FOUNDATION WORKS TO BE UNDERTAKEN BY EMPLOYER. HOWEVER, BHEL SHALL BE RESPONSIBLE FOR DESIGNING AND SUPPLYING DRAWINGS AND MATERIALS SUCH AS INSERT, EMBEDMENTS, BOLTS FOR FOUNDATION.
- REACTOR, UNLOADING AND HANDLING AT SITE SHALL BE ARRANGED BY BHEL.
- REFER SOAK PIT DESIGN FOR THE DETAILS OF THE SOAK PIT.
- REFER TO THE CONCEPTUAL DRAWING OF THE CONTROL ROOM BUILDING FOR THE CONTROL ROOM BUILDING DETAIL.
- SCOPE: GRAVEL AND THE GRATING IN THE REACTOR PIT SHALL BE IN THE SUPPLY SCOPE OF THE END CUSTOMER.
- THE ACTUAL CORDINATES OF THE DG AND THE BOT SHALL BE FINALISED BY THE END CUSTOMER.

MINIMUM CLEARANCE TABLE	400KV
PHASE TO PHASE (PP) (mm)	4000
PHASE TO EARTH (PE) (mm)	3500
SECTION CLEARANCE (SC) (mm)	6500
HEIGHT OF CONDUCTOR CENTRE LINE OF FIRST LEVEL (MIN.) MM. (FROM PLINTH LEVEL)	8000
GROUND CLEARANCE TO NEAREST PART NOT AT EARTH POTENTIAL OF AN INSULATOR SUPPORTING LIVE CONDUCTOR	2550
CREEPAGE DISTANCE (mm/kV)	25

BILL OF QUANTITY OUTDOOR EQUIPMENT:-

S.NO.	DESCRIPTION	SYMBOL	QUANTITY (NOS.)
1	420 kV INDOOR GIS		01
2	420 KV, 1-ph SF6 TO AIR BUSHING		06
3	420kV, 1-ph CVT		06
4	336kV, 1-ph SURGE ARRESTER		06
5	420kV, 8 KN, 1-ph, BUS POST INSULATOR		02
6	WAVE TRAP		04
7	400KV, 80MVAR REACTOR (BHEL MAKE)		03
8	NGR (BHEL MAKE)		02
9	120kV, 1-ph SURGE ARRESTER FOR NGR		2

CO-ORDINATES & ELEVATIONS OF IMPORTANT POINTS

CO-ORDINATES & ELEVATIONS OF IMPORTANT POINTS

S.NO.	DESCRIPTION	POINTS	EASTINGS	NORTHINGS	INVERT ELEVATION	REMARKS
1.	SWITCH YARD	SY1	519456.419	3043702.499	557.00	FINISHED LEVEL
		SY2	519380.269	3043677.981	557.00	-DO-
		SY3	519505.452	3043550.197	557.00	-DO-
		SY4	519443.580	3043530.277	557.00	-DO-

SYSTEM PARAMETERS

NOTES:-

- 400KV SWITCHYARD**
- RATED VOLTAGE : 400kV
 - HIGHEST SYSTEM VOLTAGE : 420kV
 - SYSTEM VOLTAGE VARIATION : -5% to +5%
 - RATED FREQUENCY : 50 Hz, ±3%
 - INSULATION LEVELS FOR 400KV CIRCUIT BREAKERS AND DISCONNECTING SWITCHES : 650 KV RMS (GIS) WITHSTAND VOLTAGE BETWEEN LIVE TERMINAL AND EARTH: 630 KV RMS FOR POTHEAD YARD EQUIPMENTS
 - 5B. RATED LIGHTNING IMPULSE WITHSTAND VOLTAGE : A) ± 1425 KVP BETWEEN LIVE TERMINALS AND EARTH. B) ± 1665 KVP IMPULSE ON ONE TERMINAL AND OTHER TERMINAL EARTHED (ACROSS ISOLATING DISTANCE).
 - 5C. RATED SWITCHING IMPULSE WITHSTAND VOLTAGE : 1050 KVP (PHASE TO EARTH) 1425 KVP (PHASE TO PHASE)
 - RATED SHORT TIME WITHSTAND CURRENT CAPACITY: 50 KA/SEC. RMS
 - SYSTEM NEUTRAL EARTHING : EFFECTIVELY EARTHED
 - AC AUX. SUPPLY : 415V, 3PH, 4 WIRE (+10% to -10%) 240V, 1PH, 2 WIRE (+10% to -10%)
 - CONTROL VOLTAGE : 220V DC, 2 WIRE, +10% TO -20%
 - GIS BUS CONFIGURATION : DOUBLE BUSBAR, 400 kV, 2500A, 50KA FOR 1S
 - ALL EQUIPMENT SHALL BE RATED FOR 50 DEG CENTIGRADE AMBIENT AND OUTDOOR INSTALLATION.

SCOPE OF CUSTOMER

ITEM NO.	DESCRIPTION	QTY.
01	GRATING IN LINE REACTOR AREA	2 LOT
02	GRATING IN BUS REACTOR AREA	1 LOT
03	PULLING BLOCK	6 NOS
04	FENCE	1 LOT
05	GRAVEL	1 LOT

LEGEND TABLE:-

	400kV TENSION INSULATOR NOT IN BHEL'S SCOPE
	QUAD MOOSE ACSR CONDUCTOR
	TWIN MOOSE ACSR
	SHIELD WIRE
	FENCE (NOT IN SCOPE OF BHEL)
	CONNECTION TO QUAD ACSR MOOSE CONDUCTOR
	PROPOSED SCOPE
	EXISTING/FUTURE SCOPE (NOT IN TBG SCOPE)
	GIB (GAS INSULATED BUS DUCT)
	TOWER WITH PEAK
	LM (LIGHTNING MAST)
	ENTRY GATE (NOT IN BHEL SCOPE)

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	ADDITIONAL INFORMATION : WO NO. :	PROJECT: ARUN-3 HYDRO ELECTRIC PROJECT (NEPAL) (4 x 225 MW)							
		CHD/APPD		06	22/06/21			CHD/APPD			05	28/05/21		CHD/APPD			
ZONE				ZONE	CURRENT REVISION INCORPORATES CHANGES AS PER EMAIL DATED 14 JUNE 2021 FROM M/S SJVN	ZONE	CURRENT REVISION INCORPORATES SOAK PIT AS PER SOAK PIT DOCUMENT REV-04 (TB-405-316-018)	STATUS OF DRAWING : DISTRIBUTION OF PRINTS :			 CUSTOMER: SJVN ARUN-3 POWER DEVELOPMENT COMPANY PVT. LTD. (SAPDC LTD.)						
										 CONSULTANT: SJVN LTD. (A JOINT VENTURE OF GOVT OF INDIA AND GOVT OF HP)							
REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED			NAME	SIGN.	DATE	
04	20/10/20	CHD/APPD	03	10/03/20	CHD/APPD	02	07/06/19	CHD/APPD	01	30/03/19	CHD/APPD		DRN.	PK			30/10/2018
													CHD.	Vyom/VK			30/10/2018
													APPD.	SKS			30/10/2018
ZONE	1. DETAILS OF THE REACTOR AND REACTOR CUM NGR AREA INCLUDED. 2. DISTANCE BETWEEN THE REACTORS OPTIMISED. 3. REPRESENTATION OF THE REACTOR UNLOADING INCLUDED.			ZONE	1. Building for Ventilation Room is now limited for catering to the requirement of GIS.	ZONE	1.Building for Inert Gas System included. 2.Common Ventilation Room for Power House and GIS Building included. 3.Cable Trench shown for the CAT to Switchyard. 4. The Layout of the Transformer Cavern shall be part of shown in "Cross Section and Plan of Transformer Cavern - 1 200 00 20558. 5. Comments marked on Rev-01 incorporated.	ZONE	Revised Switchyard Layout - Sketch - Drg No. SJVN/ED/Arun-III/EM-2017-04			DEPT. TBG		SCALE	CARD		
											CODE	NTS		CODE			
												TITLE ELECTRICAL LAYOUT PLAN AND SECTION OF 4x225MW OF ARUN-3 HEP			DRG.NO. TB-3-405-316-001		REV. 06
												SHT. No 02		NO. OF SHT. 04			

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SIZE-A2

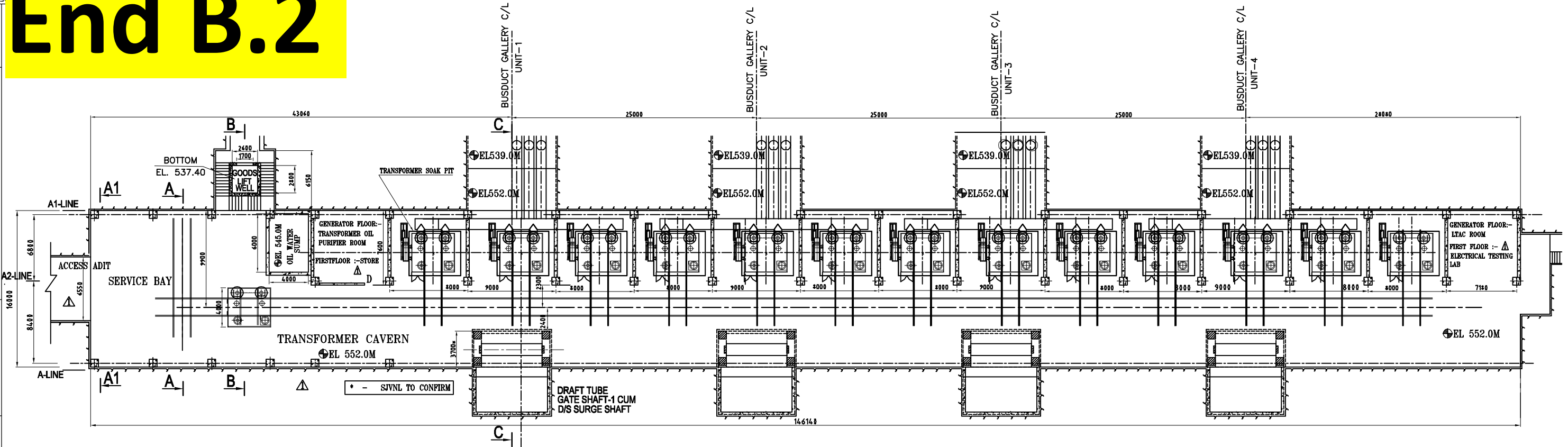
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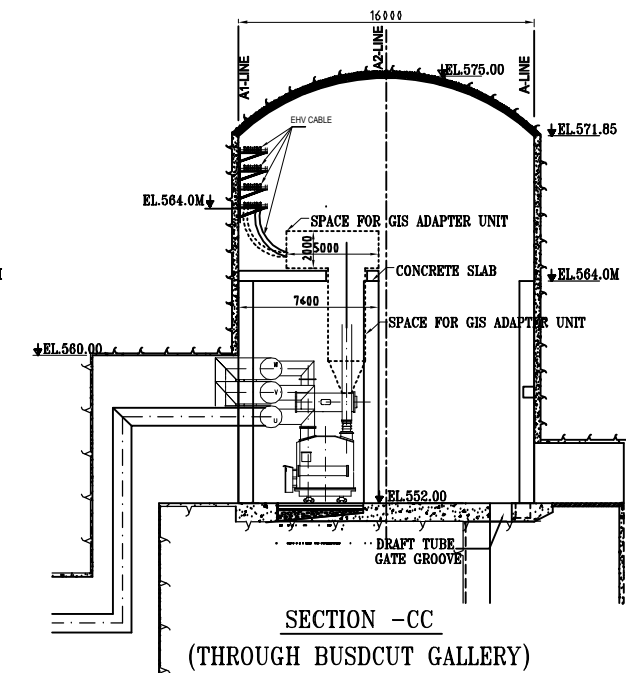
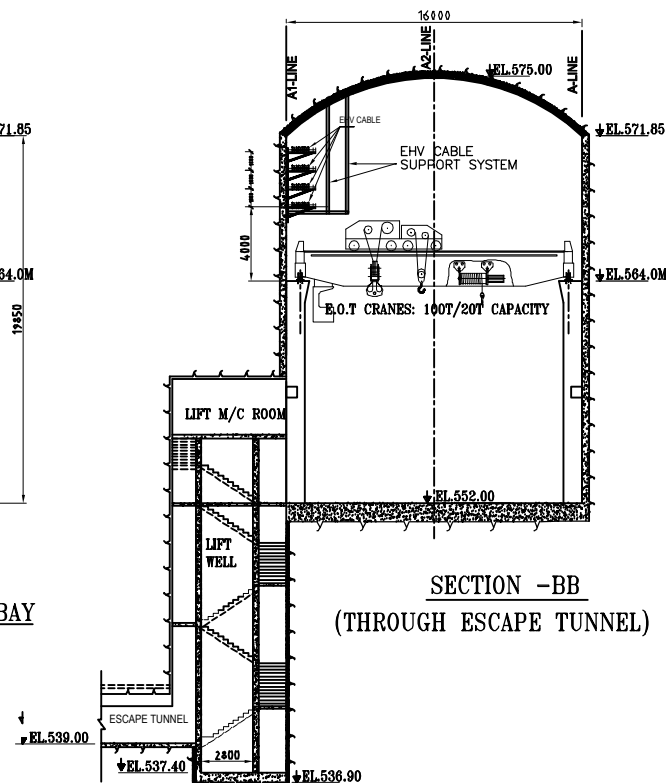
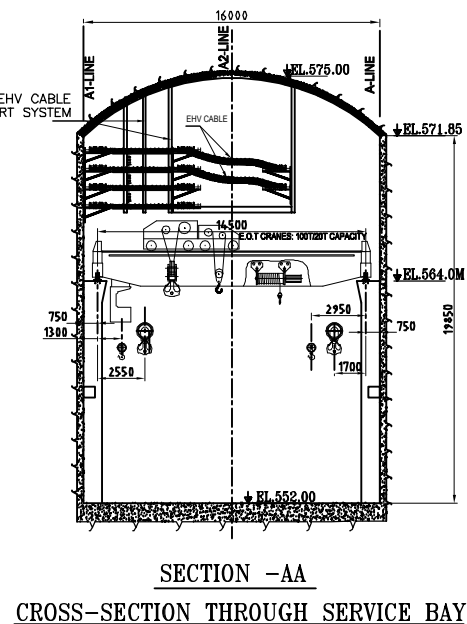
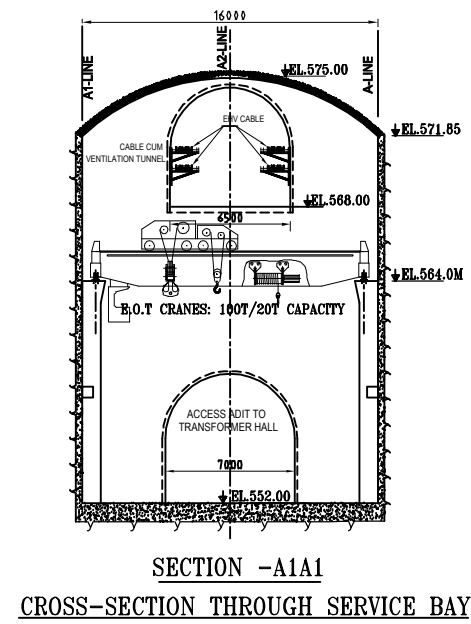
ADDITIONAL INFORMATION					PROJECT		ARUN-3 HYDRO ELECTRIC PROJECT, NEPAL (4x 225 MW)																		
STATUS OF DRAWING			U		CUSTOMER		SJVN ARUN-3 POWER DEVELOPMENT COMPANY PVT. LTD. (SAPDC LTD.)																		
DISTRIBUTION OF PRINTS					CONSULTANT		 SJVN LIMITED (A JOINT VENTURE OF GOVT. OF INDIA & GOVT. OF HP)																		
<table border="1"> <tr> <td>DRWN</td> <td>NAME</td> <td>SIGN</td> <td>DATE</td> <td rowspan="4">NO. OF VAR.</td> </tr> <tr> <td>CHKD</td> <td>DK</td> <td></td> <td>10.9.18</td> </tr> <tr> <td>APPD</td> <td>RS</td> <td></td> <td>10.9.18</td> </tr> <tr> <td></td> <td></td> <td></td> <td>10.9.18</td> </tr> </table>		DRWN	NAME	SIGN	DATE	NO. OF VAR.	CHKD	DK		10.9.18	APPD	RS		10.9.18				10.9.18	CONTRACTOR		 भारत हेवी इलेक्ट्रिकल्स लिमिटेड, भोपाल Bharat Heavy Electricals Limited, Bhopal				
DRWN	NAME	SIGN	DATE	NO. OF VAR.																					
CHKD	DK		10.9.18																						
APPD	RS		10.9.18																						
			10.9.18																						
SUB-SUPPLIER / VENDOR					DEPT CODE HSE 415		UNTOL.	DIMS.	GR.	ANGLE 	SCALE 1:200	WEIGHT(kg)	REF. TO ASSY.DRG.	ITEM NO.	NO. OF ITEMS										
TITLE							CROSS SECTION AND PLAN OF TRANSFORMER CAVERN				DRAWING NO. 1 200 00 20559		REV. 02												
											SHEET NO. 02		NO. OF SHEETS. 02												

INVENTORY NO.	SIGN. & DATE
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End B.2



PLAN OF TRANSFORMER CAVERN AT EL 552.0M



- LAYOUT PLAN AT EL 584.0 M SHALL BE INCORPORATED AFTER FINALIZATION OF HV SYSTEM DRAWINGS.
- INTERFACING DETAILS BETWEEN GSU TRANSFORMER, LV & HV BUSDUCT SHALL BE INCORPORATED LATER AFTER FINALIZATION OF SYSTEM DRAWINGS.
- DETAILS OF TRANSFORMER SOAK PIT SHALL BE INCORPORATED AFTER FINALIZATION OF TRANSFORMER DRAWING.

NOTES:

- ALL DIMENSIONS ARE IN MILLIMETRES AND ELEVATIONS ARE IN METRES.
- SIZE/LOCATION OF COLUMNS AND BEAM ARE TENTATIVE AND MAY BE REVIEWED BY SJVNL.

ADDITIONAL INFORMATION	PROJECT	ARUN-3 HYDRO ELECTRIC PROJECT, NEPAL (4x 225 MW)			
STATUS OF DRAWING	U	CUSTOMER	SJVN ARUN-3 POWER DEVELOPMENT COMPANY PVT. LTD. (SAPDC LTD.)		
DISTRIBUTION OF PRINTS		CONSULTANT	SJVN LIMITED (A JOINT VENTURE OF GOVT. OF INDIA & GOVT. OF HP)		
DRWN DK	SIGN	DATE	NO. OF	CONTRACTOR	Bharat Heavy Electricals Limited, Bhopal
CHKD DK		10.9.18	VAR.		
APPD RS		10.9.18			
SUB-SUPPLIER / VENDOR		DEPT CODE	UNTL DMS. GR.	ANGLE	SCALE
		415			1:200
		WEIGHT(kg)		REF TO ASSY.DRG.	ITEM NO.
		TITLE		DRAWING NO.	REV.
		CROSS SECTION AND PLAN OF TRANSFORMER CAVERN		1 200 00 20559	02
				SHEET NO. 01	NO. OF SHEETS. 02