Project: 400kV GIS & GIBD systems of Nuclear Power Corporation of India Limited for Main Plant Electrical System Package for KKNPP Units-5&6
Customer: M/s Nuclear Power Corporation of India Limited
Ref. No. NPCIL/400kV GIS/TQR REV00

Technical Qualifying Requirements for 400kV Gas Insulated Switchgear (GIS)

i. The manufacturer whose 400kV* level GIS bays are offered must have designed, manufactured, type tested** (as per IEC or equivalent standard), supplied and supervised erection & commissioning of at least two (2) nos. Gas Insulated Switchgear (GIS) circuit breaker bays @ of 400kV* or above voltage class in one (1) Substation or Switchyard during the last seven (7) years and these bays must be in satisfactory operation# for at least two (2) years as on the original scheduled date of techno-commercial bid opening of this tender.

Alternatively,

ii. The manufacturer, who have established manufacturing and testing facilities in India and not meeting the requirement stipulated in (i) above, can also be considered provided that

- At least one no. 400kV* or above voltage level GIS Circuit Breaker bay@ must have been manufactured in the above Indian works based on the technological support of the Collaborator(s) and either supplied or type tested the above GIS bay (as per IEC or equivalent standard) as on the as on the scheduled date of techno-commercial bid opening.

- The collaborator(s) meets the requirements stipulated in (i) above. A valid collaboration agreement for technology transfer/ license to design, manufacture, test and supply 400kV* or above voltage level GIS equipment in India shall be submitted.

- The Collaborator(s) shall furnish performance guarantee for an amount of 10% of the ex-works cost of such equipment(s) and this performance guarantee shall be in addition to Contract Performance Guarantee to be submitted by the bidder.

Note:

1. (*) voltage class of respective equipment as applicable
2. (@) For the purpose of technical requirement, one no. of circuit breaker bay shall be considered as a bay used for controlling a line or a transformer or a reactor or a bus section or a bus coupler and comprising of at least one circuit breaker, one disconnector and three nos. of single phase CTs / Bushing CTs. GIS means SF6 Gas insulated Switchgear.
3. (**) Type test reports of the collaborator/ parent company/ subsidiary company/ group company shall also be acceptable.
4. (#) Successful operation without any adverse remarks from customer.
5. Complete compliance with the NPCIL's tender specification is mandatorily required.

BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION BUSINESS ENGINEERING MANAGEMENT
NOIDA

DOCUMENT NO.	TB-PBTU-KKNPP-400kV GIS	Rev 00	Prepared	Checked	Approved
TYPE OF DOC.	TECHNICAL SPECIFICATION	NAME	BY	DKS	VK
TITLE 400kV GIS & GIBD System with accessories *(suitable for non-air conditioned, tropical, humid and corrosive environment)*		SIGN			
		DATE	18.04.2026	18.04.2026	18.04.2026
		GROUP	TBEM		
		WO No.			

CUSTOMER	M/s Nuclear Power Corporation of India Limited
PROJECT	Pre-Bid Tie up for, 400kV GIS & GIBD systems of Nuclear Power Corporation of India Limited for Main Plant Electrical System Package for KKNPP Units- 5&6

Contents

Section No.	Description	No of Pages
Section-1	Scope, Project Specific Technical Requirements & Bill of Quantities Annexure- BOQ_KKNPP	
Section-2	Equipment Specification under scope of Supplies/ service	
Section-3	Project details and general technical requirements (For all equipment under the Project)	
Section-4	Annexures Annexure- A: Compliance Certificate to Technical Specification Annexure- B: Deviation/ Change Request to Technical Specification	

Remarks:
Bidder to note that data and details of Guaranteed Technical Particulars shall not be reviewed during Technical Evaluation/ Review, hence compliance of Guaranteed Technical Particulars in line with Technical Specification has to be ensured by the bidder.

Rev. No.	Date	Altered	Checked	Approved	
Distribution				To	
				Copies	

COPYRIGHT & CONFIDENTIAL
The information in this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.
This must not be used directly or indirectly in anyway detrimental to the interest of the company.

Contents

SECTION 1:.....2
SCOPE, PROJECT SPECIFIC TECHNICAL REQUIREMENTS & BILL OF QUANTITIES.....2
1. Scope.....2
2. Codes & Standards.....3
3. Specific Technical Requirements.....4
4. Other General Requirements.....4
5. Earthing of GIS.....5
6. Modular Design & Future extensions.....5
7. Maintenance and Repair of Circuit Breaker.....7
8. Interchangeability & Future Extension.....7
9. Online Partial Discharge (PD) monitoring system for GIS, if applicable.....7
10. Bill of Quantities.....8
11. Drawings / Documents required for Engineering Manufacturing Clearance.....8
12. Type Testing.....9
13. Quality Plan.....9
14. Inspection & Testing.....10
15. Field Testing & Commissioning.....10
16. Makes of Equipment/ Components.....10
17. Packing and Dispatch.....11
18. Definitions Used.....11
19. List of Documents/ Drawings.....12

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

1. Scope

This technical specification covers the requirements of design, engineering, fabrication, manufacturing, shop assembly, inspection including third party inspection agency (TPIAs) and testing at manufacturer's works before supply, proper packing and delivery to project site, supervision of unloading & storage at site, and supervision of installation/ erection, site testing & commissioning, putting into successful operation complete with all materials, support structures, anchoring bolts, accessories, commissioning spares & maintenance spares, special spanners, tools & tackles, any specific required ancillary services, SF6 gas for first filling & spare etc. including training of Customer/ BHEL personnel for 400KV GIS & GIBD system with accessories complete in all respects for efficient & trouble-free operation 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 to site, inspection at manufacturer's work, supervision of installation, commissioning including site testing along with necessary equipment, training to Customer/ BHEL personnel, Insulation coordination studies, supply of all mandatory spares, commissioning spares, special tools and tackles as defined in the equipment datasheet, drawings, standard specifications, standards etc. attached or referred with technical specification.

This section covers the specific technical requirements of 400KV GIS & GIBD system with accessories. This constitutes minimum technical parameters for the above item as specified by the BHEL/ Customer. The offered 400KV GIS with LCC & its Accessories shall also comply with the Section-3 (Project Details and General technical requirements for all equipment under the Project) of this specification.

The specification comprises of following sections:

Section-1	:	Scope, Project Specific Technical Requirements & Bill of Quantities
Section-2	:	Equipment Specification under scope of Supplies/ Services
Section-3	:	Project Details & General Technical Requirements (For All Equipment under the Project)
Section-4	:	Annexures Annexure A- Compliance Certificate Annexure B- Schedule of Technical Deviations

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

1. Statutory Regulations

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

- o Indian Electricity Act
- o CEA regulations
- o The Factory Act
- o The Petroleum Rules

o OISD standards
o Requirements of other statutory bodies as applicable, e.g. CEA, CCE, LPCB.

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

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

GIS shall be designed in such a way that transfer from one bus isolator to another bus isolator shall be possible in energized condition without any break in supply to the loads.

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-B), however bidder shall furnish list of conflicts/ ambiguities/ deviations (Annexure-A), if any. Any conflicts/ ambiguities/ deviations mentioned elsewhere in technical offer shall not be reviewed.

The equipment is required for the following project:

Name of the Customer	:	M/s Nuclear Power Corporation of India Limited
Name of Main Contractor	:	Bharat Heavy Electricals Limited (BHEL)
Name of the Project	:	400kV GIS & GIBD systems of Nuclear Power Corporation of India Limited for Main Plant Electrical System Package for KKNPP Units- 5&6

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

2. Codes & Standards

The performance, testing and rating of the switchgear shall conform to the latest edition of the following IEC / IS publications, but not limited to,

IEC 60694	Common clauses for High Voltage Switchgear & Control Gear
IEC 62271-203	Gas Insulated metal-enclosed Switchgear for rated voltages above 52kV
IEC 62271-207	Seismic Qualification for Gas-insulated Switchgear Assemblies for rated voltages above 52kV
IEC 60376	New Sulphur Hexafluoride
IEC 62271-100	High Voltage Alternating Current Circuit Breakers
IEC 62271-1	Common Clauses for High Voltage Switchgear and Control-Gear Standards
IEC 62271-102	Alternating Current Disconnections (Isolators) and Earthing Switches
IEC 60044-1	Current Transformers
IEC 60044-2	Voltage Transformers
IEC 60137	Bushings for Alternating Voltages above 1000V

IEC 62271-209	Cable Connections for Gas-insulated Switchgear
IEC 60480	Guide to Checking of Sulphur Hexafluoride taken from Electrical Equipment
IEC 60099-1/4	Non-linear Resistor type Arresters for AC Systems
IEC 60439	Factory-built Assemblies of Low-voltage Switchgear and Control Gear.
IEEE 80 (2000)	IEEE Guide for Safety in AC Substation Grounding.
CIGRE-44	Earthing of GIS- An Application Guide. (Electra no. 151, Dec'93).
IEC 61639	Direct connection between Power Transformers and Gas-insulated metal-enclosed Switchgear for Rated Voltage 72.5kV and above

These are only indicative list and hence any other codes & standards, if applicable shall be complied by bidder.

3. Specific Technical Requirements

Specific technical requirements of Equipment shall be as per section-2, unless noted otherwise elsewhere. The 400kV GIS & GIBD shall be designed suitable for operating satisfactorily when placed in tropical, humid and highly corrosive atmosphere. The equipment shall be designed to meet the site conditions as specified in the data sheets.

4. Other General Requirements

Other general requirements of Equipment shall be as follows,

1. Storage shall be provided by BHEL/ its contractor. However, bidder shall provide their tentative space requirement for covered and/ or open store area during tender stage only. In addition to this, bidder shall submit their standard storage instruction manual specifically specifying the item detailed with details of type of storage.
2. Bidder shall submit list of consumables with shelf life of less than six months and same shall be dispatched just before the erection and only after specific clearance from BHEL/Customer.
3. Packing of GIS & its accessories shall be suitable for long term storage without any deterioration in quality and performance (minimum 2 years, if required).
4. Bidder shall offer their latest type tested compact model to accommodate the specified & allocated space as per attached layout drawing of GIS. Bidder to note that if bidder fails to meet above requirement, its technical offer is liable for non-evaluation.
5. Bidder shall conduct insulation co-ordination and VFTO studies in line with IEC 60071 for establishing surge arrester rating, quantity and any other requirement for successful operation of GIS.
6. Bidder shall be required to submit 3D OGA Drawing compatible with Primtech for complete GIS & its accessories.
7. Bidder shall check and ensure adequacy of system protection for successful operation of GIS. After checking of system by bidder, GIS shall be installed and if any failure, malfunction of any part occurs after/ during commissioning, same shall be replaced immediately without any extra cost.
8. The 400KVGIS hall shall comprise an EOT (Electric overhead travel) crane of sufficient capacity, electrically operated with pendant type control. However, EOT crane for GIS is not envisaged in bidder's scope but bidder shall provide all the calculations basis for sizing of EOT crane during tender stage only. EOT cranes for GIS hall shall be provided for erection & maintenance of largest GIS component/assembly. The crane shall consist of all special requirements & lifting assemblies for erection & maintenance of GIS equipment.
9. CT/ VT parameters mentioned in CT VT parameter document is indicative only. Bidder has to ensure correctness of CT/VT sizing for GIS during contact stage / detailed Engineering stage.

10. Any change in bay pitch (distance between bays) as per civil requirement for during detailed engineering stage shall be incorporated by the bidder without any cost and delivery implication to BHEL.
11. Bidder shall include painting and marking of all buses, individual incomers, all outgoing feeders etc. with details such as tag no., feeder rating, sending end source reference etc. for all switchboards.
12. The GIS shall be designed in such a way that suitable walkways are provided all around the switchgears so that the operators will be able to have free access to all the operating mechanism.
13. The GIS Equipment shall be complete with all necessary supports, ladders, galleries, staircases, catwalks, movable platforms or walkways (for accessing the equipment above two meters for maintenance and operation), mechanism cabinets, internal cable raceways etc for each bay and it shall be of modular construction and extendable design. All structures, galleries, staircases and walkways shall conform to the relevant Occupational Safety and Health Administration (OSHA).
14. Special tools & tackles for installation and testing kits for testing & commissioning shall be in bidder's scope, however, it shall be brought at site on returnable basis only.
15. Bidder shall provide list of general tools, tackles, slings, spanners, gauges and other lifting devices, drills, instruments, testing kits and appliances necessary for the complete assembly, installation, gas filling, maintenance, site testing of the GIS, however, the same shall be arranged by BHEL.

5. Earthing of GIS

An effective grounding network within the switchgear location shall be established by providing a continuous copper ground bus extending over the entire length of switchgear enclosure. The bus shall be adequately sized to withstand the specified short-circuit current. Frames, cubicles, panels etc shall be grounded by copper strip bolted on one end to the equipment and the other end to the nearest earth riser. The temperature of the grounding conductors shall not exceed the temperatures specified in IEC 60517 during normal operation. bidder shall provide a main earth bus for a specified short circuit current of 63kA for 1 sec. for GIS to which all intentionally earthed parts and the switchgear assemblies as well as the outdoor bus duct must be connected.

Accordingly, the bidder shall submit detailed calculations and layout drawings for earthing system during detailed engineering stage based on technical specification Section-2 of technical specification, bidder’s design philosophy, IS/IEC requirement as applicable. Bidder to provide the bill of quantity of entire items required for the earthing of the GIS. However, supply of 40mm MS ROD, 75X12/50x6mm GI Flat shall only be done by BHEL. Any other earthing material, as per design/ BOQ, shall be in bidder’s scope of supply only. Erection of earthing will be done by BHEL team under the supervision of bidder/manufacturer, as per manufacturer’s design.

6. Modular Design & Future extensions

1. The GIS switch gear shall be of modular design offering high degree of flexibility. Each module shall be complete with SF6 gas circuit breaker, disconnectors, Maintenance Grounding switches, fast Earthing switches, voltage transformers, Current transformers, bus & elbow sections, Gas Insulated Bus-duct, local control cubicle and all necessary components required

for safe & reliable operation and maintenance.

2. The GIS shall be of either single-phase enclosure type or three-phase enclosure type for voltage levels of 400KV.
3. In those design where bus bar is continuous, provision is to be made available for isolation of individual bay without disturbing adjacent bay.
4. The switchgear shall be of the freestanding, self-supporting dead-front design, with all high-voltage equipment installed inside gas-insulated, metallic grounded enclosures, and suitably sub-divided into individual arc and gas proof compartments, preferably for:
   (1) busbar section with associated busbar disconnector
   (2) Circuit breakers
   (3) Line dis-connectors
   (4) Voltage transformers
   (6) Gas Insulated bus duct section between GIS and,
   (7) Gas insulated bus section between GIS and oil filled transformer.
   (8) Current Transformers.
   Each phase / pole of GIS and SF6 busducts shall be housed in separate enclosures.
5. The bus enclosure shall be sectionalized in a manner that maintenance work on any bus disconnector (when bus and bus disconnector are enclosed in a single enclosure) can be carried out by isolating and evacuating the small effected section and not the entire bus.
6. Arc faults caused by external reasons shall be positively confined to the originating compartment and shall not spread to other parts of the switchgear. In case of any internal arc fault in a busbar, busbar disconnector or circuit breaker, of double bus system, repair works must be possible without shutting down complete substation and at least one busbar and the undisturbed bays must remain in operation.
7. The busbar system shall be sectionalized for each bay and contained in individual SF6 gas tight bus compartments to prevent contamination of the gas of the whole bus bar due to fault in one bay zone and refill lesser quantity of SF6 gas.
8. Where bus Coupler is specified and in case of any internal arc fault in a busbar, busbar disconnector or sectionaliser, repair work must be possible without shutting down the complete substation and at least one half of the substation must remain in operation.
9. Documents indicating sequence of repair work steps and description of necessary restrictions during work shall be submitted with the technical manual during as built drawing submission.
10. Each bay module should be equipped with suitable arrangement for easy dismantling and refitting during maintenance without disturbing other units.
11. Bus duct lengths shall be taken from the end of bay equipment (VT, LA etc.) to end equipment (SF6 to air bushing, SF6 to oil bushing/ connection etc.)
12. Material clearance certificate shall be issued after demonstration of the functionality of maintenance equipment.
13. Structure Materials for support of GIS, Bus Ducts, SF6 to oil bushing/ connection and SF6 to air bushing/ connection including Foundation Bolts, Embedded Items, Rails and/ or other items structural items required. All steel structure members shall be hot-dip galvanized after fabrication. Unless otherwise specified, minimum mass of zinc coating for Galvanizing shall be 610 gm/square meter unless specified otherwise. All field assembly joints shall be bolted. Field welding shall not be acceptable. Noncorrosive metal or plated steel shall be used for bolts and nuts throughout the work. Manufacturer shall provide suitable foundation channels and anchor bolts to support the switchgear assemblies. All mounting bolts, nuts and washers shall be provided to fasten the switchgear base frames to the foundation channels.

7. Maintenance and Repair of Circuit Breaker

1. The positioning of the circuit breaker in the GIS shall be such that it shall be possible to access the circuit breaker of any feeder from the front side for routine inspection, maintenance and repair without interfering with the operation of the adjacent feeders.
2. The GIS shall be so designed that any component of the GIS can be removed easily. With minimum flexibility in the layout arrangement it shall be possible to remove the circuit breaker with both busbars remaining in service and it shall be possible to remove the disconnector of the busbars, with one bus bar remaining in service. For achieving this requirement, adequate number of intermediate compartments, if required, shall be provided to ensure equipment & operating personnel's safety.
3. The bidder shall be required to demonstrate clearly in his submitted documents the suitability of the switchgear design in this respect. The arrangement shall be such that expansion of the original installation can be accomplished with minimum GIS down time.
4. In case of extension, the interface shall incorporate facilities for installation and testing of extension to limit the part of the existing GIS to be re-tested and to allow for connection to the existing GIS without further dielectric testing.
5. All the elements shall be accessible without removing support structures for routine inspections and possible repairs.

8. Interchangeability & Future Extension

1. As much as possible, all the parts shall be of standard manufacturer with similar parts and assemblies being interchangeable.
2. The GIS system shall be suitable for future extension on either end by the addition of extra feeders, bus couplers, bus-bars, circuit breakers, dis-connectors, and other switch gear components. The arrangement of gas sections or compartments shall be such as to facilitate future extension without any drilling, cutting or welding on the existing equipment. To add equipment, it shall not be necessary to move or dislocate the existing switchgear bays
3. The layout shall ensure that GIS bus link section is provided for future extension of the GIS buses to avoid de-gassing and modification of the existing bus.
4. The physical layout shall ensure free movement of the SF6 Gas Cart and easy access to all components of the GIS for maintenance purposes.

9. Online Partial Discharge (PD) monitoring system for GIS, if applicable

The equipment shall be used for detecting different types of defects in Gas Insulated Switchgear (GIS) such as Particles, Loose shields and Partial Discharges as well as for detection of Partial discharges in other types of equipment such as Cable Joints, CTs and PTs.

It shall be capable for measuring PD in charged GIS environment as EHV which shall have bandwidth in order of 100 MHz–2GHz with possibility to select a wide range of intermediate bandwidths for best measurement results. The principle of operation shall be based on UHF principle of detection. The instrument should also be able to detect partial discharges in cable joints and terminations.

Detection and measurement of PD and bouncing particles shall be displayed on provided

HMI for the system and the measurement shall be stored in the PC for further analysis to locate actual source of PD such as free conducting particles, floating components, voids in spacers, particle on spacer surfaces etc. Software for display and diagnosis of PD signals and an expert software system for accurate interpretation of cause of PD shall also, be supplied and installed on the provided HMI by the contractor.

Measurement shall be possible in the charged substation/ switchyard in the presence of EMI/EMC.

OEM for Online PD monitoring system shall comply the requirement of Pre-qualification as mentioned in Section-2.

10. Bill of Quantities

Quantities for supply and services for **Equipment** shall be as per **Annexure- BOQ_KKNPP.** However, the scope broadly covers the following requirements,

1. **400KV GIS & GIBD system with accessories** of bays as per technical specification - 1 lot
2. Specified spare parts as per technical specification- 1 lot
3. Tools and Instruments as per technical specification- 1 lot
4. The quantity variation shall be as per terms & conditions of NIT.

11. Drawings / Documents required for Engineering Manufacturing Clearance

The drawings/ documents, as follows shall be used for providing technical clearance for manufacturing of GIS and furthermore, it shall be used for delay analysis, if any, from bidder. The first drawing submission will be counted from the date of submitting reasonably correct drawings.

Sl. No.	Overall Drawings approval required in Cat I /Cat II
1	400KV GIS &GIBD- Gas Schematics with Single Line Diagram (Including CT VT Parameters)
2	400KV GIS &GIBD- Guaranteed Technical Particulars (Including all GIS equipment
3	400KV GIS &GIBD- Layout Plan & Section
4	400KV GIS &GIBD- Interfacing Drawings for Cable Connection Module, SF6 to Air Bushing, SF6 to Oil Module with Guaranteed Technical Particulars
5	400KV GIS &GIBD- Equipment Layout with Earthing philosophy
6	400KV GIS &GIBD- Type Test Reports (Including all GIS equipment)
7	400KV GIS &GIBD- Secondary Engineering Base Design
8	400KV GIS &GIBD- Control Schematics for GIS and Local Control Cabinet
9	400KV GIS &GIBD- Maintenance Equipment Catalogue with Guaranteed Technical Particulars
10	400KV GIS &GIBD- Quality Assurance Plan & Inspection Test Schedule
11	400KV GIS &GIBD- Civil Design Specification with Foundation Loading Diagram (Including interfacing details)
12	400KV GIS &GIBD- Quantification for main Items, Spares, Consumables

12. Type Testing

All the equipment offered should have been successfully type tested as per the relevant standards, amended up to date. In case the equipment of the type and design offered has already been type tested, the bidder shall furnish type test reports before proceeding with manufacture. Type tests validity shall be as per CEA regulatory guidelines from the date of bid submission. As a part of technical offer, bidder shall include a tabulation detailing various type tests on each type of equipment along with applicable type test certificate number, details of the equipment subjected to type test, place of testing and final results.

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.

Type test should have been carried out as per relevant IEC standards at the type test must have been carried out at any accredited laboratories. The following type test certificates, as specified in IEC standard 62271 – 203 & 62271-100 (amended up to date) shall be required for verification as evidence of successful completion of type tests.

1. Tests to verify the insulation level (Lightning impulse, switching impulse and ac withstand test with PD) test on each GIS device (CB, Disconnector, bus, etc).
2. Dielectric tests on auxiliary circuits.
3. Tests to prove the radio interference voltage (RIV) level.
4. Tests to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit.
5. Tests to prove the ability of the main and earthing circuits to carry the rated peak and the rated short time withstand current.
6. Tests to verify the making and breaking capacity of the included switching devices.
7. Tests to prove the satisfactory operation of the included switching devices.
8. Tests to prove the strength of enclosures.
9. Verification of the degree of protection of the enclosure.
10. Gas tightness tests
11. Electromagnetic compatibility tests (EMC).
12. Additional tests on auxiliary and control circuits.
13. Tests on partitions.
14. Tests to prove the satisfactory operation at limit temperatures.
15. Tests to prove performance under thermal cycling and gas tightness tests on insulators.
16. Corrosion test on earthing connections (if applicable).
17. Tests to assess the effects of arcing due to an internal fault.
18. Tests on solid dielectric components (operating rods, spacers, etc)
19. Seismic test
20. Test on Auxiliary switches (Electrical & Mechanical Endurance, Heat run, IR & HV test)

13. Quality Plan

The successful bidder shall submit Quality Assurance Plan for major components such as breakers, disconnecting switches, lightning arrestors, earth switches, 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 and Bidder and

approved. 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 GIS. High reliability of materials shall be ensured so as to keep maintenance work to a minimum. 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 these tests for all the equipment & components shall be deemed to be included in bidder's scope.

14. Inspection & Testing

1. Equipment shall be subject to inspection by BHEL/ Customer or authorized representative at bidder/manufacturers' works. Hence, Bidder shall furnish all necessary information concerning the supply to BHEL/ Customer.
2. During fabrication, the equipment shall be subject to inspection by BHEL/ Customer or by an agency authorized by BHEL/ Customer to assess the progress of work as well as to ascertain that only quality raw material is used.
3. Bidder shall ensure that the hazardous area equipment provided shall have the necessary test certificates and valid CCOE approval certificates.
4. Bidder shall also furnish factory acceptance test (FAT) from manufacturers for BHEL/ customer approval in line with specific requirements mentioned in Section-2.

15. Field Testing & Commissioning

1. Bidder shall carry out the supervision of installation, field testing and commissioning of 400KV GIS & GIBD with Accessories. Further appropriate test and commissioning reports and as-built documentation as necessary be submitted.
2. Field testing and commissioning of equipment 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. All switchboard protection shall be subject to primary injection test before commissioning.
5. 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.
6. All electrical equipment shall be said to be installed and mechanically complete after circuit testing, primary and secondary injection testing and loop simulation is complete. Due care and consideration shall be given to the installation of 400KV GIS with LCC & its Accessories.

16. Makes of Equipment/ Components

Bidder/ vendor while ordering shall ensure the availability of spare parts and maintenance support services for the offered equipment 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.

17. Packing and Dispatch

1. The equipment 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 the equipment shall be suitable for long storage (minimum 2 year).
2. The SF6 equipment shall be shipped in the largest factory assembled units within transport and loading limitations and considering handling facilities on site to reduce the erection and installation work on site to a minimum. Where possible all items of equipment or factory assembled units shall be boxed in substantial crates or containers to facilitate handling in a safe and secure manner.
3. Each individual piece to be shipped, whether crate, container or large unit, shall be marked special notations such as 'Fragile', 'This side up', 'Centre of gravity', 'Weight', 'Owner's particulars', 'PO no.' etc., and other details as per purchase order.
4. The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains and high ambient temperature.
5. Special precautions shall be taken to protect any parts containing electrical insulation against the ingress of moisture. This applies particularly to the equipment of which each gas section shall be sealed and pressurized prior to shipping. Either dry nitrogen/air or dry SF6 gas shall be used and the pressure shall be such as to ensure that, allowing for reasonable leakage, it will always be greater than the atmospheric pressure for all variations in ambient temperature and the atmospheric pressure encountered during shipment to site and calculating the pressure to which the sections shall be filled to ensure positive pressure at all times during shipment.
6. All blanking plates, caps, seals, etc., necessary for sealing the gas sections during shipment to site shall be provided. Any seals, gaskets, `0' rings, etc. that will be used as part of the arrangement for sealing off gas sections for shipment of site, shall not be used in the final installation of the equipment at site. Vendor to provide quantity of components accordingly considering permanent installation and commissioning.

18. 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:

2. Bid/Bidding Documents: The totality of the documents comprising the Bidding Document for the notice inviting tender.

3. Contract: The totality of agreement between Customer/ Purchaser/ Owner/NPCIL and the Contractor/ LSTK Contractor/ BHEL as derived from the contract documents.

4. Contractor/ LSTK contractor: The bidder selected by the Customer/ Purchaser/ Owner/NPCL for the performance of the work and supply of materials. In this case, it is BHEL.

5. Customer/ Purchaser/ Owner: M/s Nuclear Power Corporation Limited

6. Consultant: Any person(s)/ Firm nominated/ assigned by the Contractor/ LSTK Contractor/ BHEL for providing the engineering consultant services. In this case, it is CB&I INDIA PRIVATE LIMITED.

7. Bidder/ vendor/ Contractor: The bidder selected for this intended work shall be known as vendor.

19. List of Documents/ Drawings

Following drawing/ documents are attached for information purpose,

1. Single Line Diagram (SLD) for 400kV GIS
2. Layout Plan for 400kV switchyard

ANNEXURE: BOQ_400kV GIS_NPCIL KKNPP-5&6						
REVISION NO.:	REV00					
DATE:	22.04.2026					
Sl. NO.	**ITEM SHORT DESCRIPTION**	**ITEM DESCRIPTION**	**HSN**	**UNIT OF MEASUREMENT (UOM)**	**QUANTITY**	**REMARKS**
1	**SUPPLY- GIS : 400KV, 63KA FOR 1S, GAS INSULATED SWITCHGEAR (GIS) AS PER TS**					
	0 UAB - 400KV GIS BUILDING AND 5 and 6 UAZ TUNNELS	Equipment design, detailed engineering, preparation of drawings, procurement, fabrication, manufacture, inspection, testing, packing, forwarding, safe delivery to site and guarantee of 400kV gas insulated switchgear (GIS) system comprising the following but not limited to the same: 400kV GIS including GIBD, gas insulated bus duct (GIBD) for connection of GIS to GTs, shunt reactors, switchable line reactor and transmission lines, local control cabinets (LCC), 400kV SF6 to air bushings for connecting GIBD to outdoor switchyard, SF6 gas for 400kV GIS & GIBD, online partial discharge monitoring system, SF6 gas handling plant, SF6 gas leak detection system, GIS support structure, GIBD support structure, complete accessories like cables, GIS earthing, etc. Required for reliable functioning of GIS system. Special tools and tackles, training of owner's engineers at works and site, all tests, FAT, SAT, etc., as per the tender specifications/tender documents. Cost for all tests as brought out in the technical specification are included in this item. **400kV GIS & GIBD as mentioned (please refer Technical Specification for 400kV Gas Insulated Switchgear and Gas Insulated Bus Duct. , I02.0.0.KK56.ET.TS.PR051)** **Note: Successful bidder can propose BBU amendment, if required, indicating the items qty., based on detailed Engineering.**		-	-	
1.1	400kV GIS and GIBD:- Line Feeder Bay	400kV, 63kA GIS Line feeder bays in complete sets (for all three phases) in all respects, as per technical specifications, tender SLDs. Line feeder Bay shall consist of the following: Circuit Breaker with CSD(Control Switching Device) - 1 no. Disconnector (including Line Disconnector) - 3 nos. Earthing Switch - 3 nos. High speed Earthing switch - 1 no. Current Transformer (5 core) - 2 nos. Voltage Transformer- 1 no. LCC including BCU, control cables between LCC and GIS equipment. Partial Discharge sensors, Densimeters, as per OEM type tested design . Hardwares (nuts, bolts, washers) Bus bar modules for the bay		Nos	7	
1.2	400kV GIS and GIBD:- Line Reactor Bay	400kV, 63kA GIS Line Reactor feeder bays in complete sets (for all three phases) in all respects, as per technical specifications, tender SLDs. Line Reactor feeder Bay shall consist of the following: Circuit Breaker with CSD - 1 no. Disconnector - 2 nos. Earthing Switch - 3 nos. Gas Insulated Surge arrestor (R,Y,B) - 1 no LCC including BCU, control cables between LCC and GIS equipment. Partial Discharge sensors, Densimeters, as per OEM type tested design. Hardwares (nuts, bolts, washers) Bus bar modules for the bay		Nos	4	
1.3	400kV GIS and GIBD:- Shunt Reactor Bay	400kV, 63kA GIS Shunt Reactor feeder bays in complete sets (for all three phases) in all respects, as per technical specifications, tender SLDs. Shunt Reactor feeder Bay shall consist of the following: Circuit Breaker with CSD - 1 no. Disconnector - 3 nos. Earthing Switch - 4 nos. Current Transformer (5 core) - 1 nos. Gas Insulated Surge arrestor (R,Y,B) - 1 no LCC including BCU, control cables between LCC and GIS equipment. Partial Discharge sensors, Densimeters, as per OEM type tested design. Hardwares (nuts, bolts, washers) Bus bar modules for the bay Hardwares (nuts, bolts, washers)		Nos	3	

ANNEXURE: BOQ_400kV GIS_NPCIL KKNPP-5&6						
REVISION NO.:	REV00					
DATE:	22.04.2026					
Sl. NO.	**ITEM SHORT DESCRIPTION**	**ITEM DESCRIPTION**	**HSN**	**UNIT OF MEASUREMENT (UOM)**	**QUANTITY**	**REMARKS**
1.4	400kV GIS and GIBD:- Tie Bay	400kV, 63kA GIS Tie feeder bays in complete sets (for all three phases) in all respects, as per technical specifications, tender SLDs. Tie Bay shall consist of the following: Circuit Breaker with CSD - 1 no. Disconnector - 2 nos. Earthing Switch - 2 nos. Current Transformer (5 core) - 1 nos. LCC including BCU, control cables between LCC and GIS equipment. Partial Discharge sensors, Densimeters, as per OEM type tested design Bus bar modules for the bay Hardwares (nuts, bolts, washers)		Nos	6	
1.5	400kV GIS and GIBD:- GT feeder Bay	400kV, 63kA GIS Generator Transformer feeder bays in complete sets (for all three phases) in all respects, as per technical specifications, tender SLDs. GT feeder Bay shall consist of the following: Circuit Breaker with CSD - 1 no. Disconnector - 3 nos. Earthing Switch - 4 nos. Current Transformer (5 core) - 1 nos. Current Transformer for SEM -1 no. Voltage Transformer- 1 no. Gas Insulated Surge arrestor (R,Y,B) - 2 no LCC including BCU, control cables between LCC and GIS equipment. Bus bar modules for the bay Hardwares (nuts, bolts, washers)		Nos	2	
1.6	400kV GIS and GIBD:- Bus VT	400kV Bus VT along with 1 no. of Disconnector and 2 nos. of Earthing Switch in complete sets (for all three phases) in all respects, as per technical specifications, tender SLDs, . This shall be inclusive of PD sensors, Densimeters.		Nos	2	
1.7	400kV GIS and GIBD:- Bus Bar Extension	400kV, 63kA, 5000 A GIS Bus bar extension in complete sets (for all three phases) in all respects, as per technical specifications, tender SLDs, Eqpt Layouts, tender drawings. The Bus bar extensions will be used to connect the busbar modules of the individual dia. The same shall be inclusive of PD sensors, Densimeters, all the required Hardwares (nuts, bolts, washers)		M	85	
1.8	400kV GIS and GIBD:- Gas Insulated Bus Duct	400kV, 63kA, 2000A Gas Insulated Bus Duct inclusive of PD sensors, Densimeters (All the bends, bellows etc required for routing shall be inclusive). *It includes the arrangement of coupling with SF6 to Oil Bushing with Transformers.*		M	5500	
1.9	400kV GIS and GIBD:- SF6-AIR bushing	400kV SF6 to air bushings: 400kV SF6 to air bushings for connecting GIBD to 400kV Outdoor switchyard lines as per tender SLD, Eqpt Layout, PD sensors as required, complete in all respects along with all required accesssories hardwares as per Eqpt Layout complete in all respects.		Nos	21	
1.10	400kV GIS and GIBD:- Structural steel supports	Design and supply of Hot dip galvanised (120 micron coating thickness for elements with thickness equal to or greater than 5 mm. 85 micron coating thickness for elements with thickness less than 5 mm) steel structures for GIS/GIBD supports, platforms (as required) inclusive of all required hardwares (nuts, bolts, washers)		MT	125	
1.11	Online PD monitoring for 400kV GIS:	Online PD monitoring for 400kV GIS: Design, detailed engineering, preparation of drawings, procurement, fabrication, manufacture, inspection, testing, packing, forwarding, safe delivery to site and guarantee of Online PD monitoring system for 400kV gas insulated switchgear (GIS) system including Gas insulated bus ducts from 400kV GIS bays to Generator Transformers of KKNPP 5&6. The supply of PD sensors (as required) is included along with 400kV GIS and GIBD.		Set	1	
1.12	400kV GIS and GIBD:- SF6 Gas handling cart	SF6 Gas handling cart as per tender specification		Set	1	
1.13	400kV GIS and GIBD:- SF6 Gas	SF6 Gas as per IEC 60376 for GIS/GIBD		Kg	700	
1.14	400kV & 230kV GIS and GIBD:- SF6 Leak detection	Supply and installation of SF6 Leak detection system for 400kV and 230kV GIS/GIBD - SF6 detection monitor along with sampling box, connecting hose, clamps and accessories for fixing, and all required hardwares (nuts, bolts, washers)		Nos	10	
2	**SUPPLY- SPARES- GIS : 400KV, 63KA FOR 1S, GAS INSULATED SWITCHGEAR (GIS) AS PER TS**					
2.1	400kV GIS and GIBD-General	SF6 gas Pressure Relief Devices (3 nos. of each type)		Lot	1	
2.2	400kV GIS and GIBD-General	SF6 Pressure gauge with coupling device cum switch or density monitors and pressure switch as applicable (temperature compensated density monitors) (10% of each type/ range used in the GIS/ GIBD system)		Lot	1	

ANNEXURE: BOQ_400kV GIS_NPCIL KKNPP-5&6						
REVISION NO.:		REV00				
DATE:		22.04.2026				
SI. NO.	ITEM SHORT DESCRIPTION	ITEM DESCRIPTION	HSN	UNIT OF MEASUREMENT (UOM)	QUANTITY	REMARKS
2.3	400kV GIS and GIBD-General	Coupling device for pressure gauge cum switch for connecting Gas handling plant/ SF6 Service cart (Mega series of DILO make) (3 sets of each type)		Lot	1	
2.4	400kV GIS and GIBD-General	Regulating valves with corresponding hoses and couplings required for the SF6 gas filling directly from the SF6 gas cylinder or through SF6 service cart (3 sets of each type)		Lot	1	
2.5	400kV GIS and GIBD-General	Rubber Gaskets, “O” Rings and Seals for SF6 gas (10% of each type & size)		Lot	1	
2.6	400kV GIS and GIBD-General	Molecular filter for SF6 gas with filter bags (25% of total weight)		Lot	1	
2.7	400kV GIS and GIBD-General	All types of Control Valves for SF6 gas (2 of each type)		Lot	1	
2.8	400kV GIS and GIBD-General	SF6 gas with required properties/ parameters with test certificates over and above the SF6 gas filled inside the GIS/ GIBD equipment till the handing over of the equipment (all the SF6 gas required during the erection, testing & commissioning, till the handing over, is in the scope of GIS supplier) (10% of total gas along with gas cylinder)		Lot	1	
2.9	400kV GIS and GIBD-General	All types of coupling for SF6 gas		Set	3	
2.10	400kV GIS and GIBD-General	Required hoses for SF6 gas filling with length sufficient enough to reach each and every section of GIS/ GIBD from the possible location of SF6 gas service cart		Set	2	
2.11	400kV GIS and GIBD-General	Equalizing hose/ pipe for SF6 GIS/ GIBD section with required couplings (as applicable) (5 sets of each type and size)		Lot	1	
2.12	400kV GIS and GIBD-General	Calibrated pressure gauges All sections shall be fitted with temperature compensated density monitors for measuring SF6 pressure, but during erection, at least 6 nos. of calibrated pressure gauges (of each type and size) shall also be supplied for accurate measurement of pressure during the erection and testing (6 nos. of each type/ range)		Lot	1	
2.13	400kV GIS and GIBD-General	Covers with all accessories necessary to close a compartment in case of dismantling of any part of the enclosure to ensure the sealing of this compartment (3 Nos. of each type)		Lot	1	
2.13.1	400kV GIS and GIBD-General	Covers with all accessories necessary to close a compartment in case of dismantling of any part of the enclosure to ensure the sealing of this compartment -For 1-phase enclosure (as applicable)		Set	3	
2.14	400kV GIS and GIBD-General	Bus support insulator of each type for single phase enclosure (10% of each type and size, closed or open)		Lot	1	
2.15	400kV GIS and GIBD-General	Spares for Local control cabinet including MCB, fuses, timers, aux. relay of each type & rating and terminal of each type (5% of each and every component used in the LCP)		Lot	1	
2.16	400kV GIS and GIBD-General	Components of SF6 Gas Service Cart (DILO make, mega series) One set of all the components used in SF6 gas service cart shall be supplied as spare such as Vaccum pump oil, flange coupling, spare filter cartridge, valve, Gauge, relay, motor circuits, etc. (1 set of each type)		Lot	1	
2.17	400kV GIS and GIBD-General	Special gas mask for gas handling		Nos	4	
2.18	400kV GIS and GIBD-General	Pocket wrench set and torque wrench set		Nos	1	
2.19	400kV GIS and GIBD-General	One-ton manual hoist		Nos	1	
2.20	400kV GIS and GIBD-General	SF6 leak detector		Nos	2	

ANNEXURE: BOQ_400kV GIS_NPCIL KKNPP-5&6						
REVISION NO.:	REV00					
DATE:	22.04.2026					
SI. NO.	ITEM SHORT DESCRIPTION	ITEM DESCRIPTION	HSN	UNIT OF MEASUREMENT (UOM)	QUANTITY	REMARKS
2.21	400kV GIS and GIBD-General	Dew point tester		Nos	2	
2.22	400kV GIS and GIBD-General	Digital manometer		Nos	2	
2.23	400kV GIS and GIBD-General	Calibrated master Vacuum gauge		Nos	2	
2.24	400kV GIS and GIBD-General	2000V Insulation tester		Nos	1	
2.25	400kV GIS and GIBD-General	Ferrules, joints and couplings (5% of total qty)		Lot	1	
2.26	400kV GIS and GIBD-General	Anchor fasteners, if applicable for installation (2% of total qty)		Lot	1	
2.27	400kV GIS and GIBD-General	Silicon grease for cleaning contact assemblies		kg	2	
2.28	400kV GIS and GIBD-General	Silicon lubricant for cleaning contact assemblies		kg	2	
2.29	400kV GIS and GIBD-General	Any other lubricant & grease required for installation/ operation		kg	1	
2.30	400kV GIS and GIBD-General	Paint for touch up of the GIS/ GIBD		kg	10	
2.31	400kV GIS and GIBD-General	Complete Circuit Breaker pole of each type & rating complete with interrupter, main circuit, enclosure and Marshalling Box with operating mechanism		Set	1	
2.32	400kV GIS and GIBD-General	Fixed, moving and arcing contacts including insulating nozzles (5% of the total no. of contacts)		Lot	1	
2.33	400kV GIS and GIBD-General	Silver coated contact finger assemblies (5% of the total no. of contacts)		Lot	1	
2.34	400kV GIS and GIBD-General	Trip coil assembly with resistor as applicable (5% of the total qty)		Lot	1	
2.35	400kV GIS and GIBD-General	Closing coil assembly with resistor as applicable (5% of the total qty)		Lot	1	
2.36	400kV GIS and GIBD-General	Aux. switch assembly, Limit switches, Relays, Timers, Terminal blocks used in the CB cubicle (5% of the total qty of each type/ range/ rating)		Lot	1	
2.37	400kV GIS and GIBD-General	Operation Counter (5% of the total qty of each type/ range/ rating)		Lot	1	
2.38	400kV GIS and GIBD-General	Wind scope/Observing window		Set	5	
2.39	400kV GIS and GIBD-General	Corona rings (if applicable) (each type) for bushing (3 Nos. of each type & Size)		Lot	1	
2.40	400kV GIS and GIBD-General	Corona rings for GIS/ GIBD assembly, required during the HV testing, (if applicable) (10 Nos. of each type & size)		Lot	1	
2.41	400kV GIS and GIBD-General	Spring operated closing mechanism, if applicable		Sets	1	
2.42	400kV GIS and GIBD- 400kV Isolators	Complete set of 3 nos. of single-phase disconnector including main circuit, enclosure, driving mechanism (1 set of each type and rating)		Lot	1	
2.43	400kV GIS and GIBD- 400kV Isolators	High speed/Fast acting fault making grounding switch 3 nos. of single phase/1 no. of 3-phase of each voltage rating including main circuit, enclosure and driving mechanism (1 set of each type and rating)		Lot	1	
2.44	400kV GIS and GIBD- 400kV Isolators	Single phase Earthing switch including main circuit, enclosure, driving mechanism (Coupling rod may be supplied as loose item) (1 set of each type and rating)		Lot	1	
2.45	400kV GIS and GIBD- 400kV Isolators	Copper contact fingers for disconnector male & female contact – for one complete (3 phase) disconnector of each type and rating (3 sets of each typeand rating)		Lot	1	
2.46	400kV GIS and GIBD- 400kV Isolators	Copper contact fingers for earthing switch male & female contacts- for one complete (3 phase) earthing switch of each type and rating (3 sets of each type and rating)		Lot	1	

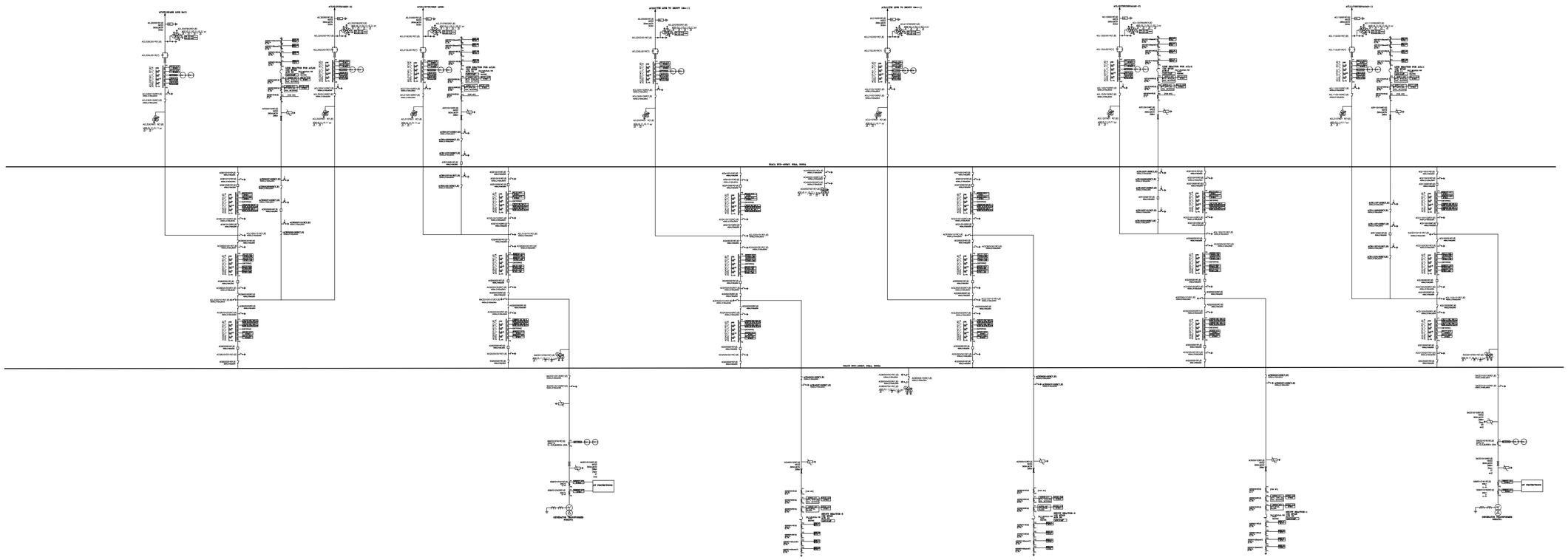
ANNEXURE: BOQ_400kV GIS_NPCIL KKNPP-5&6						
	REVISION NO.:	REV00				
	DATE:	22.04.2026				
SI. NO.	ITEM SHORT DESCRIPTION	ITEM DESCRIPTION	HSN	UNIT OF MEASUREMENT (UOM)	QUANTITY	REMARKS
2.47	400kV GIS and GIBD- 400kV Isolators	Open/ Close contactor assembly, timers, key interlock for one complete (3 phase) dis-connector and (3 phase) earthing switch of each type and rating (3 sets of each type and rating)		Lot	1	
2.48	400kV GIS and GIBD- 400kV Isolators	Push button switch-each type, as applicable (5% of total qty)		Lot	1	
2.49	400kV GIS and GIBD- 400kV Isolators	Limit switches and Aux. Switches for complete 3 phase equipment (5% of total qty)		Lot	1	
2.50	400kV GIS and GIBD- 400kV Isolators	Limit switches and Aux. Switches for complete 3 phase equipmen- For isolator (5% of total qty)		Lot	1	
2.51	400kV GIS and GIBD- 400kV Isolators	Limit switches and Aux. Switches for complete 3 phase equipmen- For earth switch (5% of total qty)		Lot	1	
2.52	400kV GIS and GIBD- 400kV Isolators	Rotor housing bearing assembly for complete 3 phase equipment (5% of total qty)		Lot	1	
2.53	400kV GIS and GIBD- 400kV Isolators	Rotor housing bearing assembly for complete 3 phase equipment -For isolator (5% of total qty)		Lot	1	
2.54	400kV GIS and GIBD- 400kV Isolators	Rotor housing bearing assembly for complete 3 phase equipment- For earth switch (5% of total qty)		Lot	1	
2.55	400kV GIS and GIBD- 400kV Isolators	Motor with gear assembly for complete 3 phase equipment (1 set for all 3 phases)		Lot	1	
2.56	400kV GIS and GIBD- 400kV Isolators	Motor with gear assembly for complete 3 phase equipment -For isolator (1 set for all 3 phases)		Lot	1	
2.57	400kV GIS and GIBD- 400kV Isolators	Motor with gear assembly for complete 3 phase equipment- For earth switch (1 set for all 3 phases)		Lot	1	
2.58	400kV GIS and GIBD- 400kV Isolators	Corona shield rings (as applicable)		Sets	3	
2.59	400kV GIS and GIBD- 400kV Isolators	Hinge pins for complete 3 phase equipment (as applicable) (5% of total qty)		Lot	1	
2.60	400kV GIS and GIBD- 400kV Isolators	Hinge pins for complete 3 phase equipment- (as applicable)- For isolator (5% of total qty)		Lot	1	
2.61	400kV GIS and GIBD- 400kV Isolators	Hinge pins for complete 3 phase equipment (as applicable)- For earth switch (5% of total qty)		Lot	1	
2.62	400kV GIS and GIBD- 400kV Isolators	Interlocking coil with resistors, timers, key interlock for complete 3 phase equipment (each type and rating)		Sets	3	
2.63	400kV GIS and GIBD- 400kV Isolators	Relays, Power contactors, resistors, fuses, push buttons, timers & MCBs (complete for one 3 phase equipment)		Sets	3	
2.64	400kV GIS and GIBD- 400kV Isolators	Relays, Power contactors, resistors, fuses, push buttons, timers & MCBs (complete for one 3 phase equipment)- For isolator		Sets	3	
2.65	400kV GIS and GIBD- 400kV Isolators	Relays, Power contactors, resistors, fuses, push buttons, timers & MCBs (complete for one 3 phase equipment)- For earth switch		Sets	3	
2.66	400kV GIS and GIBD- 400kV Isolators	Aux. switch assembly (complete) with 10 NO & 10 NC or more contacts for both isolator & earth switch		Sets	3	
2.67	400kV GIS and GIBD- 400kV Current Transformer	Gas Insulated Complete CT of each type and rating with enclosure (One Type consists of one single phase CT with enclosure) (2 sets of each type/ rating		Lot	1	
2.68	400kV GIS and GIBD- 400kV Current Transformer	Secondary bushing of each type (2 sets of each type/ rating)		Lot	1	
2.69	400kV GIS and GIBD- 400kV Voltage Transformer	Gas Insulated Complete PT of each type and rating with enclosure (One Type consists of one single phase VT with enclosure) (1 set of each type/ rating)		Lot	1	
2.70	400kV GIS and GIBD- Surge Arrestor	Surge arrestor complete with insulating base and terminal connectors (One Type consists of one single phase SA with enclosure)		Nos	1	
2.71	400kV GIS and GIBD- Surge Arrestor	Surge monitor/ counter		Nos	1	
3	**SUPPLY- SPARES-GIS : REFERENCE UNIT PRICE FOR ADDITION / DELETION OF SUPPLY ITEMS** (Unit Prices of Individual Equipment included here or in manadatory spares are required for any Addition/Deletion of Equipment and replacement of damaged items. Bidder to ensure that the unit prices have a logical relationship with prices of assemblies in main items. Quoting for unit prices is mandatory and shall be considered for evaluation)					

ANNEXURE: BOQ_400kV GIS_NPCIL KKNPP-5&6						
REVISION NO.:	REV00					
DATE:	22.04.2026					
SI. NO.	ITEM SHORT DESCRIPTION	ITEM DESCRIPTION	HSN	UNIT OF MEASUREMENT (UOM)	QUANTITY	REMARKS
3.1	400kV GIS and GIBD	GIS metallic enclosure		Kg	50	
3.2	400kV GIS and GIBD	Expansion Bellows/ Joints		Sets	1	
3.3	400kV GIS and GIBD	Tee Bends		Sets	1	
3.4	400kV GIS and GIBD	L Bends		Sets	1	
3.5	400kV GIS and GIBD	Single Phase GIB Ducts		M	1	
3.6	400kV GIS and GIBD	Surge arrestor		Sets	1	
4	**SERVICES- GIS : 400KV, 63KA FOR IS, GAS INSULATED SWITCHGEAR (GIS) AS PER TS**					
4.1	400kV GIS and GIBD	Supervision of erection of GIS		Bays	22	Supervision of erection of GIS with main bus & auxiliary bus, complete as per TS in all respect including LCC, its accessories and CSD (if applicable). It also includes verification of materials for proper storage at site for final storage. Earthing, SF6 Gas Fiiling works, Internal Cabling from GIS to LCC, interfacing of CSD (if applicable) with GIS/ CRP, including Structure Works are covered under this item. GIS Bus Duct & SF6 to Air Bushing (SAB) are not covered in this BOQ item.
4.2	400kV GIS and GIBD	Supervision of erection of Gas Insulated Bus Duct		M	5500	Supervision of erection of GIB complete as per TS in all respect. GIB outside the GIS Hall wall shall be considered for mode of measurement. Earthing, SF6 Gas Fiiling works, Internal Cabling from GIS to LCC, including Structure Works are covered under this item. Inner side GIB / Aux Bus Module etc are to be considered as part of respective GIS Assembly and cost of the same shall be deemed inclusive.
4.3	400kV GIS and GIBD	Supervision of erection of SF6 to Gas Bushing		Sets	21	Earthing, SF6 Gas Fiiling works, Internal Cabling from GIS to LCC, including Structure Works are covered under this item.
4.4	400kV GIS and GIBD	Testing & commissioning of GIS		Bays	22	Testing and commissioning of complete GIS system including main bus, LCC and associated system is to be executed by bidder. All the special testing instruments, kits, T&P etc. are to be arranged by bidder on returnable basis. Please refer relevant section of technical specification for details.
4.5	400kV GIS and GIBD	Testing & commissioning of Gas Insulated Bus Duct		M	5500	GIB outside the GIS Hall wall shall be considered for mode of measurement. Inner side GIB / Aux Bus Module e.t.c. are to be considered as part of respective GIS Assembly and cost of the same shall be deemed inclusive. All the special testing instruments, kits, T&P etc. are to be arranged by bidder on returnable basis. Please refer relevant section of technical specification for details.
4.6	400kV GIS and GIBD	Testing & commissioning of SF6 to Gas Bushing		Sets	32	
4.7	400kV GIS and GIBD	Final successful HV/ Power Frequency Testing of GIS including arrangement of HV test Kit along with Operator		Bays	22	Carrying out successful HV/ Power Frequency Testing of GIS as per IEC including Arrangement of HV Test kit with operator (on returnable basis) shall be in scope of bidder, which includes charges of HV test kit with operator, accessories & tools required for completion of HV testing. The quoted price shall include GIS bays including Main Bus, GIB & SAB and other common items as per TS complete in all respect. In this BOQ item, mobilization and demobilization for HV test kit is considered for once. In case of more, for reasons not attributable to bidder, same shall be paid extra as per BOQ Item.
4.8	400kV GIS and GIBD	Insulation Co-ordination Sudies for GIS system		Lot	1	1 Lot means Complete study report as per technical specification, Including VFTO report.

ANNEXURE: BOQ_400kV GIS_NPCIL KKNPP-5&6						
REVISION NO.:	REV00					
DATE:	22.04.2026					
Sl. NO.	**ITEM SHORT DESCRIPTION**	**ITEM DESCRIPTION**	**HSN**	**UNIT OF MEASUREMENT (UOM)**	**QUANTITY**	**REMARKS**
4.9	400kV GIS and GIBD	Training for GIS at Project Site		Mandays	2	Refer the specific clause of technical specification for scope and curriculum of training.
4.10	400kV GIS and GIBD	Training for GIS at Manufacturer Works		Mandays	2	Refer the specific clause of technical specification for scope and curriculum of training. Lodging & boarding of participants are not in bidder's scope.
5	**SERVICES- GIS : REFERENCE UNIT PRICE FOR ADDITION / DELETION OF SERVICE ITEMS:** (Unit Prices of Individual service items included here are required for any Addition/ Deletion of Equipment & Replacement of damaged items. Vendor to ensure that the unit prices have a logical relationship with prices of assemblies in main items. Quoting for unit prices is mandatory & shall be considered for evaluation)					
5.1	400kV GIS and GIBD	Services for supervision of erection of GIS		Mandays	10	Charges for repetition of services - (if required due to reasons not attributed to the bidder) This item will be executed only if repetition of services is required by BHEL.
5.2	400kV GIS and GIBD	Services for testing & commissioning of GIS		Mandays	10	Charges for repetition of services - (if required due to reasons not attributed to the bidder) This item will be executed only if repetition of services is required by BHEL.
5.4	400kV GIS and GIBD	Demobilization and remobilization charges for GIS Erection Supervision Team		Sets	2	This BOQ Item shall be executed If required for reasons not attributable to bidder.
5.5	400kV GIS and GIBD	Demobilization and remobilization charges For GIS Testing & Commissioning Team		Sets	2	This BOQ Item shall be payable if required for reasons not attribute to bidder. HV testing is not part of this item.
5.6	400kV GIS and GIBD	Demobilization and Remobilization charges of HV Test Kit along with Operator		Lot	1	In this BOQ item, mobilization and demobilization chages for HV test kit is considered for second time or more , for reasons not attributable to bidder. HV testing charges shall be paid per bay basis as per main HV testing charge.

Section 1.3_Annexure 3_SLD for 400kV system

SINGLE LINE DIAGRAM FOR 400kV SYSTEM- I02.KK56.0.0.ET.OKP.WD004



LEGEND:–

- EARTH SWITCH
- HIGH SPEED EARTH SWITCH
- RESISTOR
- LIGHTNING ARRESTOR
- THREE WINDING TRANSFORMER WITH DELTA TERTIARY
- CURRENT TRANSFORMER
- WAVE TRAP
- CIRCUIT BREAKER
- ISOLATOR
- CAPACITIVE VOLTAGE TRANSFORMER
- SURGE ARRESTOR
- GAS INSULATED BUS DUCT
- TRANSFORMER
- BUSHING CT
- EARTH
- SPECIAL ENERGY METER
- NUMERICAL RELAY

ABBREVIATIONS:–

BU	BAY UNIT FOR BUSBAR DIFFERENTIAL PROTECTION
21	DISTANCE PROTECTION
27	UNDER VOLTAGE PROTECTION
50,51	OVER CURRENT PROTECTION
50BF	CIRCUIT BREAKER FAILURE PROTECTION
51N	EARTH FAULT PROTECTION
87B/BB/UBB	DIFFERENTIAL PROTECTION
87N	TRANSFORMER RESTRICTED EARTH FAULT DIFFERENTIAL PROTECTION
87T	TRANSFORMER DIFFERENTIAL PROTECTION
87	LONGITUDINAL REACTOR DIFFERENTIAL PROTECTION
EFP	END FAULT PROTECTION

NOTES:

1. RATINGS,QUANTITIES AS SPECIFIED ARE INDICATIVE AND MINIMUM.
2. OLTC & METERS SHALL BE SUITABLE FOR BIDIRECTIONAL POWER FLOW.
3. VOLTAGE SHOWN ON THIS KEY SLD ARE UTILISATION VOLTAGE,TRAFO VOLTAGE RATIOS ARE AT NO LOAD.
4. TRANSFORMER AND SHUNT REACTOR PRIMARY SIDE CTs ARE BUSHING CTs.
5. THE VOLTAGE CLASS OF ALL 400kV EQUIPMENT SHALL BE 420kV.
6. Breaker and a half scheme is envisaged for 400kV system as shown in this SLD for 400kV systems, centralised bus bar protection will also be acceptable. The same can be worked out during detailed design stage and decision of NPCIL on the selected bus bar scheme will be final. In any case, the bus bar protection scheme shall have provision for future expansion.
7. This SLD indicates only indicative requirements on protections. TS of numerical relay and CMRP systems may be referred for detailed protection and their schemes.
8. The requirements of current transformers and potential transformers for the selected numerical relays shall be provided by relay vendor for furtherance by equipment vendor/manufacturer e.g. 400kV vendor, 230kV vendor, 6kV vendor etc. Accordingly, equipment manufacturer and contractor shall submit design calculations for current transformers and potential transformers taking into the feedback from the relay vendor.
9. KKNPP 3&4 and relays and protection panels is implemented through KKNPP 3&4 project. Considering short length of line between KKNPP 5&6 and KKNPP 3&4, contractor need to carry all coordination and matching related works including protection interface coordination and adopt protection equipment and scheme accordingly.
10. 87T Shall be provided for bus/line reactor incase of split windings

THIS DESIGN AND DRAWING IS THE PROPERTY OF THE NUCLEAR POWER CORPORATION OF INDIA LTD, IT MUST NOT BE REPRODUCED, WITH-OUT OUR WRITTEN CONSENT AND MUST NOT BE USED FOR ANY EQUIPMENT AND MUST NOT BE USED EXCEPT AS PERMISSION OF THE OWNER

ISSUE No.	REV. No.	DESCRIPTION	DATE	APP'D.	ISSUE SHT. No.
1	0	ISSUED FOR TENDER			

DRAWING ISSUED FOR

NUCLEAR POWER CORPORATION OF INDIA LIMITED

(A GOVERNMENT OF INDIA ENTERPRISE)

TITLE :–

SINGLE LINE DIAGRAM OF 400kV SYSTEM

DES'D. DATE	DR'N. DATE	REV'D. DATE
DES. CHK'D. DATE	DRG. CHK'D. DATE	APP'D. DATE
PROJECT KUNDANKULAM NUCLEAR POWER PROJECT-5&6		SCALE :–
		PROJECTION

DRG. No. I02.KK56.0.0.ET.OKP.WD004 REV. No. 0

FLOPPY/CD No.

DRG. TO BE READ IN CONJUNCTION WITH DCN/FCN/ECN, IF ANY.

DO NOT SCALE THE DRAWING.

UNLESS OTHERWISE STATED :–
ALL DIMENSIONS ARE IN mm.
MACHINE ALL OVER.
SURFACE FINISH TO BE 3.2 OR BETTER.
REMOVE ALL BURRS.
REMOVE ALL EXTERNAL SHARP CORNERS
AND EDGES BY CHAMFERING TO 0 : 15 X 45°.
0 : 40
ROUND ALL INTERNAL CORNERS AND EDGES TO R 0 : 15 0 : 40.
TOLERANCES ON RADII AND CHAMFERS (IS : 2102)

RADII AND CHAMFERS	0.5–3	3–6	6–30
TOLERANCES	± 0.2	± 0.5	± 1.0

TOLERANCES ON LINEAR DIMENSIONS (IS:2102)

DIMENSIONS	TOL.	DIMENSIONS	TOL.
UPTO 6	± 0.1	315 – 1000	± 0.8
6 – 30	± 0.2	1000 – 2000	± 1.2
30 – 120	± 0.3	2000 – 4000	± 2.0
120 – 315	± 0.5	4000 – 8000	± 3.0

TOLERANCES ON LINEAR DIMENSIONS

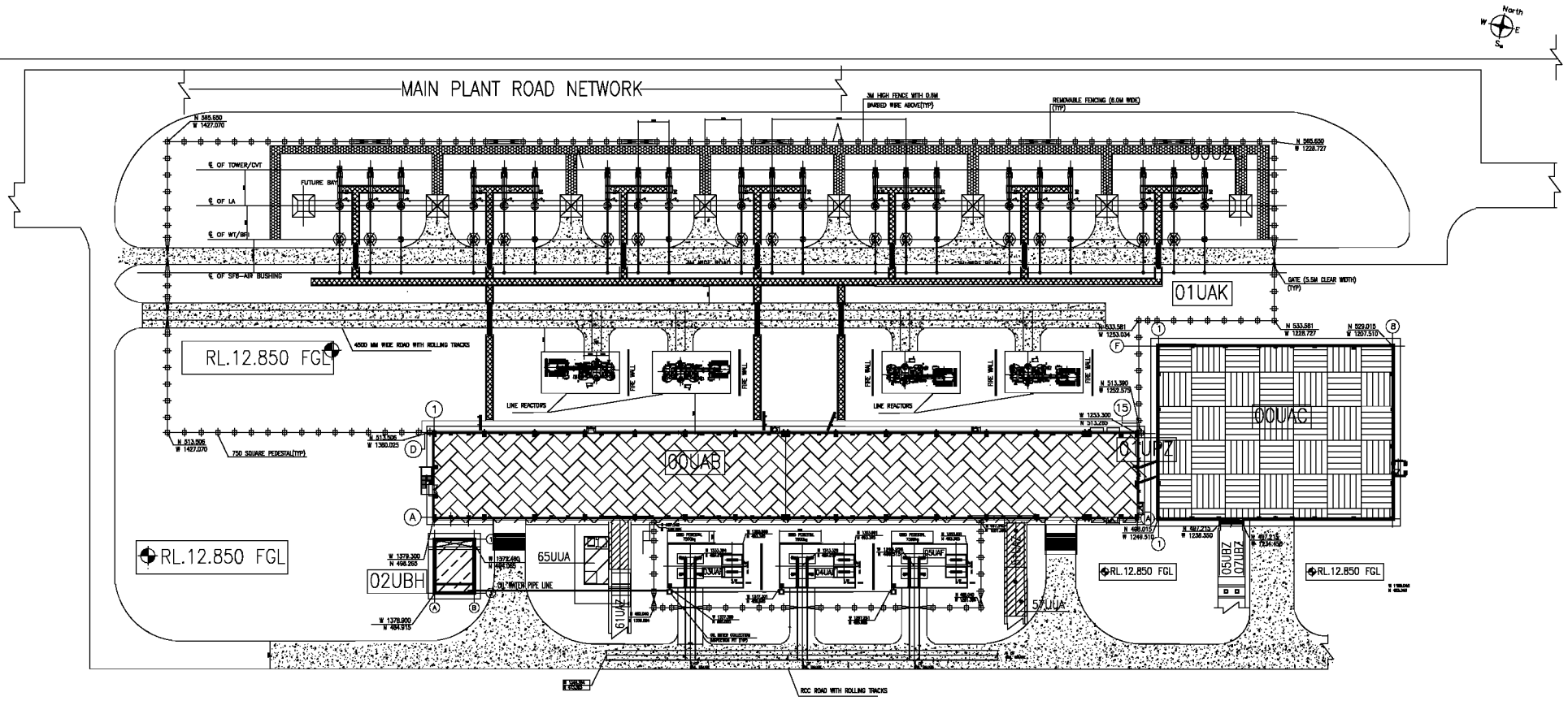
SPECIFIED DIMENSIONS	TOLERANCE
XX	± 0.40
XX.X	± 0.40
XX.XX	± 0.25

TOLERANCES ON ANGULAR DIMENSIONS : ± 0° – 30'

No.	LOCATION	DESCRIPTION	DR'N.	DES'D.	D.CHK'D.	REV'D.	APP'D.
REVISIONS			SIGNATURE WITH DATE				

REFERENCE DRAWINGS	DRAWING No.	REFERENCE DRAWINGS	DRAWING No.

A0



400kV OUTDOOR SWITCHYARD - PLAN

NOTES:

1. ALL DIMENSIONS ARE MENTIONED IN MM UNLESS MENTIONED OTHERWISE.
2. THE SWITCHYARD LAYOUT IS TENTATIVE. LOCATION OF LINE REACTORS, ROADS ETC MAY UNDERGO MINOR CHANGES DURING DETAILING.
3. OIL DISCHARGE SYSTEMS FOR LINE REACTORS IS NOT SHOWN IN THE DRAWING. THE SAME WILL BE FINALISED DURING DETAILING. THE OIL DISCHARGE OF LINE REACTORS IS ENVISAGED TO BE CONNECTED TO 02 UBH TANK.
4. CONSTRUCTION OF STRUCTURES INSIDE THE FENCING (TOWARDS NORTH OF UAB)IS UNDER THE SCOPE OF THIS CONTRACT.

RCC ROAD

PCC PAVING

CABLE TRENCH

ISSUE No.	REV. No.	DESCRIPTION	DATE	APP'D.	ISSUE SHT. No.
1	0	ISSUED FOR TENDER			

DRAWING ISSUED FOR

NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

TITLE :- LAYOUT OF 400kV OUTDOOR SWITCHYARD

PROJECT : KKNPP 5&6

SCALE – 1:1

PROJECTION

DRG. No. 102.KK56.01UAK.0.ET.OK.W0001

REV. No.

A0

REFERENCE DRAWINGS | DRAWING No. | REFERENCE DRAWINGS | DRAWING No.

DO NOT SCALE THE DRAWING.

UNLESS OTHERWISE STATED :-
ALL DIMENSIONS ARE IN mm.
MACHINE ALL OVER.
SURFACE ITEMS TO BE ▽ OR BETTER.
REMOVE ALL BURRS.
REMOVE ALL EXTERNAL SHARP CORNERS AND EDGES BY CHAMFERING TO 0 - 12 x 45°.
ROUND ALL INTERNAL CORNERS AND EDGES TO R 0 - 12 MAX.
TOLERANCES ON RADII AND CHAMFERS (IS : 2102)

RADII AND CHAMFERS	0.5-3	3-6	6-30
TOLERANCES	± 0.2	± 0.3	± 1.0

TOLERANCES ON LINEAR DIMENSIONS (IS-2102)

DIMENSIONS	TOL.	DIMENSIONS	TOL.
UPTO 6	± 0.1	315 – 1000	± 0.8
6 – 30	± 0.2	1000 – 2000	± 1.2
30 – 120	± 0.3	2000 – 4000	± 2.0
120 – 315	± 0.5	4000 – 8000	± 3.0

TOLERANCES ON UNSPECIFIED DIMENSIONS

UNSPECIFIED DIMENSIONS	TOLERANCE
30	± 0.40
30.0	± 0.40
30.00	± 0.40

TOLERANCES ON ANGULAR DIMENSIONS : ± 0° – 30'

DRG. TO BE READ IN CONJUNCTION WITH 102/KK/56/0, 0° ARR.

FLOPPY/CD No.

NUCLEAR POWER CORPORATION OF INDIA LTD.	
VENDOR DATA REQUIREMENTS OF ELECTRICAL EQUIPMENT, KKNPP-5&6	**PAGE NO**: **Page 6 of 10** **REV NO** : **R1**

1.0 SCOPE:

This Specification covers Vendor Data requirements of Electrical systems for subject package of KKNPP 5&6.

VDR provides minimum list of documents to be submitted. Review/ information category documents listed shall be taken as guidance. However, approved Document Control Index (DCI), including all required deliverables for completion of Bidder's scope of work, shall be governing.

The documents required as per the table below is in addition to the vendor documentation requirements given in the system/equipment technical specification.

2.0 VENDOR DATA REQUIREMENTS:

S. No.	**DESCRIPTION**	Documents to be submitted With Bid	Documents to be submitted After Placement of order		Final Documents required after Completion / Dispatch of Equipment
			Review	**Information**	**Record**
1.0	DCI (Document Control Index)- Master list of documents with schedule of submission.	-	✓	-	✓
2.0	Deviation/Exception List	✓	-	-	-
3.0	Preliminary Datasheet indicating parameters for all major electrical equipment's	✓	-	-	-
4.0	**Design**				
4.1	Procedure for design and procurement	-	✓	-	✓
4.2	Hazardous area classification drawings	-	✓	-	✓
4.3	Single Line Diagrams (up to LV switchgear level)	-	✓	-	✓
4.4	Single Line Diagrams (below LV switchgear level)	-	✓	-	✓
5.0	**Design Calculations**				✓

This document is an intellectual property of Nuclear Power Corporation of India

S. No.	**DESCRIPTION**	Documents to be submitted With Bid	Documents to be submitted After Placement of order		Final Documents required after Completion / Dispatch of Equipment
			Review	**Information**	**Record**
5.1	Relevant System Study Report using software as specified in respective technical specifications.	-	✓	-	✓
5.2	Design Calculations such as specified in respective technical specifications	-	✓	-	✓
6.0	**Purchase Requisition**				
6.1	Purchase Requisitions for all major equipment (e.g., 400kV GIS, 230kV GIS, CMRPs, SCADA systems, UATs, 6kV IPBDs, 6kV & 415V switchgear, rectifiers, inverters, batteries, PCC/PMCC/MCC/DB, Auxiliary transformer, cables, cable trays, etc.)	-	✓	-	✓
6.2	Purchase Requisitions for other miscellaneous electrical equipment	-	-	✓	✓
7.0	**Layouts**				
7.1	Electrical Equipment layouts taking into account TS requirements	-	✓	-	✓
7.2	Cable tray/trench route layout/ plans taking into account TS requirements	-	✓	-	✓
7.3	Lighting layouts / distribution network taking into account TS requirements	-	✓	-	✓
7.4	Grounding & Lightning protection layouts taking into account TS requirements	-	✓	-	✓
8.0	**MTO**				
8.1	Material take-off/ Bill of Materials for electrical items such as lighting fixtures, cables, grounding material etc.	-	-	✓	✓

This document is an intellectual property of Nuclear Power Corporation of India

S. No.	**DESCRIPTION**	Documents to be submitted With Bid	Documents to be submitted After Placement of order		Final Documents required after Completion / Dispatch of Equipment
			Review	**Information**	**Record**
9.0	**Vendor Drawings**				
9.1	Vendor drawings e.g. GA, SLD, load list, data sheets/GTP, control and protection schematics etc. for major equipment (e.g. 400kV GIS, 230kV GIS, CMRPs, SCADA systems, UATs, 6kV IPBDs, 6kV & 415V switchgear, rectifiers, inverters, batteries, PCC/PMCC/MCC/DB, Auxiliary transformer, cables, cable trays, etc.)	-	✓	-	✓
9.2	Vendor drawings e.g., GA, SLD, load list, data sheets/GTP, control and protection schematics etc. for all other equipment	-	-	✓	✓
9.3	SCADA I/O list with signal type (hardwired/ software) and HI/LO ranges	-	✓	-	✓
10.0	**Miscellaneous / Other documents, reports**				
10.1	Network schedule for design, supply, erection, testing and commissioning etc.	-	✓	-	✓
10.2	Vendor evaluation report of sub-contractors for the agencies not listed in the Tender document	-	✓	-	✓
10.3	DBR and design manual	-	✓	-	✓
10.4	Manufacturer's QAP	-	✓	-	✓
10.5	Cable schedule/ log	-	-	✓	✓
10.6	Interconnection drawings/ terminal list	-	-	✓	✓
10.7	Relay setting & coordination documents	-	✓	-	✓
10.8	Catalogues and brochures for all equipment's	✓	-	✓	✓
10.9	Operation and maintenance manual	-	-	✓	✓
10.10	Type test / special test certificates	-	✓	-	✓
10.11	Routine and Acceptance test reports	-	-	✓	✓

This document is an intellectual property of Nuclear Power Corporation of India

S. No.	**DESCRIPTION**	Documents to be submitted With Bid	Documents to be submitted After Placement of order		Final Documents required after Completion / Dispatch of Equipment
			Review	**Information**	**Record**
10.12	Motor list, Equipment list, Push button list etc.	-	-	✓	✓
10.13	Electrical interface with other contractors / Purchaser's systems/ buildings	-	✓	-	✓
10.14	Assembly/ Mounting/ dimensional drawings for erection works	-	✓	-	✓
10.15	Quality and safety manual	-	✓	-	✓
10.16	Erection procedures/ field quality plans/ Job hazard analysis	-	✓	-	✓
10.17	Testing & Commissioning procedures including Site acceptance procedure and performance guarantee test	-	✓	-	✓
10.18	Erection reports and Commissioning reports	-	✓	-	✓
10.19	Recommended spares list for 5 years of smooth, trouble free operation with unit wise price	✓	✓	-	✓
10.20	Certificates from previous purchasers regarding satisfactory performance	✓	-	✓	✓
10.21	Data on failure of equipment supplied in the past, if any	✓	-	✓	✓
10.22	List of erection & commissioning spares and special tools & tackles	-	✓	-	✓
10.23	All approved Deviations/Concession resolution reports, if any	-	-	-	✓
10.24	As built drawings and documents	-	✓	-	✓
10.25	Construction completion certificate (CCC) and system transfer document (STD)	-	✓	-	✓

This document is an intellectual property of Nuclear Power Corporation of India

Notes: -

✓ : to be submitted

1. Refer to the relevant portion of tender for the number of copies to be submitted and further details

2. All drawings/ documents shall be available/ submitted in English including the copies of international standards referred if any and in case of any other language, the same shall be annotated in English.

3. System/Equipment specific vendor data required is covered in the respective technical specification documents.

This document is an intellectual property of Nuclear Power Corporation of India

1.0 MANDATORY SPARES LIST

Contractor shall provide the following mandatory spares for Electrical equipment:

It must be clearly noted that, the qty. of spares shown here against each item are corresponding to the qty. of spares which needs to be handed over to the Purchaser after the successful commissioning/ handing over of the subject equipment. Any spares getting consumed/ used during the supply, delivery, transportation, erection, installation, testing, pre-commissioning/ commissioning etc. till handing over, shall be replenished by Contractor/ supplier/ manufacturer at no extra cost.

Sl. No.	Item Description	Qty. Required	
A	**400kV & 230kV GIS**	**400kV GIS & GIBD**	**230kV GIS & GIBD**
1.0	**General**		
1.1	SF6 gas Pressure Relief Devices	3 nos. of each type	3 nos. of each type
1.2	SF6 Pressure gauge with coupling device cum switch or density monitors and pressure switch as applicable (temperature compensated density monitors)	10% of each type/ range used in the GIS/ GIBD system	10% of each type/ range used in the GIS/ GIBD system
1.3	Coupling device for pressure gauge cum switch for connecting Gas handling plant/ SF6 Service cart (Mega series of DILO make)	3 sets of each type	3 sets of each type
1.4	Regulating valves with corresponding hoses and couplings required for the SF6 gas filling directly from the SF6 gas cylinder or through SF6 service cart	3 sets of each type	3 sets of each type
1.5	Rubber Gaskets, “O” Rings and Seals for SF6 gas	10% of each type & size	10% of each type & size
1.6	Molecular filter for SF6 gas with filter bags	25% of total weight	25% of total weight
1.7	All types of Control Valves for SF6gas	2 of each type	2 of each type
1.8	SF6 gas with required properties/ parameters with test certificates over and above the SF6 gas filled inside the GIS/ GIBD equipment till the handing over of the equipment (all the SF6 gas required during the erection, testing & commissioning, till the handing over, is in the scope of GIS supplier)	10% of total gas along with gas cylinder	10% of total gas along with gas cylinder
1.9	All types of coupling for SF6 gas	3 sets	3 sets
1.10	Required hoses for SF6 gas filling with length sufficient enough to reach each and every section of GIS/ GIBD from the possible location of SF6 gas service cart	2 sets	2 sets

This document is an intellectual property of Nuclear Power Corporation of India

1.11	Equalizing hose/ pipe for SF6 GIS/ GIBD section with required couplings (as applicable)	5 sets of each type and size	5 sets of each type and size
1.12	Calibrated pressure gauges All sections shall be fitted with temperature compensated density monitors for measuring SF6 pressure, but during erection, at least 6 nos. of calibrated pressure gauges (of each type and size) shall also be supplied for accurate measurement of pressure during the erection and testing.	6 nos. of each type/ range	6 nos. of each type/ range
1.13	Covers with all accessories necessary to close a compartment in case of dismantling of any part of the enclosure to ensure the sealing of this compartment	3 Nos. of each type	3 Nos. of each type
1.13.1	For 1-phase enclosure (as applicable)	3 Sets	3 Sets
1.14	Bus support insulator of each type for single phase enclosure	10% of each type and size, closed or open	10% of each type and size, closed or open
1.15	Spares for Local control cabinet including MCB, fuses, timers, aux. relay of each type & rating and terminal of each type	5% of each and every component used in the LCP	5% of each and every component used in the LCP
1.16	Components of SF6 Gas Service Cart (DILO make, mega series) One set of all the components used in SF6 gas service cart shall be supplied as spare such as Vaccum pump oil, flange coupling, spare filter cartridge, valve, Gauge, relay, motor circuits, etc.	1 set of each type	1 set of each type
1.17	Special gas mask for gas handling	4 nos.	4 nos.
1.18	Pocket wrench set and torque wrench set	1 no.	1 no.
1.19	One-ton manual hoist	1 no.	1 no.
1.20	SF6 leak detector	2 nos.	2 nos.
1.21	Dew point tester	2 nos.	2 nos.
1.22	Digital manometer	2 nos.	2 nos.
1.23	Calibrated master Vacuum gauge	2 nos.	2 nos.
1.24	2000V Insulation tester	1 no.	1 no.
1.25	Ferrules, joints and couplings	5% of total qty	5% of total qty
1.26	Anchor fasteners, if applicable for installation	2% of total qty	2% of total qty
1.27	Silicon grease for cleaning contact assemblies	2 kg	2 kg
1.28	Silicon lubricant for cleaning contact assemblies	2 kg	2 kg
1.29	Any other lubricant & grease required for installation/ operation	1 kg	1 kg
1.30	Paint for touch up of the GIS/ GIBD	10 kg	10 kg

This document is an intellectual property of Nuclear Power Corporation of India

	400kV / 230kV Circuit Breaker	**400kV**	**230kV**
1.31	Complete Circuit Breaker pole of each type & rating complete with interrupter, main circuit, enclosure and Marshalling Box with operating mechanism	1 set	1 set
1.32	Fixed, moving and arcing contacts including insulating nozzles	5% of the total no. of contacts	5% of the total no. of contacts
1.33	Silver coated contact finger assemblies	5% of the total no. of contacts	5% of the total no. of contacts
1.34	Trip coil assembly with resistor as applicable	5% of the total qty	5% of the total qty
1.35	Closing coil assembly with resistor as applicable	5% of the total qty	5% of the total qty
1.36	Aux. switch assembly, Limit switches, Relays, Timers, Terminal blocks used in the CB cubicle	5% of the total qty of each type/ range/ rating	5% of the total qty of each type/ range/ rating
1.37	Operation Counter	5% of the total qty of each type/ range/ rating	5% of the total qty of each type/ range/ rating
1.38	Wind scope/Observing window	5 sets	5 sets
1.39	Corona rings (if applicable) (each type) for bushing	3 Nos. of each type & Size	3 Nos. of each type & Size
1.40	Corona rings for GIS/ GIBD assembly, required during the HV testing, (if applicable)	10 Nos. of each type & size	10 Nos. of each type & size
1.41	Spring operated closing mechanism, if applicable	3 Sets	3 Sets
	400kV/ 230kV Isolators	**400kV**	**230kV**
1.42	Complete set of 3 nos. of single-phase disconnector including main circuit, enclosure, driving mechanism	1 set of each type and rating	1 set of each type and rating
1.43	High speed/Fast acting fault making grounding switch 3 nos. of single phase/1 no. of 3-phase of each voltage rating including main circuit, enclosure and driving mechanism	1 set of each type and rating	1 set of each type and rating
1.44	Single phase Earthing switch including main circuit, enclosure, driving mechanism (Coupling rod may be supplied as loose item)	1 set of each type and rating	1 set of each type and rating
1.45	Copper contact fingers for disconnector male & female contact – for one complete (3 phase) disconnector of each type and rating	3 sets of each type and rating	3 sets of each type and rating
1.46	Copper contact fingers for earthing switch male & female contacts- for one complete (3 phase) earthing switch of each type and rating	3 sets of each type and rating	3 sets of each type and rating
1.47	Open/ Close contactor assembly, timers, key interlock for one complete (3 phase) dis-connector and (3 phase) earthing switch of each type and rating	3 sets of each type and rating	3 sets of each type and rating

This document is an intellectual property of Nuclear Power Corporation of India

1.48	Push button switch-each type, as applicable	5% of total qty	5% of total qty
1.49	Limit switches and Aux. Switches for complete 3 phase equipment	5% of total qty	5% of total qty
1.50	For isolator	5% of total qty	5% of total qty
1.51	For earth switch	5% of total qty	5% of total qty
1.52	Rotor housing bearing assembly for complete 3 phase equipment	5% of total qty	5% of total qty
1.53	For isolator	5% of total qty	5% of total qty
1.54	For earth switch	5% of total qty	5% of total qty
1.55	Motor with gear assembly for complete 3 phase equipment		
1.56	For isolator	1 set for all 3 phases	1 set for all 3 phases
1.57	For earth switch	1 set for all 3 phases	1 set for all 3 phases
1.58	Corona shield rings (as applicable)	3 sets	3 sets
1.59	Hinge pins for complete 3 phase equipment (as applicable)		
1.60	For isolator	5% of total qty	5% of total qty
1.61	For earth switch	5% of total qty	5% of total qty
1.62	Interlocking coil with resistors, timers, key interlock for complete 3 phase equipment (each type and rating)	3 Sets	3 Sets
1.63	Relays, Power contactors, resistors, fuses, push buttons, timers & MCBs (complete for one 3 phase equipment)		
1.64	For isolator	3 Sets	3 Sets
1.65	For earth switch	3 Sets	3 Sets
1.66	Aux. switch assembly (complete) with 10 NO & 10 NC or more contacts for both isolator & earth switch	3 Sets	3 Sets
	400kV/ 230kV Current Transformer	**400kV**	**230kV**
1.67	Gas Insulated Complete CT of each type and rating with enclosure (One Type consists of one single phase CT with enclosure)	2 sets of each type/ rating	2 sets of each type/ rating
1.68	Secondary bushing of each type	2 sets of each type/ rating	2 sets of each type/ rating
	400kV/ 230kV Voltage Transformer	**400kV**	**230kV**
1.69	Gas Insulated Complete PT of each type and rating with enclosure (One Type consists of one single phase VT with enclosure)	1 set of each type/ rating	1 set of each type/ rating
	Surge Arrestor	**400kV**	**230kV**
1.70	Surge arrestor complete with insulating base and terminal connectors (One Type consists of one single phase SA with enclosure)	1 no.	1 no.
1.71	Surge monitor/counter	1 no.	1 no.

This document is an intellectual property of Nuclear Power Corporation of India

TABLE OF CONTENTS

1.0 SCOPE....5
2.0 APPLICABLE CODES AND STANDARDS....11
3.0 SITE CONDITIONS....13
4.0 GENERAL DESCRIPTION, FUNCTION, MATERIALS AND WORKMANSHIP....13
5.0 REQUIREMENTS....22
6.0 INSPECTION, NON-DESTRUCTIVE TESTING, FUNCTIONAL TESTS, ACCEPTANCE CRITERIA AND REPORTS....72
7.0 INDICATIVE QUALITY ASSURANCE PLAN....80
8.0 PACKING & SHIPMENT....80
9.0 WARRANTY/ GUARANTEE REQUIREMENT....82
10.0 LIST OF ATTACHMENTS....82
11.0 LIST OF DOCUMENTS TO BE SEEN ALONG WITH THIS SPECIFICATION....82
12.0 ABBREVIATIONS USED:....83

1.0 SCOPE

1.1 The intent of this specification is to define the requirements for design, engineering, material, construction, manufacture, inspection, shop testing, performance, packing, forwarding, delivery/supply to site, supervision of installation, testing/pre-commissioning and commissioning of 400kV (Nominal system voltage)/420kV (Rated voltage) Gas Insulated Switchgear (GIS) (KKS code ACA & ACB) & Gas insulated Bus duct (GIBD) (KKS code 5ACE01 & 6ACE01-connecting GT and 400kV switchyard) along with its accessories located in 400 kV GIS building 0UAB.

Scope also includes design, engineering, material, construction, manufacture, inspection, shop testing, performance, packing, forwarding, delivery/supply to site, installation, testing/pre-commissioning and commissioning of 400kV tie overhead line connecting 400kV GIS of KKNPP 5&6 to 400kV GIS of KKNPP 3&4 along with supply of tower structures and related interface works, associated systems/accessories.

1.2 The design, material, construction, manufacturing, inspection, testing and performance of the High Voltage Gas Insulated Switchgear, Bus ducts and accessories shall comply with all currently applicable statues, regulations and safety codes of the locality where the equipment will be installed.

1.3 The equipment shall also conform to the latest applicable International standards, some of the applicable standards are given below in Clause 2.

1.4 Switchgear Assembly and Bus Duct :

The switchgear assembly shall essentially consist of the following items, specified in subsequent clauses:

i. Circuit Breakers

ii. Isolators/ Disconnectors

iii. Earthing switches including High speed earthing switches for lines

iv. Voltage Transformers

v. Current transformers

vi. Surge Arrestors

vii. SF_6 to Air Bushing

viii. Local Control Cabinet with Bay Control Unit

ix. Gas Insulated Bus Duct

1.5 It is not the intent to specify completely here in, all the details of design, engineering, construction of the materials to be supplied. However the material shall conform in all respects to high standards of engineering, design, and workmanship and be capable of performing in continuous commercial operation up to the Contractor's guarantees in

This document is an intellectual property of Nuclear Power Corporation of India Limited

a manner acceptable to the Purchaser, who will interpret the meaning of the drawings and specifications and shall be entitled to reject any work of material which is in not full accordance with.

1.6 Supply of 400/420kV Gas Insulated Switchgear System:

1.6.1 420kV Gas Insulated Switchgear shall be of Isolated (Single) Phase Type and shall be provided with all the components required for satisfactory operation of the 'one and half circuit breaker scheme' as indicated in SLD I02.KK56.0.0.ET.OKP.WD004. All the components required for successful commissioning and operation of the GIS systems shall be considered to be designed/ engineered and included in this offer. Equipment thus supplied shall comply with requirements stated in this technical specification, but not limited to the requirements of basic intent of the system to achieve trouble free commissioning and operation of the system.

1.6.2 All the accessories, supporting structures, local control panels (1 no. for each bay), operating mechanism cabinets, power/control/ instrumentation system cabling between various GIS equipment accessories/ auxiliaries/local control panels, etc. to complete the job for 400/420 kV GIS shall be supplied by the Contractor .The accessories to be supplied shall include equipment, piping/ valves/ gauges, auxiliary relays, etc. and cabling for the type operating mechanism offered by the Contractor. 420 kV GIS shall be provided with independent sets of such equipment/ accessories, etc. suitable for satisfactory operation of the system offered.

1.6.3 All spare parts, special tools and tackles required for smooth completion of the works, as specified but not limited to that mentioned in the data sheets and technical specifications are deemed to be a part of the supply, at no extra cost to the Purchaser. Please refer specification no: I02.KK56.0.0.ET.TB.PR002 (Mandatory spares for Electrical Equipment, KKNPP-5&6).

1.6.4 The scope also includes mobilisation/ arrangement of High Voltage Testing equipment with due calibration, necessary test certificates and manufacturer's specialists for carrying out HV test of GIS/ GIBD system at site, complete in all respects for all sections of the GIS/ GIBD, at no extra cost. The Partial discharge test of GIS & GIBD system shall also be carried out at site, as detailed by the manufacturer, at no extra cost. All necessary set up/ instruments/ equipment, etc. required for carrying out the test shall also be arranged by the Contractor.

1.6.5 The scope also includes supervision of installation, testing/ pre-commissioning and commissioning of GIS/ GIBD system including deployment of necessary representatives of equipment supplier/ manufacturer's special tools and tackles required for the erection, testing, pre-commissioning/ commissioning etc. The entire responsibility of coordination with equipment supplier in this regard lies with Contractor only.

1.6.6 The equipment shall be complete with all necessary supports, platforms, ladders, staircases, catwalks, mechanism cabinets and internal cable raceways, etc. The three phases of equipment of each bay shall be arranged side by side in segregated phase blocks. The arrangement of equipment offered must provide adequate access for operation, testing and maintenance and shall be subject to approval of Purchaser. **Two**

This document is an intellectual property of Nuclear Power Corporation of India Limited

sets of mobile maintenance platform of Aluminium material shall also be included in the scope of supply.

1.6.7 The tentative scope of supply includes the following:

- Line bays (7 Nos.) : each bay comprising the following:
  - i. Circuit Breaker
  - ii. Disconnecting switches (Bus Bar and Line Side)
  - iii. Earthing switches
  - iv. High speed earthing switches (at the beginning of the line feeder bay modules)
  - v. Current transformers
  - vi. Voltage transformer (in Line Feeder)
  - vii. Isolated (Single) phase bus duct for line termination from line side isolator and earthing switch flange up to SF_6-Air bushing
  - viii. SF_6-Air bushing.
- Generator Transformer bays (2 Nos.): each bay comprising the following:
  - i. Circuit breaker
  - ii. Disconnecting switches
  - iii. Earthing switches
  - iv. Current transformers
  - v. Isolated (Single) phase bus duct for circuit termination up to bushings of the transformers
  - vi. Surge Arrestors in GIBD at generator transformer end and GIS end
- Shunt reactor feeder (3 Nos.): each feeder comprising of the following:
  - i. Circuit breaker
  - ii. Disconnecting switches (bus bar and shunt reactor side)
  - iii. Earthing switches
  - iv. Current transformers
  - v. Isolated (Single) phase bus duct for circuit termination from flange of earthing switch upto bushings of the transformers.

This document is an intellectual property of Nuclear Power Corporation of India Limited

- Switchable line reactor bays (4 Nos.): each bay comprising the following:

    i. Circuit breaker

    ii. Disconnecting switches

    iii. Earthing switches

    iv. Isolated (Single) phase bus duct for circuit termination up to bushings of the switchable line reactors

    v. Surge Arrestors in GIBD at switchable line reactor end

- Surge Arrestors in GIBD at shunt reactor end

- Two bus bars: the bus comprising of the following:

    i. Two sets of 5000A single phase bus duct with Al bus bars

    ii. Bus voltage transformer

    iii. Disconnecting switch between bus and VT

    iv. Earthing switch between bus and VT

- 400kV overhead line connection from KKNPP 5&6 to KKNPP 3&4: The 400kV Tie line from KKNPP 5&6 to KKNPP 3&4 shall be through overhead line. The details of the same will be decided by the Purchaser based on the site survey to be conducted by the Contractor. Annexure B and I02.KK56.0.0.ET.TS.PR052 shall be referred for further details.

- One and half breaker scheme with 6 nos. of diameters: Each diameter comprising the following:

    i. Two sets of 5000A single phase bus duct with Al bus bars

    ii. 3150A Circuit breaker (3 nos.) - single pole type

        - 3 sets each for all 6 diameters

    iii. Disconnecting switches

        (i) 6 nos. each for all 6 diameters

    iv. Earthing switches

        (i) 6 nos. each for all 6 diameters

    v. Five core current transformers

This document is an intellectual property of Nuclear Power Corporation of India Limited

(i) 3 nos. each for all 6 diameters

vi. Single phase bus duct for circuit termination from one bus upto other bus, as applicable

vii. Switchable line reactor feeder: GIS Components as per SLD I02.KK56.0.0.ET.OKP.WD004

The above quantities shall be based on the single line diagram (SLD I02.KK56.0.0.ET.OKP.WD004) and all the three phases shall be considered. As mentioned previously, the connection between Generator Transformer (GT) and the 400kV switchyard shall be through 400kV gas insulated bus duct which is included in this specification (Annexure A). GIBD tunnel (51(52,53,54)UAZ and 61(62,63,64) UAZ) geometry drawings are included as Annexure D for finalizing the routing layout (Refer list of attachments).

All other items to be supplied under this contract shall be as per IS/IEC/IEEE standards and as directed by NPCIL.

1.6.8 The 400kV GIS of KKNPP 5&6 and KKNPP 3&4 is to be interconnected through overhead lines. All works regarding the same are within the scope of the subject work.

400kV Over Head Lines interconnection between KKNPP 3&4 and KKNPP 5&6 shall comprise Quad Moose ACSR conductor, insulators, transmission towers (lattice), cables, gantry, clamps & connectors and all other supporting equipment/structures, foundation needed to complete the work in all respects under this tender. Necessary accessories, supports structures, interface works, etc. shall form a part of the supply. For the over head line between the 400kV of KKNPP 5&6 and 400kV of KKNPP 3&4, additional requirements are also given in Annexure B of this document and I02.KK56.0.0.ET.TS.PR052.

Scope also includes detailed site survey to fix routing, locations of tower/foundations, clearances, interference with other structures, crossing of 230kV lines, etc. for 400kV interconnection as described in Annexure B and I02.KK56.0.0.ET.TS.PR052 . The interconnection shall comply with seismic requirements as per IS 1893.

1.7 The 400kV GIS and GIBD shall be supplied as per Data Sheet no. I02.KK56.0.0.ET.DS.PR045 and this specification.

1.8 Essential/ Mandatory spares for 400kV GIS & GIBD shall be supplied as per the list attached in the relevant section in the Tender document.

1.9 Seismic analysis and Qualification of 400kV GIS and GIBD – The Contractor/Manufacturer shall carry out the necessary analysis/tests to prove the seismic withstand capability of **400kV GIS and GIBD as per IEEE 693-high design level for GIS.**

This document is an intellectual property of Nuclear Power Corporation of India Limited

1.10 SF6 Gas handling Cart and accessories shall be supplied as per clause 5.22 of this specification.

1.11 Online PD monitoring System. Appropriate number of sensors for online PD monitoring shall be embedded in various sections of the GIS. Details/requirements have been specified in the relevant clause of this document.

1.12 Portable Partial Discharge meter & dew point meter shall also be provided.

1.13 Contractor/ Manufacturer shall submit a list of O&M spares, which they feel are necessary for five years normal operation of the items included, over and above the Essential spares, along with the recommended quantity and unit rate for each.

1.14 Auto-Reclosing (either Single Phase or Three Phase) shall be made available on the lines as specified by NPCIL in due course of work

1.15 Makes of all components and devices shall be as per the approved list attached in the relevant section of the Tender.

1.16 Where-ever Software is used for Control and Monitoring, all requisite Software Tools for maintenance should be made available for the scope of supply.

1.17 **Layout engineering of GIS and GIBD**

The Contractor shall place the order of GIS to the OEM preferably within 3 months after PO placement. Upon OEM finalisation, the Contractor shall share the Civil drawings (Issued by Purchaser) of GIS building to the OEM. The GIS layout shall be designed so that the entire equipment is accommodated within space/EPs allocated by the Purchaser.

Though design & construction of GIS Building is not in the bidder scope, design, supply and construction of GIBD civil foundations outside GIS buildings in Outdoor Switchyard area/ line reactor area (01UAK) is included under the scope of bidder. The location and number of foundations shall be determined as a part of equipment layout engineering.

The layout and embedded part (EP) details of 400kV GIS and GIBD within the UAB building (I02.KK56.0UAB.0.ET.OK.WD001) is attached as Annexure C. Bidders are requested to take note of the same while finalising their sub-orders for 400kV GIS and GIBD. The bidder/Contractor shall ensure that the layout and design of 400kV GIS and GIBD shall match the layout and EP drawings as provided in Annexure C.

Transformers/reactors (oil filled) are being procured by the Purchaser through a separate contract but are intended to be installed through the subject tender. The Purchaser shall issue the transformers as a 'Free Issue Item' to the Contractor for installation, testing and commissioning. For 400kV GIBD, the Purchaser, on receipt of the input details from the transformer manufacturer, shall provide the inputs to the subject Contractor, during execution of the contract, based on which the Contractor

This document is an intellectual property of Nuclear Power Corporation of India Limited

shall design, procure, supply, install, test and commission the termination modules of GIBD at no extra cost and time to the Purchaser.

Outdoor switchyard (I02.KK56.01UAK.0.ET.OK.WD001) -Tentative layout including the GIBD routing is attached as Annexure of I02.KK56.0.0.ET.TS.PR052. The Contractor shall try to follow the above layout preferably. Any changes in the layout due to technical constraints shall be brought out for review and concurrence of the Purchaser.

The GIS layout design activities including earthing grid layout for GIS shall be completed at the earliest, preferably within 3 months of suborder placement.

2.0 APPLICABLE CODES AND STANDARDS

2.1 The design, material, construction, manufacture, inspection, testing and performance of GIS & GIBD and accessories supplied shall comply with the latest editions (including amendments thereto) of all currently applicable standards, statutes, regulations and safety codes in the locality where the GIS & GIBD will be installed. Nothing in this specification shall be construed to relieve the Contractor of his responsibility.

2.2 In case of conflict between the standards, the more stringent specifications out of these standards shall govern, whereas in case of conflict between the standards and this specification, requirements of this specification shall govern.

2.3 Other National Standards are acceptable if they are established to be equal to or superior to the listed standards subject to approval by the Purchaser. In all such cases, however, copies of English translation of such National Standards shall be submitted/attached with the tender. The tenders not complying with this requirement are liable for rejection.

2.4 The electrical installation shall meet the requirements of CEA Regulations as amended up to date and relevant IS/ IEEE/ IEC codes of practices. Some of the applicable codes and standards are listed below:

2.5 The metal-enclosed gas-insulated switchgear, including the operating devices, accessories and auxiliary equipment forming integral part thereof, shall be designed, manufactured, assembled and tested in accordance with the following International Electro-technical Commission (IEC) Publications including their parts and supplements as amended or revised to date:

IEC 61869-1	Current transformers
IEC 61869-2	Voltage transformers
IEC 60060	High voltage test techniques
IEC 60071	Insulation coordination
IEC 60099 -1/4	Non-linear resistor type arresters for AC systems
IEC 60114	Recommendation for heat treated al alloy bus bar material of al. Magnesium –silicon type.

This document is an intellectual property of Nuclear Power Corporation of India Limited

IEC 60137	Bushings for alternating voltages above 1000 V
IEC 60255	Electrical Relays
IEC 60270	Partial discharge measurement
IEC 60376	Specification of technical grade sulfur hexafluoride (SF_6) for use in electrical equipment
IEC 60480	Guidelines for the checking and treatment of sulfur hexafluoride (SF_6) taken from electrical equipment and specification for its re-use
IEC 60529	Degrees of protection provided by enclosures (IP Code)
IEC 60694	Common clauses for high voltage switchgear and control gear standards
IEC 60815	Selection and dimensioning of high-voltage insulators intended for use in polluted conditions
IEC 60859	Cable connections for gas insulated switchgear
IEC 61639	Direct connection between Power Transformers and gas insulated metal enclosed switchgear for rated voltage 72.5 kV and above
IEC 61869-3	Additional requirements for inductive voltage transformers
IEC 62271-1	HV switchgear and control gear – Common specifications
IEC 62271-100	Alternating current circuit-breakers
IEC 62271-102	Alternating current disconnectors (isolators) and earthing switches
IEC 62271-104	Alternating current switches for rated voltages of 52 kV and above
IEC 62271-110	inductive load switching
IEC 62271-203	Gas Insulated metal-enclosed switchgear for rated Voltages above 52 kV
IEC 62271-209	High-voltage switchgear and control gear - Part 209: Cable connections for gas-insulated metal-enclosed switchgear for rated voltages above 52 kV
IEC 62271-303	Use & handling of SF_6
IEC 62271-211	
IEC 62271-207	
IEEE 693	
IEEE 80 (2000)	IEEE Guide for Safety in AC Substation grounding
CIGRE-44	Earthing of GIS- an application guide (Electra no.151, Dec'93)

2.6 The components and devices which are not covered by the above standards shall conform to, and comply with, the latest applicable standards, rules, codes and regulations of the internationally recognized standardizing bodies and professional societies as may be approved by the Purchaser. The manufacturer shall list all applicable standards, Codes etc. and provide copies thereof for necessary approval.

2.7 In case the requirements laid down herein differ from those given in above standard in any aspect the switchgear shall comply with the requirements indicated herein in regard thereto.

This document is an intellectual property of Nuclear Power Corporation of India Limited

2.8 In case IEC standards are not available for any equipment, standards issued by BS/ VDE/ IEEE/ NEMA or equivalent agency shall be applicable but decision of engineer in charge is final in this regard.

3.0 SITE CONDITIONS

The 400kV GIS & GIBD shall be designed suitable for operating satisfactorily when placed in tropical, humid and highly corrosive atmosphere. The equipment shall be designed to meet the site conditions as specified in the data sheets.

4.0 GENERAL DESCRIPTION, FUNCTION, MATERIALS AND WORKMANSHIP

4.1 For 400 kV GIS 'one and half breaker' configuration shall be used as per single line diagram (I02.KK56.0.0.ET.OKP.WD004).

4.2 'One and half breaker' configuration has two buses, both of which are energised during normal operation. For every 2 circuits, there are 3 circuit breakers with each circuit sharing a common centre breaker. Any breaker can be removed for maintenance without affecting the service on the corresponding exiting feeder, and a fault on either bus can be isolated without interrupting service to the outgoing feeders.

4.3 The GIS shall be of single phase enclosure for each phase. The switchgear shall be of modular design, having complete phase isolation. The SF6 gas insulated metal enclosed switchgear shall be totally safe against inadvertent touch of any of its live constituent parts. It should be designed for indoor application with meteorological conditions at site as per datasheet. All parts of the switchgear should be single phase enclosed for 400kV.

4.4 The GIS assembly shall consist of separate modular compartments e.g. Circuit Breaker compartment/poles, Bus bar compartment, CT (as applicable for the specific manufacturer), PT compartment, isolator compartment, GIBD termination compartment, etc. filled with SF_6 Gas and separated by gas tight partitions so as to minimize risk to human life, allow ease of maintenance and limit the effects of gas leaks failures & internal arcs, etc. These compartments shall be designed to minimize the risk of damage to adjacent sections and protection of personnel in the event of a failure occurring within the compartments. Information pertaining to length of each compartment of GIS/GIBD shall be provided along with the bid for review by the Purchaser.

4.5 Location of 400kV SF_6 to air bushing termination shall be decided to have proper alignment with 400kV Outdoor Switchyard bays without any GIBD bends outside the building for achieving all the required clearances.

The number of diameters shall be as brought out in the 400kV SLD enclosed with this specification.
Though the GIBD is suitable for outdoor application, the layout shall accommodate GIBD inside the building matching the layout and EP drawings provided along with the tender.

This document is an intellectual property of Nuclear Power Corporation of India Limited

The Contractor shall provide the layout of the GIS along with the GIBD routing for review and acceptance by the Purchaser.

Line reactors are proposed to be located at the northern end of the UAB building in 01UAK area. The GIBD routing in the 01UAK area shall take into account GIBD crossing over the road. The height of the GIBD support shall take into account the height level with trailer loaded with line reactor.
As already mentioned in the BoQ, the cost towards the same is deemed to be included in the per meter cost of the GIBD.

4.6 GIS shall be capable of extension in the future on either sides without dismantling any major parts of the equipment. While extending one feeder module of the GIS, it shall be possible to operate all the running feeders (except adjacent bay to the extension module) either from one bus or both the buses, in stages.

4.7 Each section shall have plug- in or easily removable connection pieces to allow for easy replacement of any component with the minimum of disturbance to the remainder of the equipment. Inspection windows shall be provided for dis-connector and earth switches.

4.8 Preferably, busbar disconnecting switches, sectionalizers and earthing switches shall be housed in separate gas compartments. Providing DS & ES in single gas compartment is acceptable if the same is as per the type tested design

4.9 The conductors and the live parts shall be mounted on high grade epoxy resin insulators. These insulators shall be designed to have high structural strength and electrical dielectric properties and shall be free of any voids and free of partial discharge at a voltage as per IEC 62271-203.They shall be shaped so as to provide uniform field distribution and to minimize the effects of particle deposition either from migration of foreign particles within the enclosures or from the by-products of SF_6 breakdown under arcing conditions.

4.10 The provision of closed or open type insulators and their locations in the GIS design assembly shall be judiciously based taking into account ease of system operation and maintenance, without compromising the safety and quality of the equipment.

4.11 Gas barrier insulators shall be provided so as to divide the GIS into separate compartments. They shall be suitably located in order to minimize disturbance in case of leakage or dismantling/maintenance. They shall be designed to withstand any internal fault thereby keeping an internal arc inside the faulty compartment.. The gas tight barriers shall be clearly marked on the outside of the enclosures. The differential pressure to be maintained between the adjacent sections shall be defined suitably in the data sheet. The gas tight barriers shall be capable of withstanding the full differential pressure continuously in case of one compartment at rated SF6 pressure and adjacent compartment open to atmosphere.

A gas line diagram showing the location of these close or open type insulators shall be furnished along with the bid, for review/comparison by the Purchaser and for acceptance of design/engineering.

This document is an intellectual property of Nuclear Power Corporation of India Limited

4.12 The gas line diagrams shall be prepared considering the following aspects:

1. In case of maintenance of any of the CBs, both the buses and all the other feeders shall remain energized.

2. In case of maintenance of any of the bus disconnector switches, one of the buses and all the feeders shall remain energized

3. In case of maintenance of any other disconnector switches (besides bus disconnector switches), only one feeder of that diameter shall be affected. While maintenance on line side disconnector, all three phases of particular bay can be out of service

4.13 Gas barrier insulators and support insulators shall have the same basis of design. The support insulators shall have open cone type insulators on both sides for proper flow of gas. Each type of gas barrier insulators and support insulators shall be supplied as spare (as per Mandatory spare list)

4.14 Covers and conductor shields shall be provided as per manufacturer's recommendation

4.15 Covering/Capping/Blanking module (for maintenance purposes: (Details provided in Mandatory spare list)

4.16 Each gas-filled compartment shall be equipped with static filters (e.g. Alumina), density switches,filling valve and safety diaphragm. The filters shall be capable of absorbing any water vapour which may penetrate into the enclosures as well as the by-products of SF_6 during interruption. Each gas compartment shall be fitted with separate non-return valve connectors for evacuating & filling the gas and checking the gas pressure etc.

4.17 Rupture diaphragms with suitable deflectors shall be provided to prevent uncontrolled bursting pressures developing within the enclosures under worst operating conditions, thus providing controlled pressure relief in the affected compartment.

4.18 Each gas compartment shall be fitted with permanent valves through which gas is passed into or evacuated from the compartment.

4.19 The bus ducts shall comprise of straight lengths bends, elbows, gas seals and accessories such as flanges, gaskets, fixing hardware etc. The bus ducts between GIS building and circuit termination points shall be suitable for outdoor installation.. Necessary accessories, supports etc. including wall frame assemblies shall form part of supply. The connection between GIBD and transformer bushing shall be in accordance with standard flange details as per IEC 62271- 211 and with tolerances that are practically achievable in the manufacturing/assembly of the transformer and the GIBD . Suitable arrangements shall be made to minimise the induced current crossover between transformer tanks and GIS enclosure.

This document is an intellectual property of Nuclear Power Corporation of India Limited

Supply of oil filled power transformers/reactors are covered under a separate contract but erection & commissioning of them including all interface related works for them are covered under the scope of this contract. Thus termination of SF6-Oil bushing is also under the scope of this Tender.

Supply of SF6-Oil Bushing is included along with Transformer/Shunt Reactor. Termination of GIBDs on the bushing flange is under the scope of the Bidder. Bushing CTs are also included along with the supply of SF6-Oil Bushing and transformer.

4.20 The switchgear line-up when installed and operating under the ambient conditions shall perform satisfactorily and safely under all normal and fault conditions. Even repeated operations up to the permissible servicing intervals under 100% rated and fault conditions shall not diminish the performance or significantly shorten the useful life of the switchgear. Any fault caused by external reasons shall be positively confined to the originating compartment and shall not spread to other parts of the switchgear.

4.21 The enclosure shall be sized for carrying induced current equal to the rated current of the bus. The conductor and the enclosure shall form the concentric pair with effective shielding of the field internal to the enclosure.

4.21.1 The enclosure shall be designed to practically eliminate the external electromagnetic field and thereby electrodynamic stresses even under short circuit conditions.

4.21.2 The enclosure & support structure shall be designed that a mechanic of height 1780 mm and 80 kg in weight is able to climb on the equipment for maintenance.

4.22 In general, the contours of energized metal parts of the GIS and any other accessory shall be such, so as to eliminate areas or points of high electrostatic flux concentrations. The surfaces shall be smooth with no projection or irregularities which may cause visible corona.. There shall be no radio interference from the energized switchgear at rated voltage.

4.23 The elbows, bends, cross and T-sections of interconnections shall include the insulators bearing the conductor when the direction changes take place in order to ensure that live parts remain perfectly centred and the electrical field is not increased at such points.

4.24 During installation, protection shall be provided in order to prevent moisture or dirt entering the equipment. Contractor’s scope of work includes providing all temporary requirements like protection with PVC flooring, temporary ventilation arrangement & enclosures, if any, needed. All the requirements for ensuring safety and workmanship shall be provided/ ensured by the Contractor at no extra cost to the Purchaser.

4.25 The workmanship shall be of the highest quality and shall conform to the latest modern practices for the manufacture of high technology machinery and electrical switchgear.

This document is an intellectual property of Nuclear Power Corporation of India Limited

4.26 Minimum assembly work shall be required during the installation. Completely factory assembled switchgear bays that require only overhead line connections at site will be preferred.

4.27 The equipment shall be complete with all necessary supports, platforms, ladders staircases, catwalks mechanism cabinets and internal cable raceways etc.

4.28 It should be impossible to touch live parts of the switchgear or to perform operations that lead to arcing faults without the use of tools or brute force, even inadvertently.

4.29 All interlocks that prevent potentially dangerous mal-operations shall be constructed such that they cannot be operated easily, i.e. the operator must use tools or brute force to over-ride them.

4.30 The switchgear shall have provision for connection with earth mat risers. This provision shall consist of earthing pads to be connected to the earth mat riser in the vicinity of the equipment.

4.31 The ladders and walkways shall be provided wherever necessary for access to the equipment. A portable ladder with adjustable height shall also be supplied to access to the equipment.

4.32 **GIS/GIBD enclosure, Conductors**

4.32.1 The enclosure for the SF_6 gas and circuit elements of enclosure shall be made from Al/Al alloy having high resistance to corrosion, low electrical loses and negligible magnetic losses. The type of material and thickness shall also be such as to keep heating due to induced circulating currents to a minimum. Enclosures of the same phase shall be electrically interconnected, and shall be earthed at appropriate places. The enclosure shall be of continuous design and shall meet the requirement as specified in clause no. 10 (special considerations for GIS) of IEEE- 80, Year- 2000. At appropriate points single phase enclosures shall be either earthed or shall be connected to other phases, thus ensuring a return current capability almost equal to the current circulating in the conductor.

4.32.2 The enclosure shall be designed for the mechanical and thermal loads to which it is subjected in service. The enclosure shall be manufactured and tested according to the pressure vessel code (ASME/ CENELEC code for pressure Vessel.) and based on the design temperature and design pressures as defined in IEC-62271-203/CENELAC.

4.32.3 Each enclosure shall be tested to withstand 1.3/1.2 times the design pressure for 1 minute for welded/cast enclosures respectively, as a routine test. The fabricated metal enclosures shall be of Aluminium alloy having high resistance to corrosion, low electrical loses and negligible magnetic losses.

4.32.4 All joint surfaces shall be machined and all castings shall be spot faced for all bolt heads or nuts and washers. All screws, bolts, studs and nuts shall conform to metric system.

This document is an intellectual property of Nuclear Power Corporation of India Limited

4.32.5 400kV GIS equipment enclosures shall be able to withstand the effect of an internal arc as per IEC 62271-203. The material shall be such that it has no effect of environment as well as from the by-products of SF_6 breakdown under arcing condition.

4.32.6 The bus enclosures for main buses shall be of bolted flange.

4.32.7 The finish of interior surfaces of the metal-enclosed enclosures shall facilitate cleaning and inspection. Any paint or other coating that may be used shall be such that they will not deteriorate when exposed to the SF_6 gas and other vapours, arc products, etc. that may be present in the enclosures. They shall also not contain any substances which could contaminate the enclosed SF_6 gas or affect its insulating properties over a period of time.

4.32.8 The Contractor shall furnish the finish to be used for interior of pressurised bus duct enclosure. Measures taken to eliminate conducting particles in the interior finish shall be brought out clearly.

4.32.9 The material used for manufacturing the switchgear conductor shall be of the type, composition and have physical properties best suited to their particular purposes and in accordance with the latest engineering practices. All the conductors shall be fabricated of aluminium alloy tubes of cross sectional area suitable to meet the normal and short circuit current rating requirements. The finish of the conductors shall be smooth so as to prevent any electrical discharge. The conductor ends shall be silver plated/copper sprayed/manufacturer's type tested design and fitted into finger contacts or tulip contacts. The contacts shall be of sliding type to allow the conductors to expand or contract axially due to temperature variation without imposing any mechanical stress on supporting insulators.

4.32.10 The equipment shall be manufactured and assembled at the Manufacturer's works under conditions of utmost cleanliness and before works testing and packing for shipping, interior surfaces, insulators, barriers, etc. must be thoroughly cleaned.

4.32.11 Temperature rise of enclosure and conductor shall be such that the final temperature does not exceed the values specified in data sheets for specified site conditions Contractor shall provide test reports/calculations to prove this.

4.33 Expansion and flexible connection for enclosure/ conductors

4.33.1 Expansion joints or flexible connections shall be provided in the metal enclosure/ conductors to absorb the actual or relative thermal expansion and contraction of the SF_6 equipment as well as structures resulting from variations of the temperature of the switchgear equipment.

4.33.2 The expansion joints shall also absorb variations in height of civil foundations and elevations of floors as well as installation tolerances.

4.33.3 The expansion joints or flexible connections shall be capable of absorbing other small externally applied forces/ earth tremors without any damage to the equipment.

This document is an intellectual property of Nuclear Power Corporation of India Limited

4.33.4 The no. and position of the expansion joints or flexible connections shall be determined by the Contractor to ensure that complete installation is not subjected to any expansion stresses which could lead to failure of any piece of the GIS equipment, supporting structures.

4.33.5 Expansion joints/ flexible connections and adjustable mountings shall be provided to compensate for reasonable tolerances in the manufacture of associated equipment to which the GIS may be connected and to ensure that, unreasonably excessive accuracies are not required. When installing such equipment and constructing the associated structures, i.e. Transformers or the interconnections of isolated structures of the switchgear by means of long SF_6 bus bar or the duct installation.

4.33.6 The electrical connections for the conductor expansion joints or flexible connections shall be made by means of multiple contact connectors preferably of the same material as that provided at the joints between the separate gas compartments.

4.33.7 The surface of the connection of fingers and the conductor tubes in such connections shall be silver plated/copper sprayed/ manufacturer's type tested design

4.33.8 The bellows shall be metallic (of stainless steel 316 L grade as a minimum taking into account the highly corrosive atmosphere prevailing at KKNPP site) of following types or other suitable equivalent arrangement shall be provided wherever necessary. Additionally, appropriate protective coating shall also be provided on the bellows

a) Lateral/ Vertical mounting units: These shall be inserted, as required, between sections of bus bars, on transformers etc. Lateral mounting shall be made possible by a sliding section of enclosure and tubular conductors.

b) Axial compensators: These shall be provided to accommodate changes in length of bus bars due to temperature variations.

c) Parallel compensators: These shall be provided to accommodate large linear expansions and angle tolerances.

d) Tolerance compensators: These shall be provided for taking up manufacturing, site assembly and foundation tolerances.

e) Vibration compensators: These bellow compensators shall be provided for absorbing vibrations caused by the transformers and shunt reactors when connected to SF_6 switchgear by oil- SF_6 bushings.

4.33.9 The electrical connections across the bellows or compensating units shall be made by means of suitable connectors. Conductive currents through bellow surface shall be avoided.

4.33.10 During detail engineering, it shall be ensured that the majority of components including the bellows are located indoor to the maximum extent possible.

4.34 Protective Finish/Corrosion Protection of Surfaces

This document is an intellectual property of Nuclear Power Corporation of India Limited

4.34.1 The switchgear shall be treated and protected to withstand continuous operation under site conditions without sustaining corrosion or attacks from fungus or rodents. The protective finish shall prevent deterioration due to corrosion, humidity, temperature, ageing and weather etc. under site conditions. The exterior surface finish of outdoor portion shall be selected in agreement with the Purchaser to minimise the effect of solar radiation on continuous rating. All exterior surfaces shall be cleaned and epoxy painted before leaving the factory with at least one coat of approved primer and two coats of approved equipment finish paint. The underside of all surfaces bearing upon the concrete foundation shall be given two coats of approved primer. Extra paint for retouching shall be supplied by the manufacturer. The indoor portion of switchgear paint shade shall be aircraft grey shade 693 of IS-5 or approved equivalent.

4.34.2 Supporting structures, sheet steel used for LCC, CB drive cubicle shall be hot dip galvanised after fabrication. The minimum thickness of Zinc coating shall be120 microns for elements of thickness 5mm and more The minimum thickness of Zinc coating shall be 85 microns for elements of thickness less than 5mm.

4.34.3 Gas monitoring and service piping including all fittings and accessories shall be made of copper, brass or stainless steel.

4.34.4 Appropriate anti corrosion measures shall be followed to prevent corrosion in joints between different metals.

4.34.5 Before the metal enclosed sections are joined together and charged with the SF_6 gas they must be thoroughly cleaned.

4.35 Pressure relief

4.35.1 Pressure relief devices shall be provided in the each gas sections/ compartment to protect the main gas enclosures from damage or distortion during the occurrence of abnormal pressure increase or shock waves generated by internal electrical fault arcs (preferably in downward direction). Pressure relief shall be achieved either by means of diaphragms or plugs venting directly into the atmosphere in a controlled direction. If the pressure relief devices vent directly into the atmosphere, suitable guards and deflectors shall be provided to prevent pieces of the diaphragm or plug from flying out or any dangerous SF_6 arc product gases escaping, in a manner that could endanger personnel who may be present over there. Contractor shall submit the detailed criteria/ design regarding location of pressure relief devices/rupture diaphragms.

4.35.2 The set points for the pressure relief device shall be lower than pressure withstanding capability of the enclosure with sufficient margin.

4.35.3 If over pressure is relieved by collapse of internal gas barriers, then the direction of barrier collapse and volume of adjacent gas sections shall be such that the pressure will always be reduced to a safe level by the collapse of only one barrier. When an arc equal to the maximum fault current persists for the maximum fault clearing time as specified, the direction of barrier collapse shall also be preferably designed to ensure that, (a) other circuits or bus bars will not be rendered inoperative (b) minimise the damage and the extent of repair works required.

This document is an intellectual property of Nuclear Power Corporation of India Limited

4.35.4 If the over pressure is relieved with collapse of internal gas barriers, then the manufacture to indicate the serviceability of the adjacent compartment where in the pressure is relieved.

4.36 Indication & verification of switch position

4.36.1 Indicators mounted external to the equipment shall be provided on all circuit breakers, isolators and earth-switches, which shall clearly show whether the switches/ CBs/ DSs etc. are open or closed. The indicators shall be mechanically coupled directly to the main contact operating drive rod or linkages and shall be mounted in a position where they are clearly visible from the floor or the platform in the vicinity of the equipment. Windows shall also be provided with all isolators and earth switches so that the switch contact positions can be verified by direct visual inspection.

4.36.2 The Contractor shall offer equipment fitted with viewing ports on each earth switch suitable for viewing and illumination of the position of the switch. Viewing ports shall also be provided on the bus VT isolators. Viewing ports shall be of type, whereby the open/ close position can be checked without any danger to the eyes when a flashover occurs at that time.

4.36.3 The design shall include glass endoscope/observation windows for viewing the position of switches of disconnector and earthing switch and separate piece for the same shall be provided (if applicable).

4.37 Bolts & Hardware:

4.37.1 Details of bolt sizes and threading shall be clearly shown on the appropriate drawings. Where self-locking type of nuts are used, they shall be of the re-usable type. Fasteners used for current carrying parts shall be of SS - 304/ Brass/manufacturer’s type tested design.

4.38 Maintenance

4.38.1 GIS components shall be installed and arranged to facilitate realistic access for maintenance and removal of equipment, with minimum disturbance to other equipment. The design should be such that all parts subjected to wear and tear are easily accessible for maintenance purposes.

4.38.2 In the event of a fault in any bay of the GIS/ GIBD, it is a firm requirement that subsequent repairs/ testing shall be possible to be carried out without outage of any other bay or bus bar. If busbar disconnector goes under maintenance then particular busbar can be taken for shutdown and another busbar shall remain in service

4.38.3 The breaker enclosure shall have provision for easy withdrawal of the interrupter assemblies. The removed interrupter assembly must be easily and safely accessible for inspection and possible repairs. This procedure shall not involve the removal or dislocation of adjacent bay enclosure parts. Checking the contact condition of the

This document is an intellectual property of Nuclear Power Corporation of India Limited

interrupter elements must be possible without disturbing any other gas compartment. Safe replacement of breaker interrupters must be possible while the remaining bays are "live".

4.38.4 It must be generally possible to remove a circuit element (breaker interrupter , disconnect switch etc), without removing another element.

4.38.5 For routine inspection and possible repairs all elements shall be accessible without removing support structures. The removal of individual enclosure parts, shall be possible with minimum disturbance to adjacent enclosures or entire breaker bays.

4.39 Future Extension

4.39.1 It shall be possible to extend the GIS switchgear by adding future feeders and the existing feeders remaining in service continuously. The Manufacturer shall clearly demonstrate in his bid documents the suitability of the switchgear design in this respect.

5.0 REQUIREMENTS

5.1 Circuit Breakers

5.1.1 General :

a) The circuit breakers shall be isolated phase type for independent pole operation and shall have redundant trip coils. They shall be trip free and with anti-pumping feature.
b) Pole discrepancy tripping shall be provided which shall detect discrepancy in opening of contacts. Local electrical operation shall be provided from the local control cubicle.
c) An emergency manual trip feature shall be available in the breaker kiosk. The breaker enclosure shall have provision for easy withdrawal of the interrupter assemblies. This procedure shall not involve the removal or dislocation of adjacent bay enclosure parts. Checking the contact condition of the interrupter elements must be possible without disturbing any other gas compartment. Safe replacement of breaker interrupters must be possible while the remaining switchgear is "live".
d) Contractor shall advice if the breakers are suitable for breaking the load current even if SF6 gas pressure has reduced to atmospheric pressure.
e) Circuit Breakers should have the provision for Controlled Switching as detailed in the relevant section of the specification.

5.1.2 Duty Cycle (Operating Mechanism)

a) Circuit breaker shall be C2 - M2 class as per IEC 62271-100.

b) Circuit breaker shall meet the duty requirements for any type of fault or fault location also for line charging and dropping when used on 400 kV effectively earthed systems and perform make and break operations as per the stipulated duty cycles satisfactorily.

This document is an intellectual property of Nuclear Power Corporation of India Limited

c) The CB shall be suitable for carrying out the duty cycle of O-0.3 sec-CO-3.0 minutes -CO

d) The maximum total break time at the minimum pressure of the mechanism shall be 2.5 cycles as specified in the data sheet

e) Operating mechanism of the circuit breakers should have local energy storage sufficient for the standard duty cycle of one CLOSE-OPEN (CO) operation. The stored energy mechanism cabinet shall be so sealed and thermally insulated that during an auxiliary power supply failure, at an ambient temperature specified in data sheet, it shall be possible for one CO operation after three hours.

5.1.3 Total Break Time

a) The total break time shall not be exceeded under any of the duties as specified by IEC 62271-100

Total break time of the breaker shall not exceed under any duty conditions specified such as with the combined variation of the trip coil voltage (70-110%), and SF_6 gas pressure etc. The values guaranteed shall be supported with the type test reports.

5.1.4 Circuit Breaker Construction Features:

a) SF_6 circuit breakers shall be of single pressure type and shall utilise puffer cylinder for arc interruption. Each SF_6 CB pole shall be with single interrupting chamber. Each SF_6 circuit breaker pole shall be provided with its own self-contained gas system.

b) The service connections for gas handling shall be located on each pole tank to facilitate servicing. The SF_6 breaker shall be designed to ensure that condensation of moisture is controlled by proper selection of organic insulating materials having low moisture absorbing characteristics, complete drying of container and breaker, selection of 'O' ring, etc.

c) Materials such as activated alumina or molecular sieve shall be provided at appropriate locations as moisture absorbents. Also suitable absorbents for removing SF_6 arc products shall be employed.

d) Breakers shall be so designed that when operated within their specified rating, the temperature of each part will be limited to values consistent with a long life for the material used. The temperature rise shall not exceed that indicated in IEC-62271-100 under specified ambient conditions.

e) The material used in the construction of the circuit breakers shall be such as to be fully compatible with SF_6 gas decomposition products.

f) Provisions shall be made for attaching operational analyzer to record travel, speed and making measurement of operating timings etc. after installation at site.

5.1.5 Breaker Contacts:

This document is an intellectual property of Nuclear Power Corporation of India Limited

a) All making and breaking contacts' shall be sealed and free from atmospheric effects. Contacts shall be designed to have adequate thermal and current carrying capacity for the duty specified and to have a life expectancy so that frequent replacement due to excessive burning will not be necessary.

b) Main contacts shall be of **copper/ aluminium/ aluminium alloy with silver plating/ any other material as per type tested design** and have ample area and contact pressure for carrying the rated current and the short time rated current of the breaker without excessive temperature rise which may cause pitting or welding. Contacts shall be easily replaceable and shall have a minimum of movable parts and adjustments to accomplish these results. Main contacts shall be the first to open and the last to close so that there will be little contact burning and wear.

c) Arcing contacts, if provided, shall be the first to close and the last to open and shall be easily accessible for inspection and replacement. Tips of arcing and shall be silver/ tungsten/ tungsten alloy. Provision shall be made for rapid dissipation of heat generated by the arc on opening.

d) Positive mechanism interconnection shall be provided between interrupting contacts, resistor switches (when used), , if any, to ensure maximum operating reliability or retention timing.

e) Any device provided for voltage grading to damp oscillations or, to prevent re-strike prior to the complete interruption of the circuit or to limit over voltage on closing, shall have a life expectancy comparable of that of the breaker as a whole.

5.1.6 Name Plate

a) A weather-proof and corrosion-proof name plate shall be provided and shall conform to IEC 62271-203. Adhesive label for stating compliance for Kyoto protocol to be provided in Circuit breaker Cubicle.

b) Details regarding each gas compartment, quantity of SF6 gas in each compartment, operating and lockout pressure etc., need to be provided appropriately for every bays. SF6 Kyoto label shall be provided Circuit breaker Cubicle. The details of the label shall be as per the manufacturer's standard.

5.1.7 Short Circuit Rating

a) Contractor shall furnish proof of short circuit rating including breaking capacity with transient voltage severity in accordance with latest versions of IECs.

b) All short circuit testing shall be carried out as per relevant IEC requirements. Reports of out-of-phase testing in accordance with latest versions of IEC shall be provided with the bid.

5.1.8 The circuit breaker shall be capable of the following:

This document is an intellectual property of Nuclear Power Corporation of India Limited

a) Interruption of fault currents having a delayed zero passage for a considerable number of cycles.

b) Interrupting line/cable charging current as per IEC without re-strikes and without use of opening resistors.

c) Breaking 25% the rated fault current at twice the rated voltage under phase opposition condition.

d) The breaker shall satisfactorily withstand the high stresses imposed on them during fault clearing, load rejection and re-energisation of lines with trapped charges.

e) 400 kV breakers shall be able to switch in and out the 400 kV shunt reactor for any value within the range of shunt reactor without giving rise to overvoltage more than 1.5 p.u./ or as per type tested design.

f) Other Switching Duties :

i. It is required that the circuit breakers shall be restrike free when de-energizing overhead lines and shall be capable of switching unloaded transformers without exceeding specified over voltages.

5.1.9 Circuit Breaker Operating Mechanism

a) General Requirements

i. Circuit breaker shall be operated by spring charged mechanism. The mechanism shall be housed in a dust proof cabinet and shall have minimum IP 42 degree of protection.

ii. Main poles of the breaker shall be such that the design shall ensure that the difference in the instants of closing and opening shall not exceed values specified in data sheet.

iii. Circuit breakers shall feature high repeatability of absolute trip and closing time over a wide range of parameters (ambient temperature, , control voltages, etc.).

iv. Operating mechanism shall be suitable for high speed reclosing. It shall be anti-pumping under every method of closing (except during manual closing of a breaker for maintenance). Provision shall be provided on trip free mechanisms to prevent reclosure before the breaker latches have reset.

v. Main poles shall operate simultaneously. There shall be no objectionable rebound and the mechanism shall not require any critical adjustment. It shall be strong, rigid, positive and fast in operation.

vi. The design of the circuit breaker shall be such that contacts will not close automatically upon loss of gas.

This document is an intellectual property of Nuclear Power Corporation of India Limited

vii. A mechanical indicator shall be provided to show open and close position of the breaker. It shall be located in a position where it will be visible to a man standing on the ground level with the mechanism housing closed. An operation counter shall also be provided in the local control cabinet.

viii. Working parts of the mechanism shall be of corrosion resisting material. Bearings which require grease shall be equipped with pressure type grease fittings. Bearing pin, bolts, nuts and other parts shall be adequately pinned or locked to prevent loosening or changing of adjustment with repeated operation of the breaker.

ix. The operating mechanism shall be strong, rigid, not subject to rebound or to critical adjustments at site and shall be readily accessible for maintenance.

x. The Manufacturer shall furnish detailed operation and maintenance manual of the mechanism along with the operation manual for the circuit breaker.

b) Spring operated Mechanism

i. Spring operated mechanism shall be complete with motor in accordance with guaranteed technical parameters. Opening spring and closing spring with limit switch for automatic charging and other necessary accessories to make the mechanism a complete operating unit shall also be provided.

ii. As long as power is available to the motor, a continuous sequence of the closing and opening operations shall be possible. The motor shall have adequate thermal rating for this duty.

iii. After failure of power supply to the motor atleast one close open shall be possible with the energy contained in the operating mechanism.

iv. Breaker operation shall be independent of the motor which shall be used solely for compressing the closing spring. Facility for manual charging of the closing spring shall also be provided. The motor rating shall be such that it required preferably not more than 30 seconds for full charging of the closing spring.

v. Closing action of circuit breaker shall compress the opening spring ready for tripping.

vi. When closing springs are discharged after closing a breaker, closing springs shall automatically be charged for the next operation and an indication of this shall be provided in the local and remote control cabinet.

vii. Provisions shall be made to prevent a closing operation of the breaker when the spring is in the partial charged condition.

viii. Mechanical interlocks/padlock shall be provided in the operating mechanism to prevent discharging of closing springs when the breaker is in the closed position.

ix. The spring operating mechanism shall have adequate energy stored in the operating spring to close and latch the circuit breaker against the rated making

This document is an intellectual property of Nuclear Power Corporation of India Limited

current and also to provide the required energy for the tripping mechanism in case the tripping energy is derived from the operating mechanism.

c) Purchaser Operating Mechanism Control

i. The breaker shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coils. However, provisions shall be made for local electrical control. For this purpose a local/remote selector switch and close and trip control switch/push buttons shall be provided in the Local control cabinet. Provision for local manual closing device shall be also be available for maintenance purpose. Direction of motion of handle shall be clearly and indelibly marked.

d) All electrical sequence interlocks will apply in both remote and local control modes.

i. Section 5.25 shall be referred for the minimum electrical sequence interlock requirements

ii. The trip coil shall be suitable for trip circuit supervision during both open and close position of breaker.

iii. Closing coil and associated circuits shall operate correctly at all values of voltage between 85% and 110% of the rated voltage. Shunt trip and associated circuits shall operate correctly under all operating conditions of the circuit breaker upto the rated breaking capacity of the circuit breaker and at all values of supply voltage between 70% and 110% of rated voltage. If additional elements are introduced in the trip coil circuit their successful operation and reliability for similar applications on circuit breakers shall be clearly brought out.

iv. The close and trip circuits shall be designed to permit use of momentary-contact switches and push buttons.

v. Each breaker pole shall be provided with two (2) independent tripping circuitsand coils

vi. Densimeter contacts shall be suitable for direct use as permissives in closing and tripping circuits. Separate contacts have to be used for each of tripping and closing circuits. If contacts are not suitably rated and multiplying relays are used then fail safe logic/schemes are to be employed. DC supplies for all auxiliary circuit shall be monitored and operation lockout in case of dc failures.

vii. The auxiliary switch of the breaker shall be positively driven by the breaker operating rod.

viii. Operating mechanism, and all accessories shall be enclosed in a weather-proof mechanism cabinet of hot dip galvanised sheet steel construction, the thickness of which shall not be less than 2 mm. Hinged doors giving access to the mechanism at the front/back/sides as applicable shall be provided. Suitable gaskets shall be provided to make the mechanism housing water-proof and dust-

This document is an intellectual property of Nuclear Power Corporation of India Limited

proof. The housing latch shall accommodate padlock requiring a 12 mm diameter hole. Padlock and duplicate keys are in the Contractor's scope of supply.

ix. The circuit breaker operating mechanism cabinet shall also include the following

- One (1) position indicator
- One (1) number of operations operated
- Facility for electrical or mechanical timing measurement .
- Feature for Emergency manual trip
- Auxiliary switches directly connected to the main operating shaft meeting the requirements.

5.2 **Disconnectors (Isolators)**

5.2.1 General

a) Disconnectors shall be of the single-pole, group operated type, to provide electrical isolation with one motor operated mechanism per three poles. The disconnectors shall conform to IEC- 62271-102.

b) Electric motor shall be suitable for use on 220V DC/ 240V AC/ 415V AC system and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over current and short circuit. Both AC and DC type motors are acceptable if it is as per the type tested design.

Disconnectors shall be designed as per relevant IEC. These shall be suitable to make and break the charging currents during their opening and closing. They shall also be able to make and break loop current which appears during transfer between bus bars. The contact shielding shall also be designed to prevent restrikes and high local stresses caused by transient recovery voltages when these currents are interrupted.

5.2.2 Constructional features

a) The isolators shall be complete with all parts that are necessary for efficient operation. Such parts shall be deemed to be within the scope of supply, whether specifically mentioned are not.

b) All similar parts shall be interchangeable.

c) Each isolator shall have individual gas compartment.

d) The design shall be such that no lubrication of any part is required except at very infrequent intervals

e) The isolator shall be provided with high current carrying capacity contact. The contact surfaces shall be designed to keep the contact resistance to a minimum. The

This document is an intellectual property of Nuclear Power Corporation of India Limited

contact surfaces shall be silver faced copper/silver faced aluminium/manufacturer specific design.

f) Arrangement shall be provided to permit manual operation of the power isolators. Provisions shall be made to disable remote control during manual operation. Preferably, manual operating handle shall be provided with pad lock. The control circuit shall be electrically disconnected during the manual operation.

g) A mechanical position indicating device shall be provided for each isolator which shall be clearly visible from ground. Viewing post shall be provided for visual verification of open/ close position. All the disconnecting switches shall have arrangement allowing easy visual inspection of the travel of the switch contacts in both open and close positions, from the outside of the enclosure.

h) Each pole of the isolator shall be provided with two earthing pads of non-corrodible material at opposite end, brazed on to the channel base. Flexible copper earth connectors shall be provided for connecting operating handle of isolator to the earthing system.

i) The disconnecting switches shall be arranged in such a way that all the three phases operate simultaneously. All the parts of the operating mechanism shall be able to withstand starting torque of the motor mechanism without damage until the motor overload protection operates.

j) The disconnectors and safety earthing switches shall have inter-locks to prevent closing of the earthing switches when the associated isolator switches are in the closed position and vice versa

k) The disconnecting switches shall be preferably capable of being padlocked in both the fully open and fully closed positions with the operating motor automatically disengaged. The padlocking device shall be suitable for a standard size lock with a 10 mm shank. The padlock must be visible and directly lock the final output shaft of the operating mechanism. Integrally mounted lock when provided shall be equipped with a unique key for such three phase group. Master key is not permitted.

5.2.3 Name Plates

a) Weather-proof and corrosion-proof name plate shall be provided on isolator and operating device. The name plates shall confirm to applicable standards.

b) The disconnecting switches shall be provided with rating plates and shall be accessible for inspection

5.2.4 Short Circuit Requirements

a) The rated peak short-circuit current or the rated short time current carried by an isolator or earthing switch for the 'rated maximum duration of short circuit shall not cause :

This document is an intellectual property of Nuclear Power Corporation of India Limited

i. Mechanical damage to any part of the isolator or earthing switch.

ii. Separation of the contacts or contact welding.

iii. A temperature rise likely to damage insulation. After the passage of these currents, the isolator shall be able to carry its rated current under specified conditions and the operation of the operating device shall not be impaired.

b) The rated peak short circuit current and the rated short time current of the earthing switch shall be at least equal to those specified for the isolator.

5.2.5 Operating Mechanism Control

a) Isolators shall be motor operated and controlled from the LCC and from a remote point. Connections, interlocking requirements and auxiliary switches shall be in accordance with the Tender requirements.

b) Remote control of the disconnectors from the control room shall be made by means of remote/ local transfer switch.

c) The local control of the Isolator from the bay control unit should be achieved from the individual control switches with the remote/local transfer switch set to local.

d) Interlocks shall be provided so that remote/Local control is disabled during manual operation.

e) All electrical sequence interlocks will apply in both remote and local control modes.

f) Section 5.25 shall be referred for minimum electrical sequence interlock requirements

g) The operating mechanism shall provide a quick, simple and effective operation. Time of operation shall not exceed 12 seconds. One man shall be able to operate the isolator/earthing switch (when manually operated) without undue effort.

h) The operating mechanism shall be provided with sufficient adjustment to allow for final alignment of the isolator contacts for simultaneous operation. Adjustable stops shall be provided to prevent over travel in either direction.

i) The isolator shall be provided with positive continuous control throughout the entire cycle of operation. The operating pipes and rods shall be sufficiently rigid to maintain positive control under most adverse conditions and when operated in tension or compression for isolator opening/closing. They shall also be capable of withstanding all torsional and bending stresses due to operation of the isolator.

j) After final adjustment has been made, it shall not be possible for any part of the mechanism to be displaced at any point in the travel sufficiently to allow improper functioning of the isolator when the isolator is opened or closed at any speed. All holes in cranks, linkages, etc., having pins shall be drilled to accurate fit so as to maintain the minimum amount of slack and lost motion in the entire mechanism.

This document is an intellectual property of Nuclear Power Corporation of India Limited

k) Limit switches shall be provided with required number of contacts for control of power operated isolators. These switch contacts shall be positive acting type and shall be directly driven from the isolator shaft through minimum linkages.

l) The control shall be arranged such that the desired operation shall be completed when corresponding push button is pressed even momentarily. The control circuit shall be so designed that necessary interlocks with associated breakers and earthing switch shall be incorporated in it.

m) If the power supply to Isolators/ earthing switch initially off and open/ close command is given, isolators/ earth switch operation which cannot be carried out to non-availability of power at that moment, shall not take place when AC supply is restored subsequently.

n) The isolator operating mechanism shall be enclosed in a weather proof cabinet of hot dip galvanised sheet steel construction thickness of which shall not be less than 2mm. Hinged doors giving access to the mechanism at the front/ back and sides shall be provided. Suitable gaskets shall be provided to make the mechanism housing water proof and dustproof.

o) Each disconnector shall have a clearly identifiable local, positively driven mechanical position indicator, together with position indicator on the bay control unit and provisions for taking the signals to the control room. The details of the inscriptions and colouring for the indicator are given as under:

	Sign	**Colour**
open position	Open	Green
closed position	Closed	Red

p) The operating mechanisms shall be complete with all necessary linkages, clamps, couplings, operating rods, support brackets and earthing devices. All the bearings shall be permanently lubricated or shall be of such a type that no lubrication or maintenance is required.

q) Each disconnector shall be supplied with auxiliary switch having four normally open and four normally closed contacts for future use over and above those required for switchgear interlocking and automation purposes.

r) The signalling of the closed position of the disconnector shall not take place unless it is certain that the movable contacts will reach a position in which the rated normal current, peak withstand current and short-time withstand current can be carried safely.

s) The signalling of the open position of the disconnector shall not take place unless the movable contacts have reached such a position that the clearance between the contacts is at least 80 percent of the rated isolating distance.

t) All auxiliary switches and auxiliary circuits shall be as per type tested design.

This document is an intellectual property of Nuclear Power Corporation of India Limited

u) Disconnector drive stuck condition shall be sensed and the power to Disconnector operating circuit shall be automatically cut off.

5.3 Safety Earthing switches

5.3.1 Earthing switch, wherever is possible can form an integral part of each pole of the isolator. Two independent earthing pads each with flexible copper braids and suitable connectors for the specified size of earth conductor lead shall be provided at the hinge end of the switch.

5.3.2 Three-pole, group operated, safety earthing switches shall be operated by electric motor. Electric motor shall be suitable for use on 220V DC/ 240V AC/ 415V AC system and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over current and short circuit. Both AC and DC type motors are acceptable if it is as per the type tested design.

5.3.3 Each safety earthing switch shall have clearly identifiable local positive driven mechanical indicator together with position indicator on the bay control unit and provision for taking the signal to Control room.

5.3.4 The details of the inscription and colouring for the indicator are given as under :

	Sign	**Colour**
open position	Open	Green
closed position	Closed	Red

5.3.5 Interlocks shall be provided so that remote/Local control is disabled during manual operation. All electrical sequence interlocks will apply in both remote and local control modes

a) Section 5.25 shall be referred for minimum electrical sequence interlock requirements

5.3.6 Each earthing switch shall be fitted with auxiliary switches having four normally open and four normally closed contacts for use by others over and above those required for local interlocking and position indication purposes.

5.3.7 Provision shall be made for padlocking the earthing switches in either the open or closed position or the same shall be achievable through an alternative arrangement

5.3.8 All portions of the earthing switch and operating mechanism required for earthing shall be connected together utilizing adequately sized flexible copper conductors

5.3.9 The safety earthing switches shall conform to the requirements of IEC- 62271- 102.

5.3.10 Mechanical position indication shall be provided locally at each switch and remotely at each bay control unit.

5.4 High speed make-proof Earthing Switches

This document is an intellectual property of Nuclear Power Corporation of India Limited

5.4.1 Earthing switches located at the beginning of the line feeder bay modules shall be of the high speed, make-proof type and will be used to discharge the respective charging currents, in addition to their safety earthing function. High speed earthing switch shall be class E2.

5.4.2 This shall have make-proof contacts and high speed stored energy, operating mechanism that might make them suitable to close on to a fault. This motor operated earthing switches on incomer bays shall be of high speed closing type (quick make action).

5.4.3 Motor operated high speed earthing switch shall be designed in a manner to prevent transmitting of impact to earth switch bushing during high speed closing operation of the earth switch.

5.4.4 These earthing switches shall be capable of interrupting the inductive currents and to withstand the associated TRV. Single phase switches shall be provided with operating mechanism suitable for use on 220V DC/ 240V AC/ 415V AC system. High speed earthing switch can be single pole/group operated. Both AC and DC type motors are acceptable if it is as per the type tested design.

5.4.5 High speed earthing switches on the line side shall be capable of interrupting coupling currents upon opening.

5.4.6 After removal of the ground initiated by a fault making ground switch, it must be possible to re-energize the system without first carrying out the maintenance. The Contractor shall state regarding the precautions taken to minimise the accidental discharge of the stored energy operating mechanism.

5.4.7 The operating mechanism design shall be such that during the operation of the high speed earth switch (especially manual operation) the moving blades once they reach the sparking distance, springs shall take over to give a quick, snap action closing so that the earth switch closing is independent of manual efforts. Similarly, the springs must assist during the opening operation to give quick breaking feature.

5.4.8 The short circuit making current rating of each earthing switch shall be at least equal to its peak withstand current rating as applicable. The switches shall have inductive/ capacitive current switching capacity as per IEC-62271-102.

5.4.9 Each high speed make proof earthing switch shall have clearly identifiable local positive driven mechanical indicator together with position indicator on the bay control unit and provision for taking the signal Control Room.

5.4.10 The details of the inscription and colouring for the indicator shall be as under:-

	Sign	**Colour**
open position	Open	Green
closed position	Closed	Red

This document is an intellectual property of Nuclear Power Corporation of India Limited

5.4.11 High speed earthing switch operation should be possible locally from the bay control unit, or remotely from the control room in conjunction with opening of the associated disconnector.

5.4.12 Interlocks shall be provided so that remote/local control is disabled during manual operation. Each high speed earthing switch shall be fitted with auxiliary switches having four NO & four NC auxiliary contacts for use by others, over and above these required for local interlocking and position indication. All contacts shall be wired to terminal blocks in the bay control unit. Provision shall be made for padlocking the earthing switches in their open or closed position.

5.4.13 All portion of the earthing switches and operating mechanism required for connection to ground shall be connected together utilizing adequately sized copper conductor

5.4.14 The main earthing connection on each earthing switch shall be rated to carry the peak withstand current rating of the switch for 1 sec. and shall be equipped with a silver plated terminal connector suitable for steel strap of adequate design for connection to the earthing grid. Alternative type tested design of the manufacturer shall also be acceptable.

5.4.15 The high speed make proof earthing switches shall confirm to the requirements of IEC-62271-102.

5.5 Gas Insulated Surge Arrestors

5.5.1 The surge arrestors shall confirm in general to latest IEC –60099-4.

5.5.2 Rating and Quantity of the Surge arrestors may be referred from the SLD I02.KK56.0.0.ET.OKP.WD004 and GTP.

5.5.3 Duty requirements

a) The surge arrester shall be of heavy duty station class and gapless (Metal oxide) type without any series or shunt gaps.

b) The surge arresters shall be capable of discharging over-voltages occurring during switching of unloaded transformers, reactors and long lines.

c) 420kV class arrester shall be capable of discharging energy equivalent to class 5 of IEC

d) The reference current of the arresters shall be high enough to eliminate the influence of grading and stray capacitance on the measured reference voltage.

e) The surge arrestors are being provided to protect the equipment, i.e. power transformer, instrument transformer etc. The details of lightning impulse withstand capacity of the equipment are available in the Tender.

f) Short Circuit rating and PRD requirement shall be as per relevant clauses of this specification and IEC 60099-4.

This document is an intellectual property of Nuclear Power Corporation of India Limited

5.5.4 Constructional Features

a) The nonlinear blocks shall be of inferred metal oxide material. These shall be provided in such a way as to obtain robust construction, with excellent mechanical and electrical properties even after repeated operations.

b) The arrestor enclosure shall be vertically or horizontally mounted to suit the layout of the switchgear as suggested by the manufacturer and shall be fitted with a discharge counter located in an easily accessible position.

c) The main earthing connection from the surge arrestor to the earth shall be provided. The size of the connecting conductor shall be such that all the energy is dissipated to the ground without getting overheated.

5.6 Gas insulated bus duct

5.6.1 The bus conductor shall be preferably connected with plug in contacts with silver plated contact surface or any other connections types as per type tested design.

5.6.2 Necessary bellows with sealing arrangements as applicable shall be provided along with supply to fill the gap between the GIBD crossing the wall and the wall surrounding it, such that, there will be total sealing, to prevent any ingress of water, dust from outside. . In case of provision of bellows the same shall be of stainless steel grade 316L/321 (minimum) to take care of the highly corrosive atmosphere prevailing at KKNPP site. Additionally, appropriate protective coating shall also be provided on the bellows.

5.6.3 Necessary interim/ temporary arrangements of sealing of these openings shall also be made during the construction phase to prevent any ingress of water/ dust etc. without any extra cost.

5.6.4 The equipment shall be constructed with all necessary compensators to allow for thermal expansion,

5.6.5 It is required that the three phases of equipment at each bay be arranged side by side in segregated phase blocks. The arrangement of equipment offered must provide adequate access for operation, testing and maintenance and shall be subject to approval of Purchaser. Maintenance/ operation platform shall be provided between two bays, if required for satisfactory operation.

5.6.6 The quantity of SF_6 switchgear and bus duct to be offered shall be in accordance with the requirements based on single line diagram (I02.KK56.0.0.ET.OKP.WD004).

5.6.7 For the Gas insulated bus duct between the 400kV GIS and Generator Transformer(s) additional requirements are given in Annexure A of this document.

5.7 Outdoor SF_6 – Air Bushings

5.7.1 Outdoor SF_6 – Air bushings, for the connection of conventional external conductors to the GIS shall be provided. The dimensional and clearance requirements for the metal

This document is an intellectual property of Nuclear Power Corporation of India Limited

enclosure will be the responsibility of the manufacturer and their dimensions must be coordinated with the switchgear. Bushings shall generally be in accordance with the requirements of IEC publication 137 as applicable. Minimum clearances have already been specified in the relevant section of Data sheet for 400kV GIS. In addition to such clearances, the Contractor shall provide additional clearances to ensure sufficiency even during carrying out of the HV test without any need for modification/ re-arrangement/temporary removal of earthing conductors, etc.

5.7.2 Bushing types and fitting:

Bushing type selected shall be any of the following as specified in datasheet.
Composite insulator-hollow bushings /Condenser type bushings.

5.7.3 Mechanical forces on bushing terminals

Outdoor bushings must be capable of withstanding cantilever forces due to weight of bus duct and short circuit forces. Minimum Cantilever strength of the bushings shall be as per Datasheet I02.KK56.0.0.ET.TS.PR045

5.7.4 Bushings shall be designed to have ample mechanical strength and rigidity for the conditions under which they will be used. Outdoor bushings must be capable of withstanding a cantilever force applied to the terminal of at least 10kN. All bushings of identical ratings shall be interchangeable.

5.7.5 Hardware used for current carrying parts (such as nuts, bolts etc.) shall be 304 Grade/ brass or as per manufacturer type tested design. All current carrying contact surfaces shall be silver faced. Silver facing shall not be less than one mm in thickness.

5.7.6 The flange shall be made of weather resistant, corrosion proof material. Suitable arrangement for connection of flange to ground shall be provided. If required corona ring shall be provided which will be of Copper/ Brass.

5.7.7 All bushings shall have an impulse and power frequency withstand level that is greater than or equal to the level specified in the data sheet.

5.7.8 Bushing shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture. Glazing of the porcelain shall be of uniform brown colour free from blisters, burns and similar other defects.

5.7.9 The parameters characterising the SF_6- Air bushing profile shall be such that it is suitable for the "Very heavy" pollution level (salt contamination) prevailing at site and also suitable for washing. The creepage distance over the external surface of outdoor bushings shall not be less than 31 mm/kV. washing.

5.7.10 Puncture strength of bushings shall be greater than the dry flash-over value. When operating at normal rated voltage, there shall be no electric discharge between the conductors and bushing which would cause corrosion/ erosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. Radio

This document is an intellectual property of Nuclear Power Corporation of India Limited

Interference levels of the SF6-Air Bushing shall be within the limits specified as per IEC 60137. All joints shall be air-tight. Surface of the joints shall be trued-up; porcelain parts by grinding and metal parts by machining. Bushing design shall be so as to ensure uniform compressive pressure on the joints.

5.7.11 Bidders shall furnish details of provision made to bimetallic corrosion wherever dissimilar materials (such as copper, Aluminium) are used.

a) Conductor in the switchgear/ bus duct and the current carrying part in the bushing.

b) Terminal stud should be suitable for connecting to the Copper/Brass clamp with Copper tubular conductor.

5.8 Local Control Cabinet with Bay Control Unit

5.8.1 Separate Local Control Cabinet (LCC) for each bay (A bay comprises of one circuit breaker and associated disconnector, earth switches and instrument transformer) shall be supplied as a part of this contract to facilitate local control, interlock implementation and monitoring of circuit breakers, isolators and earth switches. LCCs shall be of dust and vermin proof construction. These shall be located near the GIS.

5.8.2 These panels shall also house the various selector switches, relays, timers, local indications, alarms and facia annunciation, etc. to realise various interlocks as per requirement among circuit breakers, isolators and earth switches and for breaker pole discrepancy, anti-pumping ,etc. Besides local control the LCC shall be used for termination of CT and PT cables, Gas monitoring control cables, Status monitoring cables, etc. from GIS bay.

5.8.3 Bay Control Unit (BCU) - BCUs shall be utilised for control, interlocks (as applicable), monitoring of circuit breakers, isolators and earth switches. BCUs shall be located in the local panel as envisaged in the tender. No separate mimic display other than in the BCU is envisaged. SLD including position indication of all primary components of GIS, measuring parameters, status, diagnostics, etc. are envisaged in the BCU.

5.8.4 Alarms and Messages from BCU: For I/O list refer relevant clause of TS for SCADA (I02.KK56.0.ET.TS.PR104) and CMRP for EHV system (I02.KK56.0.ET.TS.PR092)

5.8.5 LED Indications in BCU shall be finalized during execution

5.8.6 Completely separate and isolated circuits shall be used for operating mechanism control, trip-1, trip-2, close, alarms and auxiliary devices. Close and trip circuits shall be kept isolated to their final mechanical or electrical actuators from the LCC terminals.

5.8.7 Trip circuit-1 & trip circuit-2 shall be individually monitored for continuity under open and closed condition of breaker. Contractor shall provide minimum two (2) numbers of 220V DC supply feeders for each local control panel. Both the supplies shall be monitored continuously and alarm given on failure. One feeder shall be used for close, protection - 1 and one of the trip circuits whereas the other feeder shall be used exclusively for the second trip circuit and protection - 2 circuit. For alarm, auxiliary

This document is an intellectual property of Nuclear Power Corporation of India Limited

devices, annunciation indication, a separate 220V DC control supply feeder as required by Manufacturer shall be provided by Contractor to LCC.

5.8.8 Contractor shall provide separate DC/AC power supply feeders to each LCC for the purpose of heating and lighting as per OEM recommendation.

5.8.9 The Contractor shall supply all necessary equipment and control for automatic change over from one source of supply to the other in the event of failure of one source/ contactor drop out.

5.8.10 A local isolating switch for disconnection of power supply, a set of open/ close push button, Local/ Remote selector switch magnetic contactor with thermal overload relays and HRC link type fuses/MCB for short circuit protection shall be provided in LCC for each individual motor of CB, isolator and motorised earth switch by the Contractor. Overload relays shall be of hand reset type.

5.8.11 A mimic diagram (no separate mimic other than in the BCU) shall be provided on the front of the panel with control switches and position indicators for CB, isolator and earth switches. The panel will be dead front type with front door having clear glass cut out of adequate size so that mimic diagram, annunciator windows, indicating lamps are clearly visible from outside.

5.8.12 The contacts and signals originating from/going to the GIS, associated auxiliary and monitoring equipment shall be wired up to the LCC, for external use.

5.8.13 LCC schematics shall be updated with interfacing details (with CMRP, SCADA, Other Systems) and provided to the Purchaser for review and acceptance prior to start of commissioning activities.

5.8.14 Local Alarm & Annunication:

a) Alarm contacts shall be provided for monitoring all vital systems of each circuit breaker and gas system. The alarm contacts for the circuit breakers shall be wired to terminals in the LCCs.

b) Window type alarm annunciation shall be provided on LCC of each bay for the various abnormal conditions.

c) Three potential free electrical contacts shall be provided exclusively for remote alarm/ indication with each and every alarm/Trip condition. These contacts shall be in addition to those required for local indication. These are to be wired to the terminal blocks in the LCC.

d) Alarm circuit shall not respond to faults for momentary conditions.

e) The following minimum no. of abnormal conditions shall be made available in the LCC:

i. Gas refill level for each gas compartment of the bay. (low gas pressure)·

This document is an intellectual property of Nuclear Power Corporation of India Limited

ii. Breaker Block level for each gas compartment of the bay. (Minimum gas pressure)

iii. Over pressure in the bay.

iv. Isolator motor overload (one per each bay)

v. Alarm circuit D.C healthy(Continuously on)

vi. Breaker pole discrepancy

vii. Isolator open/ close incomplete

viii. DC control supply fail.

f) In addition to the minimum abnormal conditions listed above, any other abnormal condition as per the manufacturer shall also be annunciated.

5.8.15 All current transformer tap leads shall be terminated on shorting type terminal blocks in the LCC and shall be accessible at all times. All potential transformer leads shall be terminated and protected by MCB.

5.8.16 All other devices shall be wired to heavy duty terminal blocks provided in the local control cabinet. The terminal blocks shall have no less than 20% spare terminals per cabinet. Wiring shall use copper conductors, 1.5 mm^2 minimum. For PT's the wire size shall be 4 mm^2 and for CTs shall be 4/2.5 mm^2

5.8.17 All cable connections between the various GIS modules and the LCCs shall be in GIS Manufacturer’s scope. The connections shall be made by prefabricated multi-core cables with multi-point plug -in connections on both ends. VT's and CT's shall be hard wired. Input CT connections shall be converted into 3-phase, 4-wire system in LCC. Neutral of all CT/ PT shall be connected to earth in this panel through an earth link to facilitate testing. All cables shall be shielded.

5.8.18 The Bay Control Unit (BCU) shall be designed & installed so as to control and monitor all the equipment of each bay. The BCU shall comprise the following main functional parts:

- IEC 61850 standard compliant communication
- Bay control Intelligence Electronic Devices (IEDs) for control and monitoring
- Redundant human machine interface (HMI) Managed switched Ethernet switches (complying with IEC – 61859 standard requirements) for each LCC complying with IEC-61850 standard requirements.

5.8.19 Dedicated Bay Control Units (BCU) shall be provided for each bay, for Control functionality in compliance with IEC-61850 standard. The minimum required Control functions in BCU shall be as per the details given in this specification.

This document is an intellectual property of Nuclear Power Corporation of India Limited

5.8.20 One Bay Control Unit shall provide complete functionality for one bay. Each set of BCUs shall have sufficient digital inputs to acquire the status of each and every circuit breaker, isolator, earth switch, non-communicable supervisory relay, etc. of that bay. Similarly the digital output shall be sufficient to control all the switchgear and also for functions like resetting of relays, etc. in one bay. It shall include intelligent electronic devices (IED) for bay control and inter IED communication infrastructure.

5.8.21 General System Design of BCU

i. The system shall be of state-of-the art technology suitable for operation under electrical environment present in extra high voltage substations, follow the latest engineering practice, and ensure long-term compatibility requirements and continuity of equipment supply and the safety of the operating staff.

ii. The BCU shall support remote control and monitoring from Remote Control centers via gateways.

iii. The system shall be designed such that personnel even without any background knowledge in Microprocessor-based technology are able to operate the system. The operator interface shall be intuitive such that operating personnel shall be able to operate the system easily after having received some basic training.

iv. The system shall incorporate control and monitoring functions specified, self-monitoring, signaling and testing facilities, measuring as well as memory functions, event recording and evaluation of disturbance records.

v. Maintenance, modification or extension of components shall not cause a shutdown of the bay level unit. Self-monitoring/diagnostics of components, modules and communication shall be incorporated to increase the availability and the reliability of the equipment and minimize maintenance.

vi. Each bay control IED shall be independent from each other and its functioning shall not be affected by any fault occurring in any of the other bay control units of the station.

5.8.22 System Architecture

i. At bay level, the IEDs shall provide all bay level functions regarding control and monitoring, inputs for status indication and outputs for commands. The IEDs should be directly connected to the switchgear without any need for additional interposition of transducers. However, all the commands extending for control of switchgear shall be routed through suitable trip/auxiliary relays.

ii. The data exchange between the electronic devices on bay level shall take place via the communication infrastructure. This shall be realized using redundant fiber optic cables, thereby guaranteeing disturbance free and reliable communication. Data exchange is to be realized using IEC 61850 standard protocol with Ethernet communication infrastructure in a decentralized ring configuration.

This document is an intellectual property of Nuclear Power Corporation of India Limited

iii. All the numerical IEDs must be fully IEC 61850 compliant and shall have the following minimum features.

- Peer-to-peer communication using GOOSE messages (IEC 61850) for interlocking.
- Interpretability with third party IEC 61850 compliant devices
- Generate XML file for integration/engineering with vendor independent SCADA systems.
- Should be directly connected to the inter bay bus on IEC 61850 without the use of any gateways.

iv. Clear control priorities shall prevent operation of a single switch at the same time from more than one of the various control levels, i.e. station HMI, bay level or apparatus level. The priority shall always be on the lowest enabled control level and shall be finalized during detail engineering.

v. GPS time synchronizing signal (as specified elsewhere) for the synchronization of the entire system shall be provided.

5.8.23 Functional Requirements

The high-voltage apparatus within the station shall be operable from different places:

- Station HMI/ Remote control centers

- Local Bay controller IED (in the bays)

Operation shall be possible by only one operator at a time and the selection shall be governed by the Purchaser's operating personnel.

i. **Select-before-execute**

For security reasons the command is always to be given in two stages; selection of the object and command for operation under all mode of operation except emergency operation. Final execution shall take place only when selection and command are actuated.

ii. **Command Supervision**

a) Bay interlocking and blocking:

Software interlocking is to be provided to ensure that inadvertent incorrect operation of switchgear causing damage and accidents in case of false operation does not take place.

In addition to software interlocking hardwired interlocking are also to be provided for Bus earth switch interlocking.

This document is an intellectual property of Nuclear Power Corporation of India Limited

It shall be a simple layout, easy to test and simple to handle when upgrading the station with future bays. For software interlocking the bidder shall describe the scenario while an IED of another bay is switched off or fails.

A software interlock override function shall be provided which can be enabled to bypass the interlocking function.

b) Run Time Command cancellation:

Command execution timer (configurable) must be available for each control level connection. If the control action is not completed within a specified time, the command should get cancelled.

c) Self-supervision:

Continuous self-supervision function with self-diagnostic feature shall be included.

d) User Configuration:

The monitoring, controlling and configuration of all input and output logical signals and binary inputs and relay outputs for all built-in functions and signals shall be possible both locally and remotely.

It shall also be possible to interconnect and derive input and output signals, logic functions, using built-in functions, complex voltage and currents, additional logics (AND-gates, OR gates and timers).(Multi-activation of these additional functions should be possible).

iii. **Bay level functions:**

In this respect, the following functions can be allocated at bay level:

- Bay control functions including data collection functionality in bay control unit.

iv. **Bay control functions**

Overview Functions

- Control mode selection
- Select-before-execute principle
- Command supervision:
    - Interlocking and blocking
    - Double command
- Run Time Command cancellation
- Operation counters for circuit breakers
- Operating pressure supervision
- Breaker position indication per phase

This document is an intellectual property of Nuclear Power Corporation of India Limited

- Alarm annunciation
- Measurement display
- Local HMI (local guided, emergency mode)
- Interface to the station HMI.
- Data storage for at least 200 events
- Extension possibilities with additional I/Os inside the unit or via fibre-optic communication and process bus

v. **Control mode selection**

a) Bay level Operation

As soon as the operator receives the operation access at bay level the operation is normally performed via bay control IED. During normal operation bay control unit allows the safe operation of all switching devices via the bay control IED.

b) EMERGENCY mode

It shall be possible to close or open the selected Circuit Breaker with ON or OFF push buttons even during the outage of bay IED.

c) REMOTE mode

Control authority in this mode is given to a higher level (Remote Control Centre) and the installation can be controlled only remotely. Control operation from lower levels shall not be possible in this operating mode.

5.8.24 System Hardware

a) Bay level unit

The bay unit shall use industrial grade components. The bay level unit, based on microprocessor technology, shall use numerical techniques for the calculation and evaluation of externally input analogue signals. They shall incorporate select-before-operate control principles as safety measures for operation via the HMI. They shall perform all bay related functions, such as control commands, bay interlocking, data acquisition, data storage, event recording and shall provide inputs for status indication and outputs for commands. They shall be directly connected to the switchgear. The bay unit shall acquire and process all data for the bay (Equipment status, fault indications, measured values, alarms etc.) and transmit these to the other devices in substation automation system. In addition, this shall receive the operation commands from station HMI. The bay unit shall have the capability to store all the data for at least 24 hours.

One number Bay level unit shall be provided for supervision and control of bay (a bay comprises one circuit breaker and associated disconnector, earth switches and instrument transformer). The bay level unit shall be equipped with analogue and

This document is an intellectual property of Nuclear Power Corporation of India Limited

binary inputs/outputs for handling the control, status monitoring and analogue measurement functions. All bay level interlocks are to be incorporated in the Bay level unit so as to permit control from the Bay level unit/local bay mimic panel, with all bay interlocks in place, during maintenance and commissioning or in case of contingencies when the station HMI is out of service.

The Bay level unit shall meet the requirements for withstanding electromagnetic interference according to relevant parts of IEC 61850. Failure of any single component within the equipment shall neither cause unwanted operation nor lead to a complete system breakdown.

b) Input/ Output (I/O) modules

The I/O modules shall form a part of the bay level unit and shall provide coupling to the substation equipment. The I/O modules shall acquire all switchgear information (i.e. data coming directly from the switchgear or from switchgear interlocking devices) and transmit commands for operation of the switchgear. The measured values of voltage and current shall be from the secondaries of instrument transformers. The digital inputs shall be acquired by exception with 1 ms resolution. Contact bouncing in digital inputs shall not be assumed as change of state

vi. **Software structure**

The software package shall be structured and divided in various levels. Necessary firewall shall be provided at suitable points in software to protect the system. An extension of the station shall be possible with lowest possible efforts. Maintenance, modification or an extension of components of any feeder may not force a shut-down of the parts of the system which are not affected by the system adaptation.

Bay level software

System software
The system software shall be structured in various levels. This software shall be placed in a non-volatile memory. The lowest level shall assure system performance and contain basic functions, which shall not be accessible by the application and maintenance engineer for modifications. The system shall support the generation of typical control macros and a process database for user specific data storage. In case of restoration of links after failure, the software along with hardware shall be capable of automatically synchronising with the remaining system without any manual interface. This shall be demonstrated by contractor during integrated system test.

Application software
In order to ensure robust quality and reliable software functions, the main part of the application software shall consist of standard software modules built as functional block elements. The functional blocks shall be documented and thoroughly tested. They form part of a library. The application software within the control devices shall be programmed in a functional block language.

This document is an intellectual property of Nuclear Power Corporation of India Limited

5.8.25 Tests for BCU shall be as per the Indicative QAP

5.8.26 If software is used in control, the latest software version along with requisite software tools shall be supplied for the purposes of diagnostics, change in various settings including protection in LCC.

The software shall preferably have been developed indigenously to enable optimized long term cost on account of modification and upgradation.

5.9 Controlled switching scheme/cabinet

5.9.1 Controlled Switching Scheme shall be provided for all the breakers. This feature shall be selectable by the Purchaser's operator as and when required. The circuit breaker shall be suitable for the application of controlled switching for consequent optimization of switching behaviour, when:

1) Switching in and reclosing the line – reduction of switching surge severity.

2) Switching in the Transformer – reduction of inrush current.

3) Switching off the Shunt Reactor – elimination of re-ignitions

5.9.2 The controlling relay shall also record and monitor switching operations and make adjustments to the switching instant to optimize switching behaviour as necessary. It shall provide self-diagnostic facilities, signalling of alarms and enable downloading of data captured from switching events.

5.9.3 Calculations and related test reports of scheme proving rating for duties specified above shall be furnished in the bid. The calculations shall take care of requirements of programming, etc. for setting switching for various duties like long line, Shunt reactor, power transformer and time setting.

5.9.4 The proposed scheme should be designed keeping in view all the system parameters of the plant and applicability with various operations. This scheme shall not lead to any possible malfunction of the Circuit Breaker. The very advantage of provision of controlled switching should not be spoiled due to any design defect. All the preliminary literatures on this scheme should be provided with the bid. Bidder shall provide all the detailed documents, function diagrams, calculations and design criteria, etc.

5.9.5 The controlled switching relay shall be communicable and shall be supplied with all the original customized licensed software, I/O cards, required cables, etc., computer hardware, etc.

5.9.6 Any modification required in control & relay panel for incorporation of this Controlled switching device scheme requirement shall also be in the scope of bidder.

5.10 Current Transformers

5.10.1 General

a) The current transformers and accessories shall conform to IEC: 61869-1 and other relevant standards except to the extent explicitly modified in this specification.

This document is an intellectual property of Nuclear Power Corporation of India Limited

b) The particulars of the various cores may change within reasonable limits as per the requirements of protection relay supplier. Other characteristics of CTs shall be as given in datasheet.

5.10.2 Constructional Details:

a) The current transformers shall be of metal-enclosed and epoxy cast resin type and CTs shall be given tropicalised treatment for satisfactory operation in hot and humid climate. All the current transformers shall have effective electromagnetic shields to protect against high frequency transients.

b) The CT secondary terminals should be brought outside the HV enclosures through a bushing of 1.1 kV class and mounted in suitable accessible weather proof terminal box. All secondary leads must be wired to shorting type terminals on the terminal strip in the local control panel of each breaker bay. The star point shall be formed whenever required at the terminal box only.

c) Each CT shall, when called for in specific requirements in the data sheet, be equipped with an over voltage protective device to limit the voltage developed across the secondary terminals to safe value not exceeding 2.5 kV.

d) In case of multi core CTs, it shall be possible to adjust the tap setting on any core independent of the settings on the other cores. These tappings shall be provided on the secondary windings.

e) All CT cores shall be of low reactance type and no turns compensation shall be used in case of Class PS/PX CTs.

f) The magnetising characteristics, (extending well beyond knee point voltage) and secondary impedance values shall be furnished in guaranteed particulars for all protection cores.

g) Terminal and polarity marks shall be indelibly marked on the each CT, associated terminals and these marks shall be in accordance with the relevant standards.

h) Current transformers guaranteed burdens and accuracy class are to be intended as simultaneous for all cores.

i) The rated extended primary current shall be 150% at highest ratio and 200% at ratios other than highest ratios.

j) The instrument security factor at all ratios shall be less than five (5) for metering core. If any auxiliary CTs/reactor are used in the current transformers then all parameters specified shall have to be met treating auxiliary CTs as an integral part of the current transformer. The auxiliary CTs/reactor shall preferably built in construction of the CTs.

k) The wiring diagram, for the interconnections of the three single phase CTs shall be provided inside the marshalling box.

This document is an intellectual property of Nuclear Power Corporation of India Limited

l) The current transformers shall be suitable for high speed auto-reclosing.

m) Provisions shall be made for primary injection testing either within CT or outside.

n) Electromagnetic shields to be provided against high frequency transients typically 1-30 Hz.

5.10.3 Ratios and Characteristics

a) The number, rating, ratios, accuracy class, etc. for the individual current transformers secondary cores shall be in accordance with 400kV SLD (I02.KK56.0.0.ET.OKP.WD004). Where multi-ratio current transformers are required the various ratios shall be obtained by changing the effective number of turns on the secondary winding.

b) The physical relative location of the core in the CT should be in accordance with the location shown in the SLD, so as to ensure over lapping of protective zones.

5.10.4 Minimum accuracy for cores:

a) Class PX shall be provided for relaying core as per 400kV SLD. The relaying core shall be of low remanance design. The gap in the core shall not be larger than necessary to limit the remanance.

b) Accuracy class for metering core on all ratios shall be as specified in 400kV SLD. For each type of CT, the application data shall be supplied in accordance with IEC – 61869.

5.10.5 Rating and Diagram Plates

a) Rating and diagram plates shall be as specified in the IEC specification incorporating the year of manufacture. The rated extended current rating voltage and rated thermal current shall also be marked on the name plate. The low remanance designation shall also be marked.

b) The diagram plates shall show the terminal markings and the relative physical arrangement of the current transformer cores with respect to the primary terminals (P1 & P2).

c) The position of each primary terminal in the current transformer SF_6 gas section shall be clearly marked by two plates permanently fixed to the enclosure at each end of the current transformer.

5.10.6 CT shall be provided with following accessories :

a) Two earthing terminals for connecting Purchaser's earthing conductors specified.

b) Power factor testing terminal

5.11 Voltage Transformers

This document is an intellectual property of Nuclear Power Corporation of India Limited

5.11.1 General

a) The voltage transformers shall conform to IEC- 61869-3 & 61869-2 and other relevant standards except to the extent explicitly modified in this specification.

b) Voltage transformers shall be of the electromagnetic type with SF_6 gas insulation. The earth end of the high voltage winding and the ends of the secondary winding shall be brought out in the terminal box.

5.11.2 Constructional Details

a) The bus voltage transformers shall be located in a separate bay module on the bus and will be connected phase- to ground and shall be used for protection, metering and synchronization.

b) VT provided for the bus shall be metal enclosed gas insulated electromagnetic type mounted on the HV enclosure after bus VT isolator with plug in contacts that allow easy removal.

c) The voltage transformers shall be of electromagnetic type inductive type,, non-resistant and shall be contained in their own SF_6 compartment, separated from other parts of installation. The voltage transformers shall be effectively shielded against high frequency electromagnetic transients. The voltage transformers shall havetwo secondary windings.

d) Voltage transformer secondary shall be protected by HRC cartridge type fuses/MCB for all the windings.. The secondary terminals of the VT's shall be terminated to the stud type non-disconnecting terminal blocks in the secondary boxes via the fuse/MCB.

e) Both the terminals of the secondary winding must be brought through 1.1kV class bushing. Secondary terminals of each phase must be located in accessible earthed terminal box on the PT enclosure itself. The secondary connections must be wired to the respective bay LCC and the star formation should be done in the LCC. The minimum size of the conductor shall be 2.5 sq.mm copper.

f) In case of unearthed voltage transformers both the terminals of the primary winding shall be brought out through bushings rated for full line voltage. In case of earthed voltage transformers, the end of the primary winding intended to be earthed shall be brought out through a bushing and earthing connection shall be made outside.

g) This is required to facilitate meggering of the primary winding for which the earth connection has to be removed. Neutral side of HV winding shall be brought out through a bushing rated for at least 1.1kV class and located in a terminal box.

h) The secondary terminal box for the voltage transformers shall also include necessary HRC fuses/MCB for protecting the secondary circuit. Further, for the purpose of fuse supervision on remote panel, both terminals of fuse shall be brought out from the terminal box and wired up to local control panel.

This document is an intellectual property of Nuclear Power Corporation of India Limited

i) The voltage transformer should be thermally and dielectrically safe when the secondary terminals are loaded with the guaranteed thermal burdens.

5.11.3 Ratios and Characteristics

a) The number, rating, ratios, accuracy class, connection etc. for the voltage transformers shall be in accordance with 400kV SLD (I02.KK56.0.0.ET.OKP.WD004).

b) Whenever VT secondary is used for both measurement and protection application, it shall have dual accuracy class of 0.2/ 3.0 unless otherwise specified.

5.11.4 Rating and diagram plates

a) Rating and diagram plate shall be provided complying with the requirements of the IEC specification incorporating the year of manufacture and including turns ratio, voltage ratio, burden, connection diagram etc.

b) Minimum accuracy, burden and transient response characteristics shall be in accordance with data sheet of this specification.

c) The diagram for the interconnection of the VTs shall be provided inside the marshalling box.

5.11.5 Secondary Terminals, Earthing and Fuses

a) The beginning and end of each secondary winding shall be wired to suitable terminals accommodated in a terminal box mounted directly on the voltage transformer section of the SF_6 switchgear. All terminals shall be stamped or otherwise marked to correspond with the marking on the diagram plate. Provision shall be made for earthing of the secondary windings inside the terminal box.

b) The transformer shall be able to sustain full line to line voltage without saturation of transformer. The accuracy class shall be at maximum tap.

5.12 **Auxiliary switches**

5.12.1 Auxiliary switches shall be directly connected to the main operating shaft. Electrically separate, reversible and adjustable type auxiliary switches shall be provided on breakers, disconnect switches and earthing switches to satisfy the requirements.

5.12.2 Each contact shall have adequate rating as per requirements.

5.12.3 The Contractor shall indicate the operating time of all Auxiliary switches on the appropriate drawings.

5.12.4 Auxiliary switches which are not utilized in the control circuit shall be connected to the terminal blocks for external use. The auxiliary contacts shall be of silver

This document is an intellectual property of Nuclear Power Corporation of India Limited

copper/manufacturer specific design. When make before break contacts specified, they shall be wiping type.

5.13 LV Motors

LV Motors used in LCCs of the GIS shall be as per manufacturer's type tested design.

5.14 Seismic Design Criteria

5.14.1 The 400kV GIS and GIBD shall be seismically qualified as per IEEE 693 for high level.

5.14.2 To prevent the movement of GIS sub-assemblies i.e. various bay modules during the earthquake, suitable devices shall be provided for fixing the sub-assemblies to the foundation. The vendor shall supply necessary bolts for embedding in the concrete foundation. The fixing of GIS sub-assemblies to the foundation shall be designed to with-stand the seismic events. It will also be ensured that the special devices as well as bolts shall not be over stressed. The details of the devices used and the calculations for establishing the adequacy shall be furnished by the supplier and shall be subject to the Purchaser's approval.

5.14.3 Bidder should furnish test certificates, if available to prove seismic withstand capability. If identical GIS have not been tested in the past, successful bidders will have to furnish design calculation or carry out testing to prove seismic withstand capacities. If valid seismic reports are not available with bidder, bidder shall carry out seismic analysis and cost of the same shall be included in the supply cost itself.

5.14.4 Support structures of shall be designed and supplied by the GIS manufacturer.

5.15 Cabling

5.15.1 The cable supply and cabling to achieve following interconnections shall be included in Contractor's scope.

a) Entire cabling among mechanism cabinets of various circuit breakers, isolators and earth switches to local control panel.

b) Cabling between current transformer, voltage transformer cabinets to local control panel.

c) Cabling among various mechanism cabinets and local control panels for realising interlocks.

d) Cabling from various monitoring, control and instrumentation equipment being supplied under this contract up to local control panel.

5.15.2 Contractor shall include all the hardware and accessories required for cabling in his scope of supply.

This document is an intellectual property of Nuclear Power Corporation of India Limited

5.15.3 The power & control cables supplied by OEM (all cables within GIS equipment including LCC) shall be copper conductor, flame retardant and low smoke type as per OEM's standard practices.

5.15.4 Preparation of Fabrication/Erection drawings for Cable carrier systems of 400kV GIS building (UAB): - KKNPP 5&6 Cable tray routing layout for the respective areas will be provided by the Purchaser. The Contractor shall prepare the drawings for erection and fabrication of Cable carrier systems based on the layout drawings of Purchaser.

5.16 Partial Discharge Monitoring System (Online and Portable)

5.16.1 Online PD monitoring system

i. Scope

The intent of this specification is to define the requirements for design, supply, delivery, installation, site testing and commissioning of the complete continuous PD monitoring system to monitor the internal partial discharges in 400kV Gas Insulated Switchgear (GIS) including Gas Insulated Bus Duct (GIBD) portion from 400kV GIS to GT, by measuring signals in the UHF range (Ultra High Frequency).

ii. Purpose

- The system shall be a continuous monitor partial discharge in the said gas-insulated switchgear (GIS).
- The partial discharge data shall be displayed in a way that allows the operator to recognise the type of defect present. It shall be able to recognise/separate signals originating from partial discharges and switching operations/external sources of interference. Switching operations in the GIS (Very Fast Transient signals), shall be measured and evaluated separately
- Diagnostic software to assist the operator in identification of the defect discharge signal shall be provided as a part of the system.
- It shall also be able to retrieve and display data in a way that allows the operator to look for changes in the discharge behaviour that might indicate an escalation in severity (trend analysis).

iii. Pre-Qualification

The system should have a proven installation and operational history at a minimum of five (5) independent locations, each with a minimum of two (2) years of operation. Necessary documents/proof and references in this regard shall be furnished by the bidder along with the offer. Only vendors satisfying this requirement shall be further considered.

iv. Features

The subject system shall be comply/be equipped with following minimum key features:

This document is an intellectual property of Nuclear Power Corporation of India Limited

- Continuous real-time measurement and PD analysis
- Access to partial discharge data and System administration functions protected by password
- Number of UHF Sensors as per CIGRE recommendations
- Minimum noise detection and suppression
- UHF signal classification using appropriate Data Analysis System.
- Alarm and Set-up assistance wizards to guide the user in configuration
- HMI for Alarms, Reports and Configuration options
- Ability to call and display 3 Dimensional GIS schematics showing spatial relationship between couplers, in the GIS.
- Automatic report generator
- GPS time synchronisation/time stamping

v. Specifications/Requirements

The scope of work shall include but not be limited to providing:

- Suitable number of UHF PD couplers to achieve good sensitivity in line with CIGRE recommendations
- Appropriate number of PD node unit, for electronic conditioning of PD signal from couplers
- Suitable data transmission system using optical-fibre bus system and/or Copper Ethernet system
- Central processor unit and Man-machine-interface required for monitoring of the data stream from measuring nodes equipped with operating unit for visualisation, archiving and automatic interpretation of measuring data, evaluation software, etc.
- Complete sets of O & M manual and as built drawings
- Testing and commissioning of the system
- Essential spares
- Post delivery Service Agreement as detailed in the relevant section of this document but not limited to the same

vi. Detailed Scope

The System shall operate unattended and be structured to allow future expansion.
The system may also be required to be expanded, by addition of appropriate hardware and software, to monitor other parameters relevant to plant condition in future. The system shall be structured so as to allow and accommodate for future expansion. The bidder shall advise in their offer any limitation on such expansion capability .The system software shall run on Microsoft Windows XP Professional operating system.
The Contractor/Vendor shall also provide update/upgrade of software for a period no less than 5 years from the date of takeover by the Purchaser, at no extra cost. The Contractor/Vendor shall provide expert analysis of data atleast once in an year for a

This document is an intellectual property of Nuclear Power Corporation of India Limited

period no less than 5 years from the date of takeover of the system by the Purchaser, at no extra cost.

a. UHF couplers

The PD couplers to be used shall be of external, passive, maintenance free antenna type to be permanently installed on the switchgear enclosure. The sensors should be embedded into the system.

The PD couplers shall meet the following minimum specifications:

- Approved for in-service permanent continuous monitoring use
- Detection spectra range: 400 MHz to 1.8 GHz or as per CIGRE recommendations whichever is better
- Average sensitivity as per CIGRE recommendations
- Adequate shielding of the coupler and GIS to ensure that its operation and performance is not influenced by external interference

b. Node Units

Node units shall monitor all PD couplers continuously, independently and simultaneously to ensure that no PD pulse is missed. Each node will support a minimum number of continuously active input UHF Channels and minimum number of UHF noise channels as per CIGRE recommendations. The data connection must support both Copper Ethernet and Multi-Mode Fibre Optic.

c. Data Capture and Display

The system shall monitor all partial discharge couplers independently and continuously at the determined positions.
Appropriate noise gating in line with CIGRE recommendations shall be provided.

The data from all the PD converter boxes shall be transmitted to the central station during each mains voltage cycle (every 20 ms). Control signals from the central processor unit to the nodes should be transmitted simultaneously with transmission of the measured data from the measuring points to the central station.

The system shall be capable of recording and analysing all PD signals of amplitude above a pre-set level. The amplitude threshold for each coupler shall be variable and which can be set by the user.

Human Machine Interface (HMI) system with all the requisite DBMS software shall be provided.

The system should be capable of synchronizing, capturing and displaying PD data during HV testing of the GIS, for a power frequency in the range 40Hz to 220Hz.

This document is an intellectual property of Nuclear Power Corporation of India Limited

The system shall be able to retain the PD information obtained during the switchgear commissioning time as a fingerprint initial status of the switchgear to allow future monitoring, trending and analysis of the condition of the switchgear.

The system should regularly record all detectable PD activity for each coupler installed on the monitored equipment, regardless of its amplitude or intensity in order to provide the user with a clear indication of PD activity over a period of up to 5 years (trend plot).

The System shall be capable of displaying previously recorded data on a particular coupler alongside real time online data for the same coupler. A library function shall be available to allow archiving of typical or past data for each coupler. It shall be possible to save required profiles by the use of filenames, and retrieve them from storage and load them for comparison purposes against current data.

The Pattern Recognition System must have more than a Million patterns in it to enable PD signals to be identified automatically, and with high accuracy.
The system should also comply with IEC-61850 protocol.

d. Alarms

The system shall indicate by way of alarm(s), a failure in the power supply. Alarm(s) shall be generated, for a given partial discharge coupler, when PD activity meets a set criteria. A set of "clean", volt-free contacts shall be provided for each of the above alarms to allow interface with any existing site alarm scheme, and shall generate a local alarm in real time

As a minimum, power supply failure and ‘above threshold PD activity’ alarm shall be wired up to SCADA and control room panels for facia alarm.

e. Data Storage and Retrieval

The date/time stamp of all data recorded at the Substation shall as per CIGRE recommendations.
The system shall allow data to be stored in such a format that it may be imported into commercial software such as Microsoft Excel.

The System shall be designed in such a manner as to allow the backup Mass Media Storage system to be replaced with a connection to a server or other networked disk based device.

f. Installation

Any part of the System to which access for maintenance or repair may be envisaged shall, wherever possible, be located so as to be accessible from the ground level.

Where electrical cables are used to connect couplers to the partial discharge detection system, these shall be of low smoke and halogen free sheaths.

This document is an intellectual property of Nuclear Power Corporation of India Limited

g. Power supply:

PDM System shall be supplied with an uninterruptible power supply (UPS) capable of supplying the system for a minimum of 30 minutes to cover standby generator start up. The UPS shall be of 'on-line' type, generating no spikes on changeover.
The PDM System should be designed to operate from substation auxiliary supplies. Failure of auxiliary supply to the system shall be sensed and alarmed by the system. The system shall have been tested for relevant IEC EMC, environmental and vibration/shock standards and compatible with operation within a high voltage substation.

All hardware shall be corrosion resistant. All joints and connections of the panel members shall be zinc passivated, or cadmium plated, high quality steel bolts, nuts and washer.

vii. Applicable Standards

BS-EN 55022	Conducted emissions
BS-EN 60068-2-1	Low temperature
BS-EN 60068-2-2	Dry heat
BS-EN 60068-2-6	Vibration
BS-EN 60068-2-27	Shock
BS-EN 60068-2-56	Damp heat
BS-EN 60255-5	Dielectric withstand
BS-EN 60255-5	Insulation resistances
BS-EN 61000-4-2	Electrostatic discharge
BS-EN 61000-4-3	Radiated immunity
BS-EN 61000-4-4	Fast transient
BS-EN 61000-4-5	Surge
BS-EN 61000-4-6	Conducted immunity
BS-EN 61000-4-8	Power frequency magnetic field
BS-EN 61000-4-9	Pulsed magnetic field
BS-EN 61000-4-10	Damped oscillatory magnetic field
BS-EN 61000-4-12	Damped oscillatory wave

CIGRE recommendations

This document is an intellectual property of Nuclear Power Corporation of India Limited

viii. Test requirements

The Supplier shall submit the range of tests required for site acceptance tests of the equipment/system. The final test procedure shall be comprehensive and shall be to the satisfaction of Purchaser to prove that all the requirements specified above for each coupling device and the overall system have been fully and satisfactorily complied. In addition to the hardware tests specified above, the following tests shall be performed as a minimum requirement:

- Each signal input connection to the System shall be tested by injecting simulated partial discharge pulses or equivalent means. Sensitivity tests shall be done to check compliance to CIGRE requirements for UHF sensors.
- PD data shall be displayed in formats defined
- The regular recording of all PD activity shall be demonstrated together with the associated trend plots showing daily and historical archive functionality covering the specified period.
- The periodic recording of signals exceeding a pre-set threshold shall be demonstrated, together with an appropriate demonstration of the data analysis functionality.
- The backup of all data to a Mass Storage Device shall be demonstrated.
- Generation of alarm(s) for failure of part of the system which prevents capture or transmission of data shall be demonstrated. Failures may be simulated by disconnecting power supplies to parts of the System and by disconnecting signal leads.
- At the substation, correct operation of the volt-free contacts associated with the above alarms shall be confirmed.
- Demonstration of correct identification of plant switching operations wherever practical.
- Simulation of detection and alarm generation of PD signal.
- Power supply interruption.
- Demonstrate network protocol functionality.

ix. Service Life

Service Life of the complete system should be atleast 20 years.

x. Training and Manuals

The Contractor/Vendor shall provide training of the Purchaser’s personnel in all aspects of operation of the system at site. All required training materials and/or handouts necessary for the understanding of the system shall be provided by the Contractor/Vendor.
The Contractor/Vendor shall provide all the required installation, operation and maintenance (IOM) manuals for the system and interfaces. These IOM manuals shall be detailed enough to include the principle, philosophy of the monitoring system, the method of detection and analysis of information, etc.

This document is an intellectual property of Nuclear Power Corporation of India Limited

5.16.2 Portable PD monitoring system shall be Qualitrol/equivalent make using UHF technology based with wideband measurement across the frequency range of 300-1500 Mhz. Other parameters shall be as follows:

a) Input: 3 UHF channels+ 1 channel for noise antenna
b) Output: Alarm indication on the screen, PD alarm, PD warning alarm, System status indicator

Detailed specification shall be as per OEM's recommendations.

5.17 Reliability and life of GIS/ GIBD

5.17.1 All components of GIS equipments shall have the reliability parameters commensurate with the class specified in the relevant documents:

a) The standard mechanical endurance (without current in a main circuit)

i. for disconnecting switch

ii. For earthing switch –

iii. cycles "closing– arbitrary pause–opening" (C–$t_п$–O).

b) The switching endurance shall meet the values, given in table below :

Voltage class	Standard test voltage, kV									
	Switching impulse				full lightning impulse of positive and negative polarity, crest value			One--minute (rms) value		
	To earth	Between phases	Between the open contacts of the same pole		To earth	Between the open contacts of the same pole		To earth	Between the open contacts of the same pole	
			of CB	of disconnector		of CB	of disconnector		of CB	of disconnector
420	1050	1575	900(+345)	900(+345)	1425	1425(+240)	1425(+240)	650	815	815

c) The mean lifetime for current transformers shall not be less than GIS life cycle.

d) Service life up to a mid-life repair shall not be less than 15 years, if prior to this period, the mechanical and switching endurances of switchgear included in GIS are not exhausted.

e) The overall life is 30 years (minimum).

5.18 SF_6 Gas Supply

5.18.1 The contract shall include the supply of all the SF_6 gas necessary for initial filling (including entire losses, if any, during HV testing, Pre-commissioning/ commissioning) and make-up gas for leakages up to the time of take-over by Purchaser of the complete switchgear installation being supplied. The SF_6 gas shall be supplied in containers, which can be returned to be supplier after the plant is commissioned retaining only those many containers which will be required for future maintenance and spare requirement.

This document is an intellectual property of Nuclear Power Corporation of India Limited

5.18.2 The rated pressure of the SF_6 insulating gas in the GIS equipment shall be as low as possible while still meeting the requirements for electrical insulation and space limitations to reduce the effects of leaks and to ensure that there is no chance of the gas liquefying at the lowest ambient temperature. The initial gas pressure or density at the time of charging the equipment shall provide a 10% margin above the minimum allowable operating pressure for the plant to be safely operated for a reasonably long period before recharging is necessary.

5.18.3 In addition 20% of total gas requirement shall be supplied in separate cylinders as spare requirement, over & above the requirement of gas for successful commissioning.

5.19 SF_6 Gas Monitoring Devices and Alarm Circuits

5.19.1 The GIS shall be furnished with sufficient sulphur hexa-fluoride (SF_6) gas to pressurize the complete system in a sequential approach, one zone or compartment at a time to the rated nominal density.

5.19.2 All piping and fittings for gas monitoring and gas supply shall entirely be made of the same material. The earthing continuity between gas sections (enclosures) shall be kept.

5.19.3 All gas compartments must have their own independent gas supervision and alarm systems. Independent gas monitoring device shall be provided for each phase. There should not be any interconnection between gas compartments of different phases for the purpose of gas monitoring.

5.19.4 Contractor shall provide individual temperature compensated gas pressure gauge(s)/ density device(s) which continuously monitor the gas density in each of the individual gas compartments.

5.19.5 The devices shall provide continuous & automatic monitoring of the state of the gas & a separate device shall be provided for each gas compartment so that each compartment can be monitored simultaneously as follows:-

a) Compartments except circuit breaker

- 'Gas Refill' level

  This will be used to annunciate on the local control cubicle and remote control centre the need for the gas refilling. The Manufacturer shall provide a contact for remote indication.

- 'Zone Trip' level

  This is the minimum level at which the manufacturer will guarantee the insulation rating of the assembly (i.e. one minute power frequency voltage, BIL & SIL specified). At this pressure level it will be annunciated on the local control cubicle, remote control center Contact and control requirements shall be indicated by Contractor.

This document is an intellectual property of Nuclear Power Corporation of India Limited

b) Circuit Breaker

- 'Gas Refill' level

  This will be used to annunciate on the local control cubicle and remote control centre the need for the gas refilling. The Manufacturer shall provide contact for remote indication.

- 'Breaker Block' level

  This is the minimum gas density at which the manufacturer will guarantee the rated fault interrupting capability of the breaker. Beyond this level the device contacts lock out breaker (trip and close operation) circuits and annunciate the condition on the local control cubicle, remote control centre.

- High pressure alarm level.

5.19.6 Manufacturer shall provide an independent pressure switch this level for isolation of the particular zone. This alarm level shall be provided to indicate abnormal pressure rise in the gas compartment.

5.19.7 Each gas compartment shall be provided with a local indication for the gas density. The manufacturer can provide one tap-off connection for above indication and function with a root-valve with pressure gauge/switches mounted on the common header.

5.19.8 On line calibration for gauge/ switches is preferred.

5.19.9 The gas density and pressure sensitive devices, together with all relays supplied by the manufacturer for use in protection, shall be approved by the Purchaser. It shall be possible to test all gas monitoring relays without de-energising the primary equipment and without reducing pressure in the main section. To avoid possible problems of low insulation resistance in control circuits of SF6 density meters installed outdoor of GIS it needs to be seen for installation of density meters inside through extension to avoid such problems. . The degree of protection for pressure switch/gauge shall not be less than IP-65.

5.20 **Sectionalisation**

5.20.1 Contractor shall provide the necessary cover plates to enable removal of an element of switchgear and to restore the enclosure in order to resume operation of the rest of the switchgear.

5.20.2 The mass of gas in the largest compartment and the total mass of gas for the complete GIS at rated nominal density shall be indicated by Contractor.

5.20.3 Gas Loss

a) Gas Leakage Loss

This document is an intellectual property of Nuclear Power Corporation of India Limited

i. Maximum guaranteed gas leakage loss of the switchgear shall be in no case be more than 0.5% per year as indicated under Technical Particulars. In the event of a loss of pressure due to leakage exceeding the specified limit, the GIS suppliers shall replenish the gas in the installation for the minimum life of first 10 years without any cost. For outdoor bus duct compartments, a double O-rings seals is preferred.

ii. Contractors shall provide details of the losses at rated current in the data sheet.

b) Gas Handling Loss:

i. Gas handling loss may take place during gas filling, testing or checking. Method of determining gas handling loss and estimate of handling loss should be indicated by the Manufacturer.

ii. Clear instructions shall be provided by the Manufacturer about handling, recycling and treatment of new and used SF_6 gas. Components may be filled with N2 for transportation and refilled with SF_6 at site.

c) Gas seals:

i. All gas seals shall be designed to ensure that leakage rates are kept to an absolute minimum under all normal pressure, temperature, electrical load and fault conditions. All gas seals located in the flanges of the equipment enclosures shall be of the O -ring type. The material and method of sealing used shall be stated in the Bid.

5.21 Quality of SF_6 Gas

5.21.1 SF_6 gas shall comply with the recommendations of IEC 60376, 60376A & 60376B. All SF_6 gas supplied as part of the contract shall comply with the requirements of IEC 60376, 60376A & 60376B, at the time of the first charging with gas as a minimum & should be suitable in all respects for use in the switchgear under all operating conditions.

5.21.2 The high pressure cylinders in which SF_6 gas is supplied & stored at site shall comply with the requirements of following standards & regulations:

a) IS: 4379 Identification of the contents of industrial gas cylinders.

b) IS: 7311 Seamless high carbon steel cylinders for permanent & high pressure liquefiable gases. The cylinders shall also meet Indian Boilers Regulations (Mandatory).

5.21.3 Preferred cylinder size for supply of the SF_6 gas shall be such that, it is convenient to transport, handle/ store and use them at site. Around 40 litres of seamless type cylinder shall be provided.

5.21.4 The nominal operating pressure of SF_6 insulated gas in the metal-enclosed equipment shall be as low as is compatible with the requirements for electrical insulation and space limitations to reduce the effects of leaks and to ensure that there is no chance of the gas

This document is an intellectual property of Nuclear Power Corporation of India Limited

liquifying at the lowest ambient temperature. The initial gas pressure or density at the time of charging the equipment shall provide a sufficient margin above the minimum allowable pressure for the plant to be safely operated for a reasonably long period before recharging is necessary. It shall be possible to make up the SF_6 gas on line in the enclosure if the pressure reduces to alarm stage.

5.21.5 The switchgear must be able to withstand at least its rated phase to earth voltage in case the insulating gas pressure drops to atmospheric pressure.

5.21.6 Molecular sieve or activated alumina or other absorbent for removal of SF_6 arc products and moisture absorbents shall be provided in each compartment.

a) Physical properties: Colourless, odourless, non - toxic and non-flammable.

b) Density at 20°C 6.08 g/litre

c) Electric strength 2.5 times that of nitrogen. Up to temperature of about 180ºC, its compatibility with material used in electrical construction shall be similar to nitrogen. SF_6 gas shall comply with requirements of the tests as per Clause 22 of IEC - 60376. Between -40°C and – 41°C, SF_6 gas shall not have impurities more than the maximum allowable quantities given below:

d) Impurity Group Maximum permitted concentration by Mass

i. CF4 0.05%

ii. Oxygen + Nitrogen(Air) 0.05%

iii. Water 15 ppm

iv. Acidity expressed as HF 0.3 ppm

v. Hydrolysable fluorides expressed as HF 1.0 ppm

vi. Oil content 10 ppm.

5.22 SF_6 Gas Handling Plant/ Service Cart

5.22.1 SF6 gas handling plant/ service cart shall be supplied by the Contractor as a part of the subject EPC contract. The SF6 Gas handling plant/ service cart shall basically include but not limited to SF_6 gas storage tank, GIS service cart, portable service cart, vacuum/filling portable machine, weighing machine, SF_6 purity measurement kit, moisture measurement kit, SF6 leak detection kit, hydraulic drain kit, portable oil pump, SF6- hose, all required SF6- hose and other connectors for both 400kV and 230kV GIS systems. The minimum requirements are specified in the relevant data sheet I02.KK56.0.0.ET.DS.PR045..

5.22.2 Under normal operating conditions it shall not be necessary to treat the insulating SF_6 gas between major overhauls. Self sealing vacuum couplings shall be provided on all gas compartments to facilitate filling and recharging. In all gas compartments permanent

This document is an intellectual property of Nuclear Power Corporation of India Limited

efficient filters and drying agent shall be provided. The Bidder shall indicate the detail and type of filters used in the various gas sections, and should also submit the operating experience with such filters.

5.22.3 The entire SF_6 gas handling plant necessary for replenishing, filling and evacuating the SF_6 gas in the switchgear equipment shall be supplied with the contract to enable erection, gas filling (evacuating/ vacuuming/testing/ gas filling/ evacuating/re-filling etc.) and maintenance work to be carried out. SF_6 gas handling cart shall be of DILO/ENERVAC make.

5.22.4 This shall include all the necessary gas cylinders for replenishment and gas for temporarily storing the evacuated SF_6 gas as well as any other gases which may be used in the process. The capacity of the temporary storage facilities shall at least be sufficient for storing the maximum quantity of gas that could be removed from the largest compartment of GIS + 10% extra SF_6 gas when carrying out maintenance or repair work on the switchgear and associated equipment. The necessary equipment to remove SF_6 gas from the compartments, vacuum pump to create a vacuum inside the compartment before SF_6 gas filling operation, dust and moisture filter, compressor for recharging shall form a part of the plant.

5.22.5 Where any item of the filling and evacuating plant is of such a weight that it cannot easily be carried by maintenance personnel, facilities for lifting and moving with the overhead cranes shall be provided.

5.22.6 The design of the plant valves, couplings, connections, piping, hoses etc. must be of such a standard that leakage of any SF_6 gas during the filling and evacuating process is kept to an absolute minimum. The arrangement of valves, couplings and pipe shall also be such as to prevent accidental loss of gas to the atmosphere. The gas compartments shall preferably be fitted with permanent non-return valves through which the gas is pumped into or evacuated from the compartments. Details of the filling and evacuating plant that will be supplied, as well as the description of the filling and evacuating procedures shall be provided along with the bid.

5.22.7 For filling a gas compartment, a pressure relief valve shall be fitted to the filling pipe to prevent the gas pressure from rising to more than 8 – 10 % above the design pressure during filling of the enclosure. Alternatively a valve may be fitted to each of the gas section enclosure. Details of the proposed gas handling apparatus shall be provided.

5.22.8 The minimum dew point temperature in unheated SF_6 gas filled equipment (GIS) shall not exceed -50ºC at the working pressure and shall be measured during commissioning

5.22.9 The auxiliary gas purification and drying plant shall consist of facilities for removal of dust, moisture and impurities from the SF_6 gas as well as air or any other gases that may be temporarily filled in the switchgear compartment during the process of filling with SF_6 gas.

5.22.10 Details of the replenishing, filling and plant that will be supplied, as well as of the replenishing, filling and evacuating shall be given in the bid.

This document is an intellectual property of Nuclear Power Corporation of India Limited

5.22.11 The auxiliary gas purification and drying plant shall preferably be combined as a single unit with the gas filling and evacuating plant.

5.22.12 The gas maintenance plant shall be complete with all necessary instrumentation and control which may include instruments such as decomposition tester, hygrometer, test unit for the density monitors, precision pressure/ density gauge and vacuum gauge.

5.22.13 Details of the plant, its operation and any instruments for testing the purity of the SF_6 gas which are normally provided with the plant shall be submitted along with the bid.

5.22.14 Contractor shall clearly indicate the model and type of SF_6 gas handling plant/ service cart to be offered along with equipment. DILO make Mega service cart or equivalent model of ENERVAC is specified in view of its superior capacity to carry out the jobs in an expeditious manner. The capacity of the DILO tank shall be 600 litres.

5.22.15 The length of hoses to be supplied shall be sufficient enough to carry out the gas filling from a distance of at least 40 -50 meters. However the hoses of different lengths (in a combination of long and short lengths) and required couplings shall be supplied in order to select the required hose (to suit the GIS couplings) to carry out theSF_6 Gas handling plant/ service cart from a given location and all these details shall be clearly mentioned in the bid.

5.22.16 Contractors may advice the Purchaser regarding requirements of special gas masks and protective clothing during maintenance of the GIS in order to protect the personnel from SF_6 gas decomposition products.

5.22.17 The gas maintenance plant shall be mobile.

5.23 External SF_6 Gas Leakage Detection System

5.23.1 Instruments for automatic and continuous monitoring for the presence of SF_6 gas in the atmosphere shall be provided along with all accessories such as sampling box, GI clamp, hose pipe, etc. Emission monitor of type GA 35/equivalent is acceptable.

5.23.2 The instruments shall be placed in various positions and shall be arranged to give a remote alarm when the gas which has leaked out of the equipment is in these positions.

5.23.3 The positions and exact number of detectors required shall be finalized by the GIS supplier/Contractor based on the sensor range. Minimum 9 nos. of detectors shall be provided for 400kV GIS Hall and conduction room. The detectors shall be provided with the necessary brackets and fittings for fixing to steel or concrete work and shall be of a robust design. Layout drawings showing the location and mounting arrangement of the sensors/monitors in the GIS Hall and conduction room shall be provided for review and acceptance by the Purchaser.

5.23.4 The necessary steel brackets/arrangement for mounting the detectors (as applicable) wherever required shall be provided, erected and installed by the Contractor.

This document is an intellectual property of Nuclear Power Corporation of India Limited

5.23.5 Local alarm panels, electrical cable or other connection facilities that will be required between the instruments and the local alarm panels shall also be included in the Contractor's scope of supply. Cabling between the instruments and the local alarm panels shall also be included in the Contractor's scope

5.23.6 Two portable sniffer type SF_6 detectors shall additionally be provided. The portable sniffer shall be light-weight and provided with long flexible probe so as to enable detection of leakage from hard to reach areas. It shall be sensitive to the concentration of leakage gas so that the leakage point can be identified and shall be capable of detecting the presence of SF_6 even in contaminated areas.

5.23.7 In addition, one no. of portable sniffer type SF_6 detectors shall be provided for each Gas insulated bus duct between the 400kV GIS and Generator Transformer(s)

5.24 Insulators & Sealing:

5.24.1 Unless the gas section barriers have been specifically designed to collapse and act as pressure relief devices, gas section barriers including seals to the conductor and enclosure wall shall be gas-tight and shall be capable of withstanding the maximum differential pressure that could occur across the barrier, i.e. with a vacuum/air drawn on one side of the barrier and on the other side, at least twice the rated gas service pressure that can exist under normal operating and maintenance conditions for 1 minute and the maximum gas over-pressure, at least equal to the operating pressure of the relief devices, that could be attained with a persistent internal arc fault for 24 hours

5.25 Interlocks

5.25.1 Interlocking devices must provide absolute and positive protection against potentially harmful mal-operations of the switchgear.

5.25.2 The following functions shall be provided:

a) Forcing the operator into the only logical sequence to actuate breakers, and earthing switches safe and isolators

b) Checking the actual fully closed or position of all switching elements before and after each move.

c) Providing the logical checks and issuing resulting PERMISSIVE or BLOCKED signals for switchgear.

d) Indicating positively the absolute position of the supervised equipment.

e) Local manual and remote automatic operation of all essential functions.

f) Local emergency unlocking facilities via safety key switches under the full responsibility of the operator.

5.25.3 All interlocks required between circuit breaker, disconnectors and earth switches shall be provided by the Contractor. These shall take the form of an electrical interlock scheme

This document is an intellectual property of Nuclear Power Corporation of India Limited

operated from auxiliary switches attached to the mechanisms of the above equipment. The logic for this scheme shall be in Contractor's scope of supply and shall be developed in the LCC utilizing bay control units, auxiliary relays/switches/contactors, etc. mounted in local control panels.

5.25.4 CB closing permissives:

a) Disconnectors of the bay either in closed or open position

b) Pole discrepancy trip is not existing

c) SF6 pressure greater than lockout pressure

d) CB closing spring fully charged

e) Trip circuit healthy

f) Master trip relay (from CRP system) not operated.

5.25.5 CB opening permissives:

- SF6 pressure greater than lockout pressure

5.25.6 Disconnector operation (open/close) permissives

- CB of the bay in open condition
- Associated earthing switches in open condition

5.25.7 Safety Earthing switch/High speed earthing switch operation permissive

- Associated Disconnecters in open position.
- Line side HSES operation – No voltage on line shall be considered additionally.

5.25.8 Mechanical interlocks, in addition to electrical is a preferred method such that it will not be possible to close the earthing switch when the isolator is closed or vice-versa.. In specific cases of non-provision of the same it shall demonstrated that safety, in case on lack of electrical interlock, is not compromised.

5.25.9 Earthing switches shall be provided with electrical interlocks so as to prevent earthing of live bus/ line. It shall not be possible to close the earth switch in remote/local modesunless the associated line or bus is de-energised. This interlock can be derived from PT secondary voltage.

5.25.10 The switching contacts of auxiliary circuits of a drive of a disconnecting switch (earthing switch) shall be made so as the making signal occurs not earlier the touching moment of moving and stationary contacts of a main circuit of a pole of a disconnecting switch (earthing switch), and the opening signal - after travelling by a moving contact not less than 80 % of spacing interval between the contact shields.

This document is an intellectual property of Nuclear Power Corporation of India Limited

5.26 Foundation channels & Supporting frame works

5.26.1 All supporting steel structures above grade level for switchgear bays and all panels including SF_6-Air Bushing support and feeder bus duct support, etc. shall be a part of Contractor's supply.

5.26.2 All outdoor supporting steel frame work shall be hot dip galvanised/ metallised after fabrication. All factory fabricated items shall be hot dip galvanised. The thickness of zinc coating shall be no less than 85 microns for items of thickness less than 5 mm and 120 microns for items of thickness more than 5 mm. All heavy in situ fabricated items shall be metallised with Zinc + Aluminium (15%).

5.26.3 Suitable embedment in the foundation floor shall be provided by Contractor to support the switchgear assembly. Necessary supporting framework, levelling screws, inspection platforms etc. shall be provided by the Contractor to fasten the switchgear base frames to the embedments in foundation floor. Contractor shall submit drawing showing all details of the embedded parts required on the floor.

5.26.4 Free standing type supports will be preferred to the maximum extent possible.

5.27 Earthing

5.27.1 The earthing system shall be designed and provided as per IEEE-80 and CIGRE-44 to protect operating staff against any hazardous touch voltages and electro-magnetic interferences.

5.27.2 The GIS supplier must supply the entire material for earthing bus of GIS viz conductor, clamps, joints, operating and safety platforms etc. The GIS supplier is also required to supply all the earthing conductors and associated hardware material for connecting all GIS equipment, bus ducts, enclosures, control cabinets, supporting structure etc. to the ground bus of GIS.

Earthing materials on the GIS and GIBD, GIS base frame to GIS module and all earthing material on GIS and GIBD body shall be in GIS supplier's scope. GIS to riser and balance earthing can be in EPC contractor's scope and shall be as per OEM's recommendation and shall meet IEEE 80 requirements.

The earthing grid layout for GIS shall be provided to the Purchaser at the earliest, preferably within 3 months of suborder placement.

5.27.3 Contractor shall be responsible for supplying all the earthing materials required for the formation of the main ground bus for specified short circuit of 63 kA for 1 second for 400kV GIS to which all intentionally earthed parts of switchgear assembly are connected (bonding all the equipment and steel work, included in this contract).

This document is an intellectual property of Nuclear Power Corporation of India Limited

5.27.4 Material for hardware accessories like nut, bolt, washer, etc. shall be used taking into consideration the high level of saline corrosion at site.

5.27.5 The enclosure of the GIS may be earthed at several points so that there shall be earthed cage around all the live parts. A minimum of two nos. of earthing connections should be provided for each of circuit breaker, transformer terminals, cable terminals, surge arrestors, earth switches and at each end of the bus bars. The earthing continuity between each enclosure shall be effectively interconnected with Cu bonds of suitable size to bridge the flanges, wherever applicable. Further similar design should have been in service. Subassembly to subassembly bonding shall be provided to provide gap & safe voltage gradients between all intentionally grounded parts of the GIS assembly & between those parts and the main earthing bus of the GIS. Additional measures include the use of conductive platforms (ground mats) that are connected to GIS structures and grounded.

5.27.6 Readily accessible connectors of sufficient mechanical strength to withstand electromagnetic forces and normal abuse, and that are capable of carrying the anticipated maximum fault current in that portion of the circuit without overheating.

5.27.7 Each marshalling box, local control panel, power and control cable sheaths and other noncurrent carrying metallic structures shall be connected to the earthing system of GIS via connections that are separated from GIS enclosures. The earthing connector shall be of sufficient mechanical strength to withstand electromagnetic forces as well as capable of carrying the anticipated maximum fault current without overheating. At least two earthing paths shall be provided to connect each point to the main earthing bus. Necessary precautions should be under taken to prevent excessive currents from being induced into adjacent frames, structures of reinforcing steel and to avoid establishment of current loops via other station equipment.

5.27.8 All flexible bonding leads shall be tinned copper of suitable size. All connectors, for attaching flexible bonding leads to earthing conductors and earthing conductors to support structures shall be tinned bronze with stainless steel or tinned bronze hardware. Contractor shall give suitable calculations for arriving the size of the conductor used for earthing the GIS/ GIBD enclosures and supporting structures.

5.27.9 The Manufacturer shall provide suitable measure to mitigate transient enclosure voltage caused by high frequency currents caused by lightning strikes, operation of surge arrestor, ph./earth fault and discharges between contacts during switching operation. The earthing system shall ensure safe touch & step voltages in all the enclosures. The vendor shall provide suitable barrier of non-linear resistor/ counter discontinued SF_6/ Air termination, SF_6/ Transformer or Reactor termination, SF_6/ HV cable bushing etc. to mitigate transient enclosure voltage.

5.27.10 Contractor shall provide a main earth bus for a specified short circuit current of 63kA for 1 sec. for GIS to which all intentionally earthed parts and the switchgear assemblies as well as the outdoor bus duct must be connected.

5.27.11 The material for the earthing conductor should be copper of suitable size from equipment to grounding network. Earthing layout shall be provided by the Contractor/Manufacturer

This document is an intellectual property of Nuclear Power Corporation of India Limited

to the Purchaser for embedding the same in the floor. Based on the same, the embedded earthing part alone shall be provided by the Purchaser as a part of Civil works by the Purchaser.

5.27.12 It shall be the responsibility of the Contractor to provide a sufficient number of earth points so that dangerous voltage are not induced in the enclosure by the fault current circulating in the inner conductor.

5.27.13 Earthing pads/terminals shall be provided for at least two paths to earth from the "Main earth Bus" or each metallic enclosure and auxiliary equipment designated for connections to the station earth grid. The contractor shall provide data to assure that the connections from the "Main Earth Bus" to the station earth will not interfere with required enclosure current paths or any operational feature of the assembly.

5.27.14 A copper earth bus shall be provided near the control cable entrances of all main and auxiliary equipment, for the purpose of terminating the shield of each control cable.

5.27.15 Provision shall be made to extend the earth bus for future extension.

5.27.16 The design of the earthing systems and connection to the switchgear equipment shall also be compatible with the circulating currents that are present in the switchgear metal enclosing. Contractor shall provide the full details of circulating current expected to flow in the earth mat system and design the earth mat mesh accordingly.

5.27.17 All supporting structures, steel works, access decking, gangways, handrails etc. shall also be effectively bonded to the earthing system by at least one independent lead.

5.27.18 Earthing Tester

As an additional measure for the safety of the personnel, it shall be possible to ascertain the particular section of the plant is de-energised before an earth switch is closed on the conductor. Capacitive type tap shall be provided on the approximate location on each bay and one each on each phase of the main buses and one loose instrument for the complete installation. The complete details of earthing testing system should be provided along with offer.

5.28 List of special tools and tackles, if any, required for erection and maintenance of the offered GIS & GIBD, shall be clearly highlighted by the Contractor in their offer.

5.29 Contractor shall furnish the following general particulars of proposed manufacturer(s):

Sl. No.	Item	Details
1.	Name	
2.	Address	
3.	e-mail and website details	

This document is an intellectual property of Nuclear Power Corporation of India Limited

Sl. No.	Item	Details
4.	Name, designation and all contact details of the officer to whom reference shall be made for expeditious coordination	
5.	Details of foreign collaboration, if any	
6.	Place of manufacture and assembly	
7.	Current registration number	
8.	Details of service facilities	
9.	Whether sufficient spares are available in stock?	

5.30 Vendor data requirement

The following documents/ drawings shall be submitted by the Contractor/ manufacturer for Purchaser's review/ information. However, all vendor documents shall be thoroughly reviewed, to ensure compliance with Tender requirements, and vetted by Contractor prior to submission to Purchaser:

Sr. No.	Description	With Bids	Post Order		Final Documents
			For Review	For Records	
1.	Schedule of Vendor Documents		*		
2.	Data sheets (Duly Filled-In)	*	*		*
3.	Dimensional/Assembly Drawings				
	a. GA Drawings (Elevation and Plan) of switchgear including clearance requirements	*	*		*
	b. Installation Plan including foundation, cut-out and mounting details	*		*	*
	c. Cross Sectional View			*	

This document is an intellectual property of Nuclear Power Corporation of India Limited

Sr. No.	Description	With Bids	Post Order		Final Documents
			For Review	For Records	
	d. Cubicle Arrangement Drawing			*	*
	e. Component Drawing			*	*
	f. Name Plate Drawing			*	*
	g. Arrangement of cable termination		*		*
4.	Electrical Wiring Drawings				
	a. Single Line Diagram	*	*		*
	b. Gas SLDs		*		*
	c. Control Schematic			*	*
	d. Wiring Diagram And Terminal Details			*	*
	e. Inter panel Wiring Diagram			*	*
5.	Panel Schedule & Bill Of Material			*	*
6.	Calculations				
6.1	Calculation of CT/PT burdens, Vk, Im, RCT etc. for class PS CT's		*		*
7.	Relay Characteristic Curve			*	*
8.	Auxiliary Power Requirement Data (AC & DC)				

This document is an intellectual property of Nuclear Power Corporation of India Limited

Sr. No.	Description	With Bids	Post Order		Final Documents
			For Review	For Records	
9.	QA Plan Of Vendor		*		*
10.	Inspection Plan And Testing Procedure (For review by inspection)		*		*
11.	Test Records			*	*
12.	Type Test Certificate (For Panel & Breakers)	*		*	*
13.	List of Commissioning Spares	*			
14.	List of Maintenance Spares	*			*
15.	List Of Special Tools & Tackles	*			*
16.	Data Book/Manual				
	a. Installation Manual			*	*
	b. Operating/Maintenance Manual				*
	c. Catalogues/Brochures			*	*
17.	Filled-in check-list (Technical)	*			
18.	Equipment storage procedure at site				*

* DATA REQUIRED

5.31 Schedule of deviations

All deviations from the technical specification shall be filled in by the Contractor clause by clause in the following schedule:

Page Number	Section	Clause number	Deviation

This document is an intellectual property of Nuclear Power Corporation of India Limited

6.0 INSPECTION, NON-DESTRUCTIVE TESTING, FUNCTIONAL TESTS, ACCEPTANCE CRITERIA AND REPORTS

6.1 General:

6.1.1 During fabrication, the equipment shall be subjected to inspection by Purchaser or by an agency authorised by the Purchaser, if specified/ agreed in QAP/ Quality Surveillance. Manufacturer shall furnish all necessary information concerning the supply to Purchaser's inspector. All routine/ acceptance tests shall be carried out at manufacturer's works under his care and expense.

6.1.2 The contractor shall perform his internal inspection/testing before offering the equipment for Purchaser's inspection. Only after ensuring that his inspection/test results are satisfactory. Contractor shall offer the equipment for Purchaser's inspection. However, this clause is not applicable in case of such tests which are required to be done only once in the life time of the equipment.

6.1.3 Test certificates of bought out components shall be shown to the inspection agency on demand during inspection.

6.1.4 All equipment shall be subjected to various acceptance and routine tests as per the QAP/ Quality Surveillance.

6.1.5 The overall requirements for stage inspection and testing, material tests etc. in respect of equipment covered in this Tender shall be as defined in the relevant section in the Tender document. The routine tests, acceptance tests, special tests and type tests are covered in this specification. Inspections and tests at raw material stage, semi-finished or module level are detailed in the QAP attached under the relevant section in the Tender document.

6.1.6 All the equipment offered should have been successfully type tested as per the relevant standards, amended up to date. In case the equipment of the type and design offered has already been type tested, the Contractor shall furnish type test reports before proceeding with manufacture. **Type tests validity shall be as per CEA regulatory guidelines from the date of bid submission.** As a part of technical offer, Contractor shall include a tabulation detailing various type tests on each type of equipment along with applicable type test certificate number, details of the equipment subjected to type test, place of testing and final results.

6.1.7 If there are changes in the components or in the design/ type already type tested and the design/ type offered against this specification, the Purchaser reserves the right to demand repetition of tests without any extra cost before commencement of supply. The Contractor shall bring out in his offer all such changes made in components, materials, design etc. as the case may be and likely effects of such changes on type qualification.

6.1.8 The minimum inspection requirements for all components/equipment shall conform to the design and fabrication requirements as defined in the Codes and Standards referred to in the Specification document. The type of inspection shall be as prescribed in Quality Control plan and as agreed upon by the Purchaser, and shall include, if applicable,

This document is an intellectual property of Nuclear Power Corporation of India Limited

inspection procedures prescribed by Codes and Regulations recognized by the Governmental Authority having jurisdiction over the installed goods.

6.1.9 Whenever required, getting approval of Government bodies under jurisdiction is the sole responsibility of Contractor for his design, drawings, manufacturing, testing and inspection by such bodies. In such cases approval from Government bodies under jurisdiction will not relieve the Contractor from his responsibility of making good of defective material/equipment/plant. However, Contractor shall keep the Purchaser/his representative informed in writing of any approval or otherwise any comments of such Government bodies. Contractor shall take the concurrence of Purchaser or his representatives before proceeding with rectification procedures as called by the Government bodies.

6.1.10 Approval or passing of any such inspection by the Purchaser or his authorized representative shall not however prejudice the right of the Purchaser to reject the equipment if it does not comply with the Specification when erected or give complete satisfaction in service.

6.1.11 The contractor shall intimate well in advance to the Purchaser by written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the inspector. The Purchaser or his representative, unless the inspection of the test is virtually waived shall witness such test on a mutually agreed date.

6.1.12 The Purchaser shall within reasonable period from the date of completion of inspection as defined herein given notice in writing to the Contractor of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Purchaser giving reasons therein that no modifications are necessary to comply with the 'Contract'. However, Purchaser has the final authority to accept or reject the Contractor's views. The equipment/ material after rectifications by the Contractor shall be offered to the Purchaser for this final inspection and acceptance without any additional cost to Purchaser.

6.1.13 When the factory tests have been completed at the Contractor's or his Sub-Contractor's works to the satisfaction of the Purchaser, the Purchaser shall issue a certificate to this effect within fifteen (15) days after completion of tests, but if the tests are not witnessed by the Purchaser, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Purchaser provided the test results are satisfactory and conform to the specified parameters. Failure of the Purchaser to issue such certificate shall not prevent the Contractor from proceeding with the subsequent work. The completion of these tests or the issue of the certificates shall not hinder the Purchaser to accept the equipment should it, on further tests after erection, be found not to comply with the 'Contract'.

6.1.14 In all cases where the 'Contract provides for tests whether at the premises or Works of the Contractor or of any Sub-Contractor, the Contractor except where otherwise specified shall provide free of charge such items as labour materials, electricity , fuel, water, stores, apparatus instruments as may be reasonably demanded by the Purchaser or his authorized

This document is an intellectual property of Nuclear Power Corporation of India Limited

representative to carry out effectively, such tests of the Equipment in accordance with the 'Contract' and shall give facilities to the Purchaser or to this authorized representative to accomplish testing.

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

6.1.16 In case of stage inspection, the Contractor shall proceed from one stage to another only after the component is inspected by the Purchaser or his authorized representative and permission given to proceed further. The same procedure shall be adopted for any rectifications/repairs suggested by the Purchaser or his authorized representative. At all Customer hold points the Contractor shall compulsorily offer for inspection to Purchaser and if any waiver by Purchaser, shall be obtained in writing for record purposes.

6.1.17 None of the equipment to be furnished or used in connection with the Contract shall be dispatched until shop inspection, satisfactory to the Purchaser has been and specific Despatch Instruction for the equipment is issued by the Purchaser. However, such shop inspection shall not relieve the Contractor of his responsibility for furnishing the equipment conforming to the requirement of the contract not prejudice any claim right or privilege which the Purchaser may have because of the use of defective or unsatisfactory items of the equipment. Should the Purchaser waive the right to inspect any item of the equipment. Such waiver shall not relieve the contractor in any way from his obligation under the contract. In the event of the Purchaser on inspection revealing poor quality of goods, the Purchaser shall be at liberty to specify additional inspection procedures, if required to ascertain the Contractor's compliance with the equipment specification.

6.1.18 The Contractor shall submit, well in advance, a schedule of all type, routine and site tests to be conducted including a list and the scheduled dates for all stages of inspection, final inspection and shop/site testing for all equipment covered under this contract.. This document shall be subject to the Purchaser's approval.

6.2 Sub Orders:

6.2.1 To ensure getting good quality product from sub-Contractor. The main contractor shall get the approval of Purchaser by furnishing details of capability, experience, manpower, manufacturing facility quality control facilities etc of the Sub-Contractor's before placement of order. The Purchaser may visit the sub-Contractor's works to evaluate their capacity and capability to do quality job to meet specification requirements. The sub-orders should highlight the inspection and quality control requirements stipulated in the main specification and all required quality checks and tests shall be conducted as per the Specifications.

6.2.2 In order to facilitate the inspection of bought out materials and equipment, the Contractor shall submit for approval, three (3) copies of all sub-orders placed by him as soon as they are issued. Copies of any drawings referred to in the sub order shall also be submitted, unless otherwise agreed by the Purchaser or his representative.

This document is an intellectual property of Nuclear Power Corporation of India Limited

6.2.3 The sub-orders drawings referred to above shall cover all components which are subjected to electrical and mechanical pressure or stress when the plant is in operation and also auxiliaries and spares which are to be directly dispatched to Site from the Sub-Contractor's works.

6.2.4 All sub-orders shall clearly be marked with the main Contractor's name and the Purchaser's reference. They shall include and statement advising the Sub-Contractor that items being ordered will also be subject to inspection and test by the Purchaser.

6.2.5 The Contractor shall clearly bring out in his offer the makes of various brought out components being procured by him and offered against this contract. All sub-suppliers are subject to Purchaser's approval.

6.2.6 The Sub-Contractors are to comply with all the applicable requirements of this specification and in particular with this section. Orders issued by the Sub-Contractor are also to include the main contractor's name on their sub-order in addition to the above mentioned heading.

6.3 Material Test:

6.3.1 In the event of the Purchaser or his representative being supplied with the particulars of tests which have been carried out for the contractor by the suppliers of material, he may at his own discretion accept the same as proper evidence of compliance with the requirements of appropriate specifications for the materials or may ask for tests done to establish conformity of the material to its relevant code/specification.

6.3.2 5% forgings for components involved in pressure boundaries shall be subjected to ultrasonic or radiographic testing in accordance with codes specified or approved equal on random basis.

6.3.3 5% ferrous and non-ferrous pipes and tubes of 65 mm size and under forming part of pressure boundaries shall be subject to eddy current testing in accordance with codes specified or approved equal.

6.3.4 For Al/Al alloy castings, volumetric examination shall be carried out by UT/radiography on 5% random samples.

6.4 Factory acceptance test (FAT)

6.4.1 The FAT tests shall include electrical, mechanical and hydraulic tests in accordance with appropriate clauses of Statutory Regulation, relevant Codes and Standards and in addition any test called for by the Purchaser to ensure that the plant/equipment being supplied fulfils the requirements of the specification. The Contractor shall carry out all the shop tests and inspections specified in the following clauses in addition to those normally carried out by him. For plant/equipment not covered by any code or specifically mentioned in this specification, the tests are to be agreed with the Purchaser. If considered necessary by the Purchaser multipart assemblies shall be fully erected and tests in the works prior to packing and dispatch to the site.

This document is an intellectual property of Nuclear Power Corporation of India Limited

6.4.2 Type tests:

Type test shall be carried out as per relevant IEC standards at a recognized and well-reputed test laboratory. Type test certificates shall be available for verification as evidence of successful completion of type tests.

a) Test to verify the insulation level of the equipment including partial discharge test and dielectric tests viz (i) Lightning impulse test (ii) Switching impulse test iii) One min, p.f. test (iv) Partial discharge test.

b) Test to prove the temperature rise of any part of the equipment and measurement of the resistance of the main circuit.

c) Test to prove the ability of the main and the earthing circuits to carry the rated peak and the rated short time withstand current for a line bay.

d) Test to verify the making and breaking capacity of the included switching devices on a line bay.

e) Test to prove the satisfactory operation of the included switching devices on a line bay.

f) Tests to verify the protection of persons against contact with live parts and moving parts.

g) Tests to prove the strength of enclosures.

h) Short time withstand current and peak withstand current test

i) Test to verify the protection of the equipment against external effects due to weather and atmospheric agents.

j) Tests to prove the radio interference voltage (RIV) level. (For SF6-Air bushing)

k) Electromagnetic compatibility test (For SF6-Air bushing and BCU)

l) Tests to assess the effects of arcing due to an internal fault.

m) Tests to prove the thermal stability of solid insulation.

n) Tests to prove the satisfactory operation at limit temperature.

o) Gas tightness tests.

p) Salt fog test on outdoor insulators for the pollution level specified in data sheet.

q) Type tests on Circuit breakers, isolators, earth switches surge arrestors etc as per the relevant standards.

6.4.3 Routine test.

This document is an intellectual property of Nuclear Power Corporation of India Limited

a) Circuit breakers

b) Isolators and earth switches

c) Current Transformers

d) Voltage Transformers

e) Bushings

f) Partial discharge tests on all the insulations and bushings.

g) Enclosure pressure test on each gas compartment at 1.3/1.2 times the design pressure for welded/cast enclosures respectively as per IEC- 62271-203.

h) Insulation test with 2 kV on all auxiliary circuits. For Motor : As per type tested design

i) Complete mechanical operation tests.

j) Complete test of inter locking device.

k) Functional tests of all auxiliary devices including all protective relays, alarm and trip circuits.

l) Visual and dimensional checks.

m) Acceptance test on SF_6 gas

n) Routine tests on Circuit breakers, isolators, earth switches surge arrestors etc as per the relevant standards.

o) Any other tests as per manufacturer's recommendation.

6.4.4 In addition to the routine tests above, Switchgear assembly stage tests in presence of Purchaser on each shipping assembly

a) Visual and dimensional checks and check for alignment between adjacent shipping sections with switchgear on prefabricated supports.

b) Power frequency voltage dry test at 520 kV for 420kV GIS.

c) Test on local control panels and motors as listed in respective modules.

d) Voltage test on auxiliary and control circuits

e) Partial discharge test

f) Test to verify the resistance of the main circuits.

g) Mechanical operation tests

This document is an intellectual property of Nuclear Power Corporation of India Limited

h) Check of wiring.

i) Interchangeability of components of the same rating and construction.

j) Leakage test for insulating gas.

6.5 Quality of Gas

a) During commissioning the dew point of SF_6 gas shall be measured and documented.

b) SF_6 gas shall be tested for purity, dew point, air, hydrolysable fluorides and water contents as per IEC: 60376, 60376A & 60376B and test certificates shall be furnished to Purchaser indicating all test results as per IEC standards for each lot of SF_6 gas. Further site tests for moisture, air con-tent, flash point and dielectric strength to be done during commissioning of GIS. Gas bottles should be tested for leakage during receipt at site.

c) Manufacturer shall indicate diagnostic test methods for checking the quality of gas in the various sections during service. The method proposed shall, as a minimum check the moisture content & the percentage of purity of the gas on annual basis.

d) Manufacturer shall also indicate clearly the precise procedure to be adopted by maintenance personnel for handling equipment that are exposed to the products of arcing in SF_6 Gas so as to ensure that they are not affected by possible irritants of the skin and respiratory system. Recommendations shall be submitted for suitable protective clothing, method of disposal of cleaning utensils and other relevant matters.

e) Manufacturer shall also indicate the details and type of filters used in various gas sections, and should also submit the operating experience with such filters

6.6 Tests after erection at site (IEC 62271-203, Clause 10.2.101)

6.6.1 After erection and before putting into service, the gas insulated switchgear shall be tested to check the correct operation and the dielectric strength of the equipment.

a) Dielectric tests on auxiliary circuits (IEC 62271-203, Clause 10.2.101.2)

To find out possible damage on auxiliary circuits a 2kV power frequency test will be performed.Motors :

b) Measurement of the resistance of the main circuit (IEC 62271-203, Clause 10.2.101.3)

To control the quality of the connected assemblies at site, the resistance of the main circuit will be evaluated by measuring the voltage drop on 100A DC normally from bay to bay.

c) Gas leakage test (IEC 62271-203, Clause 10.2.101.4)

This document is an intellectual property of Nuclear Power Corporation of India Limited

All sealing locations of the enclosure fitted together at site will be checked with a gas leakage detector.

d) Check and verification (IEC 62271-203, Clause 10.2.101.5)

The following inspection and test will be carried out:

i. Switchgear

Conformity of the assembly with the manufacture's drawing and instructions. Tightness of all bolts including the terminals on the apparatus. Gas density meter's operating points and gas pressure. Proper function of the mechanical interlocking system.

ii. Control Cubicle (Local Control)

Conformity of the wiring with the diagram. Correct functioning of all apparatus operating mechanism, auxiliary contacts and the local control. Correct functioning of the alarm announcement through to the customer's terminals in the control cubicles.

e) Control of the auxiliary voltage input (AC & DC)

Control of the cable to be delivered by according to respective list of cable issued by manufacturer

i. Proper function of the electrical interlocking system

ii. Proper function of the heating and lighting

iii. Tightness of all bolts on the terminals and on the apparatus in the control cubicles.

f) Additional inspection

Final testing of the current transformer on site according to IEC 60044 & final testing of voltage transformers on site according to IEC-61869-3.

g) Final testing of the current transformer on site according to IEC 60044 & final testing of voltage transformers on site according to IEC-61869-3.

6.7 High Voltage test after erection on site(IEC 62271-203, Clause 10.2.101.1)

The completely erected switchgear will be tested according to IEC 62271-203, in order to locate hidden defects such as wrong fastening, damage during handling, transportation, storage and erection or the presence of foreign particles etc. Arrangement of alltest equipments, specialists at site for conducting the test at site is also in Contractor's scope. PD test:

6.8 Test reports

This document is an intellectual property of Nuclear Power Corporation of India Limited

6.8.1 The observations and test results obtained during the various tests shall be documented and produced in the form of a report by the Manufacturer.

6.9 Failure of components

6.9.1 A log of all failed components shall be maintained which shall give date and time of failure, description of the failed component/card along with designation, effect of failure on the system, cause of failure and number of hours of operation of the part before it failed.

6.9.2 For repeated failure of the component/card, the same shall be replaced by better graded components/cards. The entire test shall be restarted from the beginning or the previous logical point as the case may be. If after this one replacement the unit or sub-system still fails to meet the specifications, the Vendor shall replace the complete unit or sub-system with the one that meets the requirements and restart the test all over again.

7.0 INDICATIVE QUALITY ASSURANCE PLAN

For indicative QAP of GIS & GIDB, please refer relevant section of the Tender document.

8.0 PACKING & SHIPMENT

8.1 The Contractor/Manufacturer shall be responsible for the loading, transport, handling and offloading of all equipment and materials from the place of manufacture or supply to site. The Contractor/Manufacturer shall be responsible to select and verify the route, mode of transportation and make all necessary arrangement with the appropriate authorities as well as determining any transport restrictions and regulations imposed by the government and other local authorities. All transport packages containing critical units viz. voltage transformers, surge arrestor shall be provided with sufficient number of electronic impact recorders (on returnable basis) during transportation to measure the magnitude and duration of the impact in all three directions. The acceptance criteria and limits of impact in all three directions which can be withstood by the equipment during transportation and handling shall be submitted by the vendor during detailed engineering. The recording shall commence in the factory and must continue till the units reach site. The data of electronic impact recorders shall be downloaded at site and a soft copy of it shall be handed over to Engineer-in-charge. Mechanical (Shock watch type) impact recorders for critical units/boxes is also acceptable. Further, within three weeks the vendor shall communicate the interpretation of the data.

8.2 All the equipment shall be carefully packed for transport by sea, rail and road in such a manner that it is protected against the climatic conditions and the variations in such conditions that will be encountered en route from the manufacturer's works to the site.

8.3 The SF_6 metal-enclosed equipment shall be shipped in the largest factory assembled units that the transport and loading limitations and handling facilities on site will allow to reduce the erection and installation work on site to a minimum. Where possible all

This document is an intellectual property of Nuclear Power Corporation of India Limited

items of equipment or factory assembled units shall be boxed in substantial crates or containers to facilitate handling in a safe and secure manner. Should the units be considered too large for packing in crates, they shall be suitably lagged and protected to prevent damage to any part, particularly small projections, during transport and handling. Special lugs or protective supports shall be provided for lifting to prevent slings and other lifting equipment from causing damage. Each crate, container or shipping unit shall be marked clearly on the outside to show where the weight is bearing and the correct position for the slings.

8.4 Each individual piece to be shipped, whether crate, container or large unit, shall be marked special notations such as 'Fragile', 'This side up', 'Centre of gravity', 'Weight', 'Purchaser's particulars', 'PO no.' etc., and other details as per purchase order.

8.5 The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains, heavy corrosive atmosphere and high ambient temperature.

8.6 Special precautions shall be taken to protect any parts containing electrical insulation against the ingress of moisture. This applies particularly to the metal-enclosed equipment of which each gas section shall be sealed and pressurized prior to shipping. Either dry nitrogen/ air or dry SF_6 gas shall be used and the pressure shall be such as to ensure that, allowing for reasonable leakage, it will always be greater than the atmospheric pressure for all variations in ambient temperature and the atmospheric pressure encountered during shipment to site and calculating the pressure to which the sections shall be filled to ensure positive pressure at all times during shipment. The type of gas, the maximum pressure to which sections will be filled prior to shipment and the minimum allowable pressure during shipment shall be advised prior to dispatch.

8.7 All banking plates, caps, seals etc., necessary for sealing the gas sections during shipment to site shall be provided as part of the contract and shall remain the property of Purchaser. If considered necessary, blanking plates or other sealing devices shall be provided with facilities for measuring the gas pressure and recharging at any time during the transport period. Any seals, gaskets, 'O' rings, etc. that may be used as part of the arrangement for sealing off gas sections for shipment of site, shall not be used in the final installation of the equipment at site. Identification serial numbers shall be stamped into the blanking plates etc., and on the switchgear equipment to which they are fitted so that they can easily be identified and refitted should it ever be necessary to ship sections of the switchgear back to the manufacturer's works for repair.

8.8 Valves and other gas couplings associated with the switchgear gas systems shall be adequately protected against damage from any bumps or physical blows. They shall also be capped to prevent ingress of dirt or moisture or damage to any coupling, pipes, threads or special fittings. Any explosion vents and other pressure relief devices shall be suitably sealed and protected to prevent accidental exposure of the sealed sections during shipment to site.

This document is an intellectual property of Nuclear Power Corporation of India Limited

8.9 For bus ducts involving male and female joints of the current carrying conductor, the same shall be transported in disassembled condition to avoid any damage during transit. All bright parts liable to rust shall receive a coat of anti -rusting composition and shall be suitably protected.

8.10 The vendor will be able to use the available storage areas at site. The vendor shall ensure that during the period between arrival at site and erection, all materials and parts of the contract works are suitably stored in such approved manner as to prevent damage by weather, corrosion, insects, vermin or fungal growth. The scope of providing the necessary protection, storing off the ground, as required etc. is included in the works to be performed by the vendor.

8.11 The equipment shall only be unpacked or removed from the containers immediately prior to being installed. They shall not be left lying unnecessarily in open crates or containers. Special precautions shall be taken when gas sections which have been sealed and pressurized for shipping are opened up to reduce the ingress of dirt and atmospheric moisture to a minimum. Whenever possible this shall only be done immediately prior to installation and if any section is to be left outside for any length of time after being opened, it shall be resealed and pressurized with either dry nitrogen/air or SF_6 gas until required.

9.0 WARRANTY/ GUARANTEE REQUIREMENT

All equipment/accessories supplied shall conform to the requirements listed in this specification as well as the requirements of all applicable standards. Not meeting any of these requirements will result in rejection of the equipment/accessories.

10.0 LIST OF ATTACHMENTS

- Single line diagram of 400kV system(I02.KK56.0.0.ET.OKP.WD004) (Refer Annexure 3 of I02.KK56. 0.0.PR.TT.PR008)
- Indicative QAP
- Layout and EP details of 400kV GIS building (I02.KK56.0UAB.0.ET.OK.WD001) (Annexure C)
- UAZ Tunnel geometry drawing (I02.KK56.51UAZ.0.KZ.WD001, I02.KK56.52UAZ.0.KZ.WD001,I02.KK56.61UAZ.0.KZ.WD001, I02.KK56.62UAZ.0.KZ.WD001) (Annexure D)

11.0 LIST OF DOCUMENTS TO BE SEEN ALONG WITH THIS SPECIFICATION

- Layout of 400kV outdoor switchyard (I02.KK56.01UAK.0.ET.OK.WD001) (Refer Annexure 1 of I02.KK56.0.0.ET.TS.PR052)
- Technical Specification for 400kV Outdoor Switchyard (Doc. No.: I02.KK56.0.0.ET.TS.PR052)
- Data Sheet for 400kV Outdoor Switchyard (Doc. No.: I02.KK56.0.0.ET.DS.PR046)

This document is an intellectual property of Nuclear Power Corporation of India Limited

- Technical Specification for Control Metering Relay Protection Panels for EHV System (Doc. No.: I02.KK56.0.0.ET.TS.PR092)
- Technical Requirements for Grounding & Lightning Protection Systems (Doc. No.: I02.KK56. 0.0.ET.TT.PR004)
- Technical specification for Civil Works of Electrical Balance of Plant Outdoor Structures of KKNPP-5&6 (I02.KK56.0.0.CC.TS.PR001)
- Cable tray routing layout for 400kV GIS building

12.0 ABBREVIATIONS USED:

GIS	:	Gas insulated Switchgear
GIBD	:	Gas insulated bus duct
AC	:	Alternating Current
AERB	:	Atomic Energy Regulatory Board
BIS	:	Bureau of Indian Standards
BS	:	British Standard
CEA	:	Central Electrical Authority
IEEE	:	Institute of Electrical and Electronics Engineers
IEC	:	International Electro technical Commission
IP	:	Ingress Protection
ITP	:	Inspection and Test Plan
PO	:	Purchase Order
PVC	:	Poly Vinyl Chloride
VDE	:	Verband Der Electrotechnik, und Information Stechnik
CSAT	:	Common Station Auxiliary Transformer
RAT	:	Reserve Auxiliary Transformer
ASME	:	American Society of Mechanical Engineers
CENELEC	:	European Committee for Electrotechnical Standardization
DC	:	Direct Current
TRV	:	Transient Recovery Voltage
NO	:	Normally Open
NC	:	Normally Close
LCC	:	Local Control Cubicle
BCU	:	Bay Control Unit

This document is an intellectual property of Nuclear Power Corporation of India Limited

Annexure A

Gas Insulated Bus Duct between 400kV GIS and Generator Transformer(s)

Contractor shall also consider the following requirements during detail engineering.

1. Requirements for safety

   1.1. The design of the bus duct elements shall ensure safety of the service personnel during mounting, preparation for operation, operation, maintenance service and repair.

   1.2. Each electrically continuous segment/ compartment of the bus duct phase enclosure shall have two terminals for connection to the earthing conductor.

   1.3. The earthing terminal shall have an indelible earthing sign.

2. Requirements for earthing devices

   2.1. Protective grounding for protection of people from electrical shock shall be envisaged at contact to live metal nonconductive parts as a result of insulation damage.

   2.2. Earthing shall be as per IEEE-80.

3. Requirements for material

   3.1. Materials and accessories, used for manufacturing of the components and parts of the bus ducts shall comply with the requisite engineering requirements.

4. Environmental requirements

   4.1. Environmental safety regulations during mounting and operation of bus duct (limits on noise and vibration) shall be brought out in the manufacturer's operation manual.

5. Design Requirements

   5.1. The Contractor shall prepare the GIBD routing layout drawings inside the UAZ tunnels and submit for review and concurrence of the Purchaser. The input tunnel drawings will be provided by the Purchaser during execution. The preparation of routing layout drawings is included as a part of GIBD supply.

   5.2. The layout drawing shall clearly indicate all the required details such as the support locations, clearances, panels for Online PD monitoring (as applicable).

   5.3. Online PD monitoring system shall cover the GIBD sections upto Generator transformer. The Contractor shall workout the sensor locations and required panels and other accessories accordingly.

   5.4. The details of the embedded parts available in the tunnel will be shared by the Purchaser during execution. Any further modifications of embedded parts shall be the

This document is an intellectual property of Nuclear Power Corporation of India Limited

responsibility of the Contractor and is included under the scope of this item. Approved make of anchor fasteners may be used to compensate for the unavailability of embedded parts. However, this is subject to the review and concurrence of the Purchaser.

5.5. Gas - insulated bus duct shall be a rigid metal structure with each phase in separate sealed enclosures filled with sulphur hexafluoride (SF6) gas.

5.6. Bus duct shall include:

- straight sections, bends with support/fastening parts for necessary routing;
- sections for equipment (Surge Arrestor, etc.);
- end connections to power transformers with lead-in (oil to insulated gas) and connection to GIS with lead-in(insulated gas – insulated gas).

5.7. Design of lead-in (oil to insulated gas) for direct connection of the power transformer and bus ducts shall comply with IEC 62271-211.

5.8. All enclosures of separate sections and elements of the busduct shall be electrically connected and grounded.

5.9. The sections shall be connected through flanged joints.

5.10. The outer magnetic field between the enclosures of the adjacent phases on the ends of the all-welded sections shall be compensated by welding of conductive jumpers except for specific sections

5.11. Enclosure of bus ducts shall be insulated at the point of its fastening to the supporting structures, connection to transformers & GIS

5.12. Compensating devices shall be installed over the route of the bus-ducts at intervals of not more than 12 meters for compensation due temperature variations, as well as to take care of erection

5.13. Seismic-compensating devices shall be envisaged on the bus ducts between the bus duct tunnels and transformers, allowing relative shift of the bus duct points. Possible shifts in both horizontal and vertical directions are to be taken into account.

5.14. Design of the supports shall be safe and convenient for operation.

5.15. The support joints shall ensure a reliable fastening of the bus-duct to supporting metal structures and shall facilitate free movement (in case of a weather change) over the surface of guide members.

5.16. Busduct enclosure shall have corrosion resistance protection.

5.17. Enclosure of the bus duct shall be resistant to burnout due to an internal arc effect as per (IEC 62271-203)

5.18. Each sealed section of the bus duct shall be protected against SF6 gas over pressure.

This document is an intellectual property of Nuclear Power Corporation of India Limited

5.19. Each sealed section of the bus duct shall have atleast one SF6 gas density sensor and valves for filling and removal of SF6 gas. Design of the density sensors shall have a provision to check them even with SF6 gas in the section.

5.20. Density meters (pressure) shall have set points for alarm and interlock:

- Requiring additional filling of the SF6 gas;
- Minimum density (pressure) of the SF6 gas in order to disconnect the section from both sides

5.21. Control and signal circuit elements of the bus duct shall be placed in the cabinets with terminal blocks for external cables for central control systems.

5.22. Bus ducts shall be resistant to impact of environmental, mechanical factors and operating conditions.

5.23. Bus ducts shall withstand the impact of through short circuit current without any damage or effect on normal operation.

5.24. Design of high-voltage equipment shall exclude possible access to non-insulated conductive part.

5.25. Fire safety of the high-voltage equipment in design shall be ensured by use of non-combustible material and protection measures.

5.26. The design of bus duct and equipment, shall include requisite I&C.

Following input data shall be provided to facilitate related design by Purchaser and with regard to maintenance and repair for items which exceed 50kgs (transportation weight)

- Loads of component part on slab/floor during repair;
- mass and dimensional characteristics of component parts (components) likely to be dismantled (taken to pieces) during maintenance, repair;
- strapping diagrams with siting and indication of the center of gravity and distances from the bottom of the transported item to a hook of load-lifting device;
- dimensions of component /parts with anchors, for removal
- drawings of tools necessary for repair, equipment repartition during maintenance,
- Requirements of the station systems (requirement of compressed air, etc. and their provision in design by the Contractor) for repair and maintenance.

5.27. During temperature variations the arrangement of fastening of the buses to the supporting insulators shall ensure its free movement

5.28. All the sealing gaskets used in plug-type connection of the bus-duct casing shall be of using moisture and heat resistant rubber.

This document is an intellectual property of Nuclear Power Corporation of India Limited

5.29. All specific requirements for the GIBD like earthing, cable trays and cables for GIBD, all structural steel supports for GIBD, additional embedded parts for GIBD, etc. are included in the scope of the subject tender. Grounding Conductor grid inside the 5 1 - 4 UAZ & 6 1 - 4 UAZ Tunnel is an extension of Grounding Grid inside 0 UAB Building and hence the same is also included as part of the scope of this package.

6. Installation And Operating Condition Requirements

6.1. Environment - non explosive, not containing any aggressive dust, gases, vapor in concentration that could reduce the parameters of the bus ducts adversely. Design ambient temperature, + 45^0C, humidity: 30 to 95 %.

6.2. Design climatic data:

- design temperature of ambient air t_{min} = + 19 ^{0}C, t_{max} = + 34 ^{0}C;
- maximum temperature of ambient air t_{min} = + 15 ^{0}C, t_{max} = + 45 ^{0}C;
- relative air humidity up to 98 %;
- barometric pressure – 760 mm (Mercury column);
- wind velocity 7.7 m/s.

6.3. Data of background concentration of harmful agents in the atmospheric air and concentration of the main corrosion-active agents in the atmospheric air are given in the relevant part of the tender and repeated hereunder

- chlorides	100 mg/ m^2 per day;
- speed of chlorides deposition	0.1 cm/s;
- sulphurous gas	not more 20 mg/ m^2 per day (not more 0.025 mg/m^3);
- sulphates	50 mg/m^2 per day;
- ozone	190 µg/m^3;
- maximum dust in air during dusty storms	45 mg/m^3;
- average value of dust	0,26 mg/m^3;

Operation mode – continuous, long-term.

6.4. Manufacturer’s technical documentation for bus ducts (with surge arrestors) shall contain stresses in the parts and the elements for fastening the equipment to civil embedded metal structures / foundations, occurring during seismic loading.

7. Reliability Requirements

7.1. Service life of the bus ducts (complete with surge arrestors) must be at least 30 years

7.2. Warranty period of the bus ducts operation (complete with surge arrestors) must be at least 3 years.

This document is an intellectual property of Nuclear Power Corporation of India Limited

7.3. Degree of protection of the auxiliary circuit enclosure against contact with the live parts or approach to them and against contact with the moving parts inside the enclosure shall be as specified in the relevant standards/codes.

7.4. Working pressure of SF6 gas shall be based on the rated dielectric strength of the bus duct insulation and such that at the gas doesn't condense at low temperatures which may lead to an inadvertent pressure decrease.

7.5. Nominal (excess) pressure of the SF6 gas shall be selected in the range from 0.05 (0.5) to 1.0 (10) MPa (kg/cm^2).

7.6. Repeat of maintenance not more than once per year.

8. Acceptance and type test Requirements

8.1. The subject equipment shall be treated as a GIBD (part of GIS) and all valid type test reports in line with IEC 62271-203 shall be provided.

8.2. However, for specific requirements like sliding contacts - mechanical endurance, climatic test, - resistance to external mechanical factors, etc. in line with the IEC 62271-204/61640 which are not covered in IEC 62271-203, the intended performance shall be guaranteed and instead of providing type test reports, qualitative/analysis reports shall be furnished for Purchaser's acceptance during detail engineering.

8.3. Bus ducts (with surge arrestors) shall pass qualification, acceptance, standard tests and startup tests in-situ according to the procedure, established by International Indian standards, as well as the standards of the manufacturer.

Type tests of the bus ducts shall include:

- dielectric strength of insulation and determination of the level of partial electric discharge;
- insulation of auxiliary circuits;
- resistance to through-short currents;
- temperature rise test
- measurement of main circuit resistance;
- pneumatic test on enclosure
- enclosure tightness according to the recommendations of IEC 62271-204;
- corrosion-resistance according to the IEC 62271-204;
- sliding contacts (mechanical) according to the IEC 62271-204;
- resistance to inner arc according to the IEC 62271-204;
- climatic according to IEC 68-2-1-74;
- resistance to external mechanical factors;
- check of welds quality according to IEC 62271-204;
- level of protection of auxiliary circuits cabinets according to the IEC 529-89.

8.4. Acceptance tests shall include the following:

This document is an intellectual property of Nuclear Power Corporation of India Limited

- External examination to check compliance with assembly drawings, instructions and diagrams;
- power - frequency voltage testing of insulation strength;
- resistance measurements of main circuits;
- auxiliary circuit insulation tests;
- partial discharge tests;
- high pressure tests of enclosure;
- leak rate tightness enclosure tests as per IEC 62271-204.

8.5. The following points shall be considered:

- type tests shall be performed when changing the design and manufacturing process of busduct, as well as when changing the applied material, if such changes may affect the busduct parameters;
- the test procedure shall comply with the qualification test program;
- in technically justified cases, type tests can be carried out under a special program. Thereby, the composition of the tests shall be determined depending on the possible impact of the proposed changes in the quality of the GIBD

8.6. Start-up tests at the site shall include the following:

- external examination to check compliance with assembly drawings, instructions and diagrams;
- insulation tests of the main circuits;
- insulation tests of the auxiliary circuits;
- main circuit section resistance;
- leak tightness test as per IEC 62271-204;
- insulation gas test.

8.7. The power frequency tests for insulation of the control circuits and auxiliary circuits of the bus ducts shall be performed according to IEC 61180-1. The test voltage shall be 2 kV with a duration of 1 min.

This document is an intellectual property of Nuclear Power Corporation of India Limited

Annexure B

General requirements for interconnection between 400kV GIS of KKNPP 5&6 and 400kV GIS of KKNPP 3&4 through Overhead transmission line.

The following requirements in addition to the other requirements indicated elsewhere in the tender document shall also be complied during detail engineering and subsequently during execution.

1. Scope of work also includes the following major works:

1.1. Connection of two nos. of line feeders of 400kV GIS of KKNPP 5&6 to 2 nos. of line feeders of 400kV GIS of KKNPP 3&4 through overhead line. The overhead line shall be a 400kV double circuit line with OPGW. The requirements as brought out in the technical specification and datasheets for 400kV Outdoor Switchyard (I02.KK56.0.0.ET.TS.PR052) shall be followed.

1.2. Complete design, engineering, supply, erection and commissioning of 400kV tie lines (Overhead lines) along with its tower structure, foundation, grounding and lightning protection system.

1.3. Earthing of equipment and Structures shall be as per the per relevant applicable codes, standards, tender specification, drawings

1.4. Routing of the 400kV overhead tie line shall take into account all the relevant stipulations, existing structures, etc. 230kV overhead transmission lines emanating from KKNPP 5,6 are intended to be crossed.

1.5. Detailing and implementation of control and protection scheme, data connectivity through Fibre optic cable, and energy measurement (as required), etc. as per relevant specification

1.6. String insulator/Polymer Insulator, Connectors and Clamps (400kV Tie line from gantry of KKNPP 56 to gantry of KKNPP 34) – The requirements as brought out in the technical specification and datasheets for 400kV Outdoor Switchyard (I02.KK56.0.0.ET.TS.PR052) shall be followed.

1.7. Obtaining all required statutory clearances.

1.8. OPGW cable construction shall comply with IEEE-1138, IEC 60793. The cable provided shall meet both the construction and performance requirements such that the ground wire function, the optical fibre integrity and optical transmission characteristics are suitable for the intended purpose. The contractor shall work out nos. optical fibre units as per the system requirement. There shall be no factory splices within the cable structure of a continuous cable length. The Contractor shall determine the exact requirements of all accessories required to install and secure the OPGW.

This document is an intellectual property of Nuclear Power Corporation of India Limited

2. Presence of underground tunnels, buried piping, existing equipment like transformers, connection to the existing GIS, and other structures in proximity of KKNPP 3,4 switchyard area and along the Tie line (to be erected through this Tender) also need to be taken into account while executing the tie line.
3. The Over Head Lines comprises Quad Moose ACSR conductor, insulator, transmission tower (lattice), cables, gantry, clamps & connector and other supporting equipment/structures needed to complete the work under this tender.
4. General Requirements & Guidelines

   4.1. Design, engineering, execution of fabrication/manufacture, procurement and transportation, erection and commissioning as well as testing (both at the factory and at site) of the 400kV overhead line interconnection SSCs between 400 kV GISs of the KKNPP#5,6 and KKNPP#3,4 shall be carried out by the Contractor as per relevant applicable codes, standards, tender specification, drawings and best engineering practices. Unless otherwise specified, the latest published versions as on the day of submission of bids shall be used.

   4.2. The Contractor shall bring out any abnormality/discrepancy in the scheme selected by NPCIL with a suitable alternative (no major change envisaged) within the scheme proposed by NPCIL for 400kV switchyard interconnection arrangement.

   4.3. Notwithstanding any other provision, the Contractor, as a part of his obligation, shall perform all work and render all services, which may reasonably be required to complete the defined scope of work, whether or not mentioned specifically in this document or brought under the list of deliverables.

   4.4. Minimum ground clearance under maximum conductor sag shall not be less than statutory requirements.

   4.5. Road Crossings – At locations of road crossings, lowest point of the overhead line shall be at a height of minimum 11 M + required ground clearance (from bottom of structure to ground) on structural steel supports. Additional clearance of 150mm shall be provided for error in sagging the conductor. Scope also includes providing structural steel vehicle height restrictors (limiter) at two locations on the road – either side of the crossing.

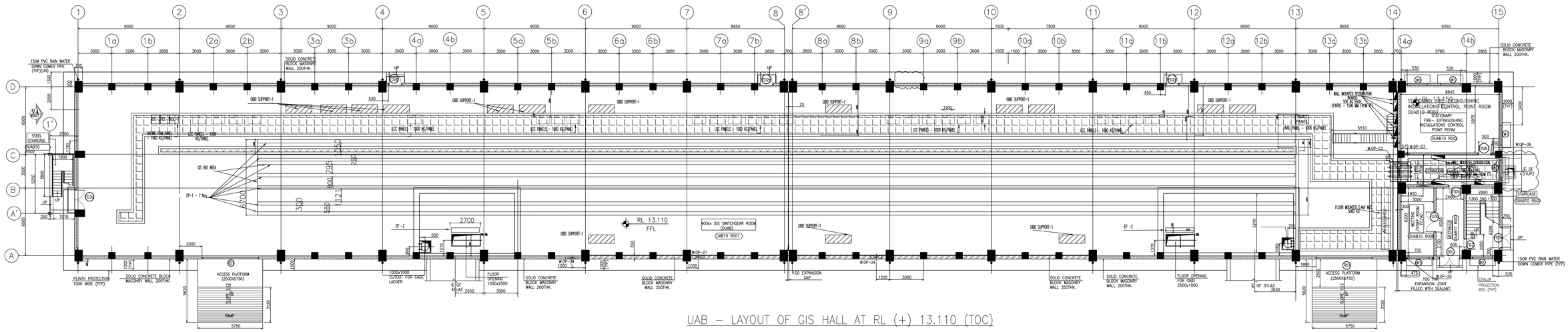
   4.6. Sag and tension limitations shall be as per IS-802 (part-1). Tower member design shall confirm to provisions of IS-802 (part-2)

5. Hot dip galvanisation of steel members – Structural steel members shall be of minimum grade E250 of IS 2052. The thickness of zinc coating shall be no less than 85 microns for items of thickness less than 5 mm and 120 microns for items of thickness more than 5 mm. All heavy in situ fabricated items shall be metallised with Zinc + Aluminium (15%).

6. Details regarding civil works and seismic and structural analysis of the overhead line and lattice structures shall be as per the document ‘Technical specification for Civil Works of Electrical Balance of Plant Outdoor Structures of KKNPP-5&6 (I02.KK56.0.0.CC.TS.PR001)’ attached with this tender.

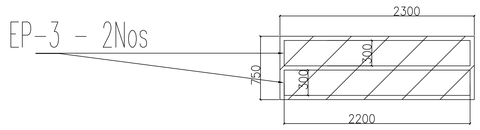
This document is an intellectual property of Nuclear Power Corporation of India Limited

ANNEXURE C- LAYOUT AND EP LOCATION FOR 400KV GIS BUILDING



UAB – LAYOUT OF GIS HALL AT RL (+) 13.110 (TOC)

EP-3 – 2Nos



EP ARRANGEMENT ON GIBD SUPPORT–1

HOLE NO. / EP NO. IDENTIFICATION TABLE

EP NO.	DESCRIPTION (B x D x T)	QTY	REMARKS
EP–1	92000X300X20THK PLATE EP	7	ELECTRICAL EP
EP–2	2500X400X20THK PLATE EP	2	ELECTRICAL EP
EP–3	2200X300X20THK PLATE EP	30	ELECTRICAL EP

LEGEND:

1. TYP – TYPICAL
2. FGL – FINISHED GRADE LEVEL
3. PCC – PLAIN CEMENT CONCRETE
4. BOF – BOTTOM OF FOOTING
5. BOBS – BOTTOM OF BASE SLAB
6. THK – THICKNESS
7. SEC – SECTION
8. EJ – EXPANSION JOINT
9. TOC – TOP OF CONCRETE
10. RL – REDUCED LEVEL (M)
11. TOG – TOP OF GROUT

– CABLE TRENCH WITH 300 MM DEPTH

– CABLE TRENCH WITH 1400 MM DEPTH

NOTES:

1. ALL DIMENSIONS ARE MENTIONED IN MM UNLESS MENTIONED OTHERWISE.
2. EP 1 –7 Nos IS ENVISAGED FOR GIS BAY AREA. EP 2&3 ARE ENVISAGED FOR GIBD SUPPORTS.
3. LOCAL CONTROL CUBICLES, 0.4kV MCCs IN GIS HALL ARE ENVISAGED TO BE INSTALLED ON TOP OF CABLE TRENCH EDGE ANGLES WITH NECESSARY FRAME SUPPORTS.
4. GIBD SUPPORT–1 ARE ISOLATED FOOTINGS. MINOR CHANGES IN LOCATION OF THE FOOTINGS MAY BE POSSIBLE. GIBD SUPPORTS CANNOT BE INSTALLED IN OTHER AREAS THAN THE FOOTINGS. EQUIPMENT LAYOUT SHALL BE DESIGNED ACCORDINGLY.
5. EP LAYOUT IS TENTATIVE. MINOR CHANGES AS PER CIVIL STRUCTURE DESIGN MAY BE EXPECTED.

THE DESIGN AND DRAWING IS THE PROPERTY OF NPCIL AND SHALL NOT BE COPIED, REPRODUCED OR LENT TO INDIA LTD. IT MUST BE RETURNED WITH OUR AUTHORISATION WHEN WORK IS COMPLETED. EQUIPMENT AND MUST NOT BE USED EXCEPT BY PERMISSION OF THE OWNER.

ISSUE No.	REV. No.	DESCRIPTION	DATE	APP'D.	ISSUE SHT. No.
1	0	ISSUED FOR TENDER			

DRAWING ISSUED FOR

NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

TITLE :–
Layout and EP location for 400kV GIS building

PROJECT : KKNPP 5&6

SCALE –

PROJECTION

DRG. No. I02.KK56.0UAB.0.ET.OK.WD001

REV. No.

FLOPPY/CD No.

DRG. TO BE READ IN CONJUNCTION WITH DCN/FCN/ECN, IF ANY.

DRG. No.

REFERENCE DRAWINGS | DRAWING No. | REFERENCE DRAWINGS | DRAWING No.

REVISIONS: No. | LOCATION | DESCRIPTION | DR'N. | DES'D. | D.CHK'D. | REV'D. | APP'D. — SIGNATURE WITH DATE

DO NOT SCALE THE DRAWING.

UNLESS OTHERWISE STATED :–
ALL DIMENSIONS ARE IN mm.
MACHINE ALL OVER.
SURFACE FINISH TO BE 3.2/ OR BETTER.
REMOVE ALL BURRS.
REMOVE ALL EXTERNAL SHARP CORNERS AND EDGES BY CHAMFERING TO 0 . 15 / 0 . 40 X 45°.
ROUND ALL INTERNAL CORNERS AND EDGES TO R 0 . 15 / 0 . 40.
TOLERANCES ON RADII AND CHAMFERS (IS : 2102)

RADII AND CHAMFERS	0.5–3	3–6	6–30
TOLERANCES	± 0.2	± 0.5	± 1.0

TOLERANCES ON LINEAR DIMENSIONS (IS-2102)

DIMENSIONS	TOL.	DIMENSIONS	TOL.
UPTO 6	± 0.1	315 – 1000	± 0.8
6 – 30	± 0.2	1000 – 2000	± 1.2
30 – 120	± 0.3	2000 – 4000	± 2.0
120 – 315	± 0.5	4000 – 8000	± 3.0

TOLERANCES ON LINEAR DIMENSIONS

SPECIFIED DIMENSIONS	TOLERANCE
XX	± 0.40
XX.X	± 0.40
XX.XX	± 0.25

TOLERANCES ON ANGULAR DIMENSIONS : ± 0° – 30'

POWER OUTPUT STATION 400 KV BUSDUCT TUNNELS (STBUDZ) STRUCTURES: GEOMETRY

LIST OF WORKING DRAWINGS OF THE MAIN SET

Sheet	Name	Rev.
1	Sheet Index	
2	Plan of cells 1-1 to 1-5, Units 1-4, Sections of cells 1-1 to 1-5	
3	Unit 1-1	
4	Unit 1-2	
5	Unit 1-3	
6	Unit 1-4	
7	Unit 1-5	
8	Unit 1-6	
9	Unit 1-7	
10	Unit 1-8	
11	Unit 1-9	
12	Unit 1-10	
13	Unit 1-11	
14	Unit 1-12	
15	Unit 1-13	
16	Unit 1-14	
17	Unit 1-15	
18	Unit 1-16	
19	Unit 1-17, Plan 1-1, Section 1-1	
20	Unit 1-17, Section 2-2, 3-3	
21	Unit 1-18	
22	Unit 1-19	
23	Details 1, 2, 3	
24	Details 4, 5, 6	
25	Floor slab 01	
26	Lining 01	
27	Miscellaneous details 01, 02, 03, 04	
28	Miscellaneous plans 01, 02, 03, 04	
29	Embedded parts 01, 02, 03, 04, 05	

LIST OF SPECIFICATIONS

Sheet	Name	Rev.
1	Specification of plan of cells 1-1 to 1-5	
02	Specification of 01	
03	Specification of 02	
04	Specification of 03, 04	
05	Specification of miscellaneous plans 01, 02, 03, 04	
06	Specification of embedded parts 01, 02, 03, 04, 05	

LIST OF VOLUMES OF MAIN CIVIL WORKS

Name	Unit	Quantity	Rev.
Excavation in soil and disintegrated rock	m³	2000	
Excavation in rock	m³	1000	
Excavation in hard rock	m³	4000	
Concrete in foundation	m³	6000	
Concrete in walls	m³	5000	
Concrete in roof	m³	3000	
Reinforcement	kg	800000	
Structural steel	kg	200000	
Miscellaneous steel	kg	50000	
Waterproofing membrane	m²	4000	
Backfill	m³	3000	
Grouting	m	2000	
Formwork	m²	10000	
Precast units	nos	500	
Miscellaneous items	lump sum	1	

LIST OF STEEL CONSUMPTION, KG

Type of Member	Reinforcement of Slabs			Reinforcement of Walls			Reinforcement of Columns												Structural Steel			Miscellaneous Steel			Total
	Bottom Layer	Top Layer	Total	Vertical	Horizontal	Total	Main Bars			Ties			Starter Bars			Dowel Bars			Beams	Columns	Total	Grating	Checkered Plates	Total	Anchor Bolts	Misc. Steel	Total	
							Dia	Nos	Total	Dia	Nos	Total	Dia	Nos	Total	Dia	Nos	Total									
S-1	NA	–	1234.5	–	–	–	–	–	–	12	–	87.2	–	16	1234.5				50	150	750	–	–	–	–	–	–	1234.5
S-2	–	–	1234.5	–	–	–	–	–	–	–	–	–	–	–	–				–	–	–	–	–	–	–	–	–	1234.5
S-3	–	–	1234.5	–	–	–	–	–	–	–	–	–	–	–	–				–	–	–	–	–	–	–	–	–	1234.5
S-4	–	–	1234.5	–	–	–	–	–	–	–	–	–	–	–	–				–	–	–	–	–	–	–	–	–	1234.5
S-5	–	–	1234.5	–	–	–	–	–	–	–	–	–	–	–	–				–	–	–	–	–	–	–	–	–	1234.5
S-6	87.3	45.2	1234.5	1234	1234	1234	–	–	123.4	FLX	–	–	FLX	12.3	–				–	–	–	–	–	–	0.1	0.1	0.2	1234.5
S-7	NA	–	1234.5	–	–	–	–	–	–	12	–	87.2	–	16	1234.5				50	150	750	–	–	–	–	–	–	1234.5
S-8	–	–	1234.5	–	–	–	–	–	–	–	–	–	–	–	–				–	–	–	–	–	–	–	–	–	1234.5
S-9	–	–	1234.5	–	–	–	–	–	–	–	–	–	–	–	–				–	–	–	–	–	–	–	–	–	1234.5
S-10	–	–	1234.5	–	–	–	–	–	–	–	–	–	–	–	–				–	–	–	–	–	–	–	–	–	1234.5
S-11	–	–	1234.5	–	–	–	–	–	–	–	–	–	–	–	–				–	–	–	–	–	–	–	–	–	1234.5
S-12	NA	–	1234.5	–	–	–	–	–	–	12	–	87.2	–	16	1234.5				50	150	750	–	–	–	–	–	–	1234.5
S-13	87.3	45.2	1234.5	1234	1234	1234	–	–	123.4	FLX	–	–	FLX	12.3	–				–	–	–	–	–	–	0.1	0.1	0.2	1234.5
S-14	–	–	1234.5	–	–	–	–	–	–	–	–	–	–	–	–				–	–	–	–	–	–	–	–	–	1234.5
S-15	–	–	1234.5	–	–	–	–	–	–	–	–	–	–	–	–				–	–	–	–	–	–	–	–	–	1234.5
S-16	NA	–	1234.5	–	–	–	–	–	–	12	–	87.2	–	16	1234.5				50	150	750	–	–	–	–	–	–	1234.5
S-17	87.3	45.2	1234.5	1234	1234	1234	–	–	123.4	FLX	–	–	FLX	12.3	–				–	–	–	–	–	–	0.1	0.1	0.2	1234.5
S-18	–	–	1234.5	–	–	–	–	–	–	–	–	–	–	–	–				–	–	–	–	–	–	–	–	–	1234.5
S-19	–	–	1234.5	–	–	–	–	–	–	–	–	–	–	–	–				–	–	–	–	–	–	–	–	–	1234.5
S-20	NA	–	1234.5	–	–	–	–	–	–	12	–	87.2	–	16	1234.5				50	150	750	–	–	–	–	–	–	1234.5
S-21	87.3	45.2	1234.5	1234	1234	1234	–	–	123.4	FLX	–	–	FLX	12.3	–				–	–	–	–	–	–	0.1	0.1	0.2	1234.5
S-22	–	–	1234.5	–	–	–	–	–	–	–	–	–	–	–	–				–	–	–	–	–	–	–	–	–	1234.5

GENERAL GUIDELINES

1. The general and detailed specifications mentioned in the drawings shall be followed.
2. All dimensions are in millimetres unless otherwise stated.
3. Concrete grade as mentioned in the drawings.
4. Reinforcement bars shall be of Fe 500 grade conforming to IS 1786.
5. Minimum cover to reinforcement shall be as mentioned in the drawings.
6. All concrete surfaces exposed to earth shall be painted with two coats of bituminous paint.
7. Construction joints shall be provided as shown in the drawings.
8. Waterstops shall be provided in all construction joints in walls and floors.
9. All dimensions shall be checked at site before fabrication.
10. Any discrepancy between drawings shall be brought to the notice of the Engineer-in-Charge.
11. All welding shall be done by qualified welders.
12. Structural steel shall conform to IS 2062 grade A.
13. All bolts shall be of grade 4.6 unless otherwise specified.
14. Anchor bolts shall be provided as shown in the drawings.
15. All exposed steel surfaces shall be painted with one coat of red oxide zinc chromate primer and two coats of synthetic enamel paint.
16. Expansion joints shall be provided at intervals not exceeding 30 m.
17. Contraction joints shall be provided at intervals not exceeding 15 m.
18. All dimensions shall be verified at site before fabrication.
19. Any deviation from the drawings shall be approved by the Engineer-in-Charge.
20. All concrete shall be cured for a minimum period of 7 days.

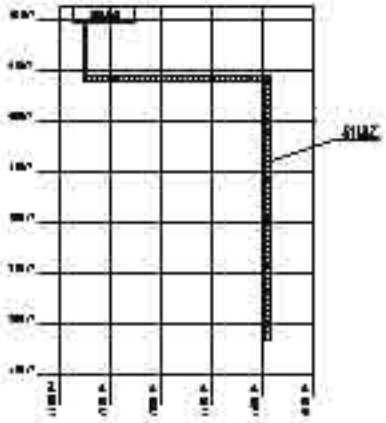
LIST OF MANHOLES

Reference or grid coordinates	Sheet No.	Name	Size of manhole (L x B x D)	Shape	Cover	Cover thickness	Cover reinforcement	Cover concrete	Steel ladder	Type	Remarks	Rev.
A1-A2	S-1	MH-1	1200 x 1200 x 1500	Rect.	RCC	100	8 mm @ 150 c/c	M25	Yes	MS		
B1-B2	S-2	MH-2	1200 x 1200 x 1500	Rect.	RCC	100	8 mm @ 150 c/c	M25	Yes	MS		
C1-C2	S-3	MH-3	1200 x 1200 x 1500	Rect.	RCC	100	8 mm @ 150 c/c	M25	Yes	MS		
D1-D2	S-4	MH-4	1200 x 1200 x 1500	Rect.	RCC	100	8 mm @ 150 c/c	M25	Yes	MS		

LEGEND

- Boundary of Unit 1-1
- Boundary of Unit 1-2
- Section line of cells 1-1 to 1-5 (refer Section 1-1, Sheet 3)
- Line of existing ground profile (refer Section 1-1, Sheet 3)
- Line of the roof slab

KEY PLAN



3	CONSTRUCTION	
2		
1		

NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

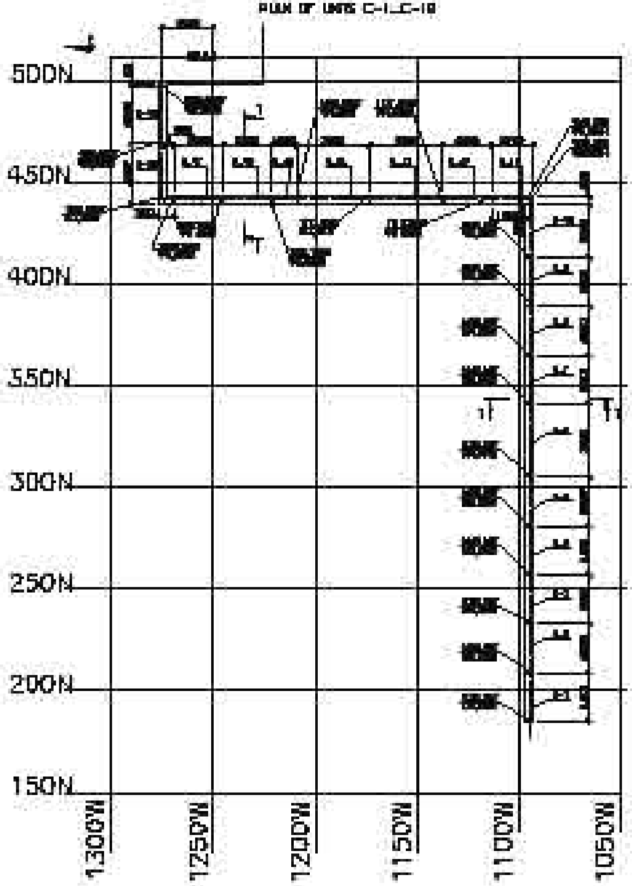
TITLE: KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6
POWER OUTPUT STATION 400 KV BUSDUCT TUNNELS (STBUDZ) STRUCTURES: GEOMETRY
GENERAL PLAN

DRAWN	DESIGNED	CHECKED
CHECKED	APPROVED	ENGINEER-IN-CHARGE

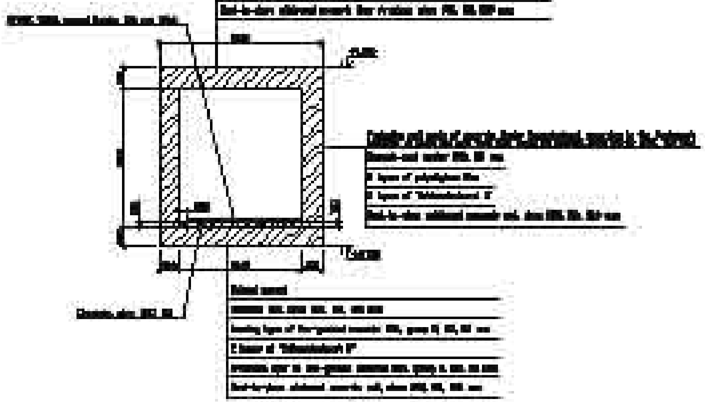
PROJECT: KUDANKULAM NUCLEAR POWER PROJECT 5&6
SCALE: AS SHOWN
PROJECTION
DRG. No. 5&6/STR/STBUDZ/GEN/D/01/01
SHEET No. 1
REV. 0

POWER OUTPUT SYSTEM 400 KV BUSDUCT TUNNELS (31UKC) STRUCTURES. GEOMETRY

PLAN OF UNITS C-1...C-18



SECTION 1-1



SPECIFICATION OF PLAN OF UNITS C-1...C-18

[illegible]

LIST OF PARTS

Item	Sketch
[illegible]	[illegible]

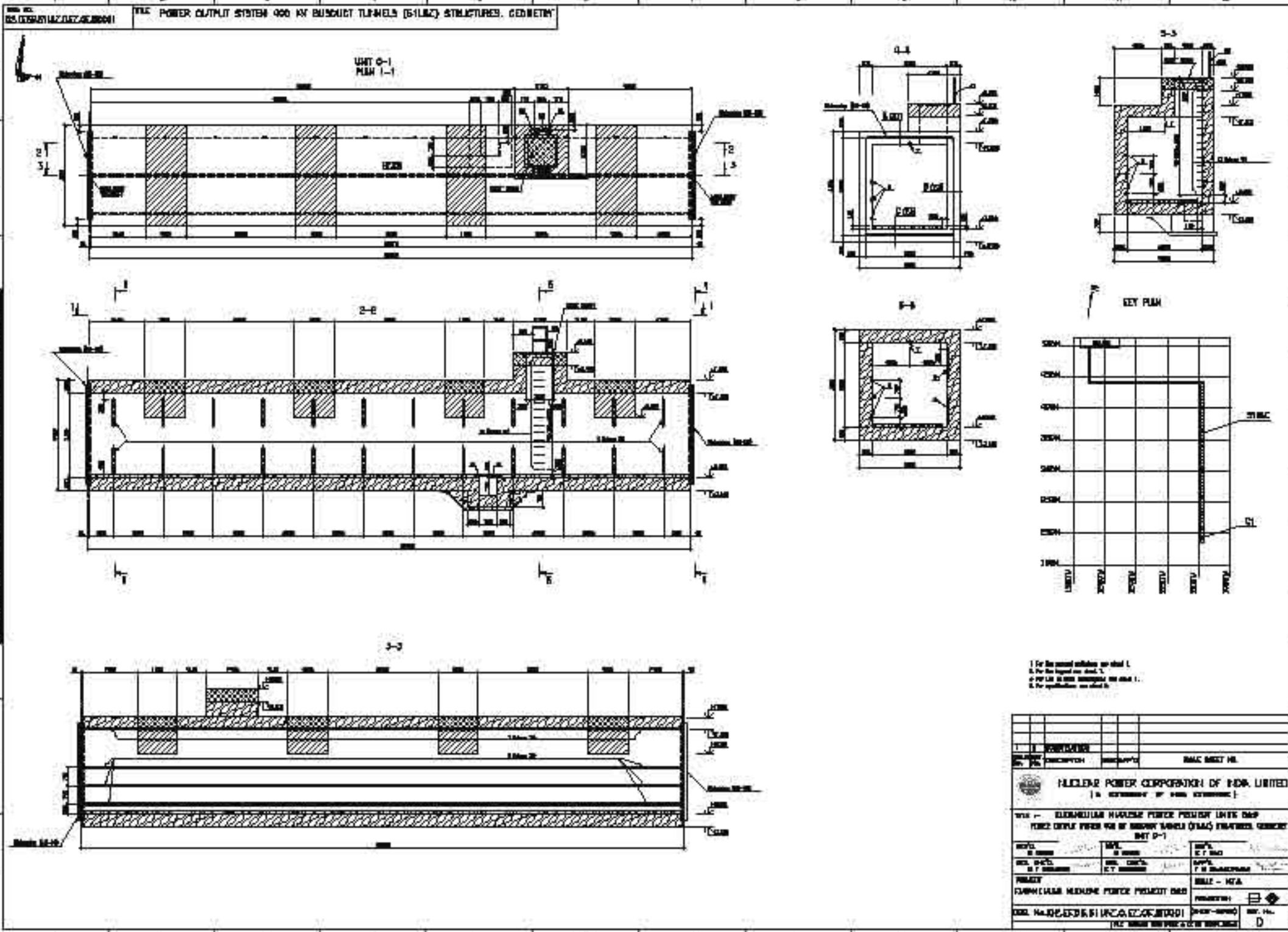
1 For the general guidelines see sheet 1.
2 For the legend see sheet 1.
3 For list of steel consumption see sheet 1.

NUCLEAR POWER CORPORATION OF INDIA LIMITED

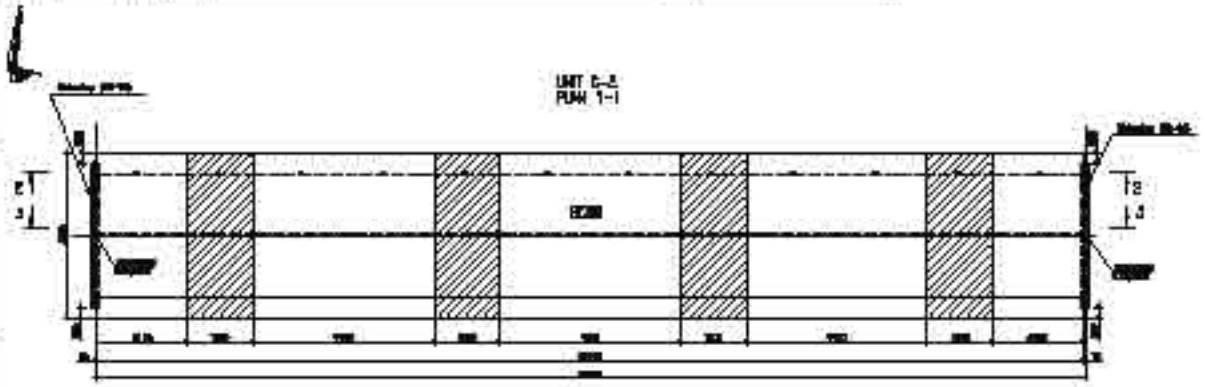
KUDANKULAM NUCLEAR POWER PROJECT UNITS 3&4

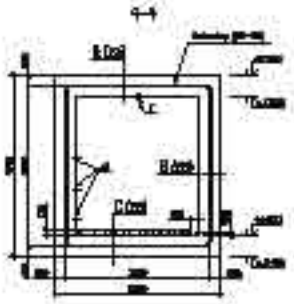
PROJECT: KUDANKULAM NUCLEAR POWER PROJECT 3&4

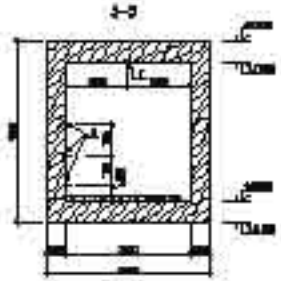
SCALE – N.T.S.

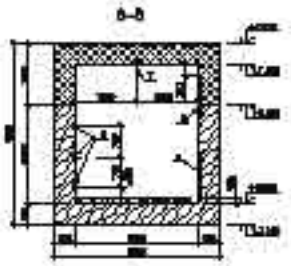

UNIT 0-1
PLAN 1-1
2-2
3-3
4-4
5-5
6-6
KEY PLAN
NUCLEAR POWER CORPORATION OF INDIA LIMITED

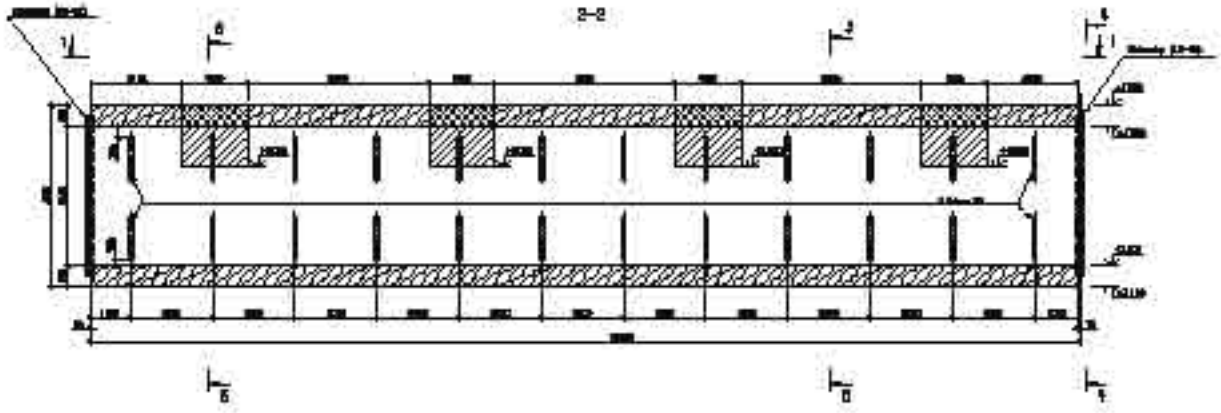
POWER OUTPUT SYSTEM 400 KV SUBDUCT TUNNELS (SIUAC) STRUCTURES GEOMETRY

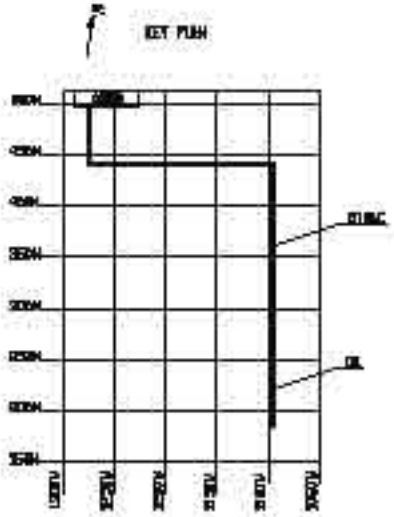


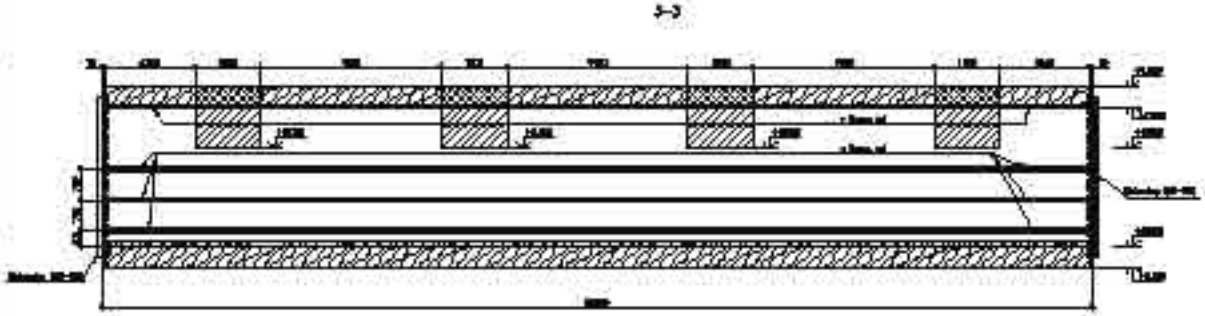










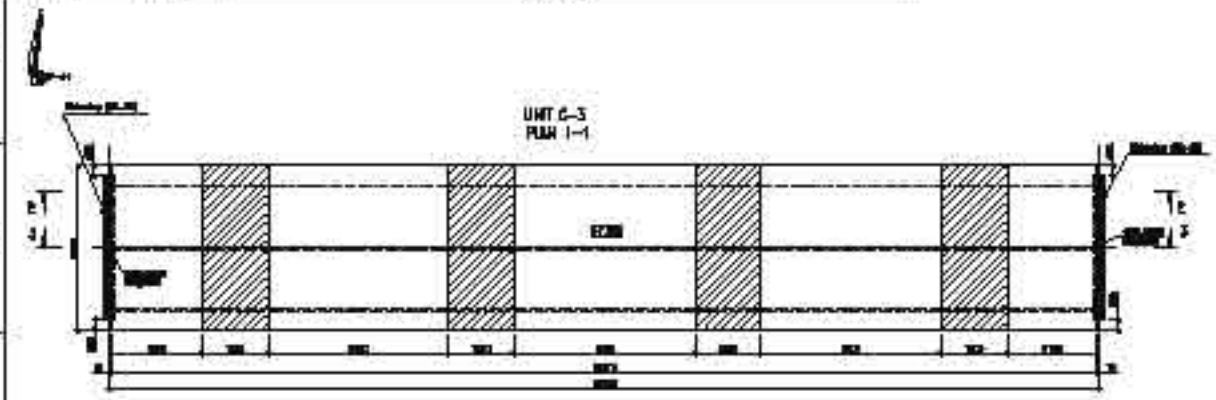


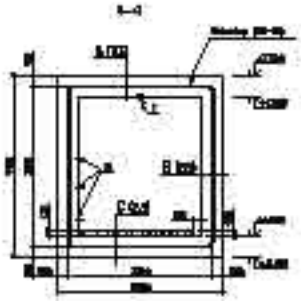
1. For the general guidelines see sheet 1.
2. For the legend see sheet 1.
3. For list of steel corrosion plan see sheet 1.
4. For specifications see sheet 2.

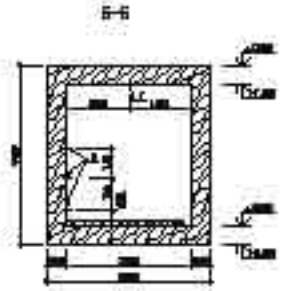
NUCLEAR POWER CORPORATION OF INDIA LIMITED

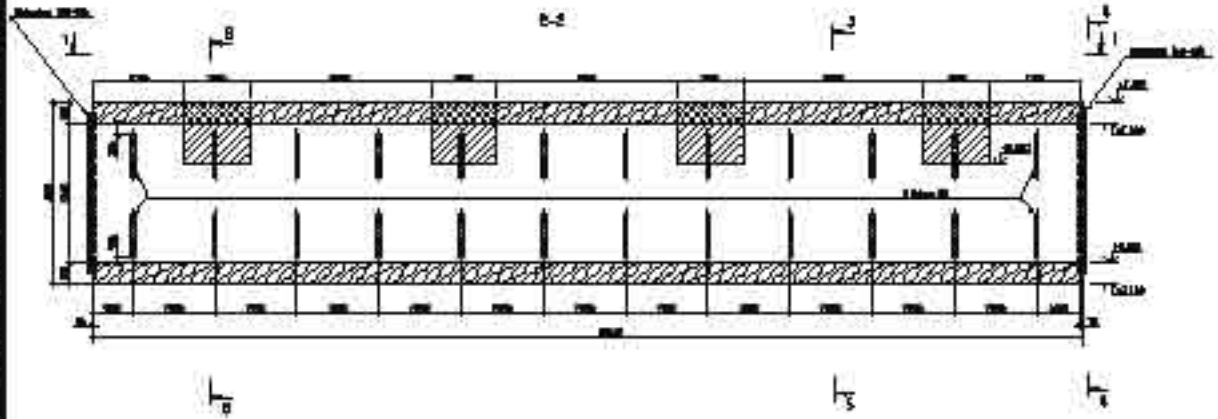
D

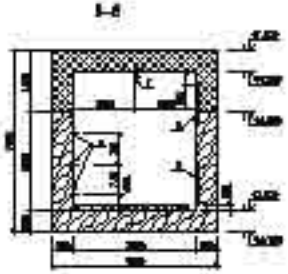
POWER OUTPUT SYSTEM 400 KV BUSDUCT TUNNELS (S1/L&2) STRUCTURES, GEOMETRY
UNIT C-3

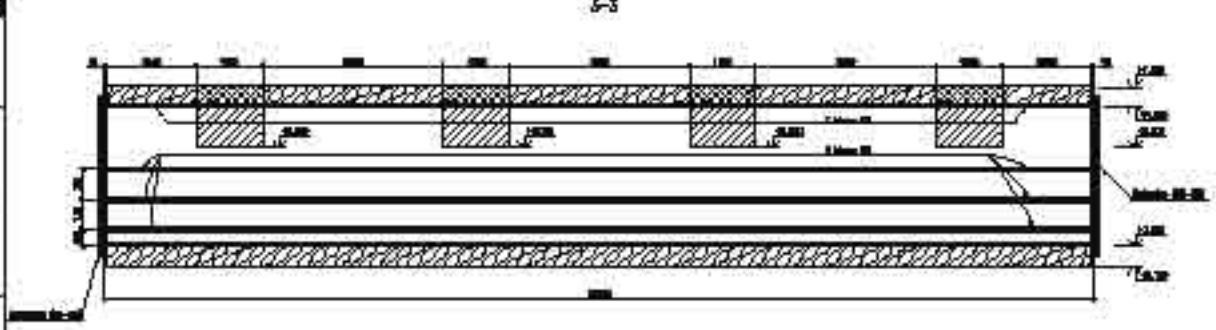


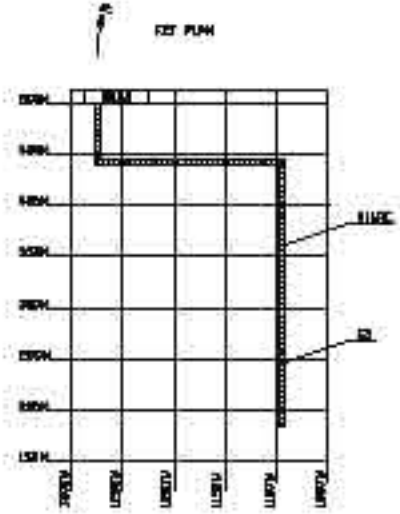








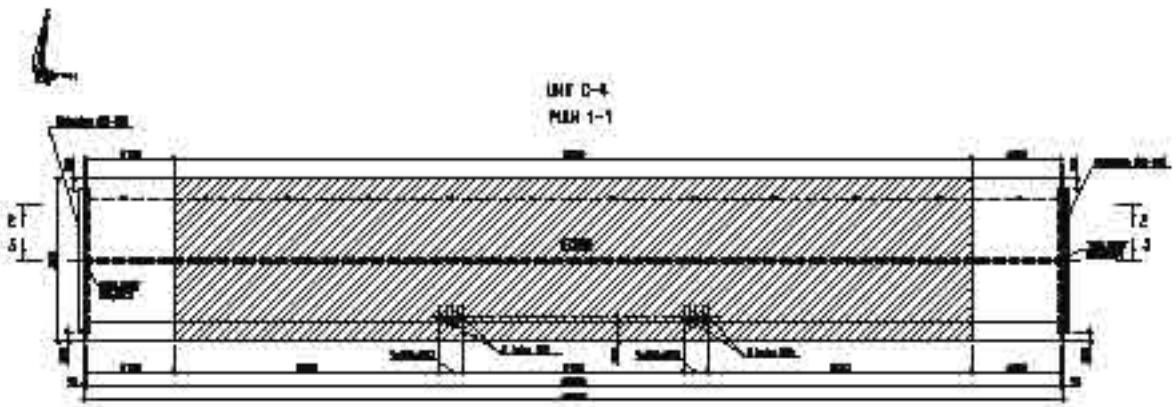


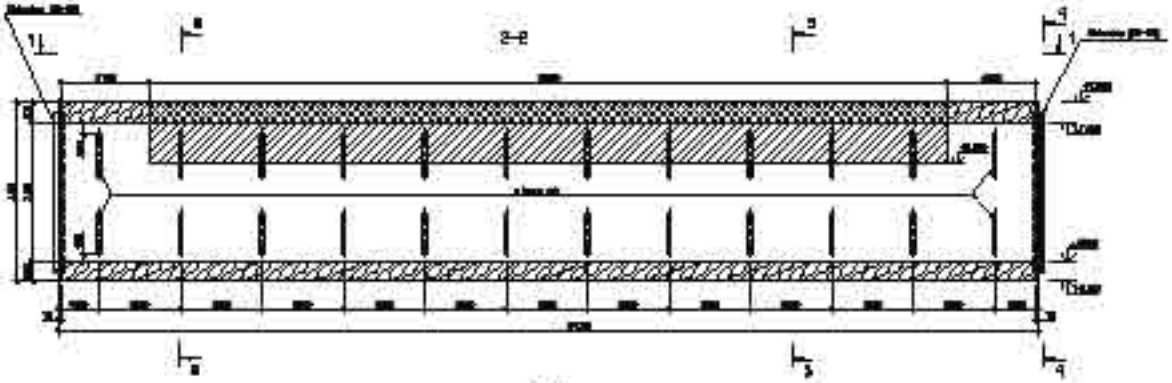


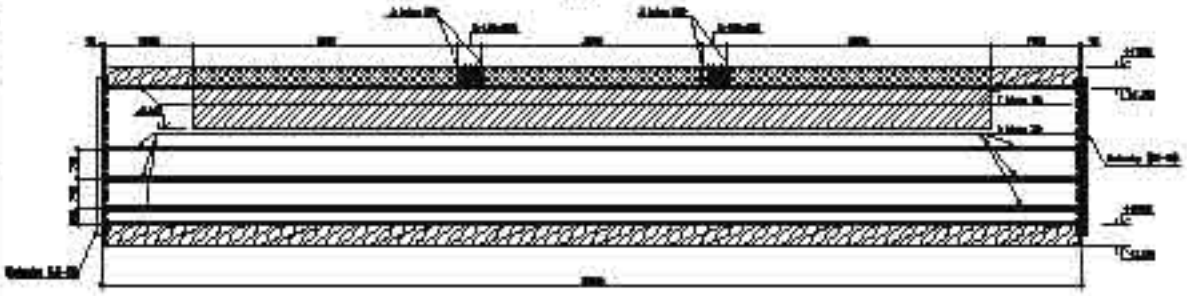
NUCLEAR POWER CORPORATION OF INDIA LIMITED

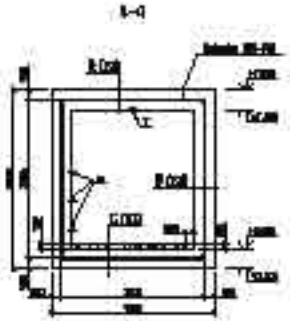
POWER OUTPUT SYSTEM 400 KV BUSDUCT TUNNELS (BTUBZ) STRUCTURAL GEOMETRY

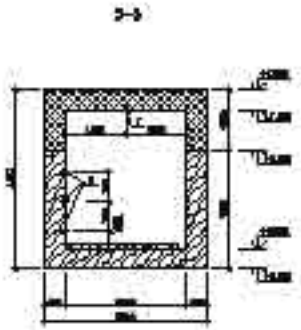
UNIT 0-4
PLAN 1-1

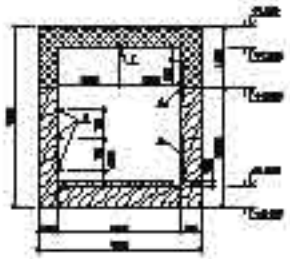


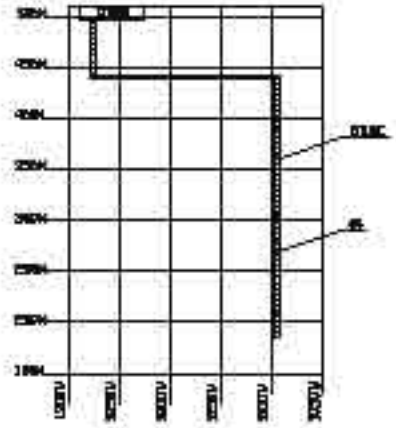












1. For the general guidelines see sheet 1.
2. For the legend see sheet 1.
3. For list of steel consumption see sheet 1.
4. For specification see sheet 2.
5. For wall cornice detail refer note no. 13 of General Guidelines.

NUCLEAR POWER CORPORATION OF INDIA LIMITED

KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6

POWER OUTPUT SYSTEM 400 KV BUSDUCT TUNNELS (BTUBZ) STRUCTURAL GEOMETRY

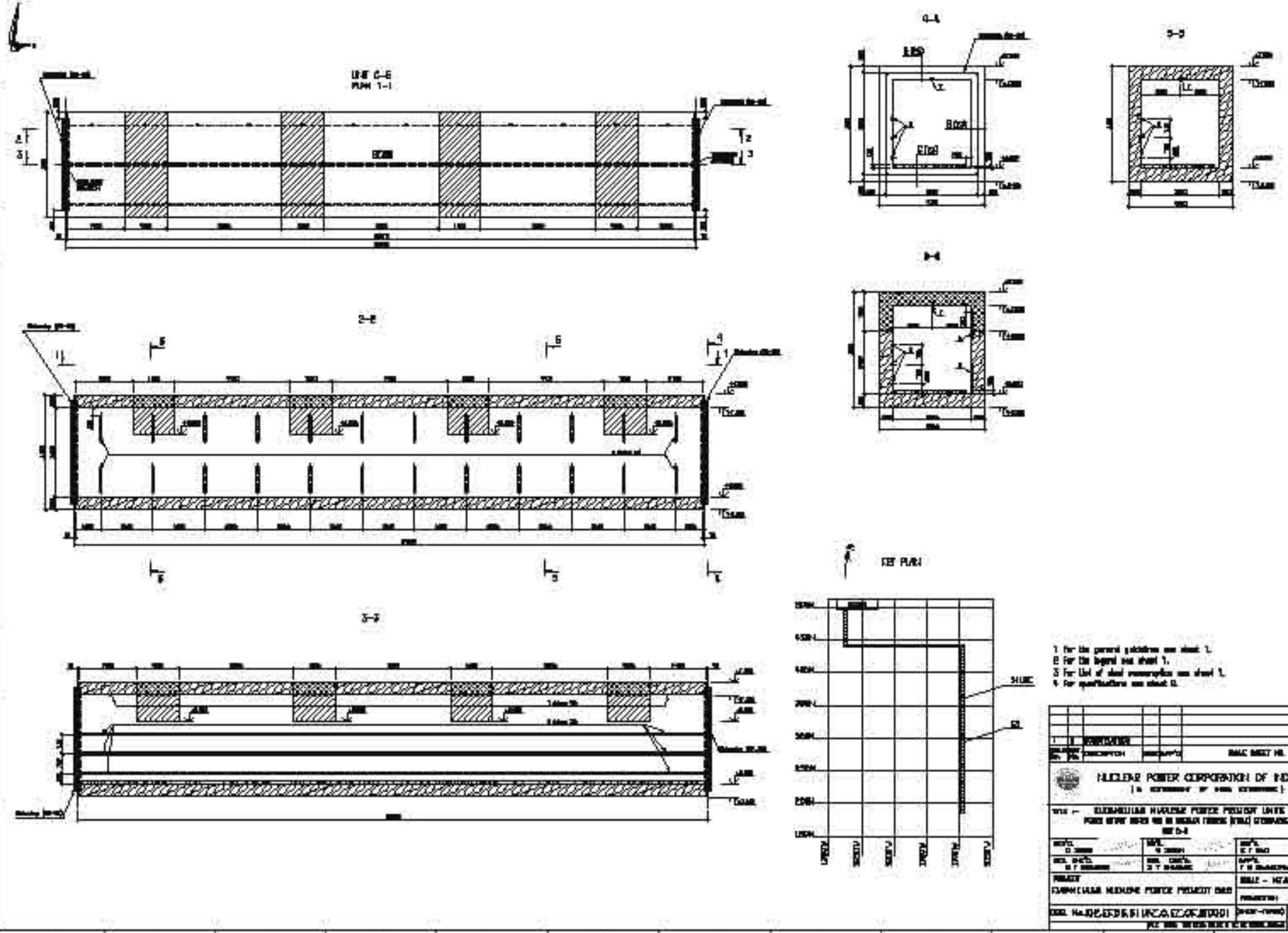
SHEET 1 OF 2

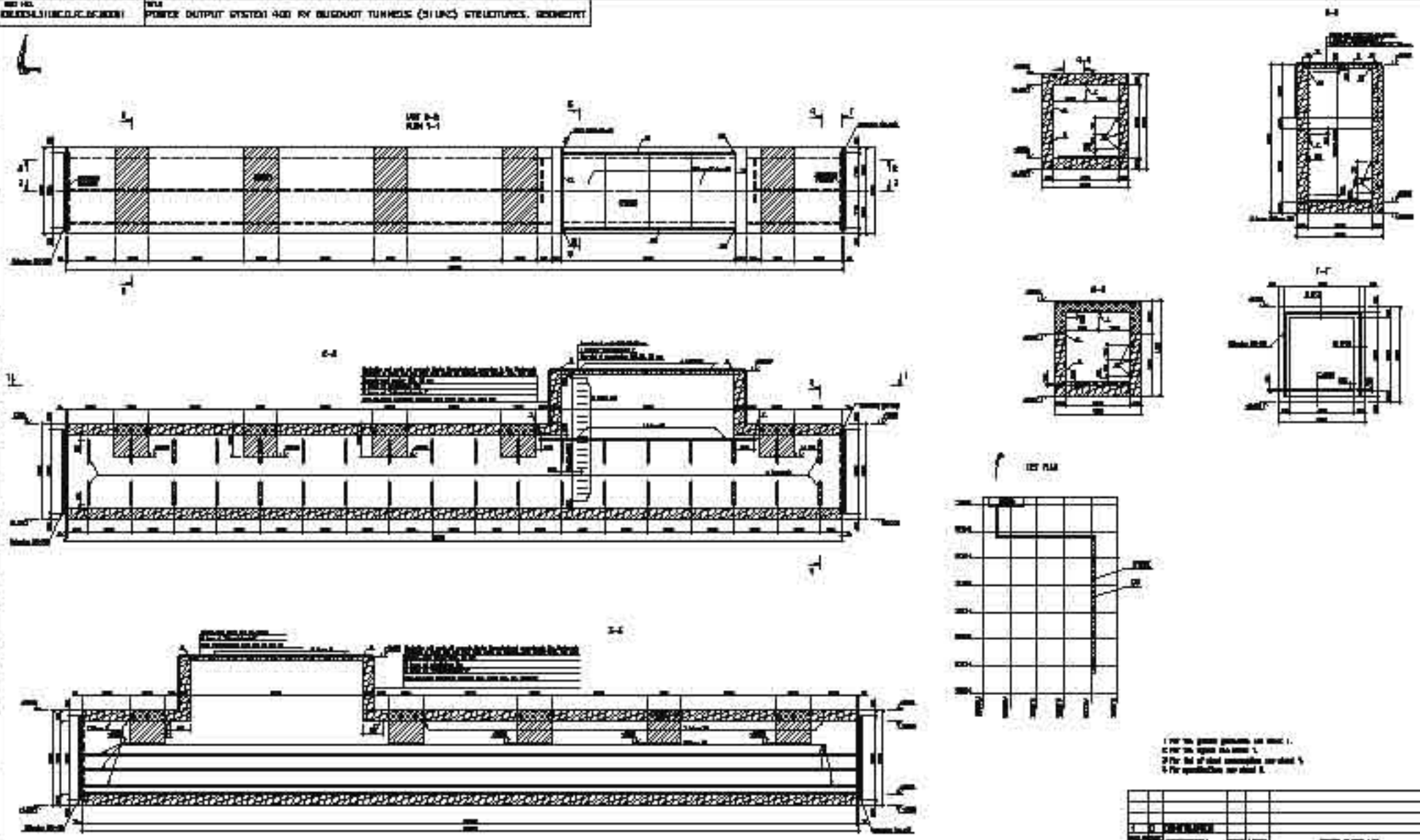
PROJECT: KUDANKULAM NUCLEAR POWER PROJECT 5&6

SCALE - AS SHOWN

DRG. No. 5&6/X/BTUBZ/STR/C_D_GZ_GM/BTUBZ001

SHEET No. 0

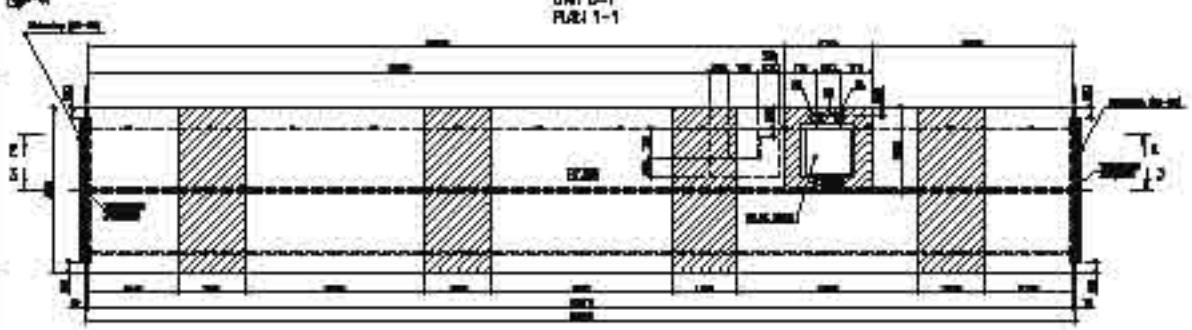

LINE C-C
PLAN 1-1
C-C
B-B
A-A
2-2
3-3
REF PLAN
1. For the general guidelines see sheet 1.
2. For the legend see sheet 1.
3. For List of steel reinforcement see sheet 1.
4. For specifications see sheet 2.
NUCLEAR POWER CORPORATION OF INDIA LIMITED
D

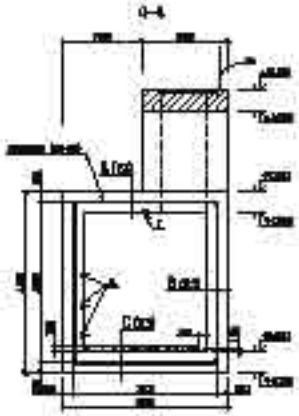


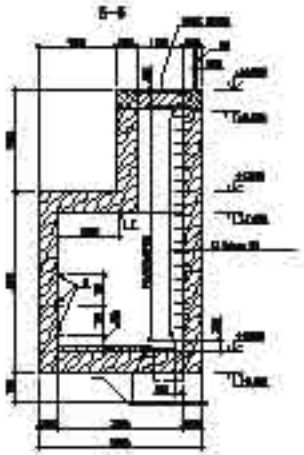
NUCLEAR POWER CORPORATION OF INDIA LIMITED

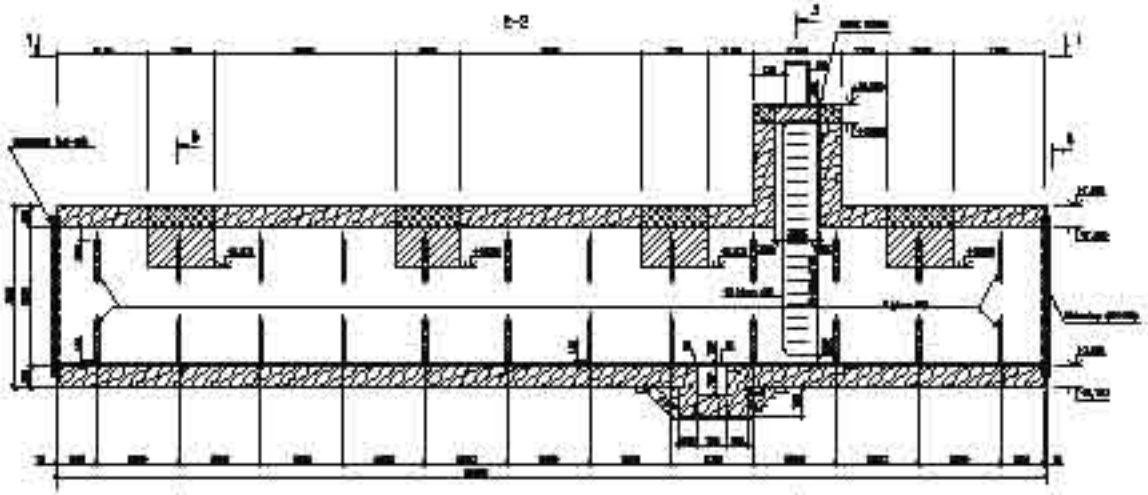
DOC. NO.
TITLE
POWER OUTPUT SYSTEM 400 KV SWITCHGEAR TUNNELS (SYSWGZ) STRUCTURES, GEOMETRY

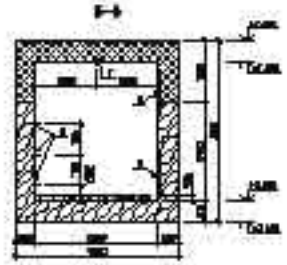
UNIT C-T
PLAN 1-1

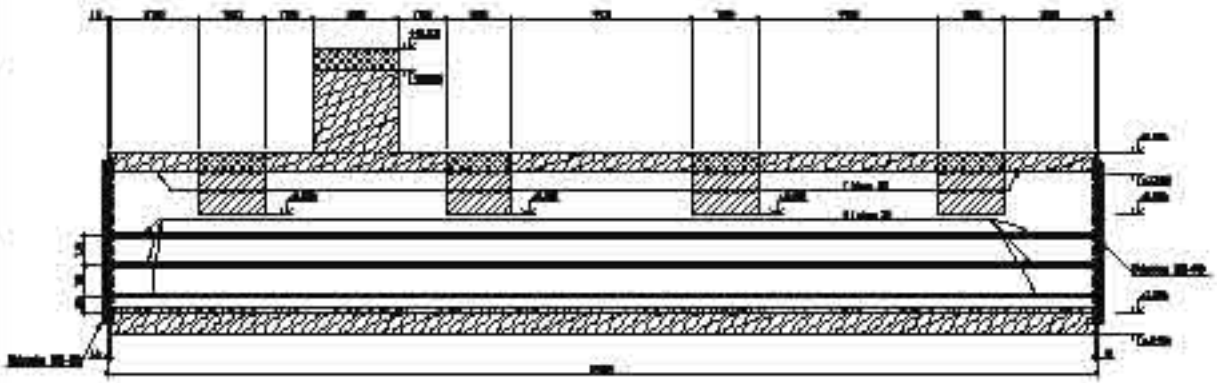




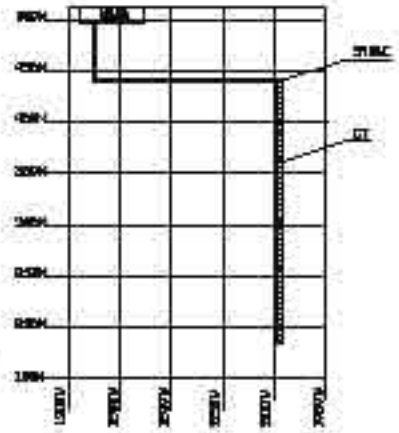








KEY PLAN



1 For the general guidelines see sheet 1.
2 For the legend see sheet 1.
3 For List of steel consumption see sheet 1.
4 For specifications see sheet 5.

NO.	DESCRIPTION	BY	DATE	MAC SHEET NO.
1				
0				

NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

TITLE : ELECTRICAL MEDIUM POWER PROJECT UNITS 5&6
PRESS CONCRETE WORKS TO BE EXECUTED THROUGH PLANT) MECHANICAL CONTRACT
UNIT C-T

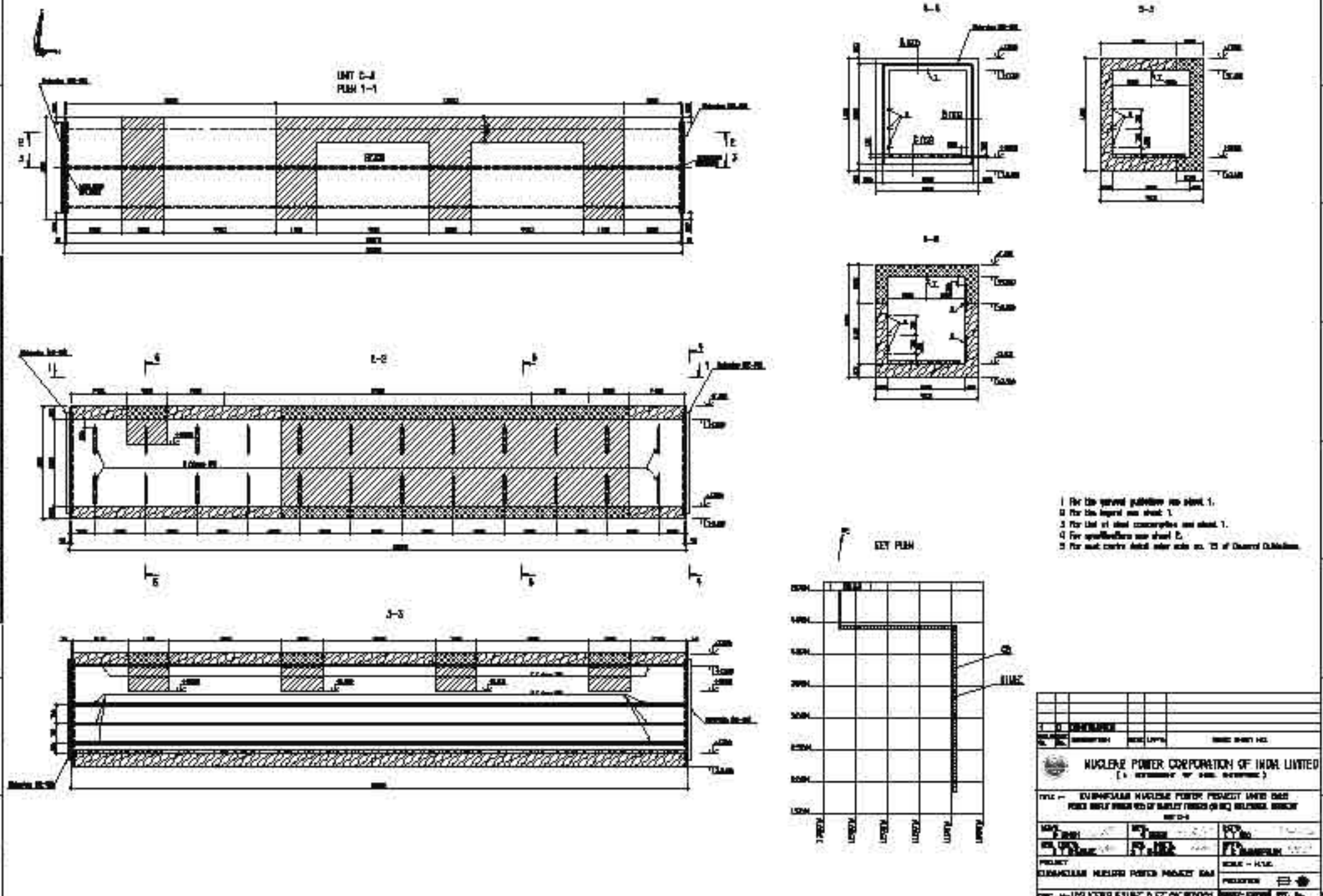
DESIGNED	DRAWN	CHECKED
D. [illegible]	M. [illegible]	K.T. [illegible]
RECD. CHECKED	RECD. CHECKED	CHECKED
M.T. [illegible]	J.T. [illegible]	T.M. [illegible]

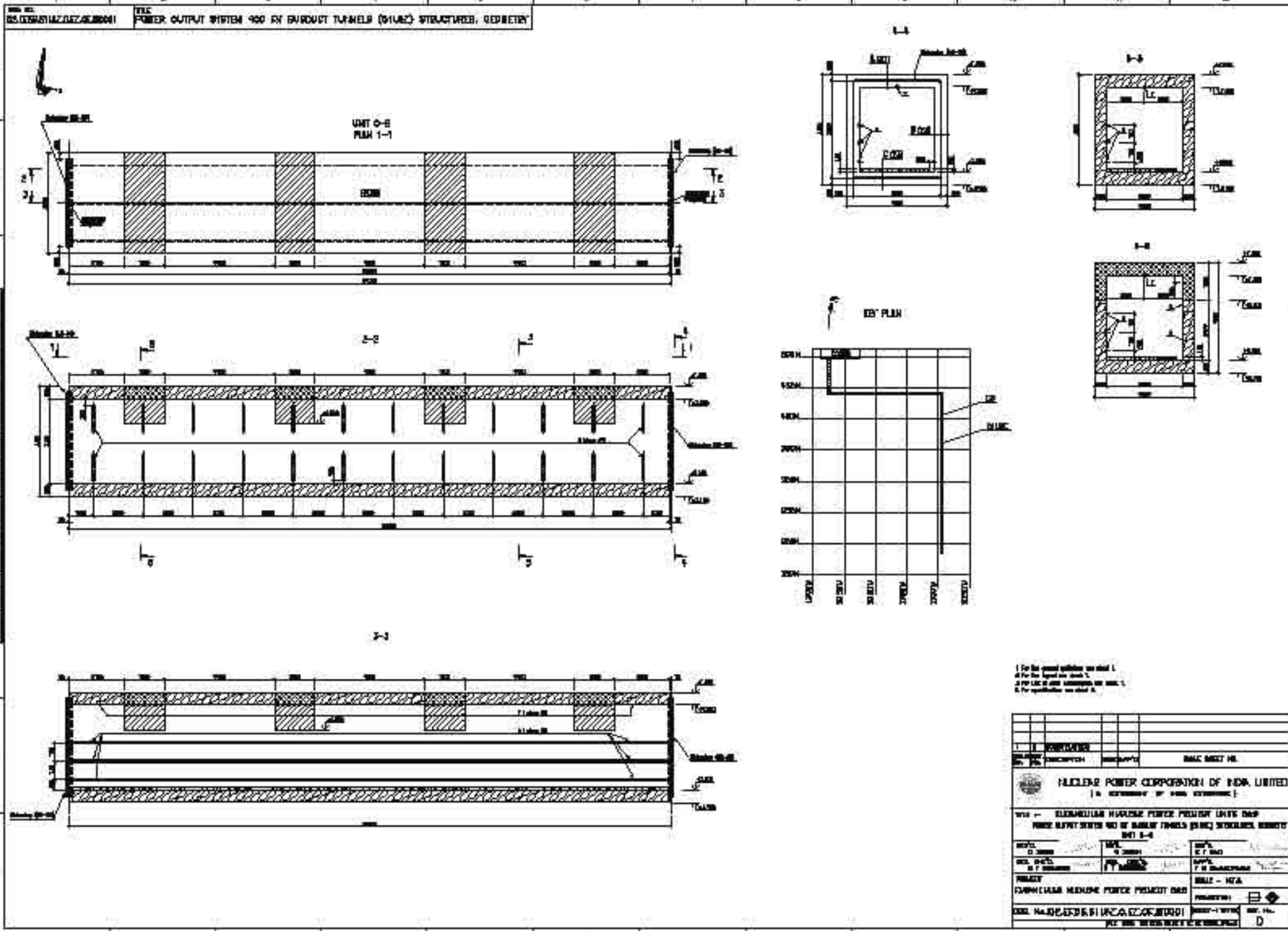
PROJECT: ELECTRICAL MEDIUM POWER PROJECT (5&6)

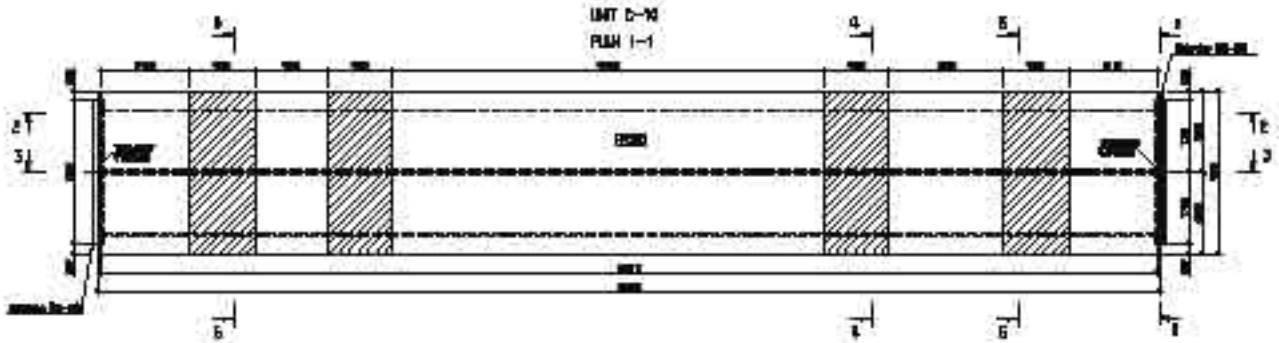
SCALE - NTS

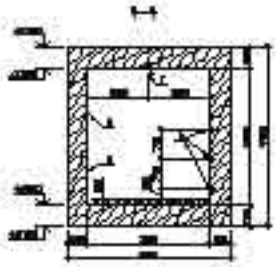
PROJECTION

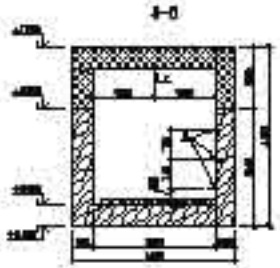
DRAWING NO. [illegible] | DRAWING STATUS | REV. NO. D

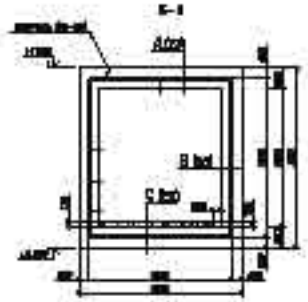

UNIT 2-3
PLAN 1-1
2-2
3-3
SET PLAN
1. For the general guidelines see sheet 1.
2. For the legend see sheet 1.
3. For list of steel concentrates see sheet 1.
4. For specifications see sheet 2.
5. For most centre detail refer note no. 15 of General Guidelines.
NUCLEAR POWER CORPORATION OF INDIA LIMITED

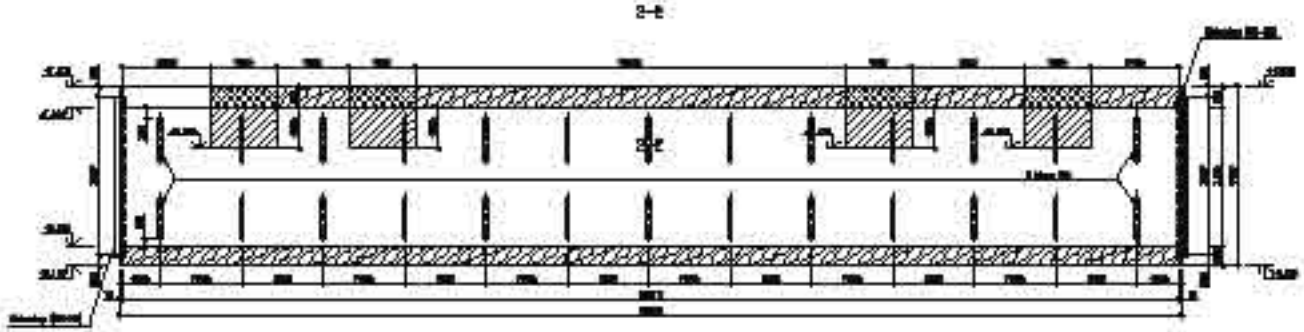

UNIT 5-6
PLAN 1-1
2-2
3-3
4-4
5-5
6-6
EOT PLAN
NUCLEAR POWER CORPORATION OF INDIA LIMITED

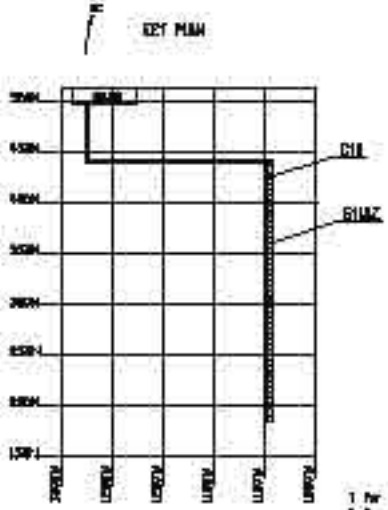


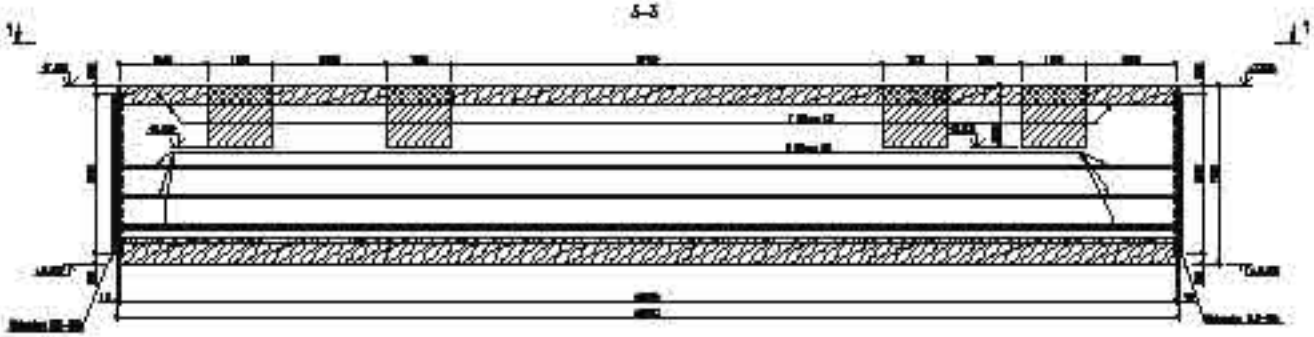












1. For the general guidelines see sheet 1.
2. For the legend see sheet 1.
3. For list of steel consumption see sheet 1.
4. For specifications see sheet 1.

NO.	DESCRIPTION	DATE
1	0 CONSTRUCTION	

NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6
PRETENSIONED PRESTRESSED CONCRETE (PPC) GIRDER
UNIT 5-10

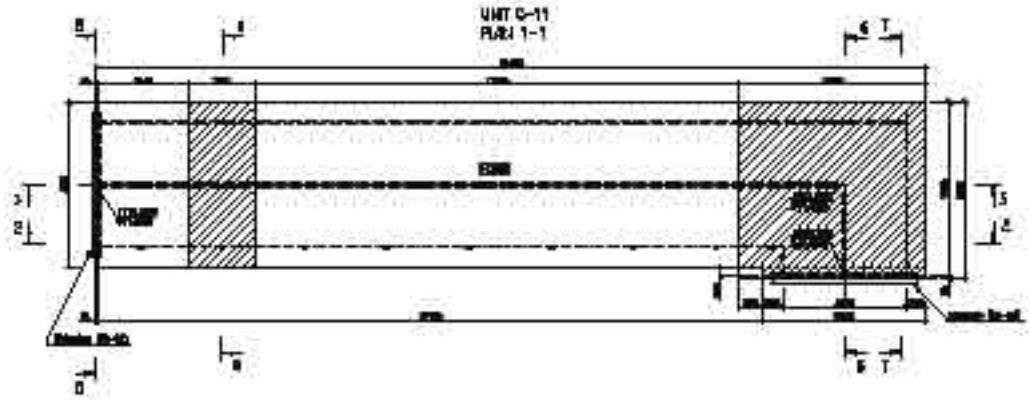
DRAWN	DESIGNED	CHECKED
CHECKED	APPROVED	

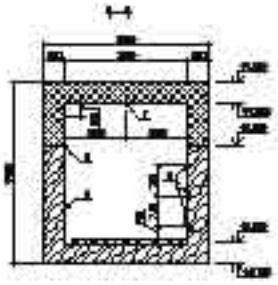
PROJECT: KUDANKULAM NUCLEAR POWER PROJECT 5&6

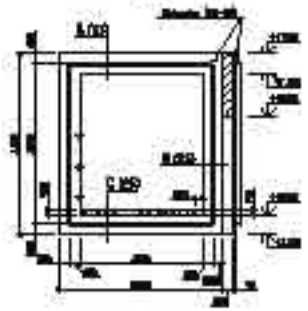
SCALE - AS SHOWN

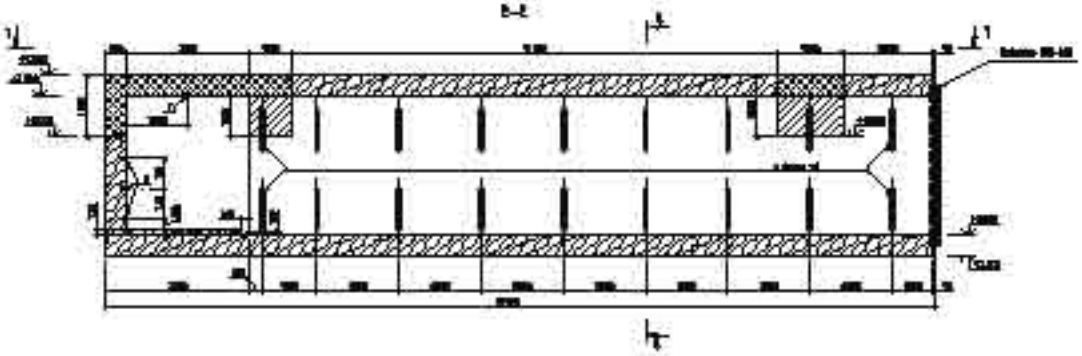
DRG. No. 0

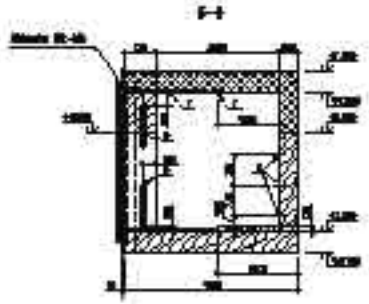
POWER OUTPUT UPRATING FROM 1000 MW TO 1070 MW (3 UNITS) STRUCTURES - REDESIGN

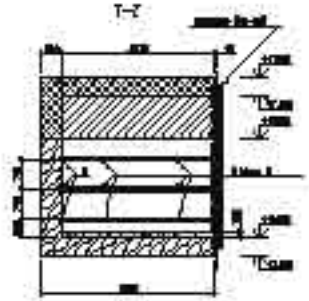


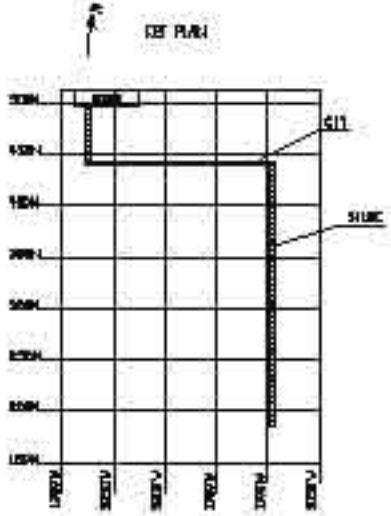


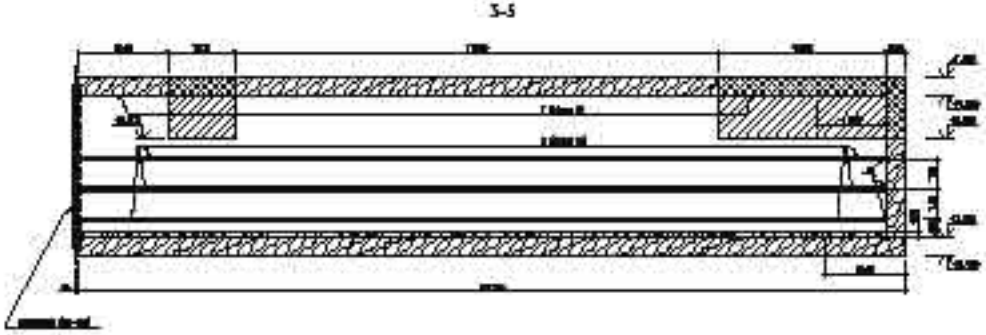








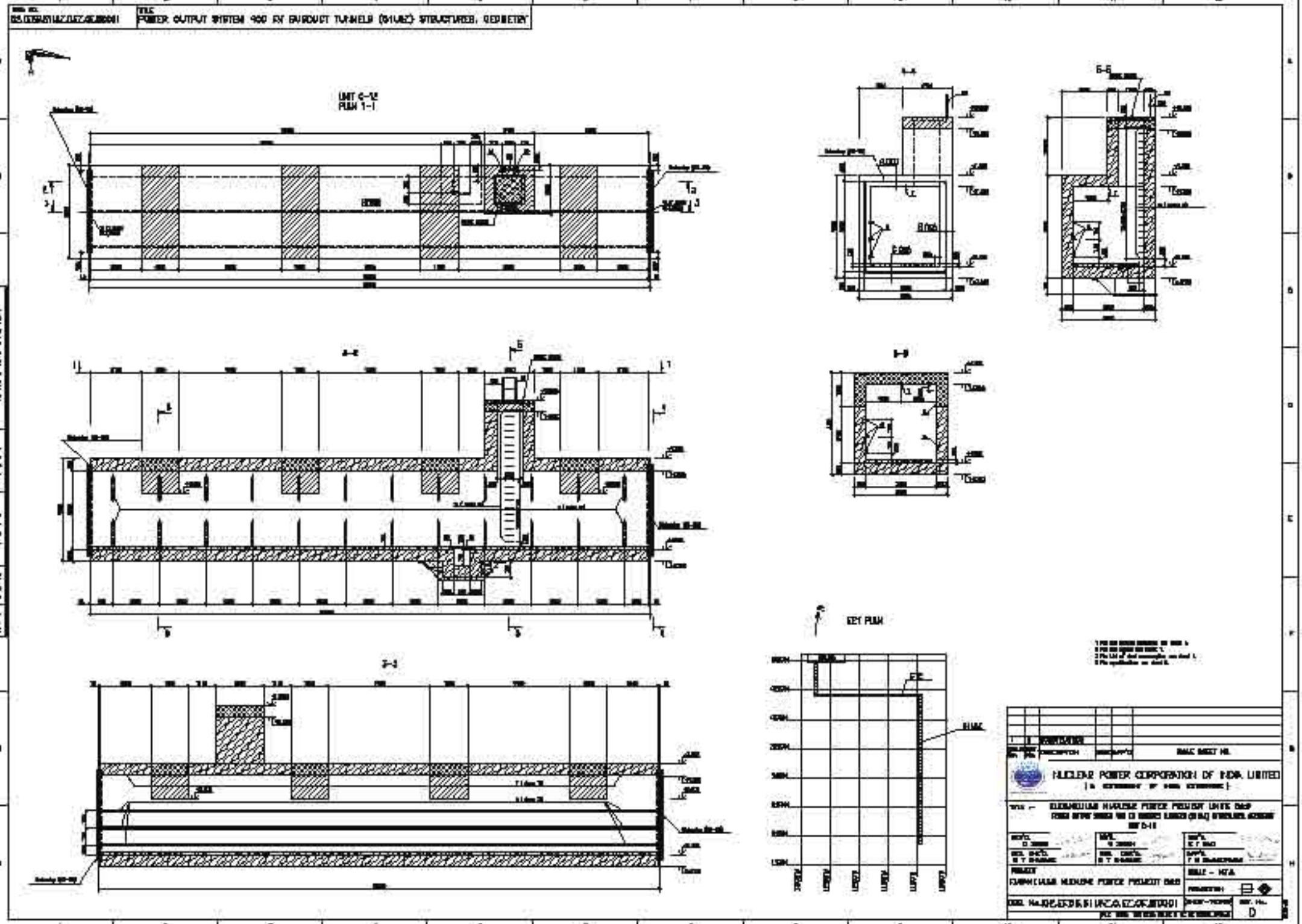


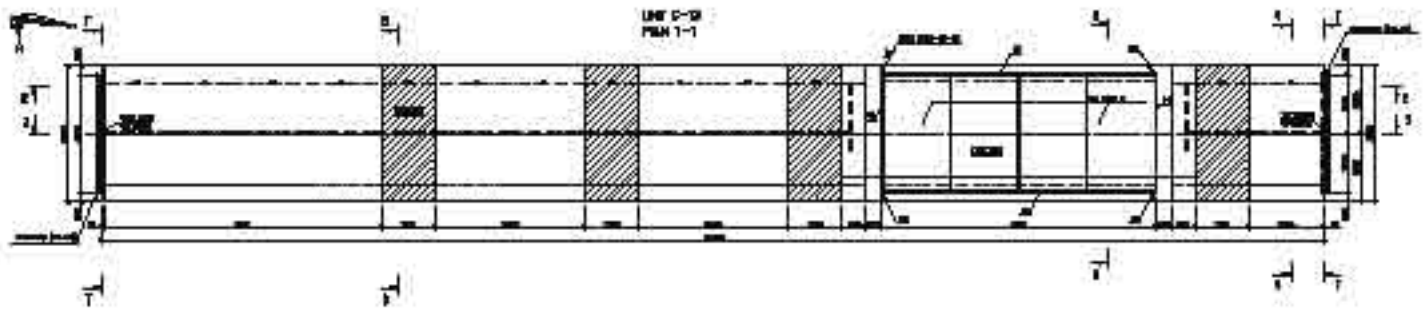


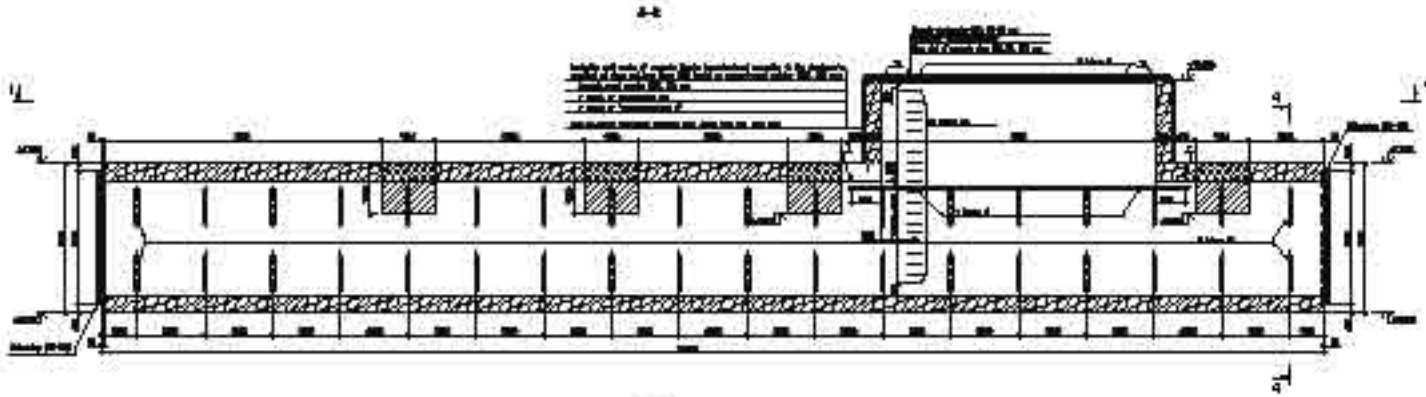
1 For the general guidelines see sheet 1.
2 For the legend see sheet 1.
3 For List of steel consumption see sheet 1.
4 For specifications see sheet 2.

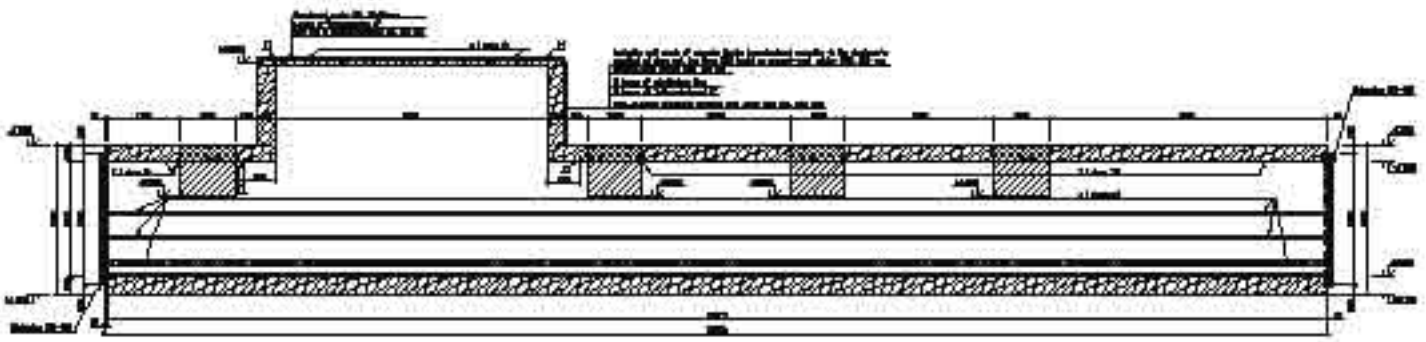
NUCLEAR POWER CORPORATION OF INDIA LIMITED

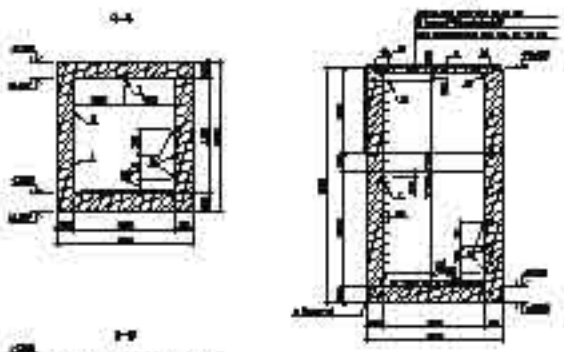
D

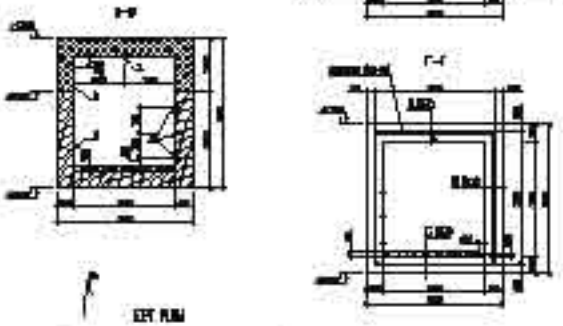

UNIT C-12
PLAN 1-1
KEY PLAN
NUCLEAR POWER CORPORATION OF INDIA LIMITED

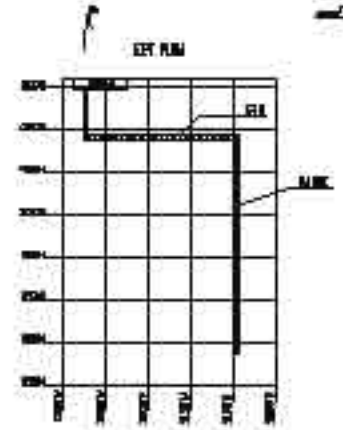




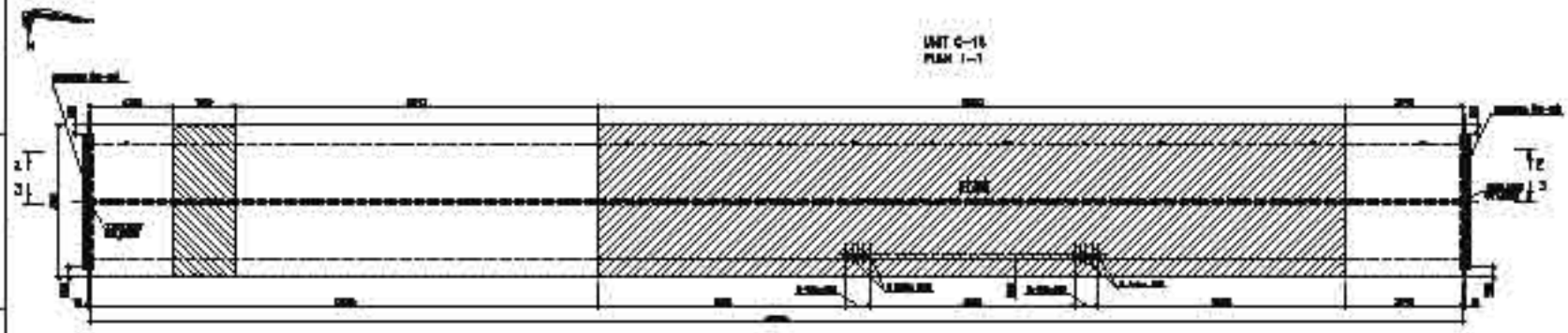


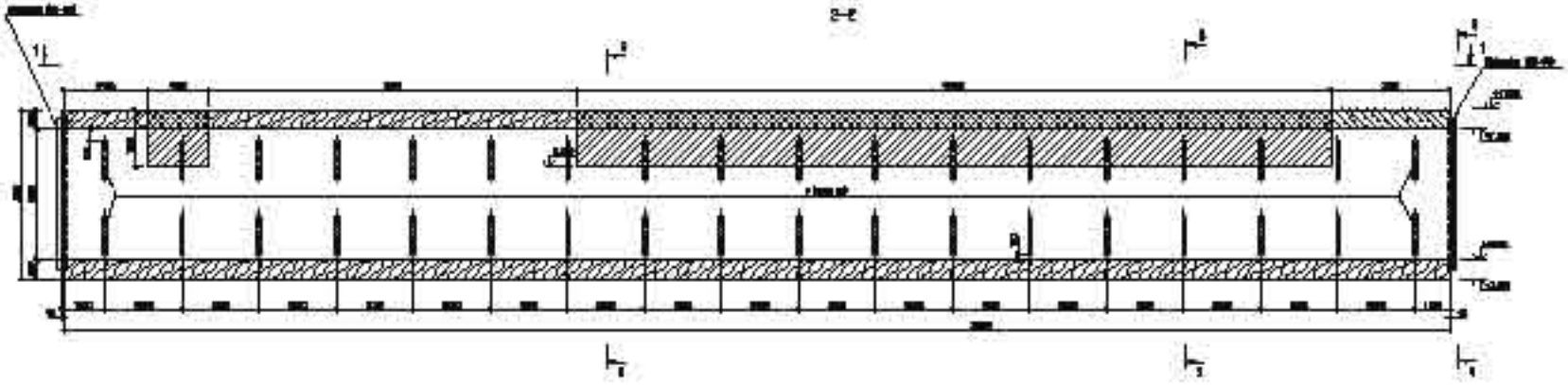


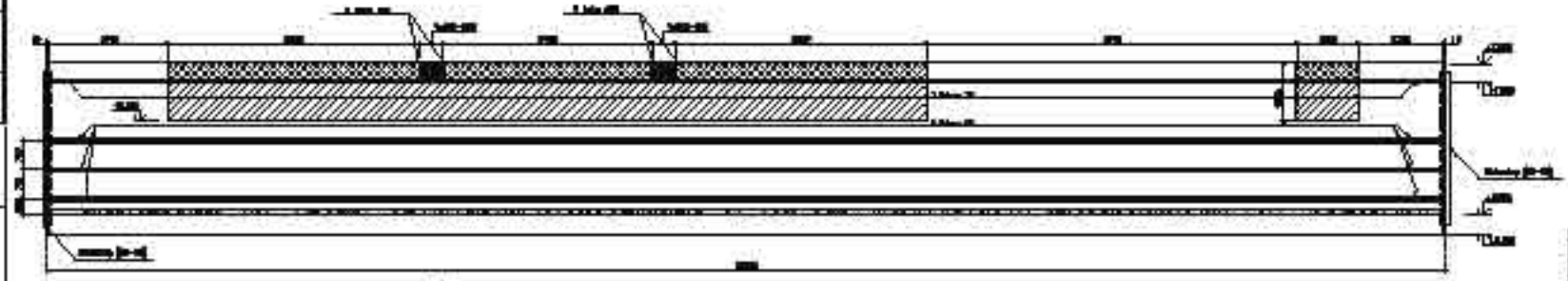


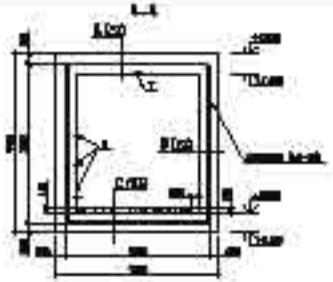


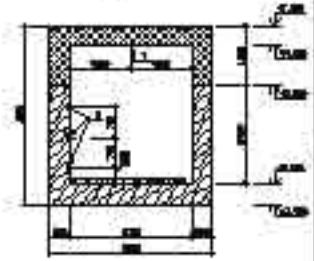
NUCLEAR POWER CORPORATION OF INDIA LIMITED

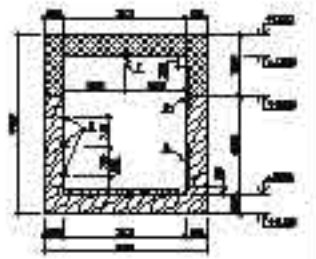


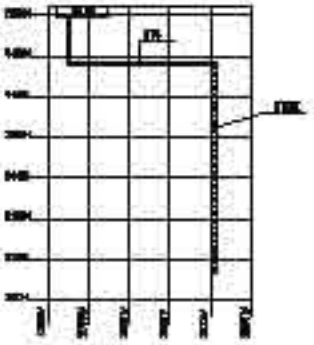












1. For the general guidelines see sheet 1.
2. For the legend see sheet 1.
3. For Unit of steel measurement see sheet 1.
4. For specifications see sheet 2.
5. For rest, water stop detail refer note no. 15 of General Guidelines.

1	0	CONSTRUCTION		
REVISION NO.	DATE	DESCRIPTION	SCALE	ISSUED SHEET NO.

NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

TITLE :- KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6
PROTECTIVE STRUCTURES OF SINGLE BARREL (SB-SC) BALANCE SHEET
SET C-15

DRAWN	DESIGN	CHECKED
CHECKED	APPROVED	APPROVED

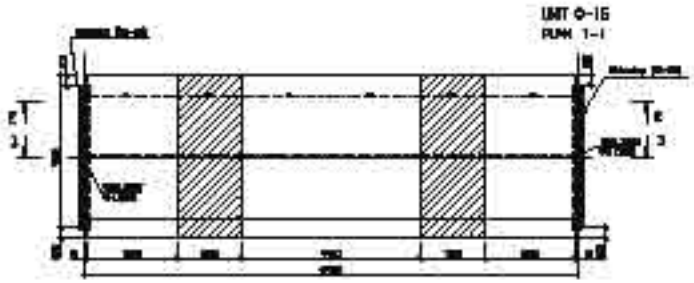
PROJECT: KUDANKULAM NUCLEAR POWER PROJECT 5&6

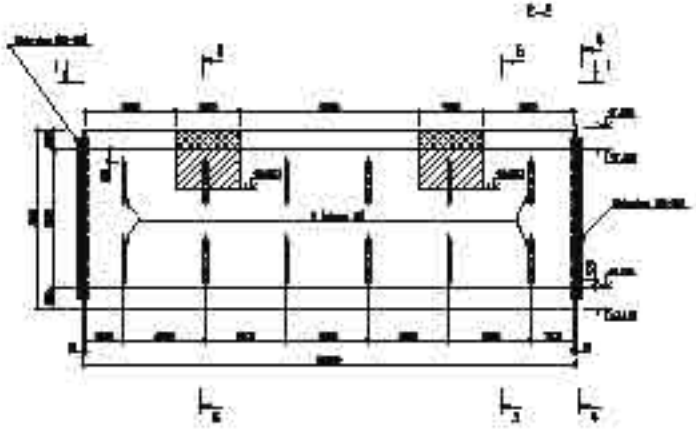
SCALE :- N.T.S.

PROJECTION

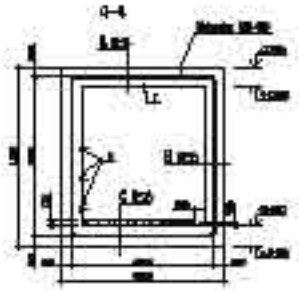
DRG. No. NP/KK5&6/STR/C_0.12_CH/C15/0001

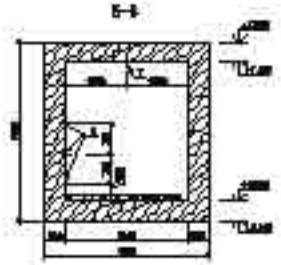
REV. No. 0

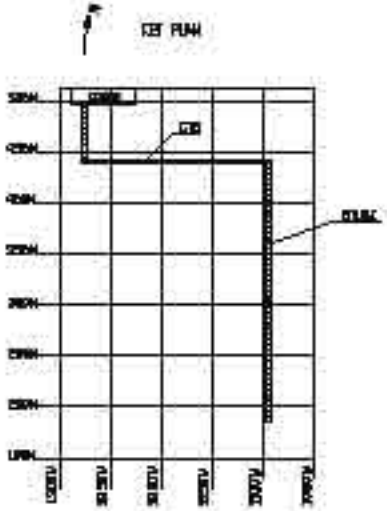


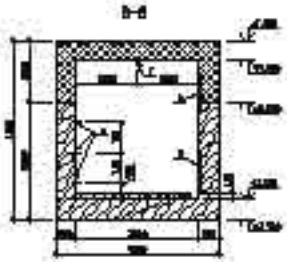




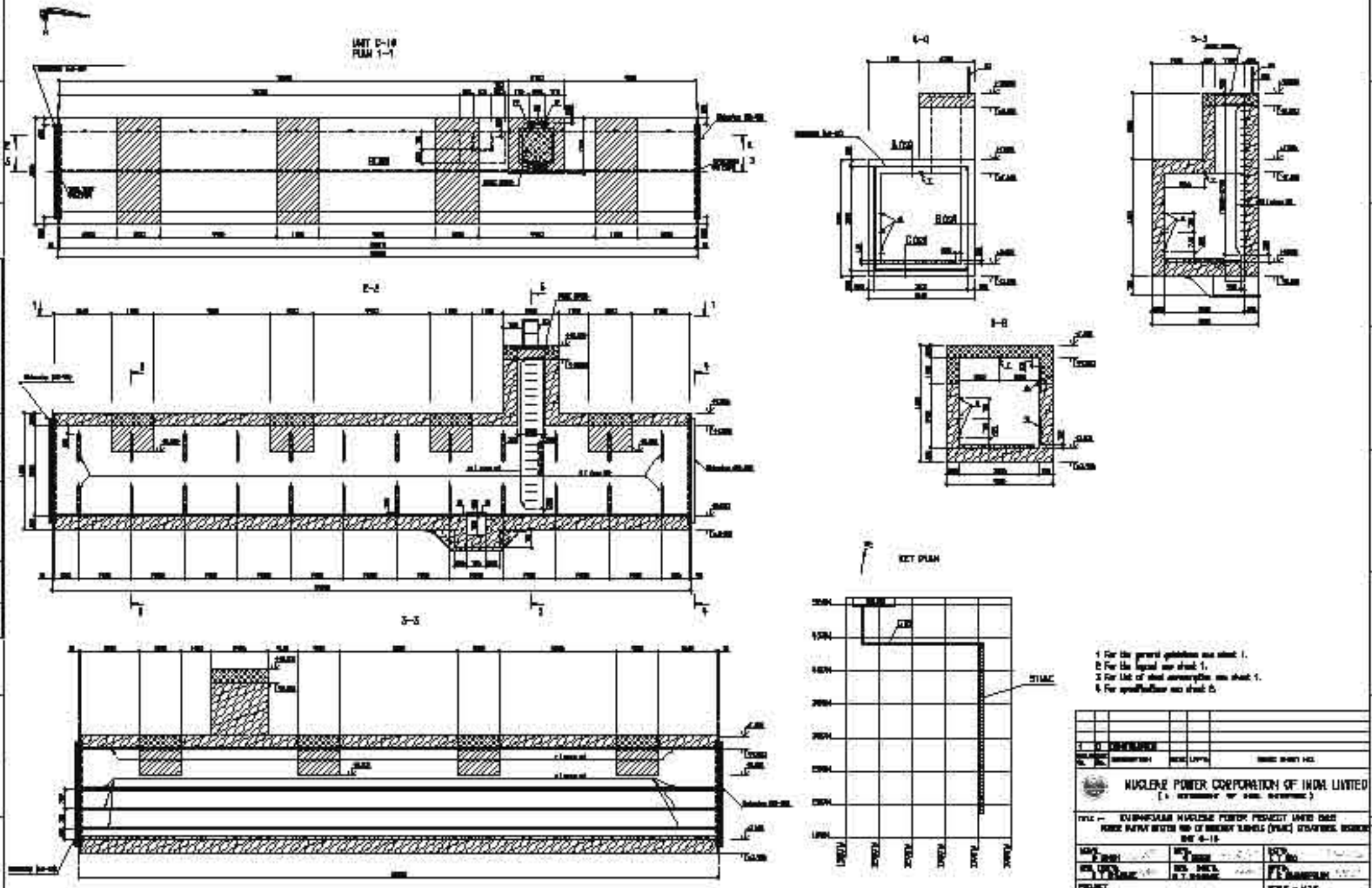


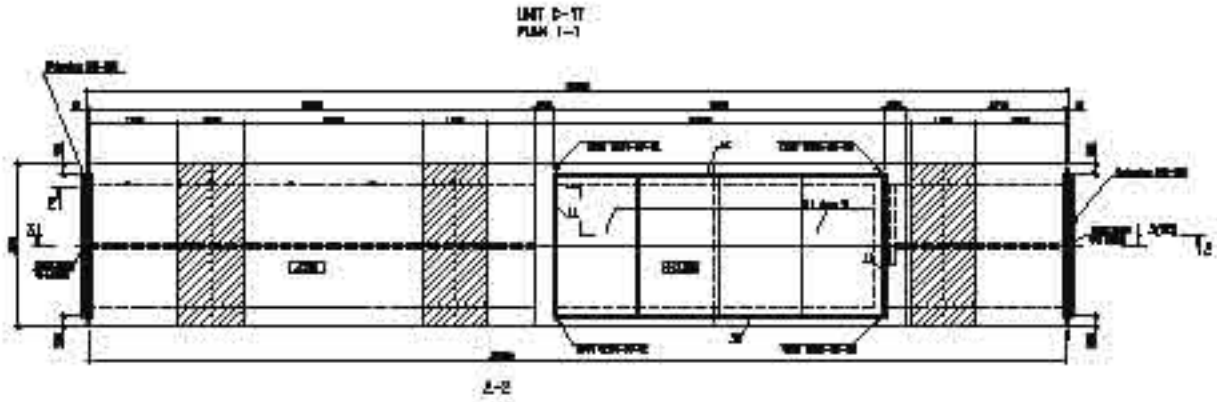


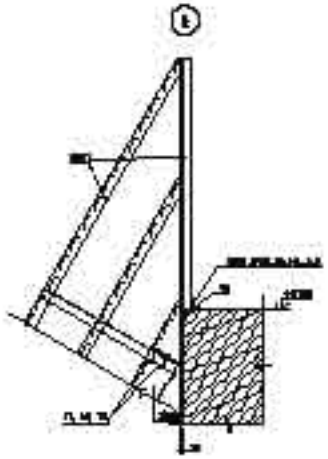


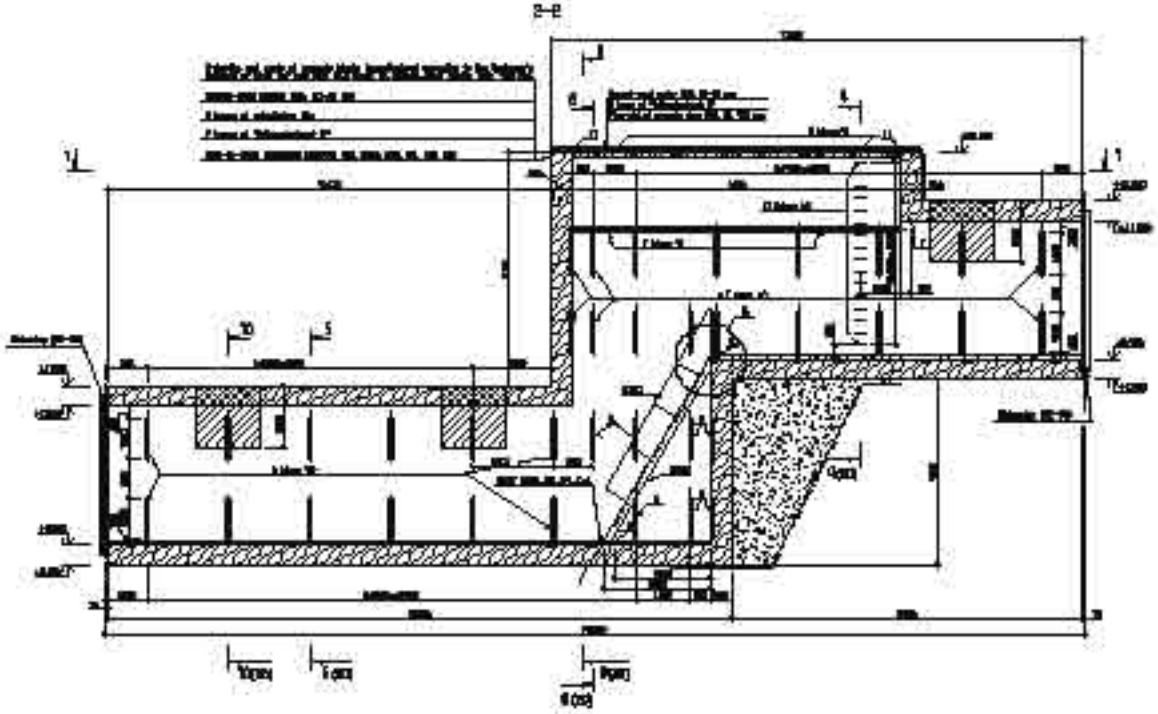


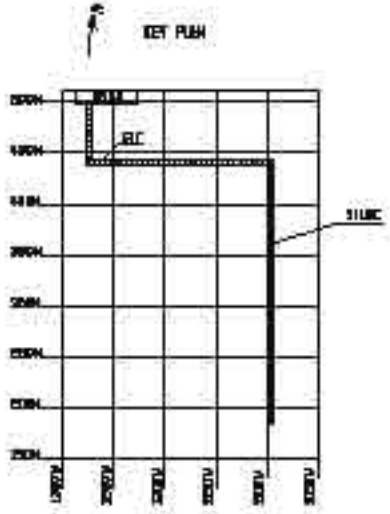
NUCLEAR POWER CORPORATION OF INDIA LIMITED


UNIT 5-10
PLAN 1-1
5-5
KEY PLAN
1 For the general guidelines see sheet 1.
2 For the legend see sheet 1.
3 For list of steel assemblies see sheet 1.
4 For specification see sheet 5.
NUCLEAR POWER CORPORATION OF INDIA LIMITED







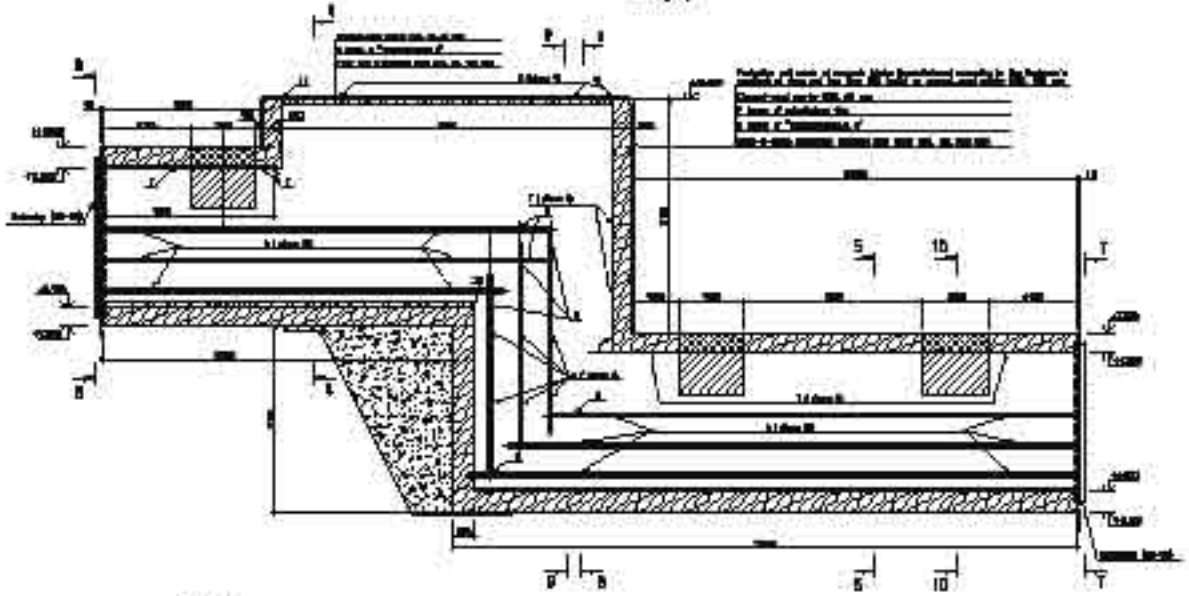


1 For the general guidelines see sheet 1.
2 For the legend see sheet 1.
3 For List of steel corresponding see sheet 1.
4 For specifications see sheet 1.

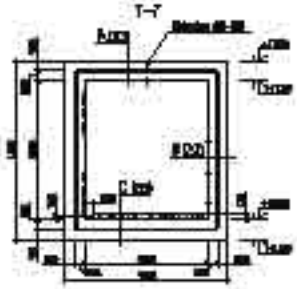
NUCLEAR POWER CORPORATION OF INDIA LIMITED

DOC NO.
TITLE
POWER OUTPUT SYSTEM 400 KV BUSDUCT TUNNELS (31 UNIT) STRUCTURES, REINFORCEMENT

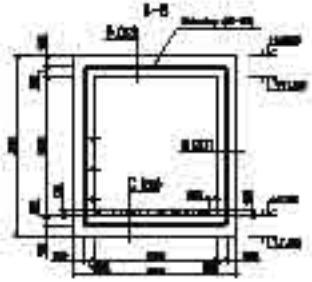
3-3 (TYP)



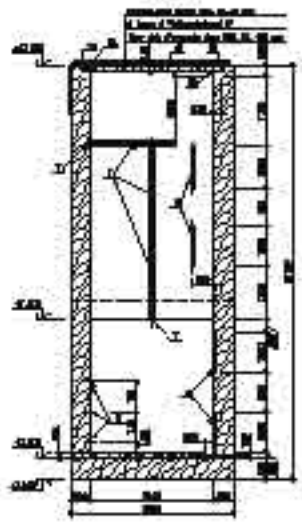
T-T



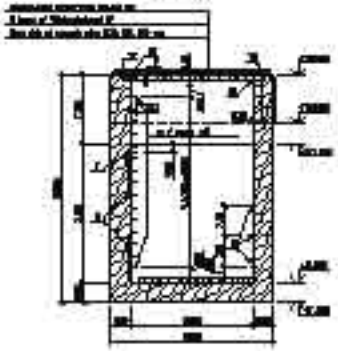
8-8 (TYP)



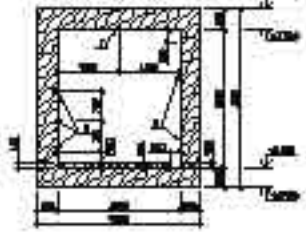
9-9 (TYP)



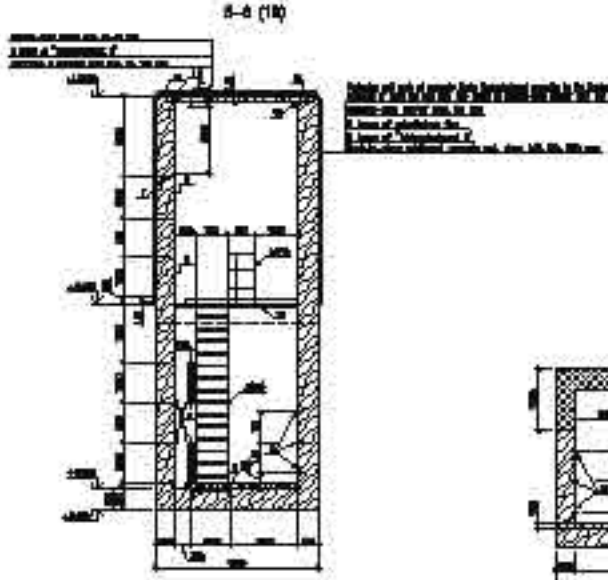
4-4 (TYP)



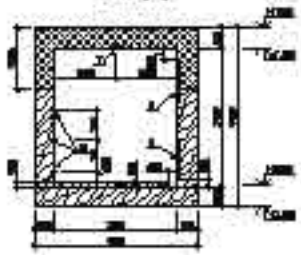
6-6 (TYP)



8-8 (TYP)



10-10 (TYP)



1 For the general guidelines see sheet 1.
2. For the legend see sheet 1.
3 For list of steel consumption see sheet 7.
4. For specifications see sheet 8.

NO.	DESCRIPTION	DATE	SIGN
0	CONFIDENCE		

NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

TITLE :- KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6
POWER OUTPUT SYSTEM 400 KV BUSDUCT TUNNELS (31 UNIT) STRUCTURES, REINFORCEMENT
UNIT 5-11, SECTIONS 3-3, 8-8, 9-9

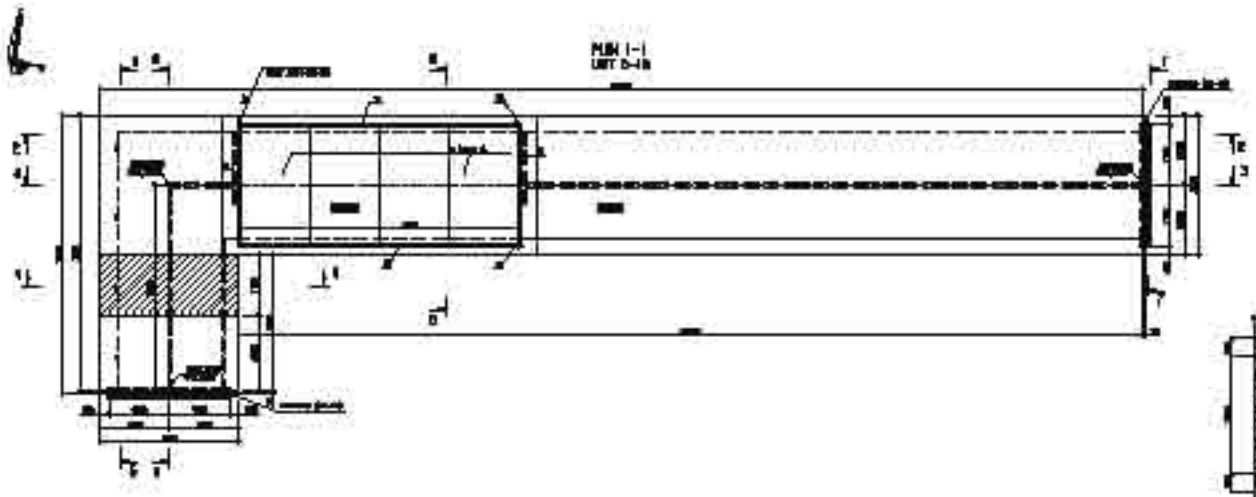
DRAWN	DESIGNED	CHECKED
CHECKED	APPROVED	

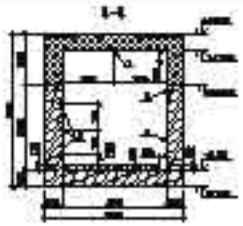
PROJECT
KUDANKULAM NUCLEAR POWER PROJECT 5&6

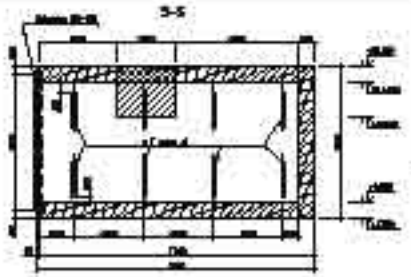
SCALE - N.T.S.

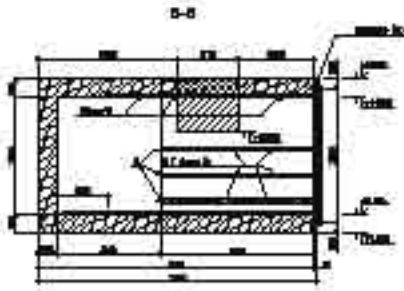
PROJECTION

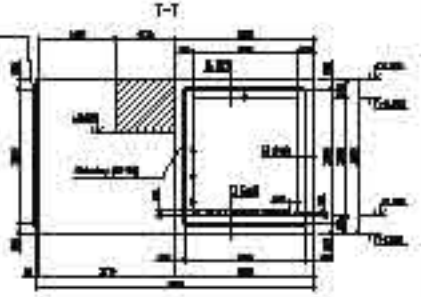
DRG. No. [illegible] 0

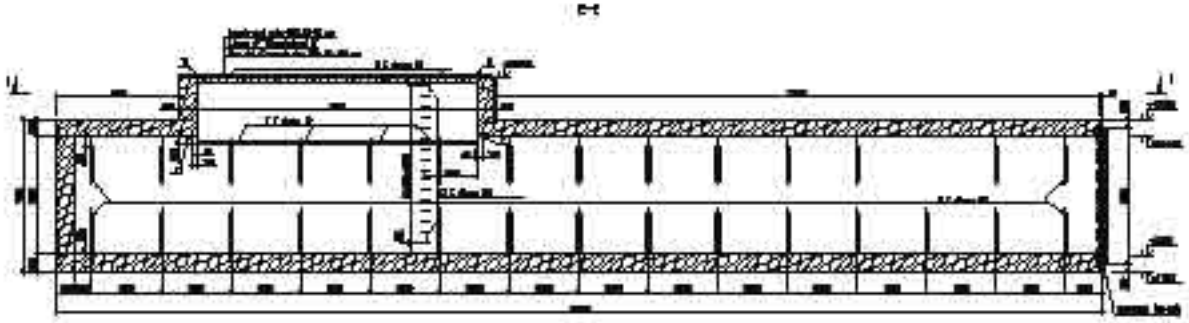




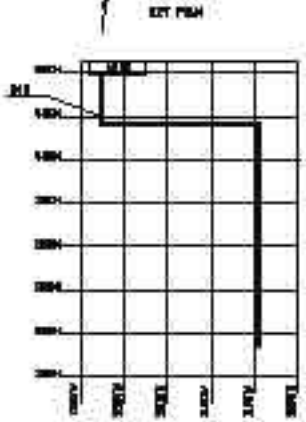


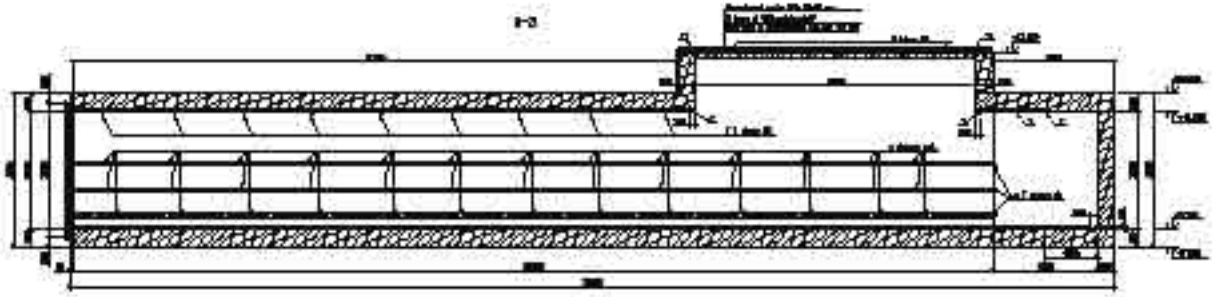












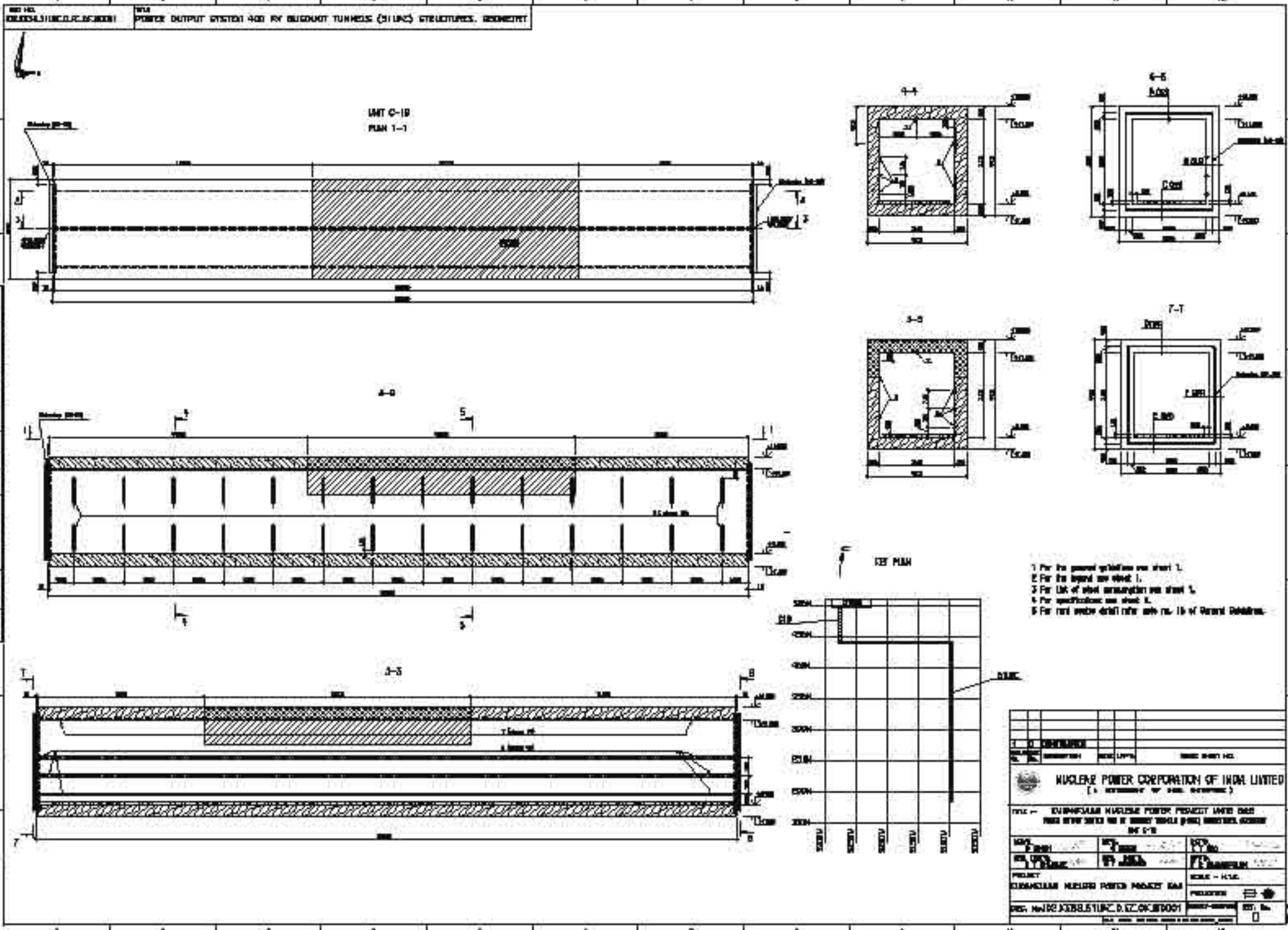
1. For the general guidelines see sheet 1.
2. For the legend see sheet 1.
3. For List of sheet description see sheet 1.
4. For modifications see sheet 2.

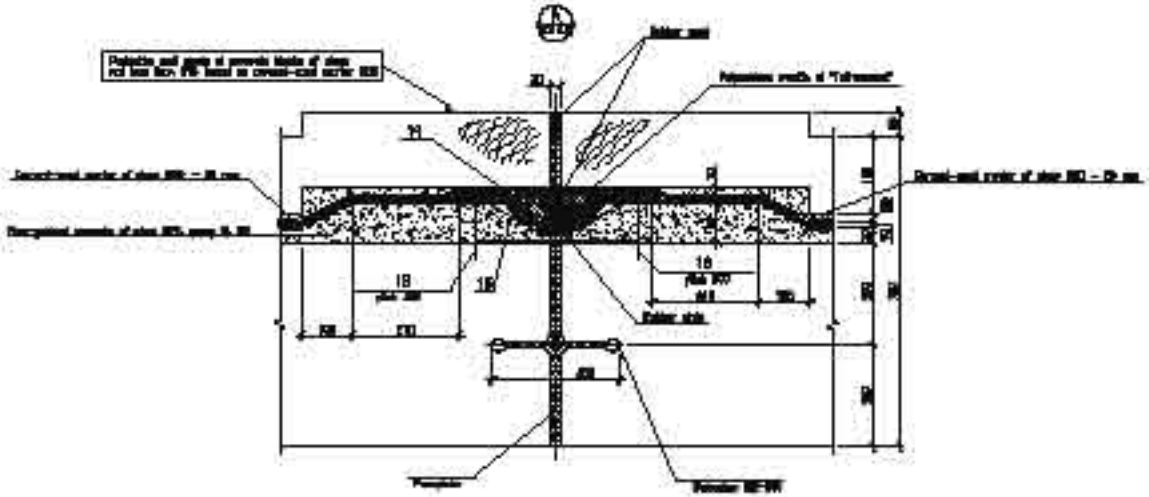
1	0	CONFIRMED		
REVISION NO.	DESCRIPTION	BASIS	APPD.	ISSUED SHEET NO.

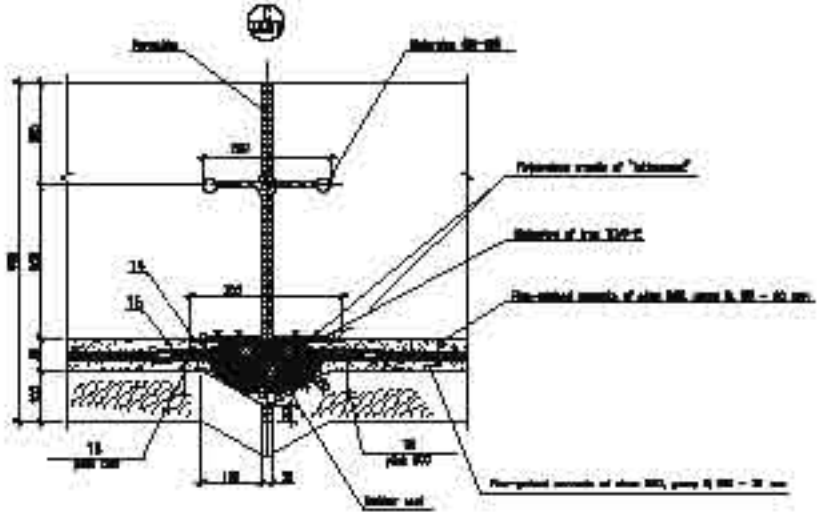
NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

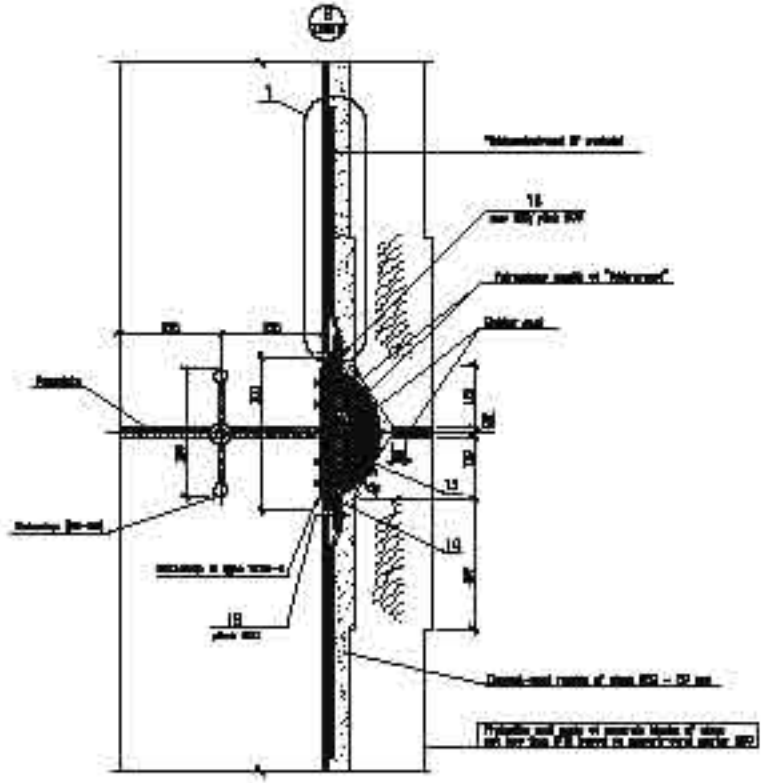
TITLE :- KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6
POWER OUTPUT SYSTEM 400 KV BUSDUCT TUNNELS (31 UNC) STRUCTURES, REINFORCEMENT
SET 0-10

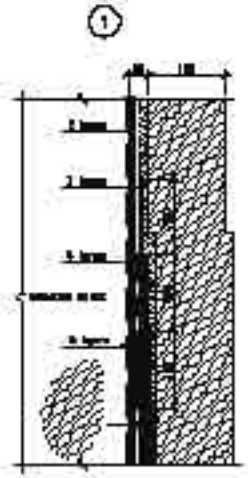
DRAWN	DES.	DRG. NO.
DES. CHKD.	DES. MGR.	
PROJECT		SCALE :- N.T.S.
KUDANKULAM NUCLEAR POWER PROJECT 5&6		PROJECTION
DRG. No. NPCIL/KKNPP5&6/STR/C_D_EZ_CIV_SET0001		SHEET No. 0


UNIT C-1B
PLAN 1-1
4-4
6-6
5-5
7-7
A-A
3-3
SEE PLAN
1 For the general guidelines see sheet 1.
2 For the legend see sheet 1.
3 For list of steel consumption see sheet 4.
4 For specifications see sheet 4.
5 For roof section detail refer note no. 15 of General Guidelines.
NUCLEAR POWER CORPORATION OF INDIA LIMITED









1 For the general guidelines see sheet 1.
2 For the legend see sheet 1.
3 For List of steel reinforcement see sheet 1.
4 For specifications see sheet 2.

NO.	DESCRIPTION	DATE	APPD.
0	FOR REFERENCE		

NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

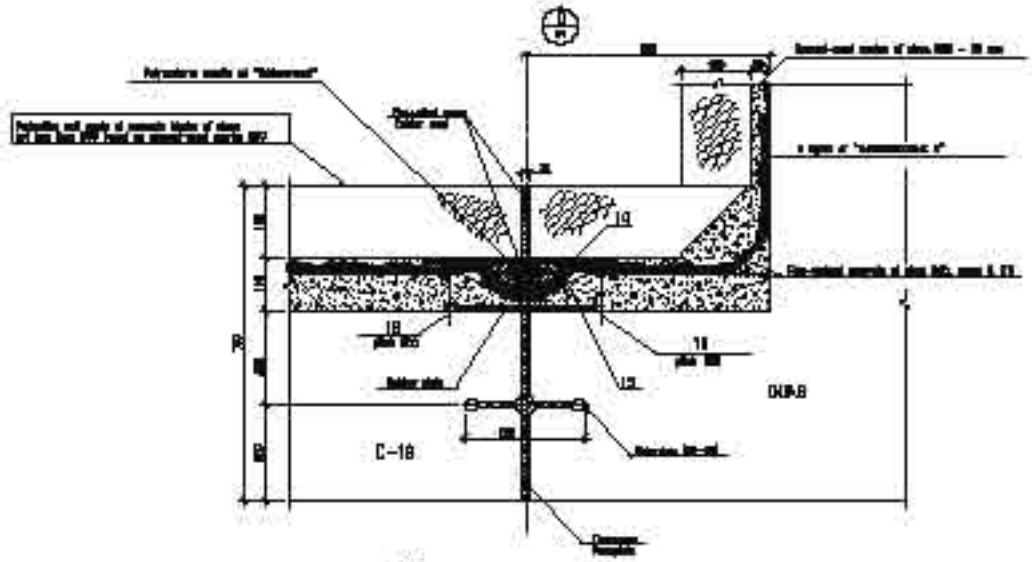
TITLE :- KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6
PRESSURISED WATER REACTOR (PWR) TYPE
SCALE 1, 2, 3

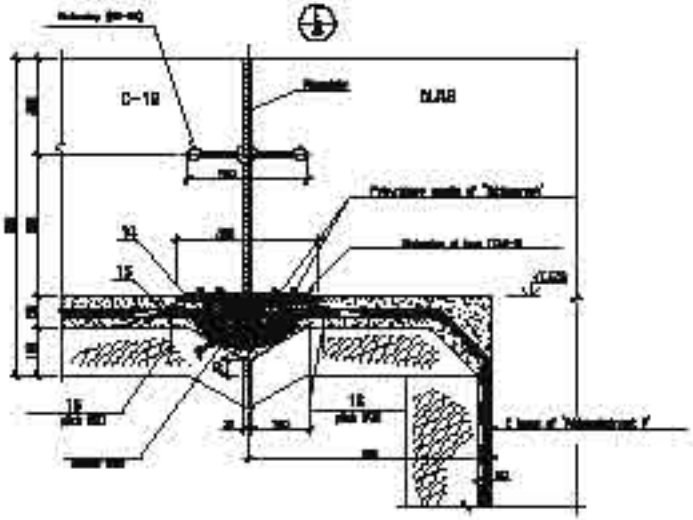
PROJECT: KUDANKULAM NUCLEAR POWER PROJECT 5&6

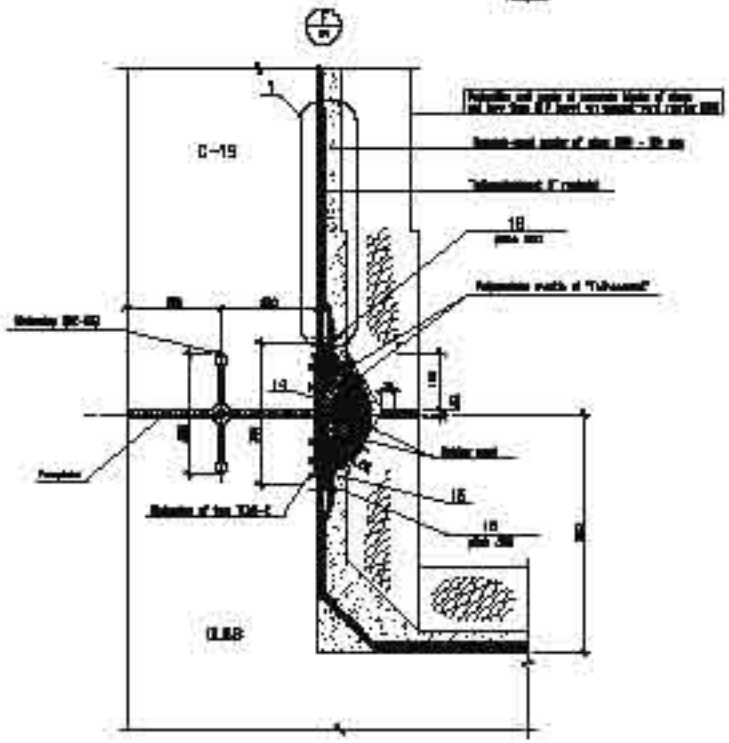
SCALE :- AS SHOWN

DRG. No. 5&6/XXBBL/STR/C_D_EZ_CW_001001

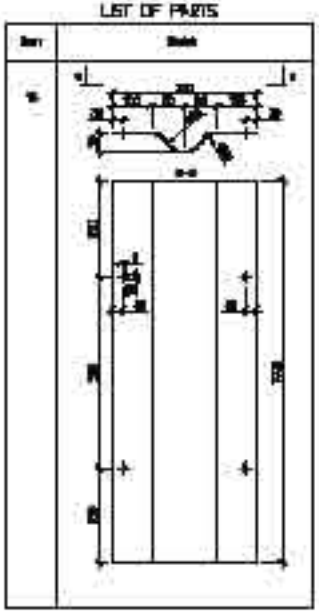
REV. No. 0

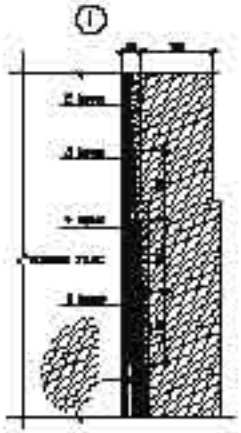






LIST OF PARTS





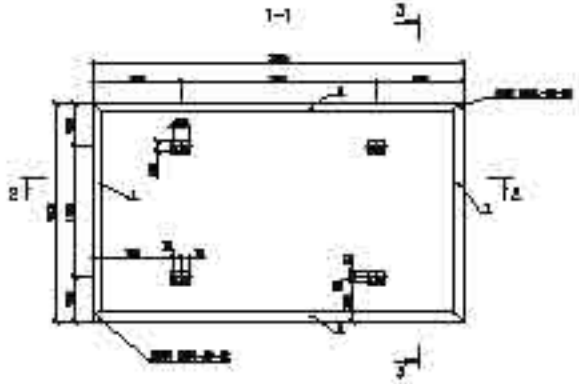
1. For the general guidelines see sheet 1.
2. For the legend see sheet 1.
3. For List of sheet see explain see sheet 1.
4. For specifications see sheet 15.

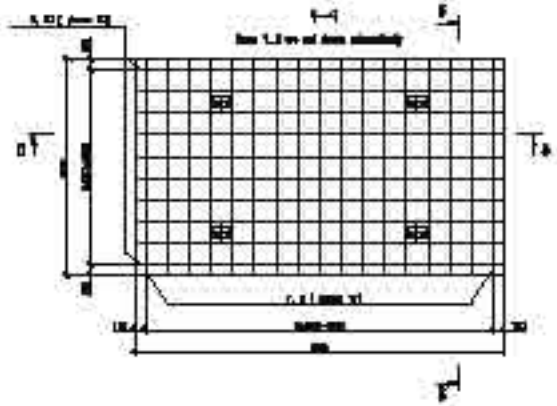
NUCLEAR POWER CORPORATION OF INDIA LIMITED

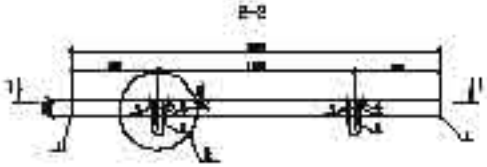
KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6

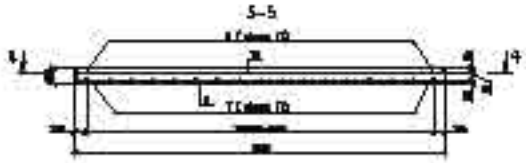
PROJECT
KUDANKULAM NUCLEAR POWER PROJECT 5&6

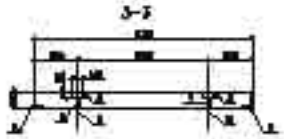
0

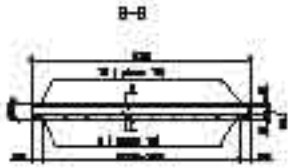


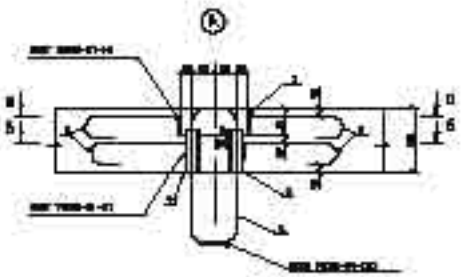


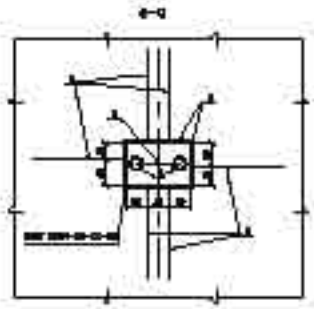


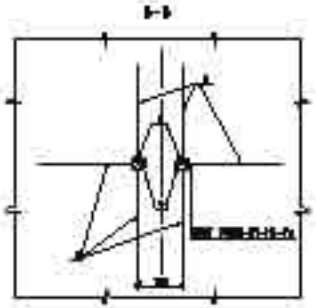












LIST OF STEEL CONSUMPTION (T)

Item of element	Reinforcement (in MT)						Structural steel (in MT)						Total
	Fe 500			Fe 415			Fe 500			Fe 415			
	Dia less than 16 mm	Dia 16 mm and above	Total	Dia less than 16 mm	Dia 16 mm and above	Total	Plates	Rolled sections	Total	Plates	Rolled sections	Total	
R	30	30	60.0	30.0	30.0	60.0	570	570	90	90	15	15	1350

LIST OF PARTS

Item	Sketch
1	
2	
3	
4	

SPECIFICATION OF SI

Item	Designation	Name	Nos.	Weight	Remarks
		Plates			
P1		L=6000	2	1200	
P2		L=4000	1	1000	
3					
		20x400	1	1.57	
5					
		L=400	8	0.8	
P4					
		L=400	10	0.8	
P4					
		L=400	1	1.57	
7		L=6000	10	1.57	
8		L=2000	10	0.5	
9		L=2000	10	0.8	
10		L=2000	10	1.57	
		Bolts			
		Assembly of above MS SI	LS		10%

*- As Per Detail Sheet

No.	Description	Date	Drawing No.
1	0 CONFIDENCE		

NUCLEAR POWER CORPORATION OF INDIA LIMITED

(A GOVERNMENT OF INDIA ENTERPRISE)

KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6

POWER OUTPUT SYSTEM 400 KV BUSDUCT TUNNELS (31 UNC) STRUCTURES, REINFORCEMENT

PLAN SHEET NO.

DESIGNED	DRAWN	CHECKED

APPROVED	APPROVED	APPROVED

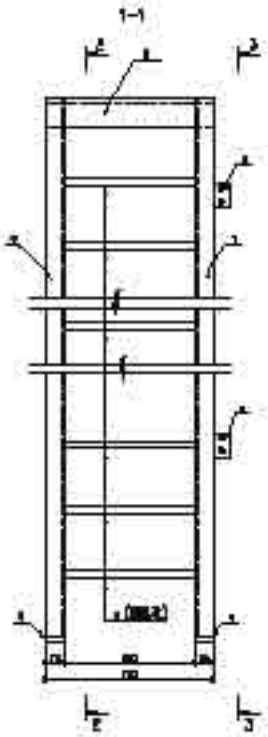
PROJECT: KUDANKULAM NUCLEAR POWER PROJECT 5&6

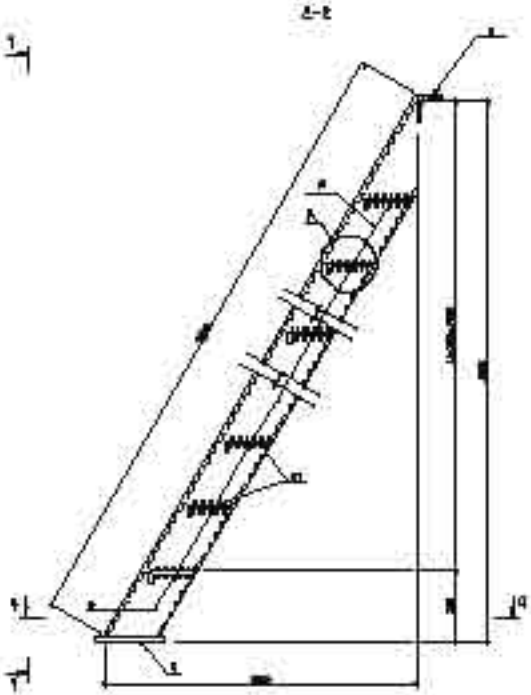
SCALE: AS SHOWN

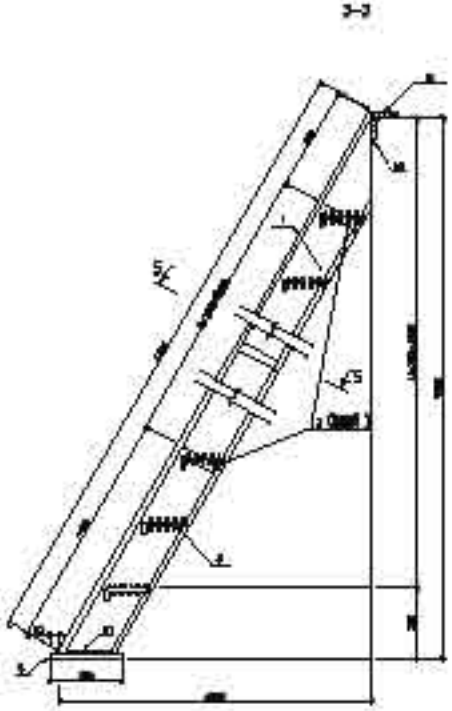
PROJECTION

DRG. No. | REV. No.

0





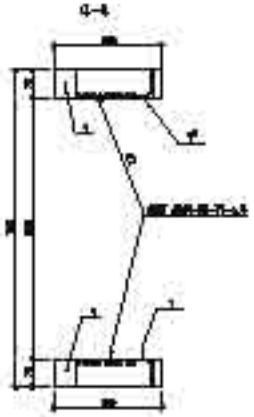


LIST OF STEEL CONSUMPTION, KG

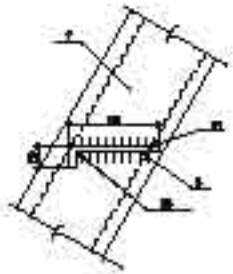
Type of element	Total weight of grade							Total
L1								

SPECIFICATION OF L1

Item	Designation	Name	Nos.	Unit Wt. kg	Note
1					
2					
3					
24					
4					
5					







LIST OF PARTS

Sr.	Details
1	

Rev.	Description	Date	Drawn	Checked	Approved
1	0	CONSTRUCTION			

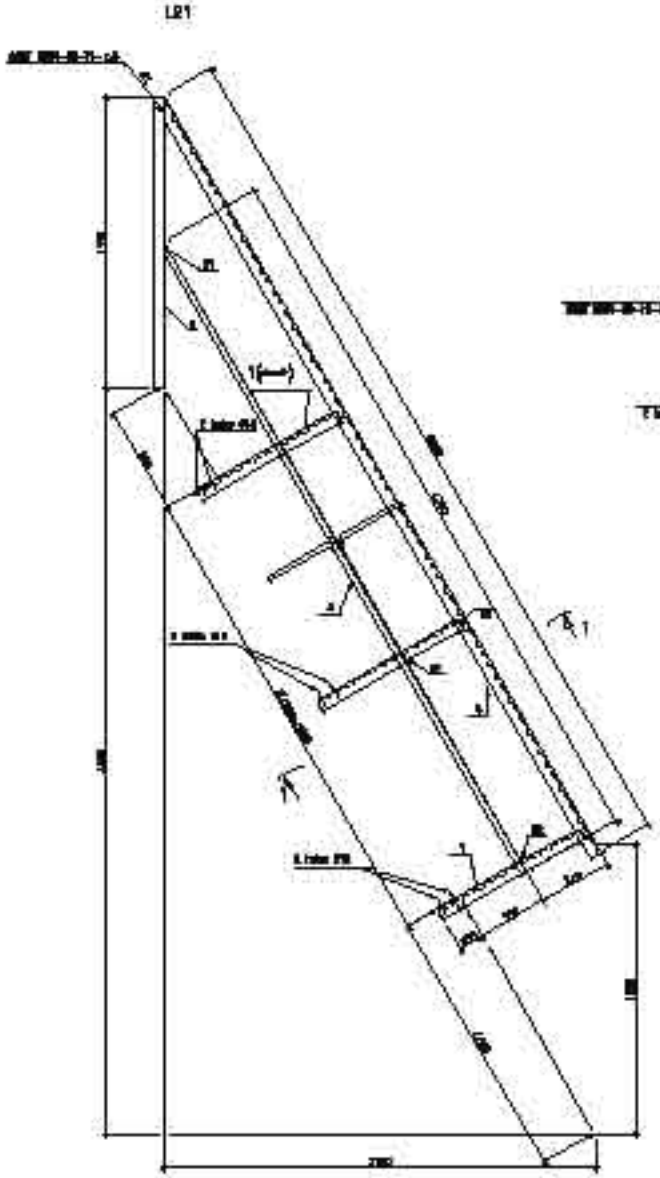
NUCLEAR POWER CORPORATION OF INDIA LIMITED

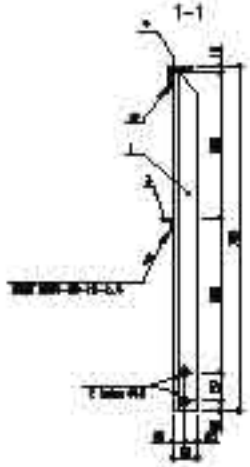
KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6

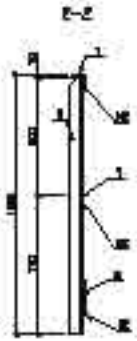
KUDANKULAM NUCLEAR POWER PROJECT 5&6

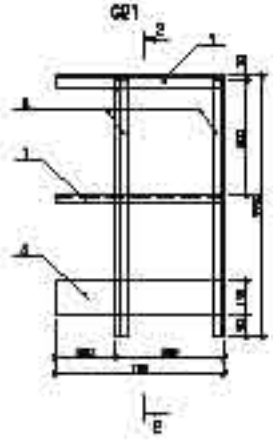
Drawing No. 5&6/X-XXXX-S-STR-C-D-XX-CW-XXXXX

Rev. 0









SPECIFICATION OF L21, G21

Mark	Designation	Name	Quantity				Unit weight (kg)	Remarks
		Details						
1		L-170	1	0		0	157	
0		L-000	1	0		2	1/0	
2		L-000	1	–		1	170	
4		L-000	1	–		1	1500	
5								
			1	–		1	157	

LIST OF STEEL CONSUMPTION, KG

Type of element	Material grade					Total

1. As per general specification mark L1.
2. Structural for welding shall be of E-41 type as per ASTM A36-72.
3. Anti-corrosive coating shall be applied in accordance with the requirements of IS:1200(PART10)1966 "Method of measurement for paint work for Method of Painting of Iron, Steel and Timber".

1	0	CONFORMANCE			
REVISION No.	DATE	DESCRIPTION	DRAWN	CHKD.	ISSUED SHEET NOS.

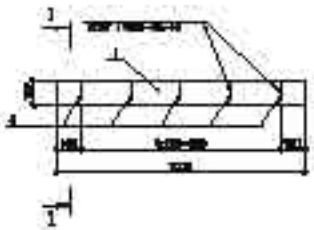
NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6
POWER OUTPUT SYSTEM 400 KV BUSDUCT TUNNELS (31 LNOS) STRUCTURES, REDIMENSIONING
SUBSTRUCTURE BUILDING L21 SOLAR PV/PANEL BUILDING G21

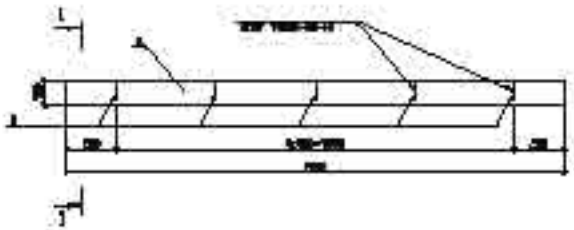
DRAWN	DESIGNED	CHECKED
PROJECT		SCALE – N.T.S.
KUDANKULAM NUCLEAR POWER PROJECT 5&6		PROJECTION
DRG. No.		REV. No.
		0

DRG NO.	TITLE
[illegible]	POWER OUTPUT SYSTEM 400 KV BUSDUCT TUNNELS (31 UNIT) STRUCTURES. REDIMENSIONING

TA1



TA2



LIST OF STEEL CONSUMPTION, KG

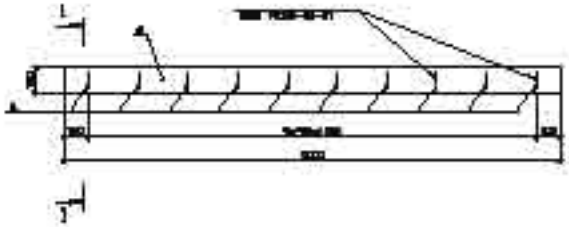
Type of element	Reinforcing articles				
	Reinforcement of rectangular solid of grade				Total
	[illegible]	Total	0.0	Total	
TA1	14.9	1162	7.2	7.2	19.49
TA2	18.9	1206	12.3	12.3	31.20
TA3	19.0	49.2	12.3	12.3	31.5
TA4	12.9	1206	23.1	23.1	36.0

SPECIFICATION OF EMBEDDED PART
TA1, TA2, TA3, TA4

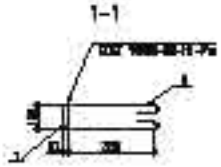
Mark No.	Item	Name	Number	Mass, kg	Total mass, kg
TA1	1	[illegible]	1	12.5	13.0
	2*	[illegible]	8	0.5	
TA2	1	[illegible]	1	12.5	12.8
	2*	[illegible]	8	0.5	
TA3	1	[illegible]	1	12.5	12.5
	2*	[illegible]	18	0.5	
TA4	1	[illegible]	1	23.1	23.1
	2*	[illegible]	11	1.3	

* Item "List of parts"

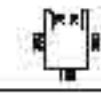
TA3



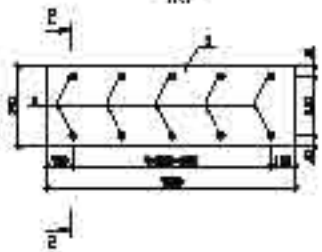
1–1



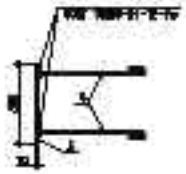
LIST OF PARTS

Item	Mark
1	
2	

TA4



2–2



1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]

1	0	[illegible]			
REVISION NO.	DATE	DESCRIPTION	SCALE	UNITS	DRAWING SHEET NO.

NUCLEAR POWER CORPORATION OF INDIA LIMITED
[A GOVERNMENT OF INDIA ENTERPRISE]

TITLE :- KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6
POWER OUTPUT SYSTEM 400 KV BUSDUCT TUNNELS (31 UNIT) STRUCTURES. REDESIGN
Embedded part TA1, TA2, TA3, TA4

DESIGNED	CHECKED	APPROVED
DRAWN	APPROVED	
PROJECT	SCALE – N.T.S.	
KUDANKULAM NUCLEAR POWER PROJECT 5&6	PROJECTION	
DRG. No. [illegible]	SHEET No.	REV. No. 0

TITLE: POWER OUTPUT SYSTEM 400 KV BUSDUCT TUNNELS (31 UNS) STRUCTURES. REINFORCEMENT

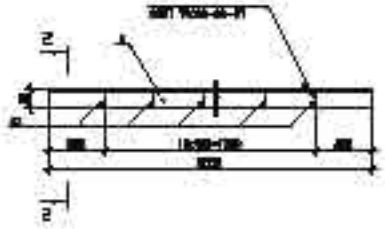
TA8



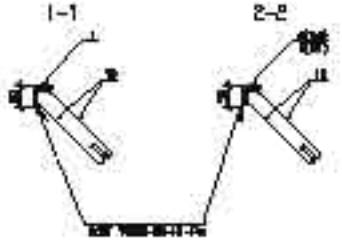
TA8



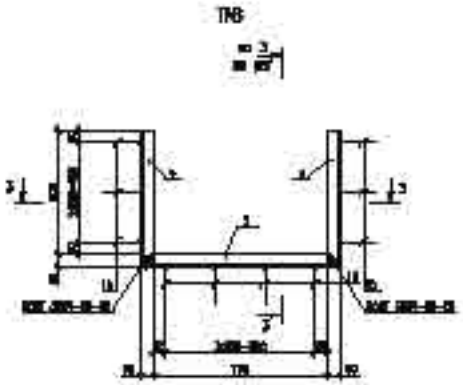
TA7



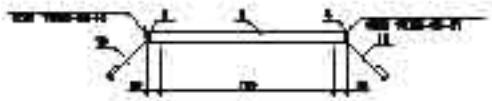
1–1 2–2



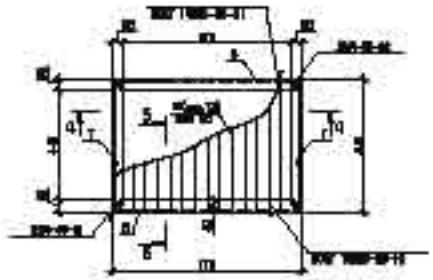
TA6



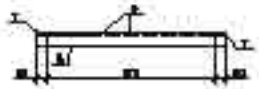
3–3



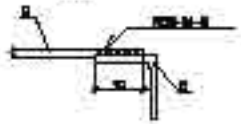
TA9



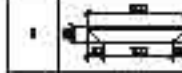
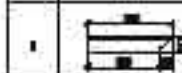
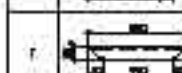
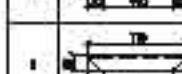
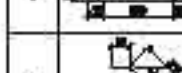
4–4



5–5



LIST OF PARTS

Name	Sketch
A	
B	
E	
F	
G	
H	

SPECIFICATION OF EMBEDDED PART
TA5, TA6, TA7, TA8, TA9

Part Mark	Sketch	Name	Qty	Unit Wt.	Total Wt.
TA5	1	[illegible]	1	45.3	55.4
	1P	[illegible]	16	9.3	
TA6	2	[illegible]	1	18.7	28.4
	2P	[illegible]	8	9.3	
TA7	3	[illegible]	1	28.4	37.7
	3P	[illegible]	10	9.3	
TA8	4	[illegible]	1	23	74.5
	5	[illegible]	1	4.5	
	6	[illegible]	1	9.3	
	6P	[illegible]	16	9.3	
TA9	7	[illegible]	2	6.2	12.4
	8	[illegible]	2	6.2	
	9	[illegible]	12	9.3	

* See 'List of parts'

LIST OF STEEL CONSUMPTION, KG

Type of element	Reinforcing rebars						Total
	Reinforcement of Grade [illegible]		Rolled sections of grade [illegible]				
	[illegible]	Total	[illegible]	[illegible]		Total	
TA5	9.3	9.3	45.3	–		45.3	55.4
TA6	9.7	9.7	18.7	–		18.7	28.4
TA7	9.3	9.3	–	28.4		28.4	37.7
TA8	9.3	9.3	–	7.3		7.3	16.6
TA9	9.3	9.3	–	12.4		12.4	21.7

1. See the general guidelines and sheet 1.
2. Welding has to be made with a continuous weld joint.
3. Calculation for welding shall be of C-AC type as per IS 800 : 2007 – LSM.
4. The fabrication, corrosion protection, quality control, acceptance and installation of the embedded parts in the designed position shall be carried out as per the requirements of IS 2062 "Hot rolled low and medium tensile structural steel – Specification" and IS 800 "General construction in steel – Code of practice".
5. All welds shall be checked in accordance with IS 816 "Code of practice for use of metal arc welding for general construction in mild steel" – Part 1.

1	0	CONSTRUCTION				
Drawing No.	Revision No.	Description	Date	Drawn	Checked	Approved

NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

TITLE: KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6
PROJECT: KUDANKULAM NUCLEAR POWER PROJECT 5&6
SCALE: AS SHOWN
DRG. No.: 5&6/3300/STR/C_D_EC_CAC/BT0001
SHEET No.: 0

[illegible]	POWER OUTPUT SYSTEM 400 MW BRIDGET TUNNELS (3RUNC, 3.3KAC, 5HLAC) STRUCTURES. GEOMETRY

LIST OF WORKING DRAWINGS OF THE MAIN SET

Sheet	Name	Note
1	General data	
2	Specification of plan of axis C-1, C-2, C-3, C-4	
3	Unit C-1	
4	Unit C-2	
5	Unit C-3	
6	Unit C-4	
7	Details A, B, C	
8	Embedded parts TB1, TB2, TB3. Mesh C1	

LIST OF SPECIFICATIONS

Sheet	Name	Note
2	Specification of plan of axis C-1, C-2, C-3, C-4	
8	Specification of embedded parts TB1, TB2, TB3, mesh C1	

LIST OF VOLUMES OF MAIN CIVIL WORKS

Name		Code	Quantity	Note
Concrete bed made of concrete of class B20, W8,	m³	–	88.0	
Fine-aggregate concrete of class B20, group II, W8,	m³	–	4,8	
Cast-in-place reinforced concrete of class B35, W8,	m³	–	9456,0	
Rubber waterpower – material "Waterstop R",	m²	–	2140,8	
Cement-sand mortar M80,	m³	–	34,0	
Concrete blocks of class not less than B15,	m³	–	196,0	
Double-fold TPO water-proof roof	m	–	81,0	
Plinoplate,	m²	–	1,8	
Outer TPO water-proof roof	m	–	80,0	
Stainless steel, thickness 2 mm,	kg	–	110,0	
Figured metal components,	kg	–	1180,0	
Rubber cord Ø40 mm,	m	–	650,0	
Water insulation tape of thickness of 3 mm,	m	–	89,0	
Universal screw HAS 7,9/30,	pcs.	–	420	
Polymerizing mastic of "Izhhermast",	m²	–	7,0	
Polyethylene film,	m²	–	1180,0	
EPDM "RUFLEX" geomembrane 2.0 mm thick	m²	–	850,5	

GENERAL GUIDELINES

1 The elevations of the structures are given with respect to the BBL.
2 Orientation level is assumed equal to BBL.
3 Concrete, concrete structures and reinforced concrete structures shall meet the requirements of 001.0029-0.0.0.ZZ.TT.000001 Technical requirements to performing the concrete and reinforced concrete structures of buildings and constructions".
4 The cast-in-place structures shall be made of concrete having compressive strength B25, and waterproofness grade not less than W8.
5 Concrete mix shall be selected by grouting, with regard to the placeability, and have the minimum water-cement ratio for this class of concrete.
6 Addition to the concrete composition of calcium chloride, sodium chloride, or other salts causing corrosion of the reinforcement and embedded parts is prohibited.
7 Non-admitted spots, segregations, voids and cracks in the concrete of the structures are unacceptable. The spots with them shall be repaired in accordance with the repair and process documentation. Quality control of the concrete of the structures shall be carried out in compliance with GOST 3.003.01-83" Reading and receiving structures".
8 When placing concrete of class B30, W8 in the bottom of the tunnels with 0,01 C slope for the means of drainage water discharge, thoroughness of the work execution is to be provided. Concrete floor surface shall not have asperities and recesses, that interfere the water discharge.
9 Thoroughness of the waterproofing is to be provided when executing works. Waterproofing shall be carried out and checked as per 001.0029-0.0.0.ZZ.TT.000005. "Waterproofing of the underground parts of buildings and structures. Technical requirements".
10 Packing-back concrete is to be placed after elaboration of construction solutions concerning tunnels supports.
11 Work execution and acceptance shall be carried out in compliance with 001.0029-0.0.0.ZZ.TT.000001 Technical requirements to performing the concrete and reinforced concrete structures of building and constructions". Sealing and sanitary structures 001.0029-0.0.0.ZZ.TT.000005 Technical requirements to performing the reinforcement base coverings in the concrete structures and observing the safety engineering regulations.
12 Backfilling of excavation chambers is to be done when executing of the floor structure slabs is accomplished and the concrete of the structure gains 70 % design strength.
13 Backfill is to be made of hard-to-kept consolidated sand-gravel mix with grained density of not less than 1,70 t/m³. Size of coarse aggregate of the sand-gravel mix shall be not more than 40 mm, size of fine aggregate – not less than 0,5 mm.

LIST OF STEEL CONSUMPTION, KG

Type of element	Calculated grade: Reinforcement of class GOST 5781-82				Rolled metal of grade 3SP5 GOST 27772-88			Total
	A-III	A-III (K)		Total	B-II		Total	
C-1	–	872,0		872,0	798,0		798,0	1670,0
C-2	6,8	894,0		900,8	894,0		894,0	1670,8
C-3	6,8	894,0		900,8	894,0		894,0	1670,8
C-4	6,8	887,2		894,0	827,8		823,8	1550,9

LEGEND

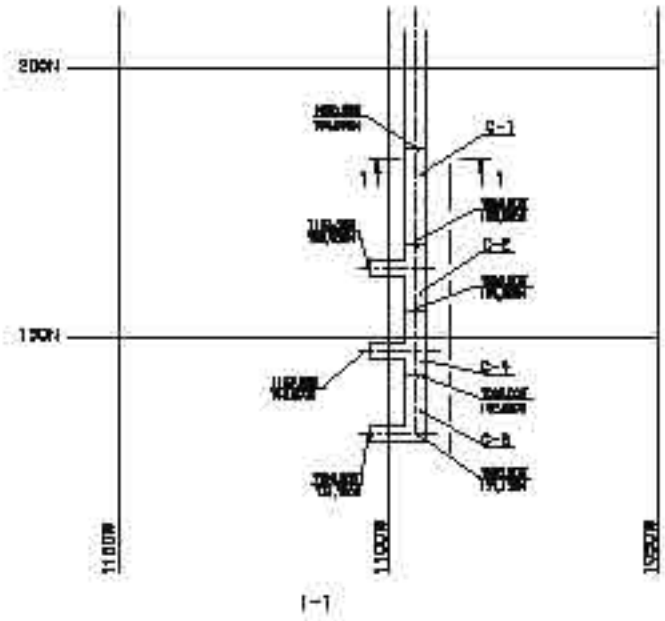
– Concrete, class B30, W8
– Concrete, class B20, W8
– Packing-back concrete. Section (see general guidelines item 10, sheet 1)
– Packing-back concrete. Form (see general guidelines item 10, sheet 1)
– Concrete border

KEY PLAN

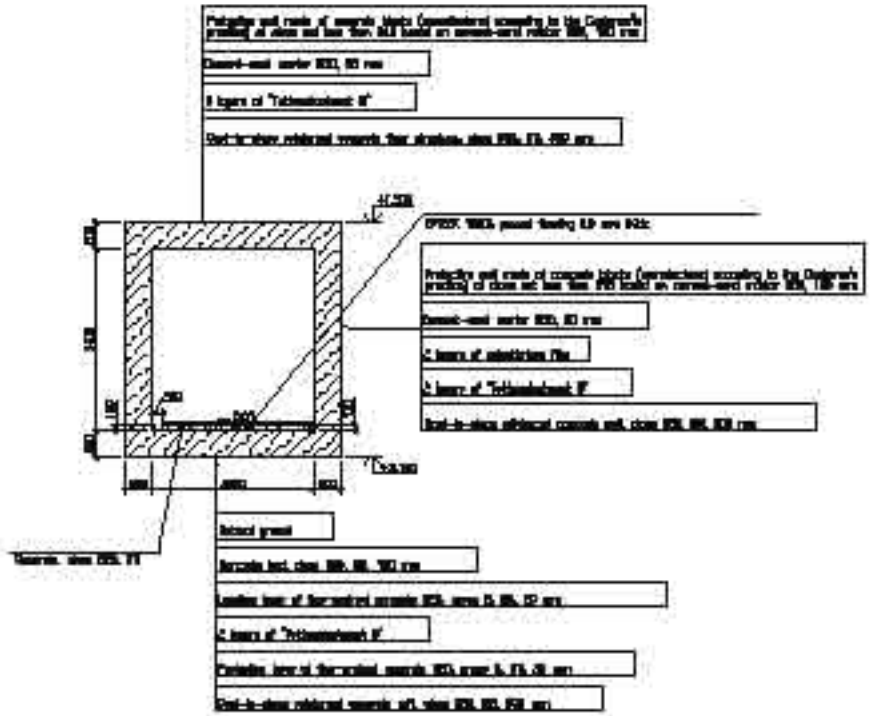


NUCLEAR POWER CORPORATION OF INDIA LIMITED	
EURAMEGUAN NUCLEAR POWER PROJECT UNITS 5&6	
GENERAL DATA	
PROJECT: EURAMEGUAN NUCLEAR POWER PROJECT 5&6	SCALE – N/A
DRWG. No. 001.0029-0.0.0.ZZ.GE.000001	SHT. No. 0

PLAN OF UNITS C-1, C-2, C-4, C-6



C-1



SPECIFICATION OF PLAN OF UNITS C-1, C-2, C-4, C-6

Item	Designation	Name	Quantity per unit						Note
			C-1	C-2	C-4	C-6	Total		
		Concrete M30							
2		Steel	–	9	9	9	77	14.8	
3		Steel	8	18	45	18	58	47.8	
4		Steel	33	66	99	66	191	36.8	
17		Steel	–	1	1	1	3	0.6	
		Plate							
19		Steel Gr as per IS 2062 Fe 410 WA 20mm thick	14	28	28	28	178	6.71	
119		Steel Gr as per IS 2062 Fe 410 WA 40mm thick	14	28	28	28	178	13.41	
		Standard articles							
12	"M.S."	Reinforcement bars Fe 415 TMT Gr	72	108	108	108	426		kg
		Materials							
		Concrete of class M30, 20	17.2	15.87	8.67	79.4	80.9		m³
		Plain reinforcement as per clause 26.5.3.1	0.7	1.4	1.4	1.4	5.1		m³
		Concrete of class M20, 20	1.8	13.67	13.8	13.67	13.67		m³
		Cement mortar M20	0.4	0.8	0.8	0.8	2.8		m³
	Shuttering and supporting to the Engineer's approval	Concrete faces of class not less than M20	20.8	20.8	20.8	20.8	118.0		m²
	EXCAVATION AND DISPOSAL	Trimming of pit							m²
	EXCAVATION AND DISPOSAL	Foundation Rock							m³
	EXCAVATION AND DISPOSAL	Excavation	0.3	0.7	0.7	0.8	1.8		m³
	EXCAVATION AND DISPOSAL	Excavation upto foundation	1.8	2.8	2.8	1.1	7.3		m³
	EXCAVATION AND DISPOSAL	Backfill with approved soil	18.8	20.8	20.8	18.8	80.2		m³
	EXCAVATION AND DISPOSAL	Extra for water proof coat	13.8	15.8	15.8	15.8	60.2		m²
		Coat 1-ply APP water proof coat	20.8	20.8	20.8	20.8	100.8		m
	EXCAVATION AND DISPOSAL	Water Treatment bore	0.8	0.8	0.8	0.8	80.8		m
	SAFETY AND URBAN WORKS	CONCRETE / WORK PLACING Works	87.8	85.8	79.8	83.8	886.8		m³

1 See "Bill of steel" sheet 7

1 For the general guidelines see sheet 1.
2 For the legend see sheet 1.
3 For list of steel reinforcement see sheet 1.

1	0	CONFORMANCE			
REVISION NO.	DATE	DESCRIPTION	SCALE	APPD.	ISSUED SHEET NO.

NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

TITLE :- KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6

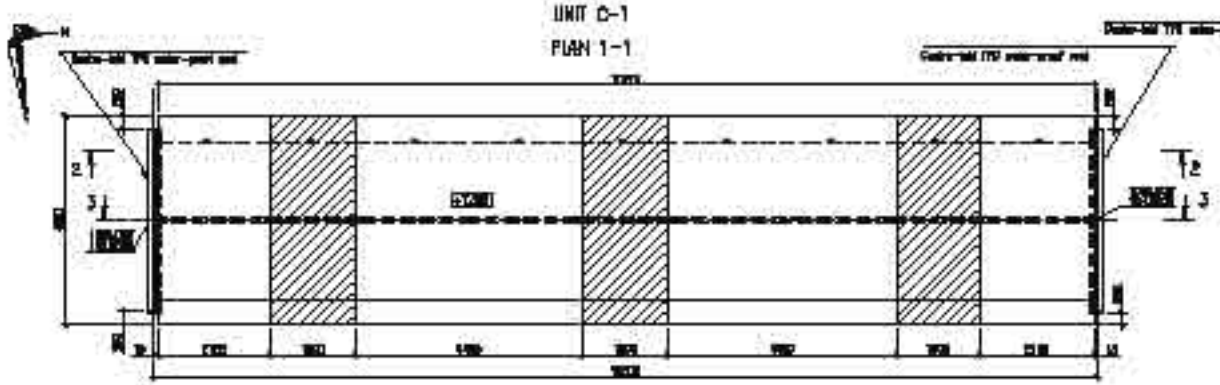
POWER OUTPUT SYSTEM 400 KV SWITCHYARD TUNNELS (765 KV, 420 KV, 245 KV) STRUCTURES, GEOMETRY

SPECIFICATION OF PLAN OF UNITS C-1, C-2, C-4, C-6

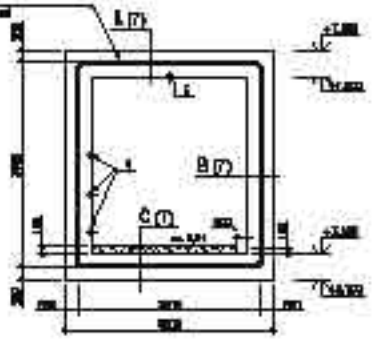
DRAWN	DESIGNED	CHECKED	
TRACED	APPROVED	APPROVED	
PROJECT KUDANKULAM NUCLEAR POWER PROJECT 5&6		SCALE – N.T.S.	
		PROJECTION	
SPEC. No. PE-E-1756-S-0012-Z-D-EZ-DE-XD-0001		DRAWING No.	REV. No. 0

UNIT C-1

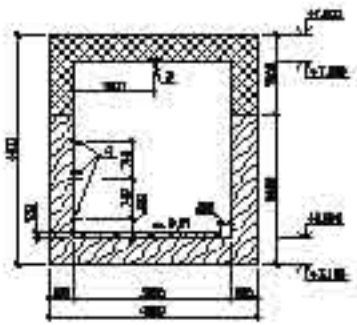
PLAN 1-1



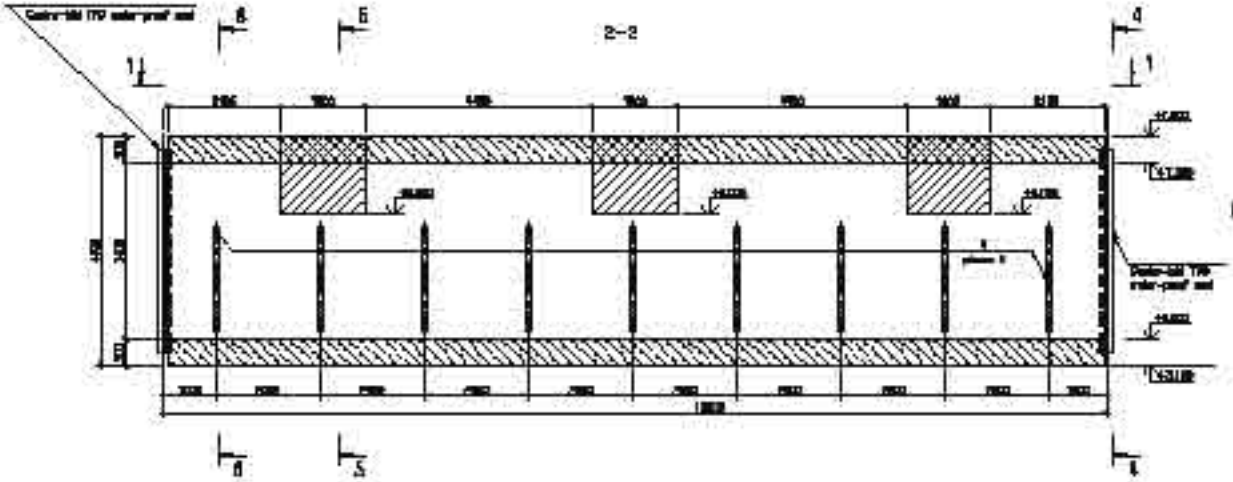
4-4



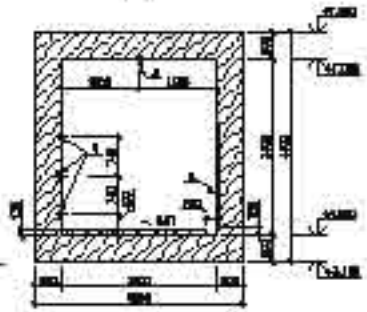
6-6



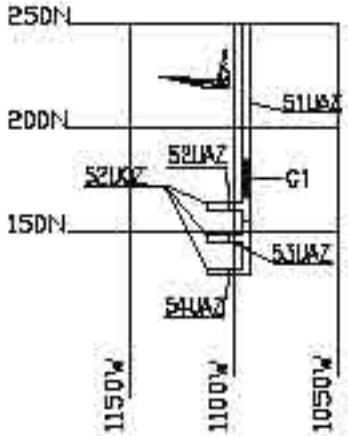
2-2



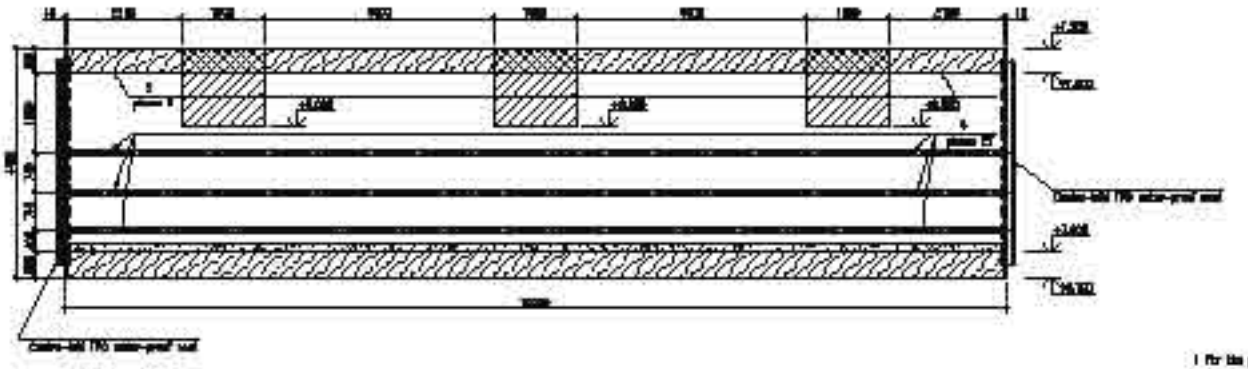
5-5



KEY PLAN



3-3



1 For the general guidelines see sheet 1.
2 For the legend see sheet 1.
3 For list of steel consumption see sheet 1.
4 For specification see sheet 2.

NUCLEAR POWER CORPORATION OF INDIA LIMITED

KUDANKULAM NUCLEAR POWER PROJECT UNIT 5&6

UNIT C-1

PROJECT KUDANKULAM NUCLEAR POWER PROJECT 5&6

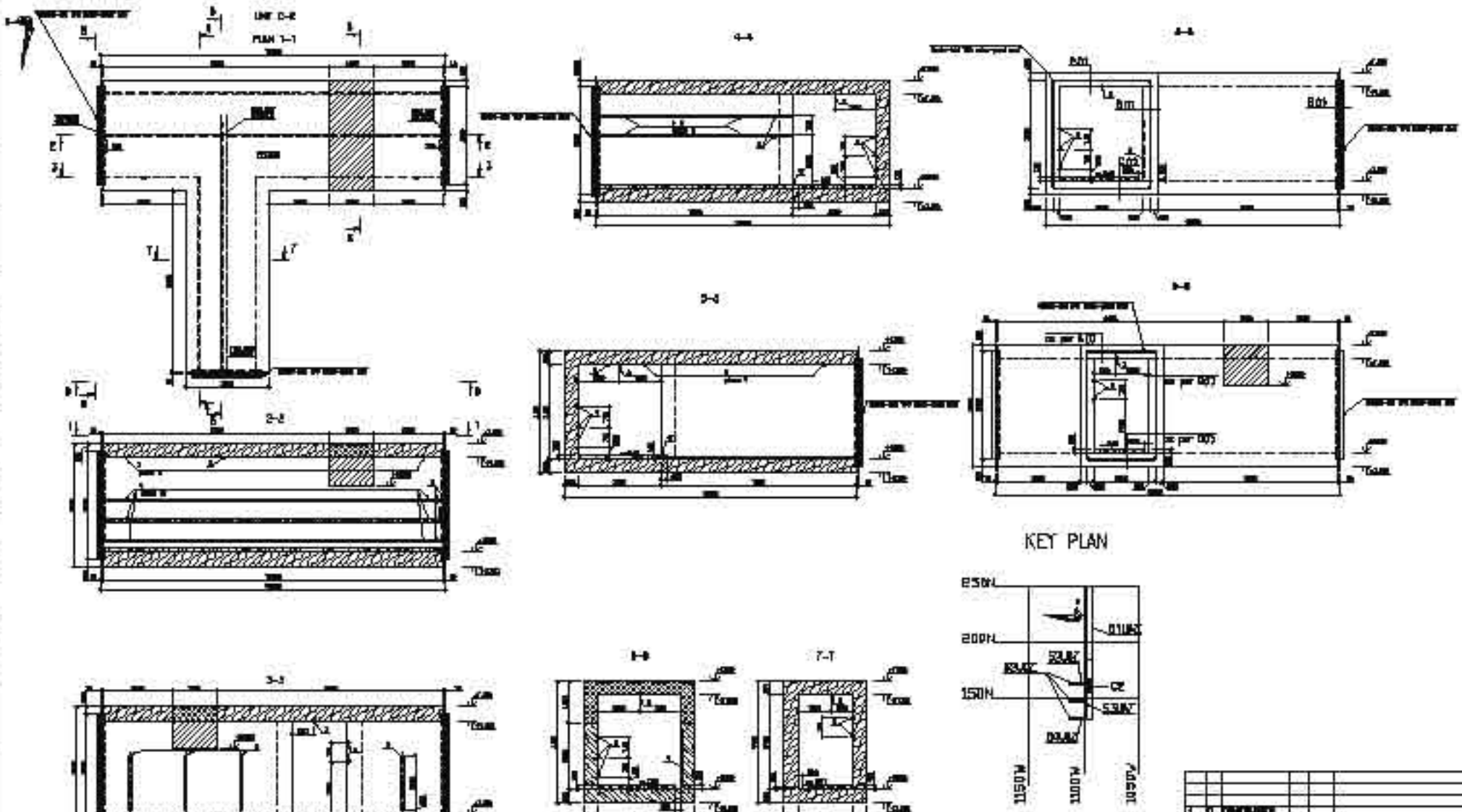
SCALE - AS SHOWN

PROJECTION

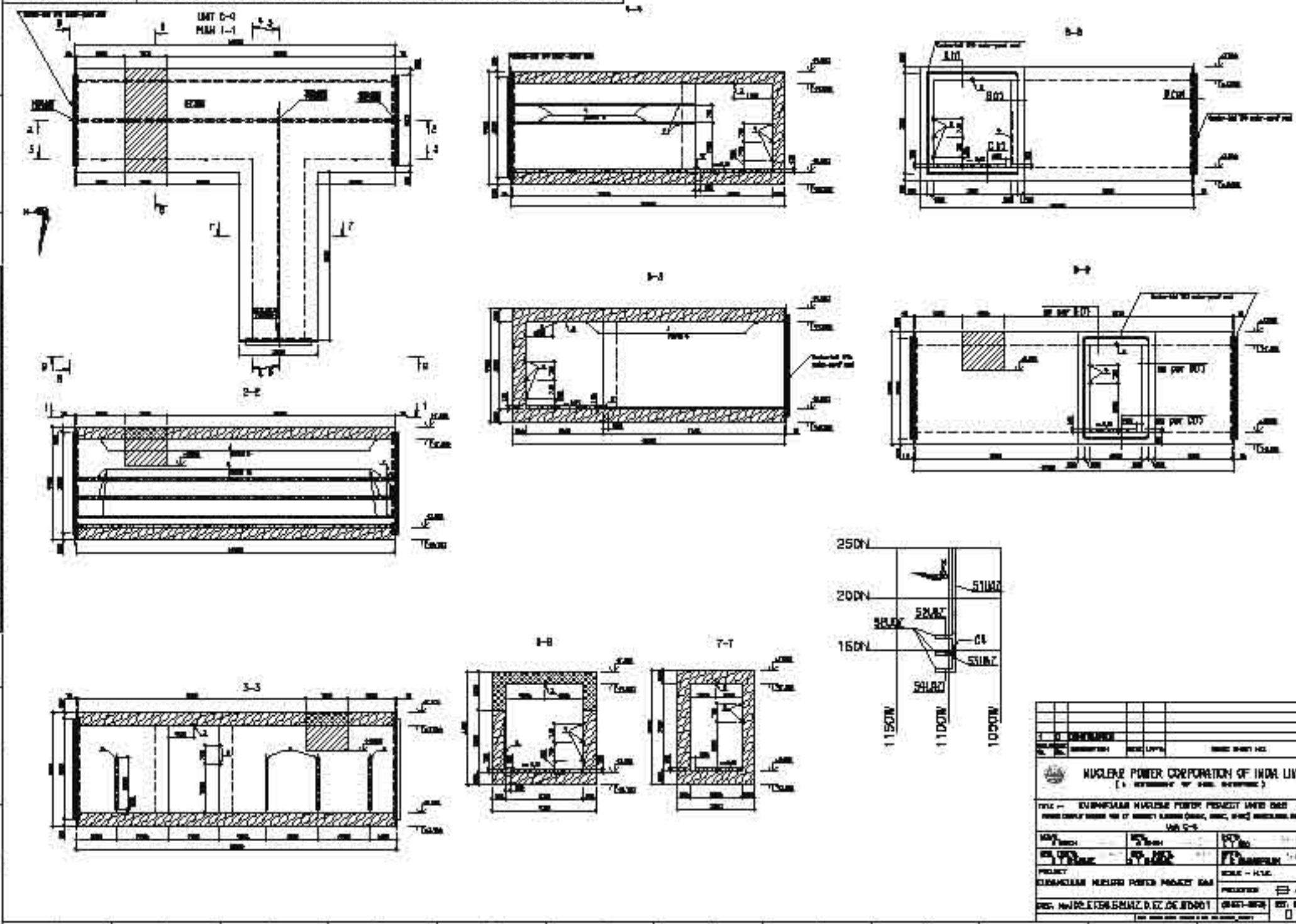
DRG. No. PDS-E-1536-5&6-AAZ-D-XZ-DE-ED001

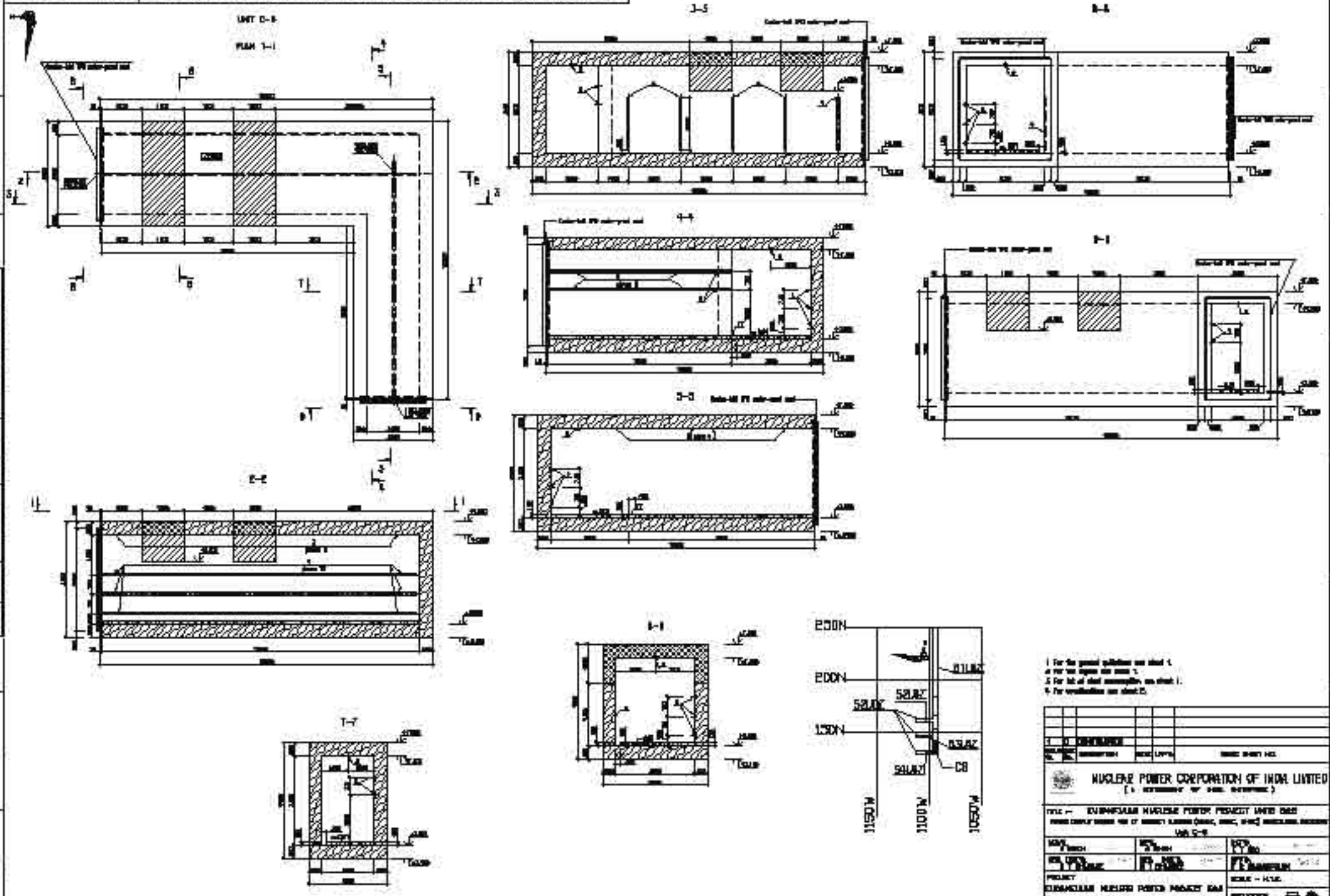
DRAWING NO.

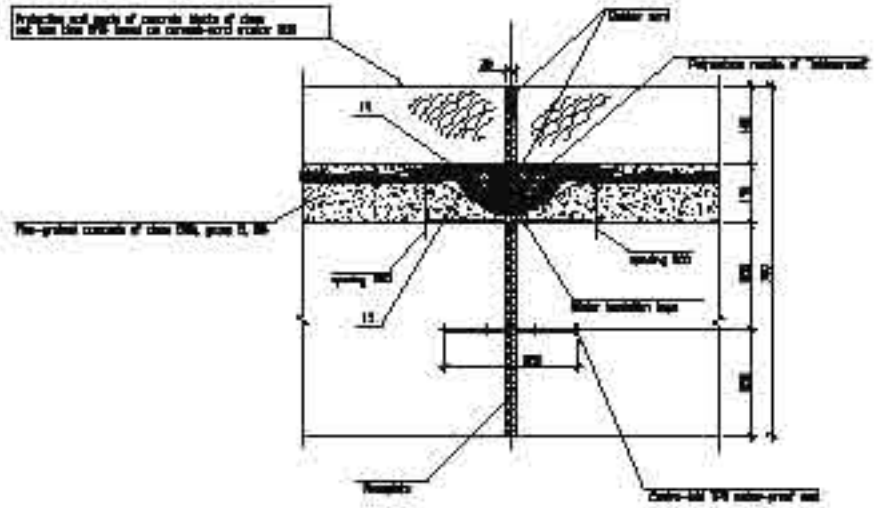
REV. No. 0

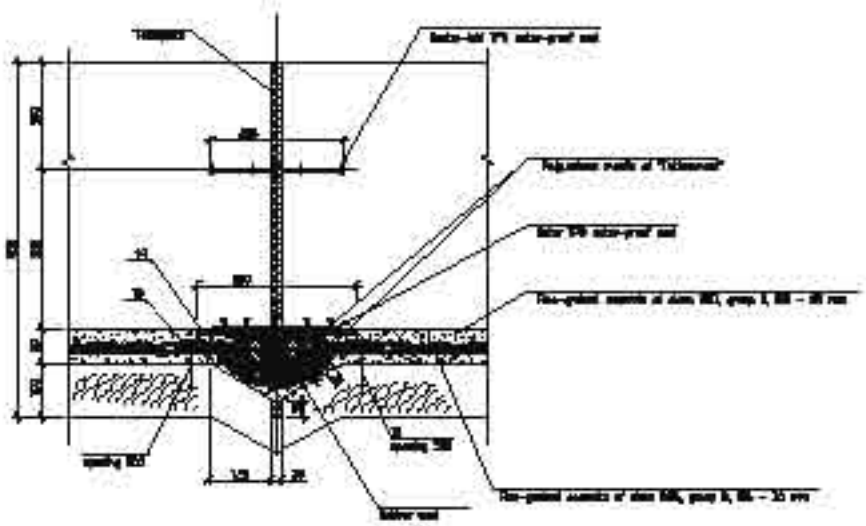


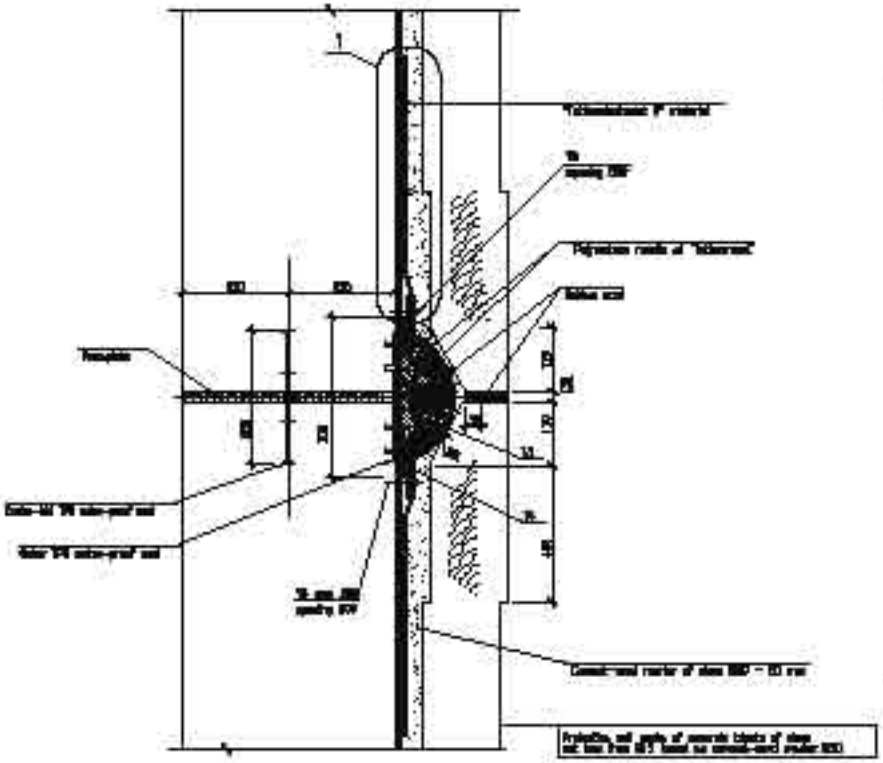
NUCLEAR POWER CORPORATION OF INDIA LIMITED


UNIT 0-0
MAIN 1-1
2-2
3-3
4-4
5-5
6-6
7-7
8-8
250DN
200DN
150DN
115DN
110DN
105DN

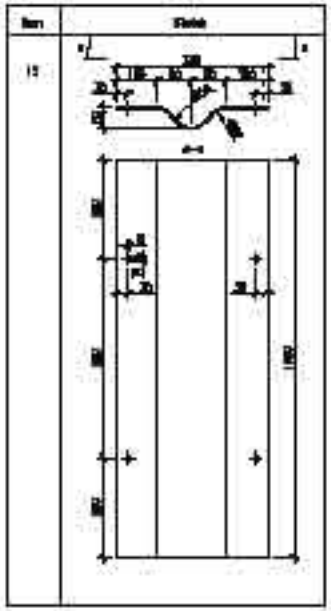

UNIT 0-0
PLAN 1-1
2-2
3-3
4-4
5-5
6-6
7-7
8-8
250N
200N
150N
115.0 M
110.0 M
105.0 M
NUCLEAR POWER CORPORATION OF INDIA LIMITED

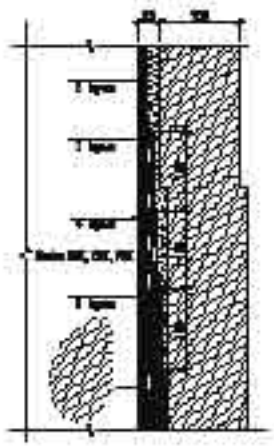






LIST OF PARTS





1 For the general guidelines see sheet 1.
2 For the legend see sheet 1.
3 For list of steel consumption see sheet 1.
4 For specifications see sheet 2.

NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6

PROJECT
KUDANKULAM NUCLEAR POWER PROJECT 5&6

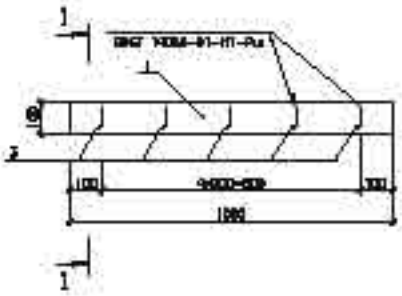
SCALE – N.T.S.

DRG. No. PDS-E-TSW-S-SHAZ-0-XZ-DE-JD0001

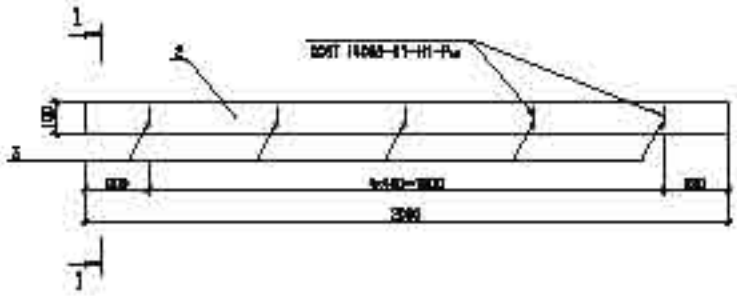
REV. No. 0

DWG NO. [illegible] | TITLE POWER OUTPUT SYSTEM 400 KV BUSDUCT TUNNELS (3X1AC, 3X1PC, 3X1AC) STRUCTURES, GEOMETRY

TA1



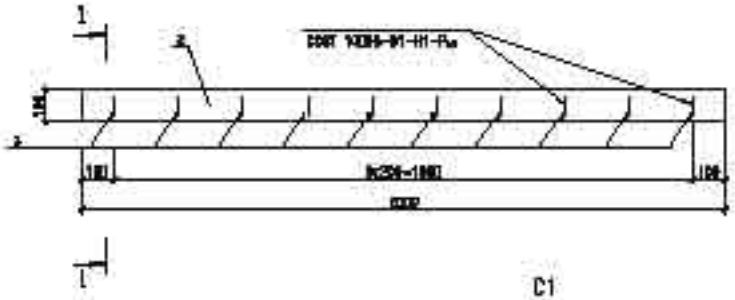
TA2



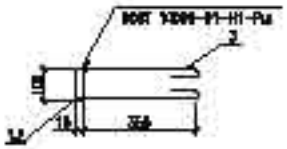
LIST OF PARTS

Item	Sketch
3	

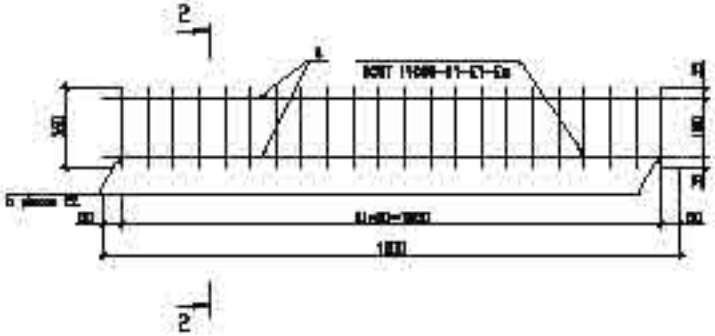
TA3



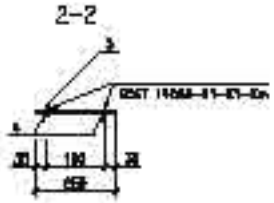
1–1



C1



2–2



SPECIFICATION OF EMBEDDED PART
TA1, TA2, TA3, MESH C1

Mark of pos.	Item	Name	Q-ty	Mass, kg	Mass of assembly unit, kg
TA1	1	[illegible]	1	7,8	19,8
	2*	[illegible]	6	2,0	
TA2	1	[illegible]	1	15,8	27,8
	2*	[illegible]	6	2,0	
TA3	1	[illegible]	1	16,8	28,8
	2*	[illegible]	10	2,0	
C1	1	[illegible]	2	1,1	8,8
	3	[illegible]	20	0,4	

* SEE "LIST OF PARTS"

1. For the general guidelines see sheet 1.
2. [illegible]
3. Dimensions for existing shell in of C-42 type as per [illegible].
4. The fabrication, erection, protection, quality control, acceptance and installation of the embedded parts in the designed position shall be carried out as per the requirements of [illegible] "Technical requirements for plain concrete and reinforced concrete structures of buildings and constructions" and [illegible] "Steel lining and reinforcing structures".
5. All welds shall be checked in accordance with [illegible]
– visual examination – 100 %.

LIST OF STEEL CONSUMPTION, KG

Type of element	Embedded parts						Total
	Reinforcement of class [illegible]			Total	Rolled metal of grade [illegible]			
	[illegible]	[illegible]			110		Total	
TA1	–	12,0		12,0	7,8		7,8	19,8
TA2	–	12,0		12,0	15,8		15,8	27,8
TA3	–	14,0		14,0	15,8		15,8	28,8
C1	8,8	–		8,8	–		–	8,8

NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA UNDERTAKING)

TITLE: – [illegible]

Embedded parts TA1, TA2, TA3 Mesh C1

PROJECT [illegible]

DRG. No. [illegible]

POWER OUTPUT SYSTEM 400 OF SUBDUCT TUNNELS (STUAZ) STRUCTURES. GEOMETRY

LIST OF WORKING DRAWINGS OF THE MAIN SET

Sheet	Name	Note
1	General data	
2	[illegible]	
3	[illegible]	
4	[illegible]	
5	[illegible]	
6	[illegible]	
7	[illegible]	
8	[illegible]	
9	[illegible]	
10	[illegible]	
11	[illegible]	
12	[illegible]	
13	[illegible]	
14	[illegible]	
15	[illegible]	
16	[illegible]	
17	[illegible]	
18	[illegible]	
19	[illegible]	
20	[illegible]	
21	[illegible]	

LIST OF VOLUMES OF MAIN CIVIL WORKS

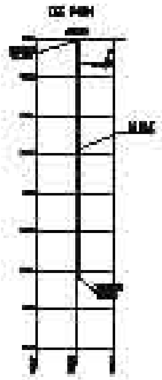
Name	Units	Quantity	Note
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	

LIST OF SPECIFICATIONS

Sheet	Name	Note
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	

LIST OF MANHOLES

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]



LIST OF STEEL EXPENDITURE, KG

Type of element	Values
Ø-1	[illegible]
Ø-2	[illegible]
Ø-3	[illegible]
Ø-4	[illegible]
Ø-5	[illegible]
Ø-6	[illegible]
Ø-7	[illegible]
Ø-8	[illegible]
Ø-9	[illegible]
Ø-10	[illegible]
Ø-11	[illegible]

LEGEND

- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]

GENERAL GUIDELINES

[illegible]

NUCLEAR POWER CORPORATION OF INDIA LIMITED

KUDANKULAM NUCLEAR POWER PROJECT UNITS 3&4

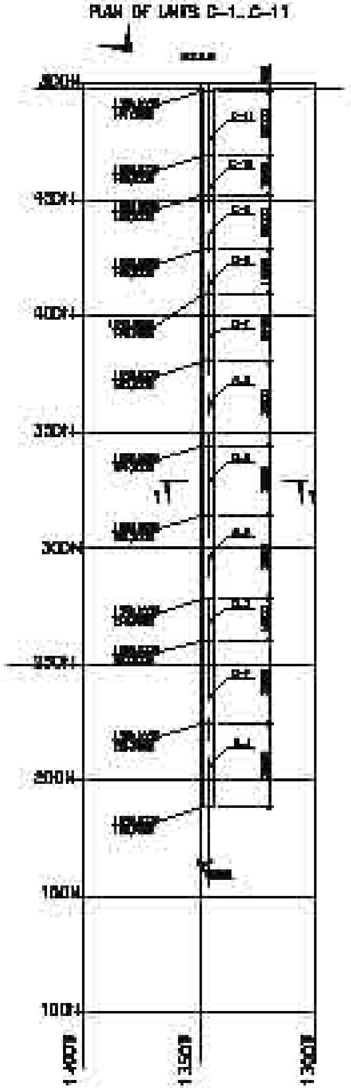
POWER OUTPUT SYSTEM 400 OF SUBDUCT TUNNELS (STUAZ) STRUCTURES. GEOMETRY GENERAL DATA

PROJECT: KUDANKULAM NUCLEAR POWER PROJECT 3&4

SCALE – N.T.S.

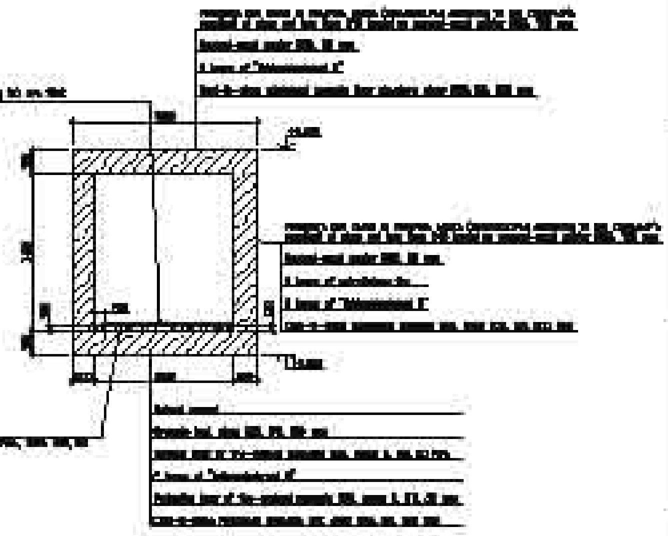
POWER OUTPUT SYSTEM 400 OF BUSDUCT TUNNELS (81UAZ) STRUCTURES. GEOMETRY

PLAN OF UNITS C–1…C–11



SPECIFICATION OF PLAN OF UNITS C–1…C–11

1–1



LIST OF PARTS

Pos.	Sketch
[illegible]	[illegible]

NUCLEAR POWER CORPORATION OF INDIA LIMITED

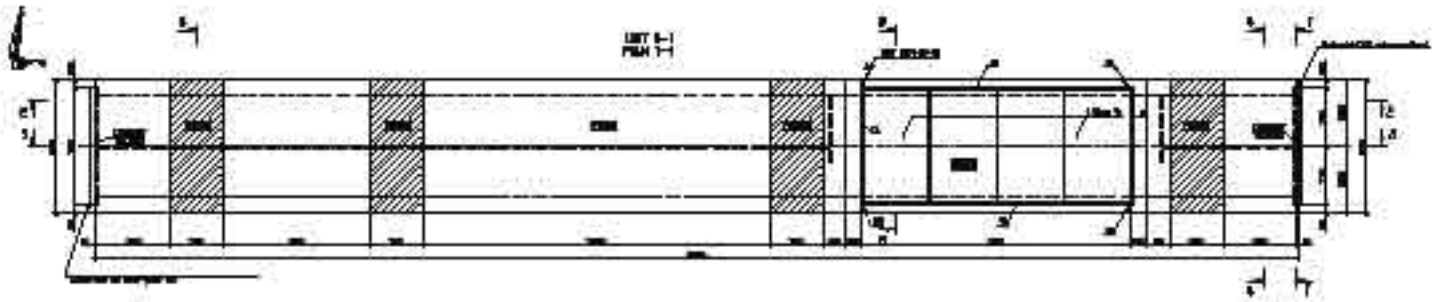
KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6

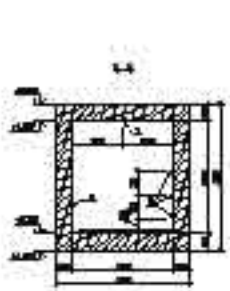
SPECIFICATION OF PLAN OF UNITS C–1…C–11

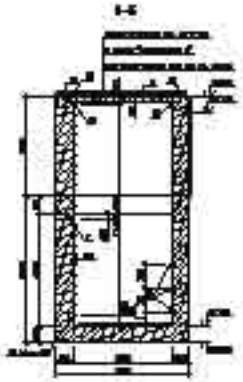
SCALE – N.T.S.

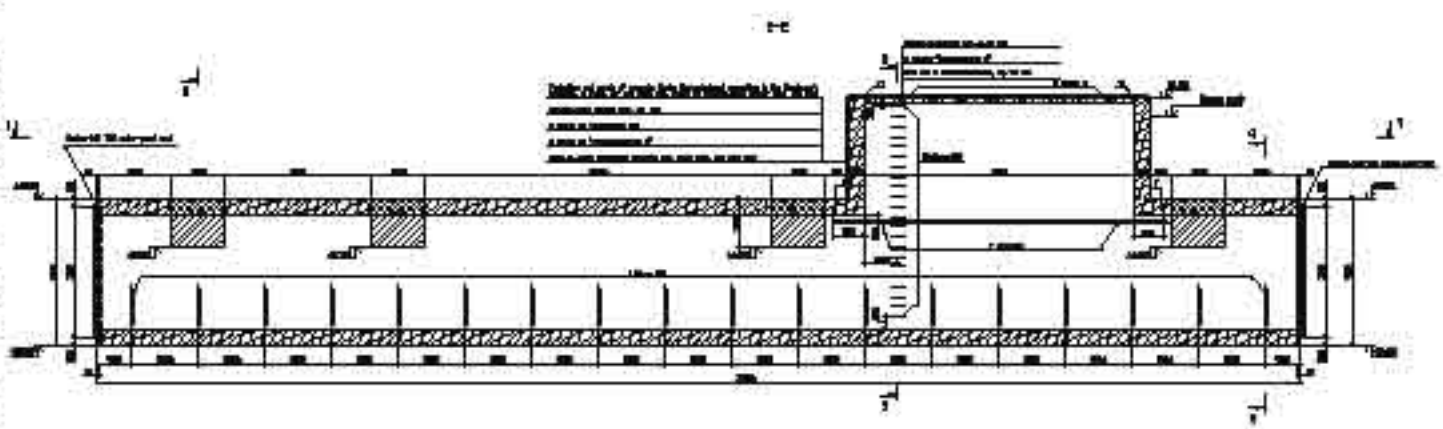
KUDANKULAM NUCLEAR POWER PROJECT 5&6

DWG. No. [illegible]

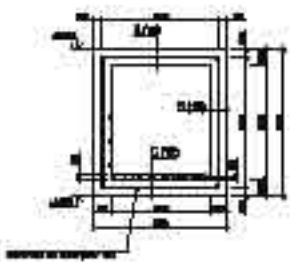


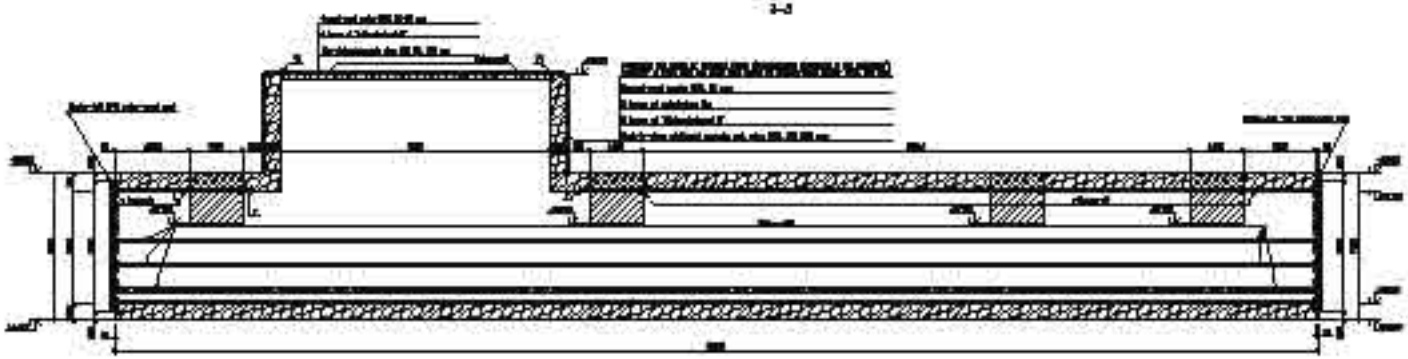














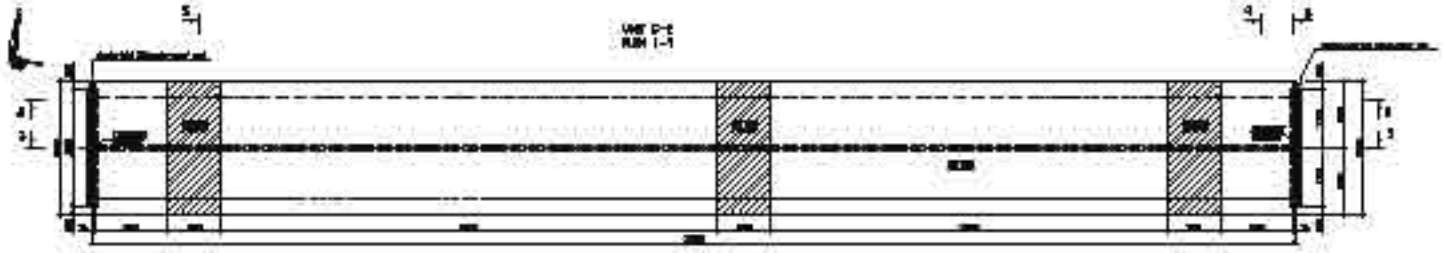
1. For the general notations see sheet 1.
2. For the legend see sheet 1.
3. For bill of steel reinforcement see sheet 5.
4. For specifications see sheet 6.

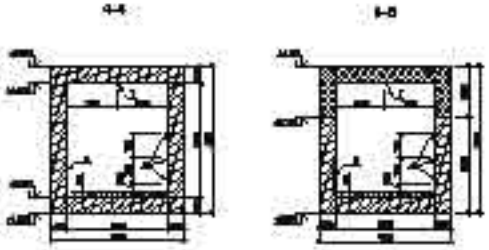
1	0	CONSTRUCTION			
REVISION NO.	DATE	DESCRIPTION	SCALE	DRAWN	ISSUED SHEET NO.

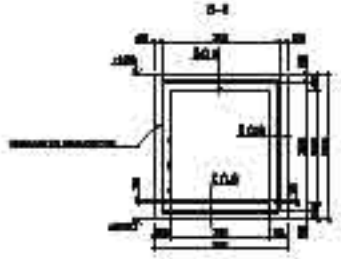
NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

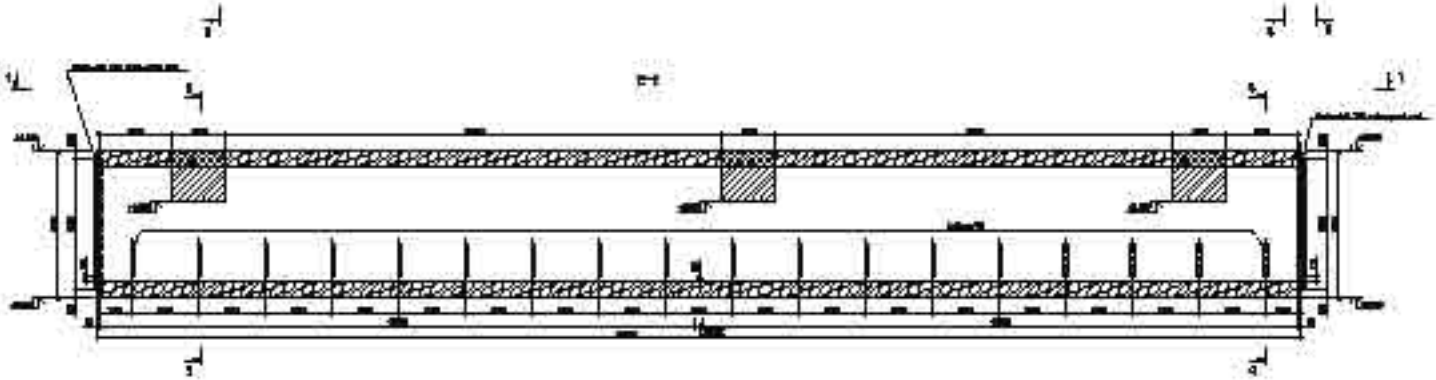
TITLE :- KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6
POWER OUTPUT SYSTEM 400 KV BUSDUCT TUNNELS (BTUNC) STRUCTURES GENERAL
LINE D-1

DRAWN	DESIGN	CHECKED
DES. CHECKED	DES. APPROVED	APPROVED
PROJECT: KUDANKULAM NUCLEAR POWER PROJECT 5&6		SCALE :- N.T.S.
DRG. No. NPCIL/KKNPP/5&6/STR/C_D_BTUNC_D_BTUNC/GA/CIV/0001		REV. No. 0

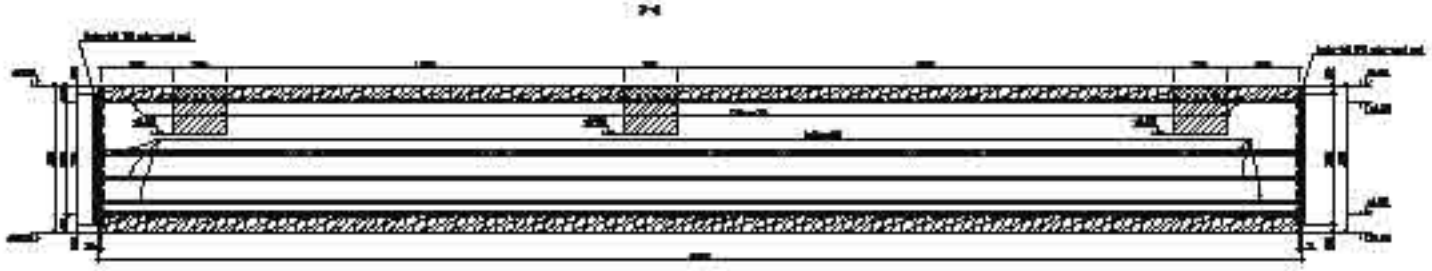








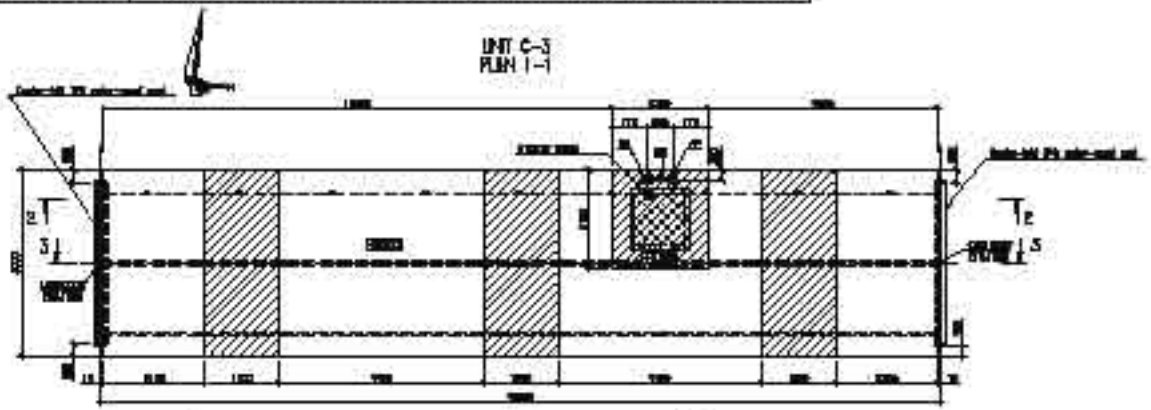


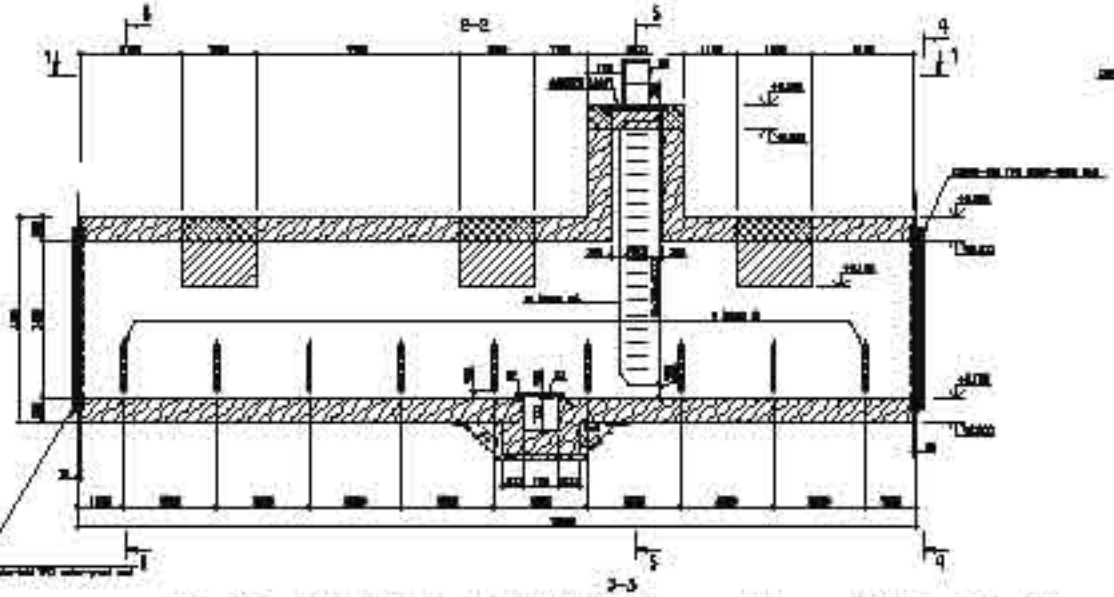


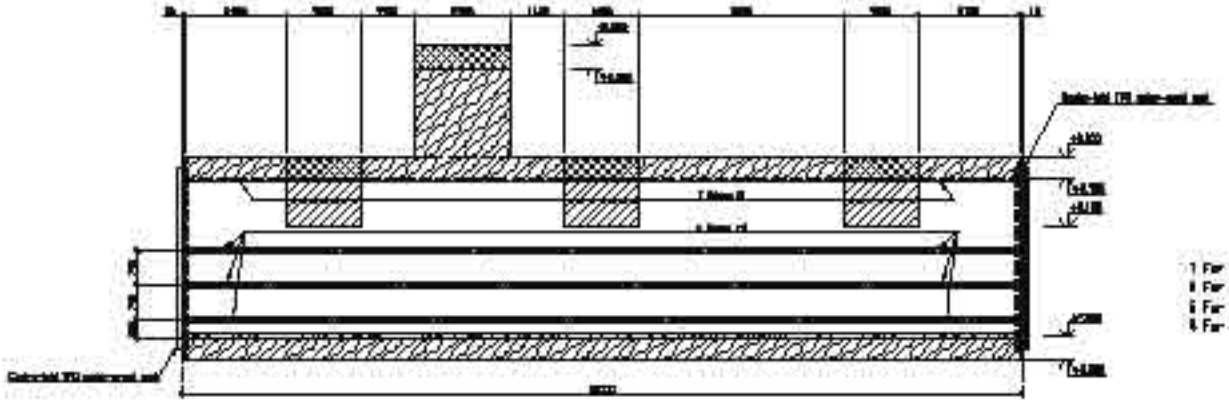
NUCLEAR POWER CORPORATION OF INDIA LIMITED

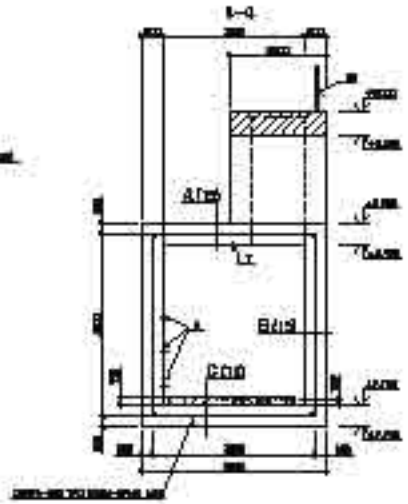
POWER OUTPUT SYSTEM 500 CF INVERT TUNNELS (911WZ) STRUCTURES, GEOMETRY

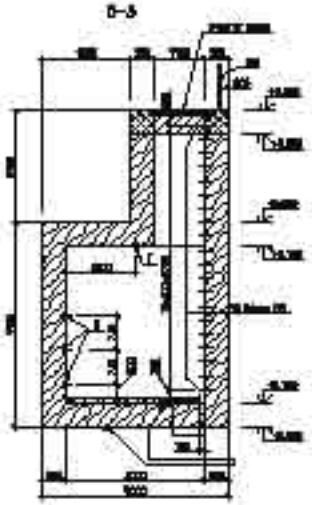
UNIT C-3
PLAN 1-1

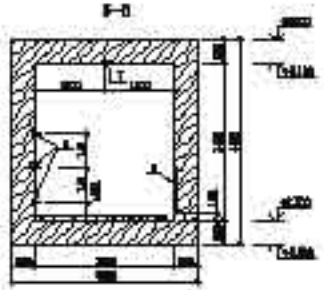


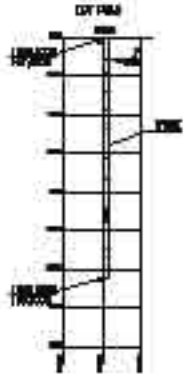












1. For the general guidelines see sheet 1.
2. For the legend see sheet 1.
3. For list of steel reinforcing see sheet 1.
4. For specifications see sheet 2.

NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6
POWER OUTPUT SYSTEM 500 CF INVERT TUNNELS (911WZ) STRUCTURES, GEOMETRY
UNIT C-3

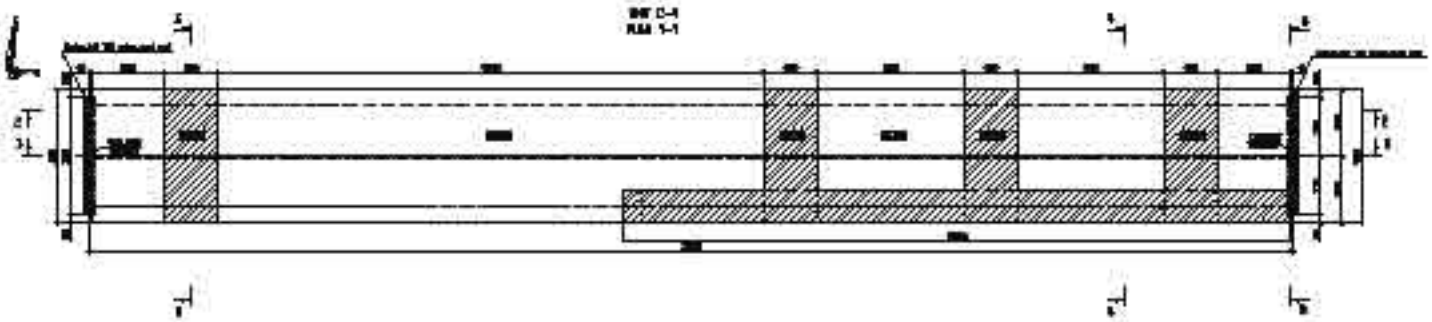
KUDANKULAM NUCLEAR POWER PROJECT 5&6

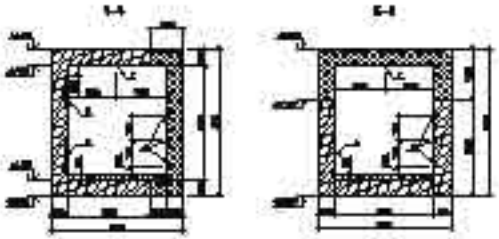
SCALE - AS SHOWN

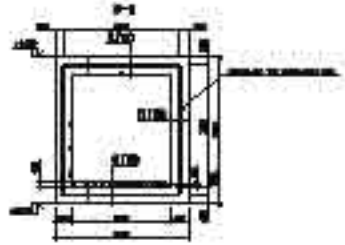
PROJECTION

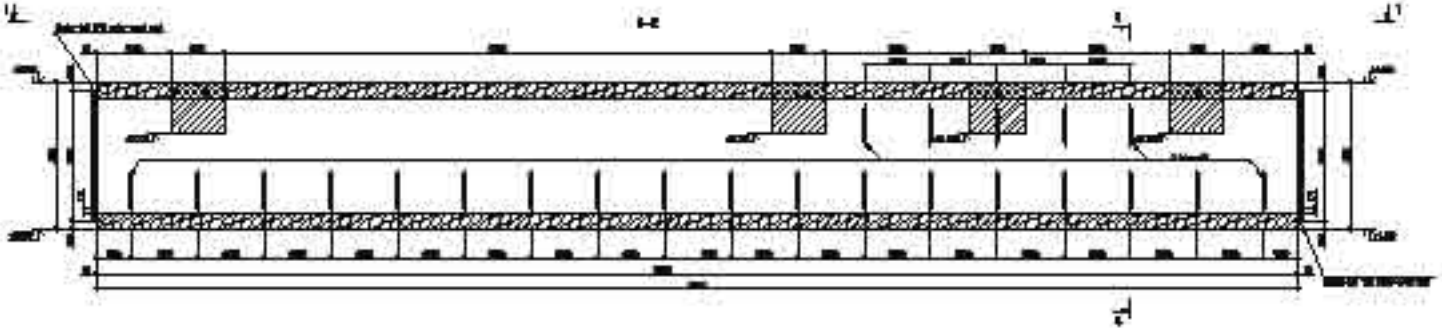
DRG. No. 5&6-911WZ-S-STRUC-D-GZ-GA-C3-S0001

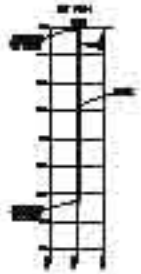
SHEET No. 0



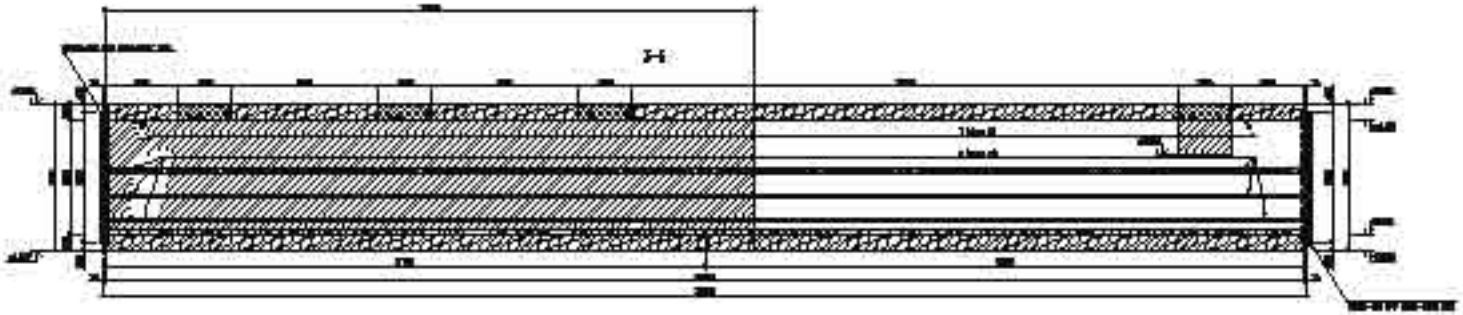




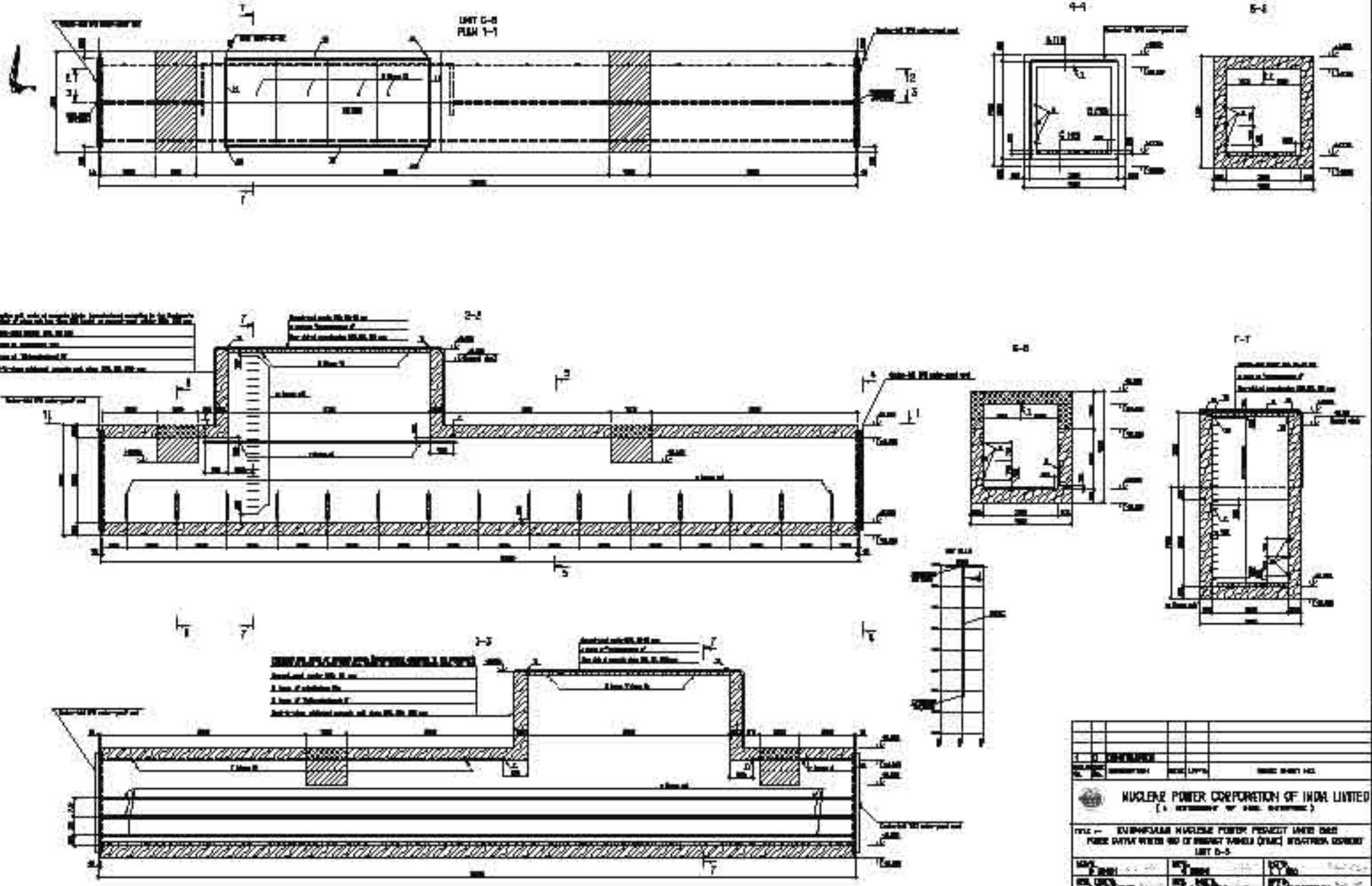


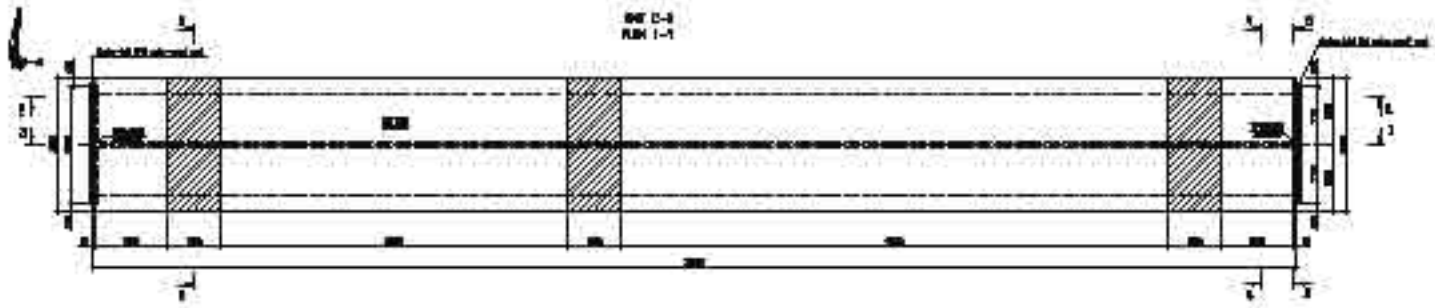


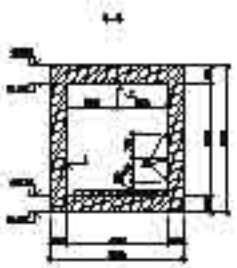
1. For the general guidelines see sheet 1.
2. For the legend see sheet 1.
3. For list of steel reinforcement see sheet 1.
4. For specifications see sheet 1.

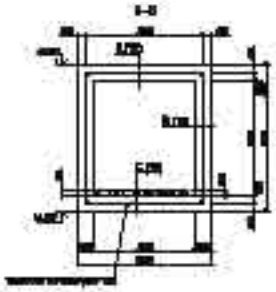


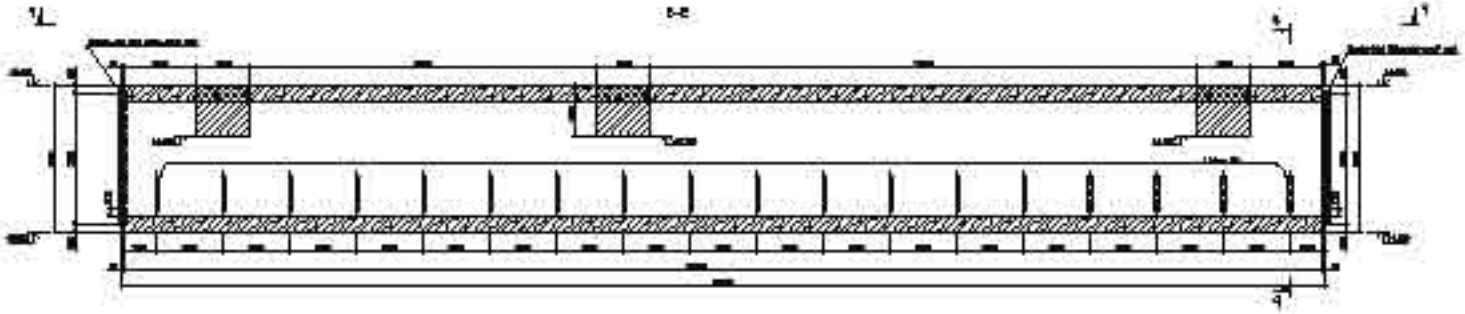
NUCLEAR POWER CORPORATION OF INDIA LIMITED

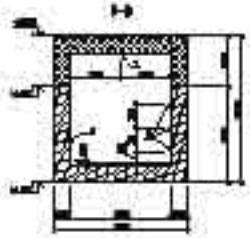

UNIT 0-0
PLAN 1-1
1-1
2-2
3-3
4-4
5-5
6-6
7-7

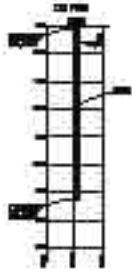




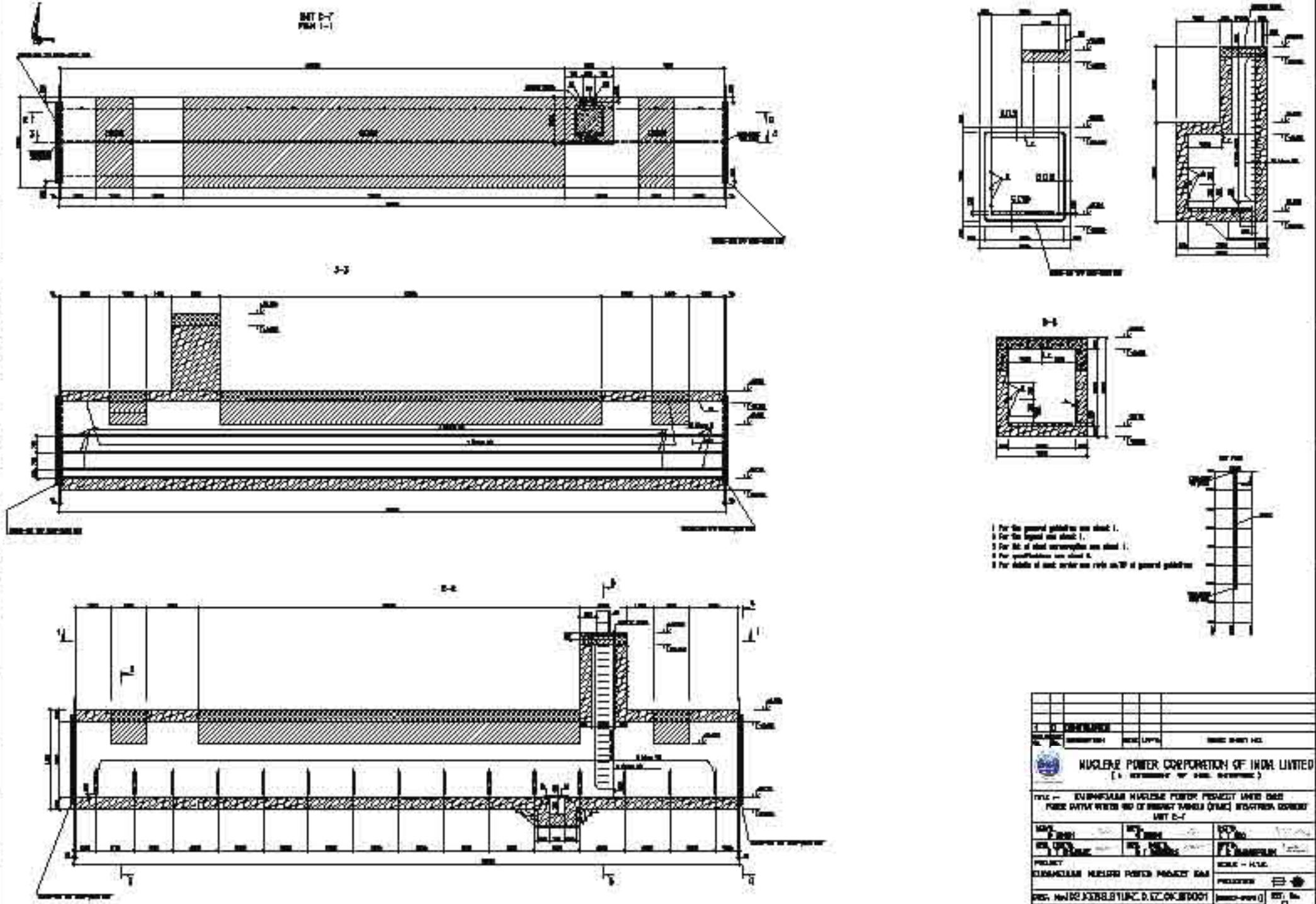






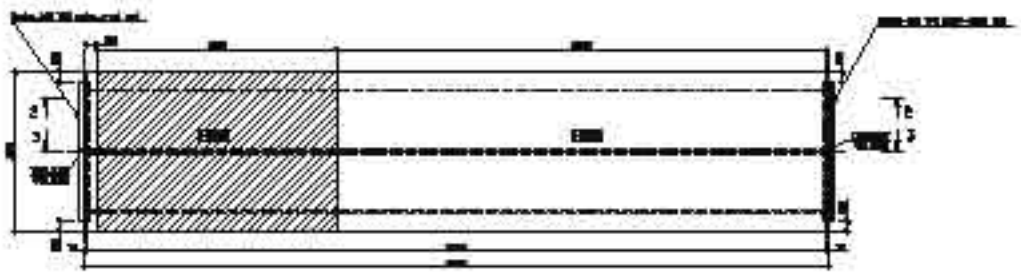


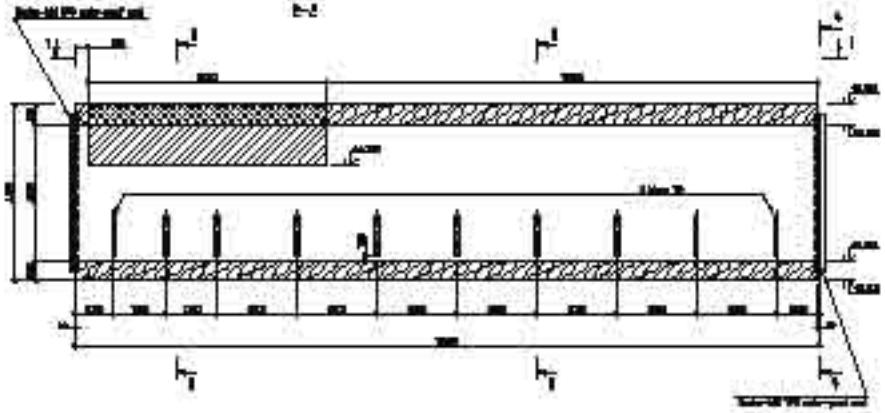


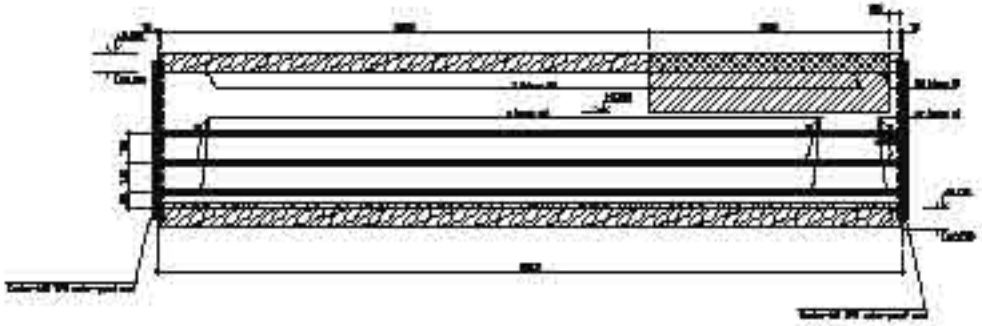

POWER OUTPUT SYSTEM 500 CF INTAKE TUNNELS (STUAC) STRUCTURES GEOMETRY
UNIT 5-7
SECTION 1-1
SECTION 2-2
SECTION 3-3
SECTION 4-4
SECTION 5-5
SECTION 6-6
SECTION 7-7
SECTION 8-8
1 For the general guidelines see sheet 1.
2 For the legend see sheet 1.
3 For list of steel corrosion see sheet 1.
4 For specifications see sheet 4.
5 For details of steel reinforcement refer to GAD of general guidelines
NUCLEAR POWER CORPORATION OF INDIA LIMITED
KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6
UNIT 5-7
KUDANKULAM NUCLEAR POWER PROJECT 5&6

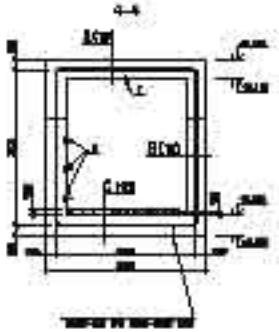
POWER OUTPUT SYSTEM 500 CF INDUCT TUNNELS (STUAZ) STRUCTURES, GEOMETRY

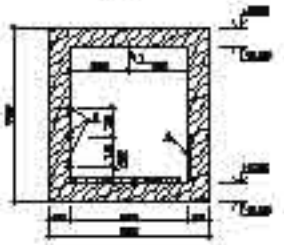
UNIT 5-6
PLAN 1-1

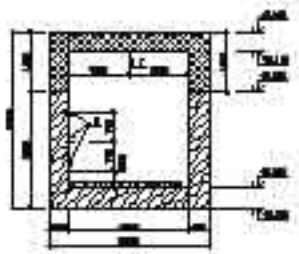


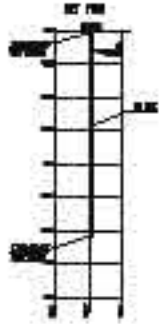












1. For the general guidelines see sheet 1.
2. For the legend see sheet 1.
3. For list of steel consumption see sheet 1.
4. For specifications see sheet 2.

NUCLEAR POWER CORPORATION OF INDIA LIMITED

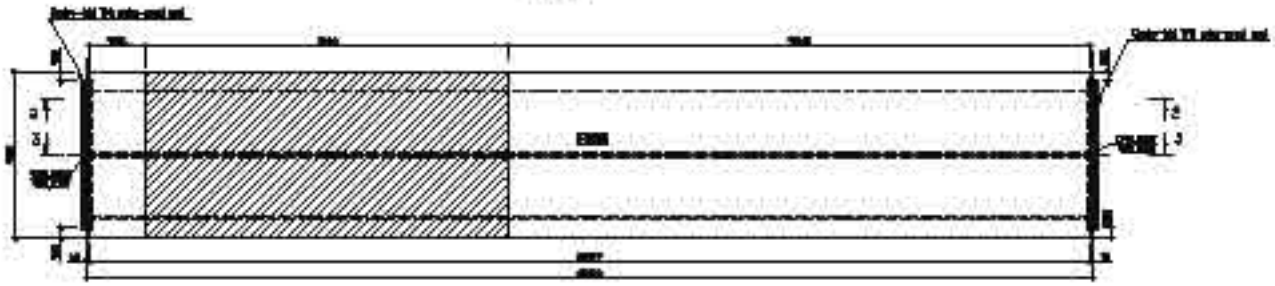
KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6
POWER OUTPUT SYSTEM 500 CF INDUCT TUNNELS (STUAZ) STRUCTURES, GEOMETRY
UNIT 5-6

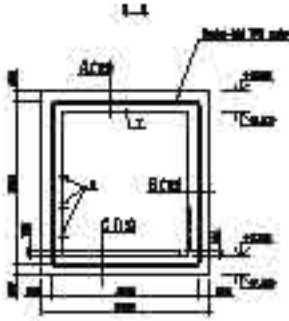
KUDANKULAM NUCLEAR POWER PROJECT 5&6

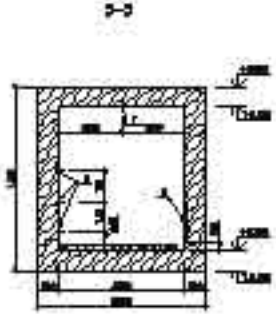
0

POWER OUTPUT SYSTEM 500 CF INTAKE TUNNELS (STUAZ) STRUCTURES, GEOMETRY

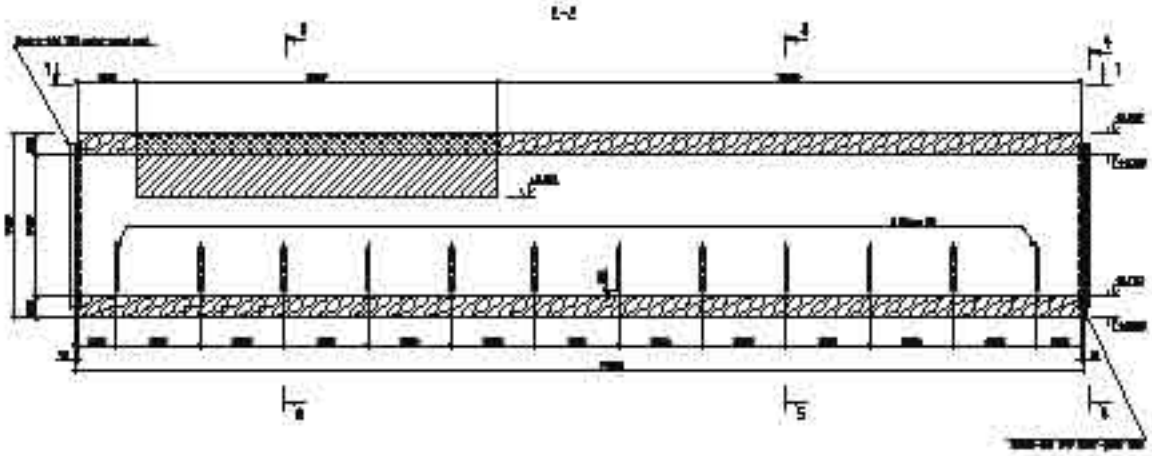
UNIT 5-6
PLAN 1-1

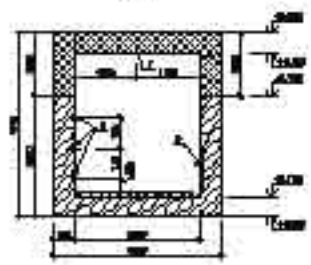


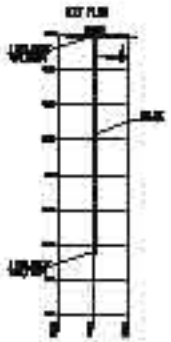




2-2

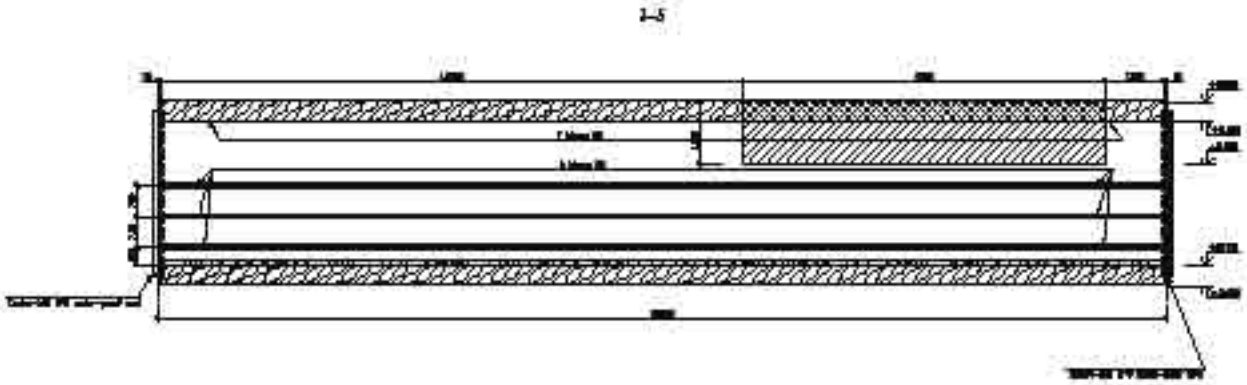






1 For the general guidelines see sheet 1.
2 For the legend see sheet 1.
3 For list of steel consumption see sheet 1.
4 For specifications see sheet 2.

3-3



1	0	CONSTRUCTION			
REVISION NO.	DATE	DESCRIPTION	SCALE	APPD.	DRAWING SHEET NO.

NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6
POWER OUTPUT SYSTEM 500 CF INTAKE TUNNELS (STUAZ) STRUCTURES, GEOMETRY
UNIT 5-6

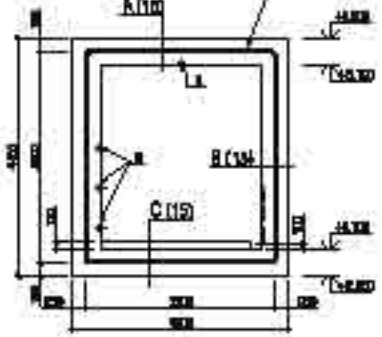
DRAWN	DES.	CHKD.
DES. CHKD.	DES. APPD.	APPD.
PROJECT: KUDANKULAM NUCLEAR POWER PROJECT 5&6		SCALE - N.T.S.
		PROJECTION
DRG. No.		SHEET No. 0

POWER OUTPUT SYSTEM 500 CF INTAKE TUNNELS (STUAC) STRUCTURES, GEOMETRY

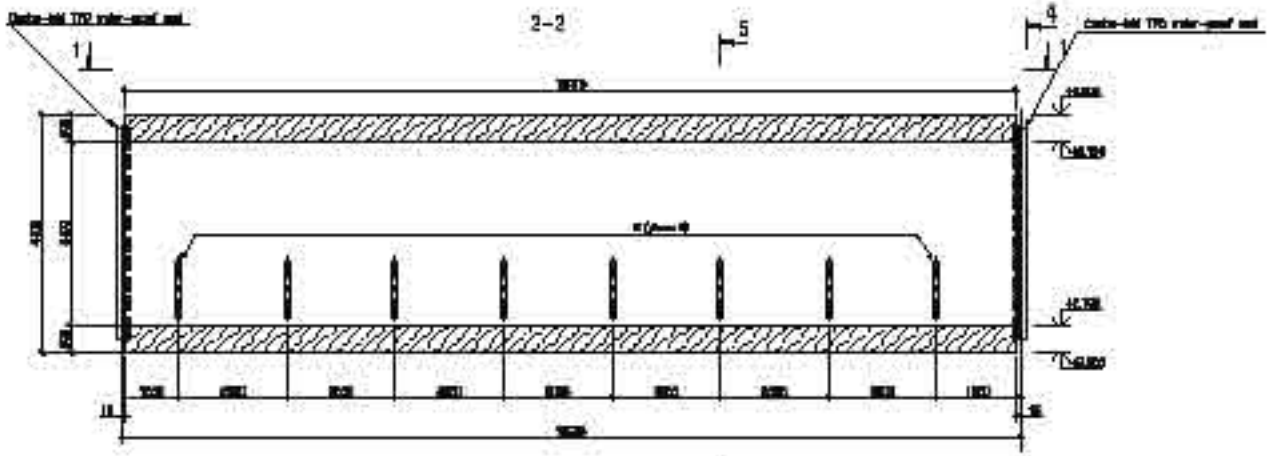
UNIT C-10
PLAN 1-1



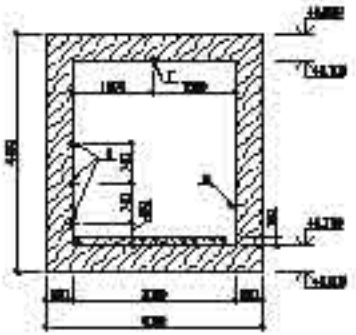
4-4

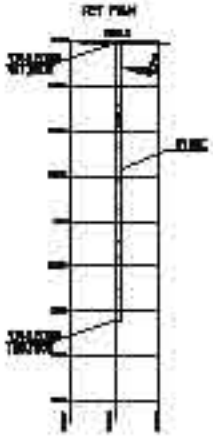


2-2

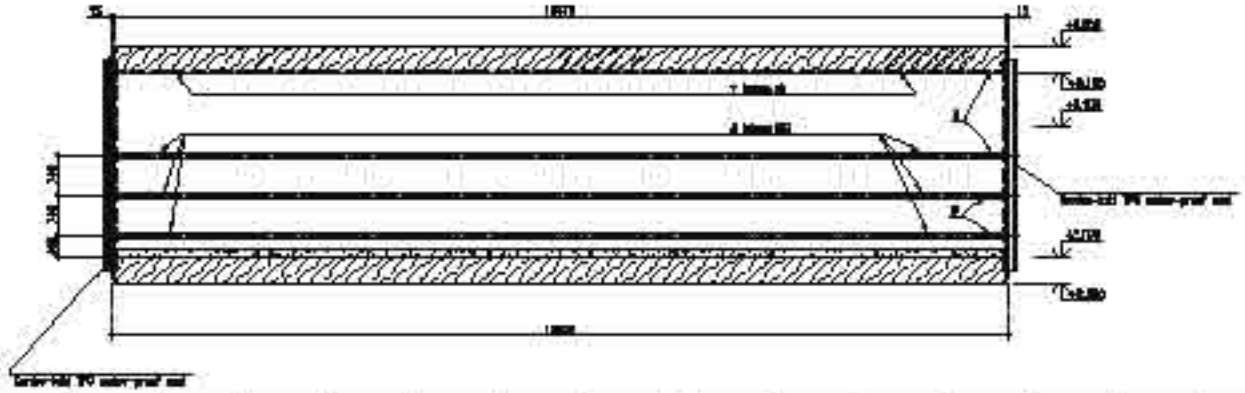


5-5





3-3



1. For the general guidelines see sheet 1.
2. For the legend see sheet 1.
3. For list of sheet incorporation, see sheet 1.
4. For specifications see sheet 2.

NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

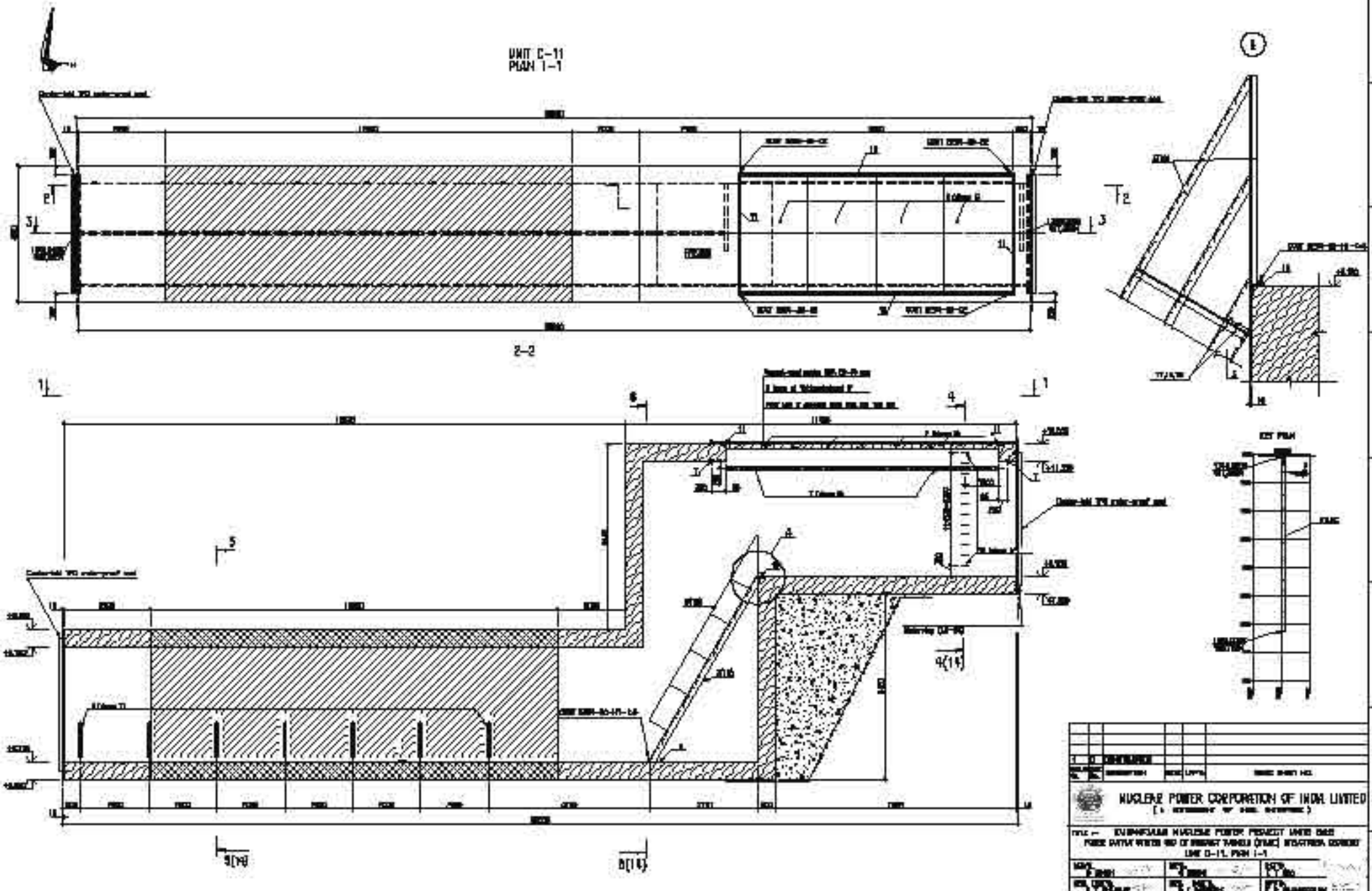
KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6
POWER OUTPUT SYSTEM 500 CF INTAKE TUNNELS (STUAC) STRUCTURES, GEOMETRY
UNIT C-10

KUDANKULAM NUCLEAR POWER PROJECT 5&6

0

POWER OUTPUT SYSTEM 400 KV BUSDUCT TUNNELS (BTUNC) STRUCTURES, GEOMETRY

UNIT C-11
PLAN 1-1



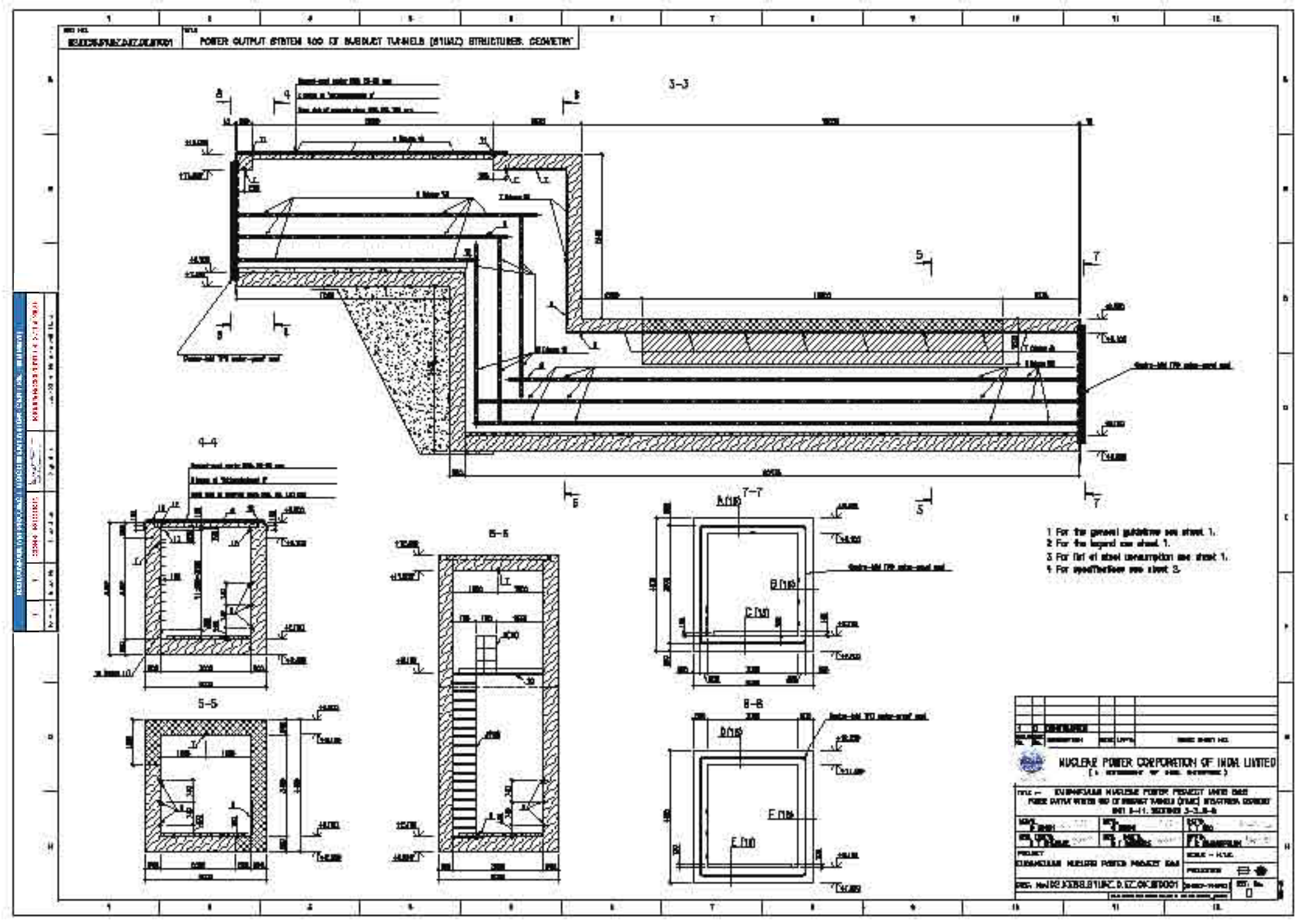
1. For the general guidelines see sheet 1.
2. For the legend see sheet 1.
3. For list of steel consumption see sheet 1.
4. For specification see sheet 15.
5. For details of roof water drain see note no.11 of general guidelines.

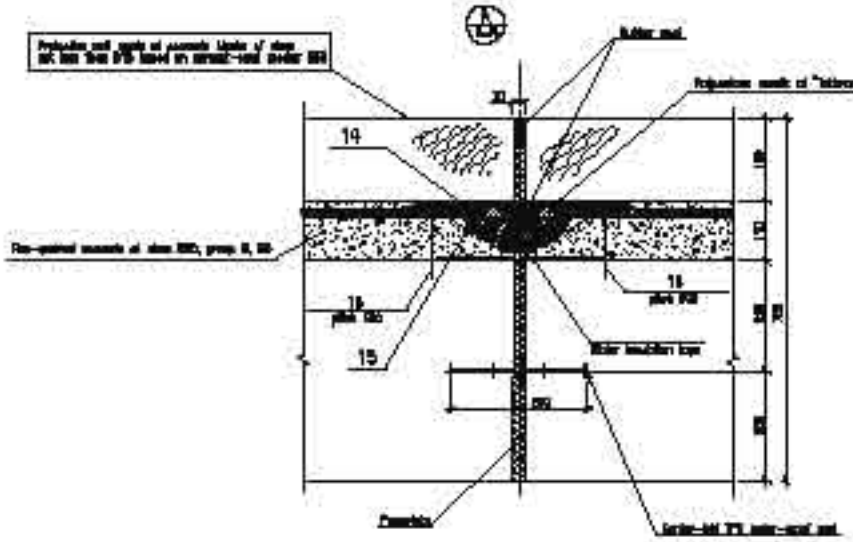
NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

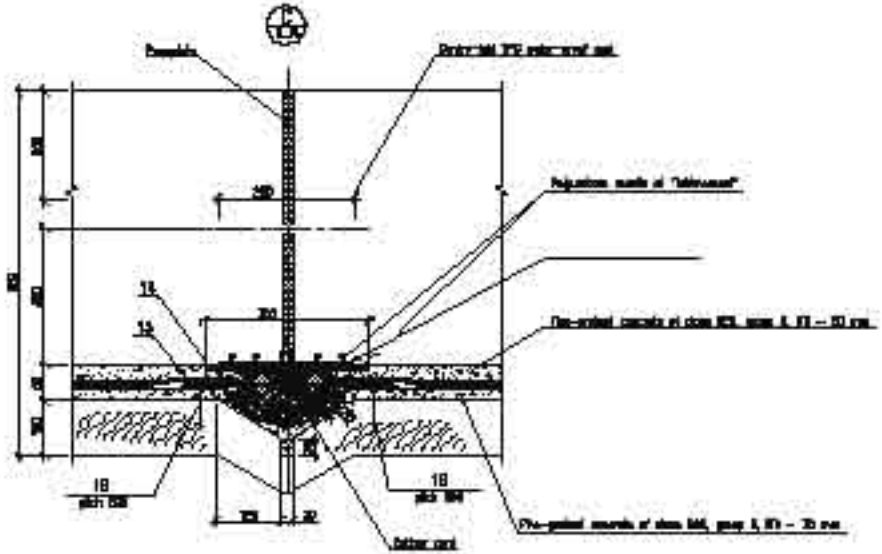
KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6
POWER OUTPUT SYSTEM 400 KV BUSDUCT TUNNELS (BTUNC) STRUCTURES, GEOMETRY
UNIT C-11, PLAN 1-1

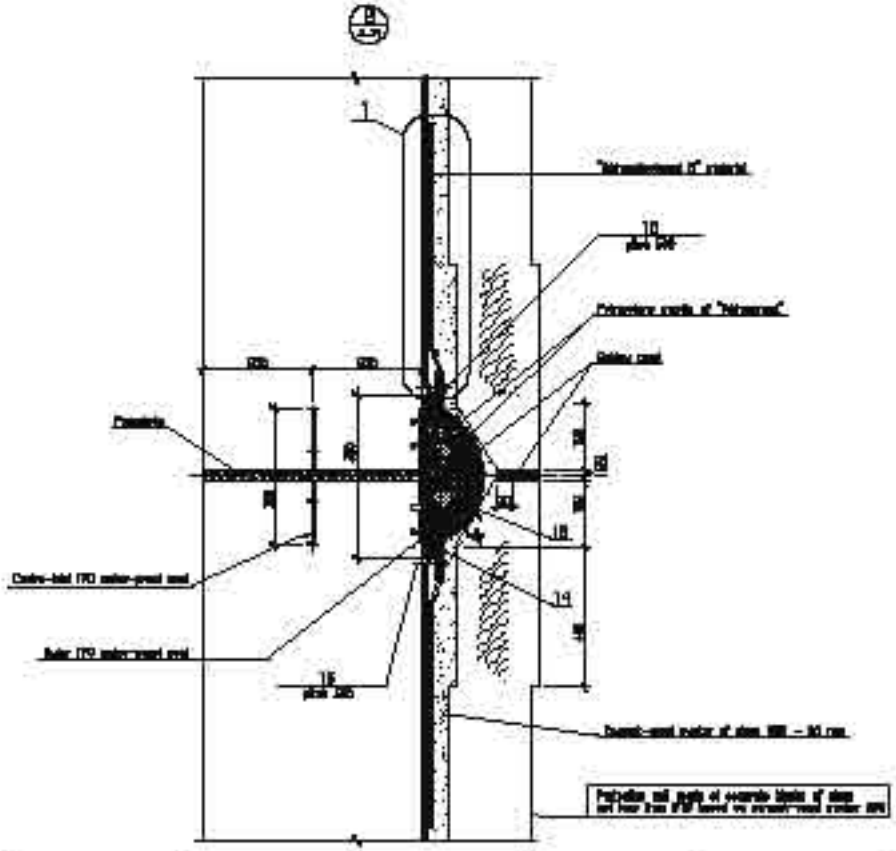
KUDANKULAM NUCLEAR POWER PROJECT 5&6

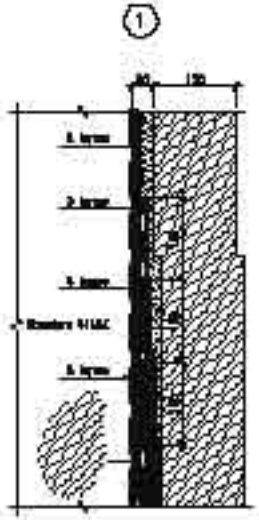
0


3-3
4-4
5-5
6-6
7-7
8-8
1 For the general guidelines see sheet 1.
2 For the legend see sheet 1.
3 For list of steel consumption see sheet 1.
4 For specification see sheet 3.
NUCLEAR POWER CORPORATION OF INDIA LIMITED



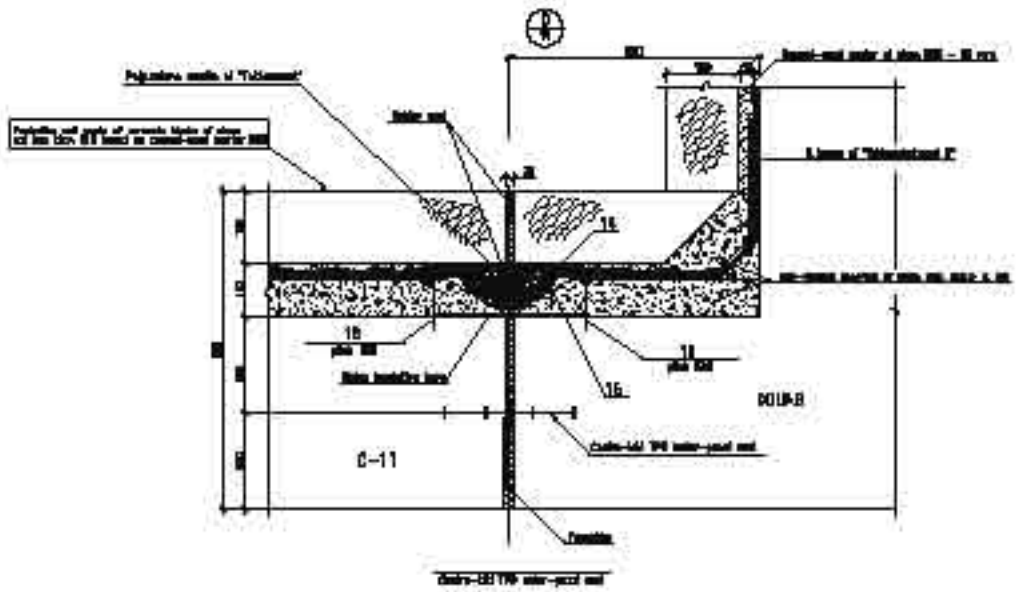


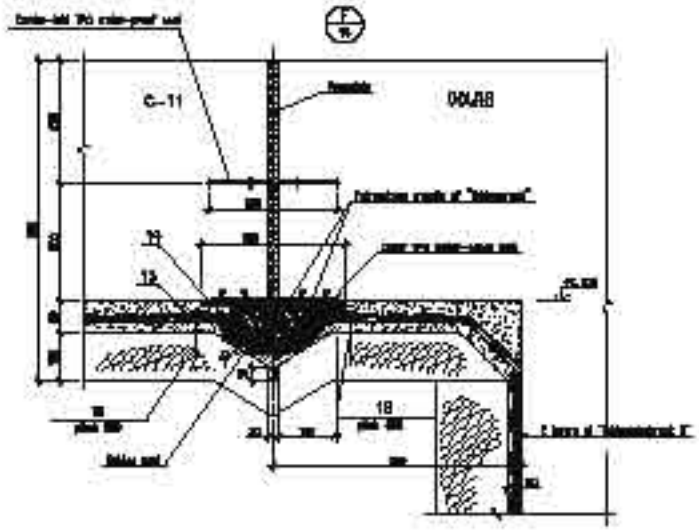


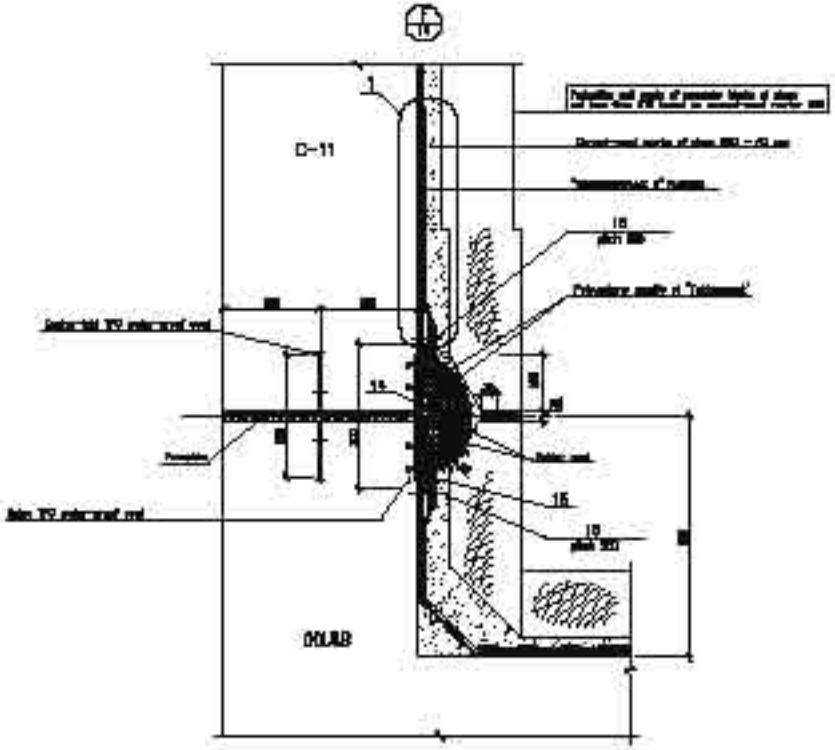


NUCLEAR POWER CORPORATION OF INDIA LIMITED

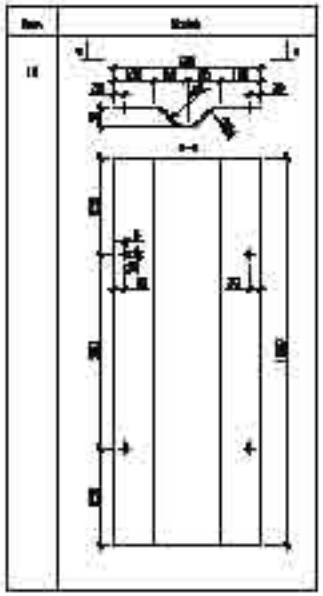
POWER OUTPUT SYSTEM 500 CF INDUCT TUNNELS (01UAZ) STRUCTURES, GEOMETRY

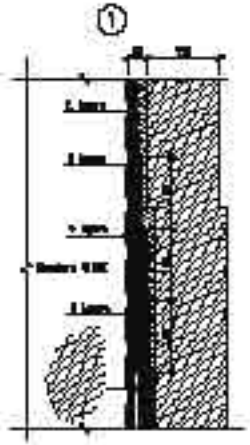






LIST OF PARTS





1. For the general guidelines see sheet 1.
2. For the legend see sheet 1.
3. For list of steel reinforcement see sheet 1.
4. For specifications see sheet 2.

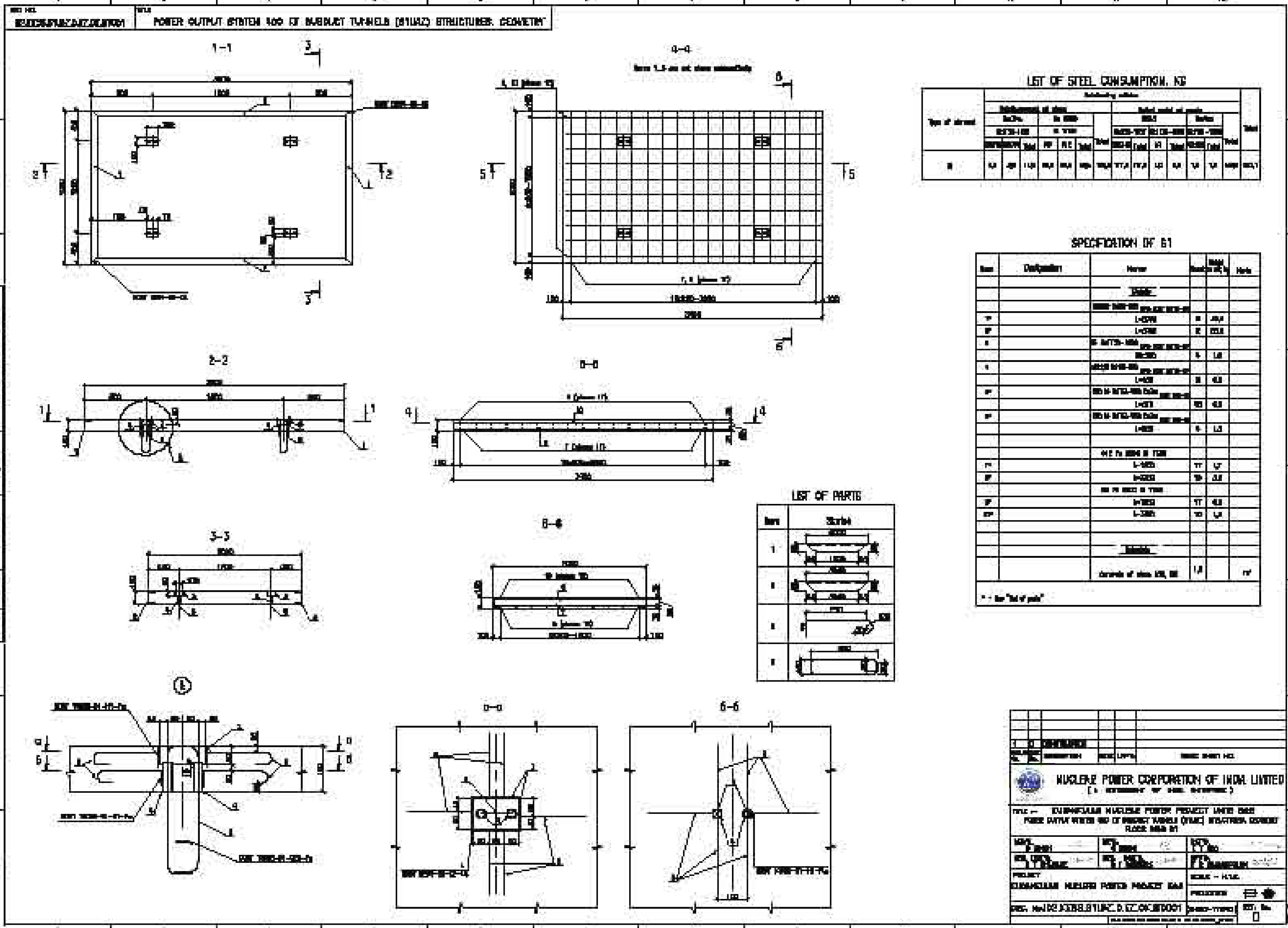
NUCLEAR POWER CORPORATION OF INDIA LIMITED

KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6

POWER OUTPUT SYSTEM 500 CF INDUCT TUNNELS (01UAZ) STRUCTURES, GEOMETRY

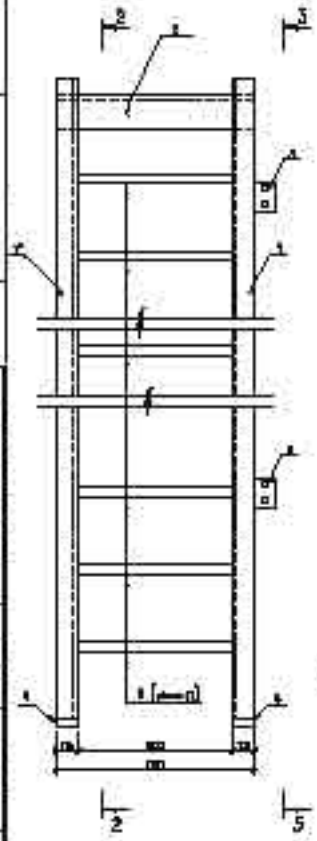
DETAILS A, C, F

KUDANKULAM NUCLEAR POWER PROJECT 5&6

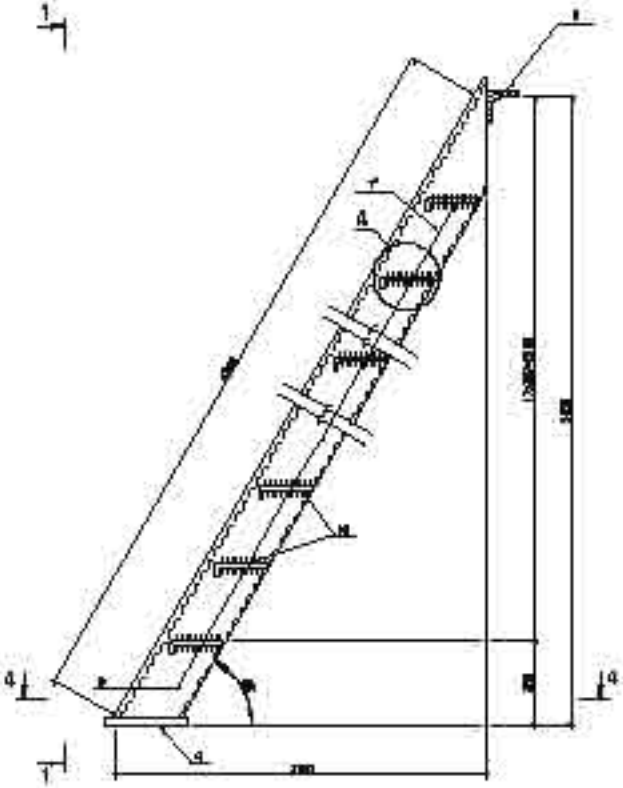

POWER OUTPUT SYSTEM 100 OF SUBJECT TUNNELS (B1UAZ) STRUCTURES. GEOMETRY
1-1
2-2
3-3
4-4
5-5
6-6
LIST OF STEEL CONSUMPTION, KG
SPECIFICATION OF E1
LIST OF PARTS
NUCLEAR POWER CORPORATION OF INDIA LIMITED
KUDANKULAM NUCLEAR POWER PROJECT

POWER OUTPUT STATION 500 CF BYEPRODUCT TUNNELS (BYTUNL) STRUCTURES, GEOMETRY

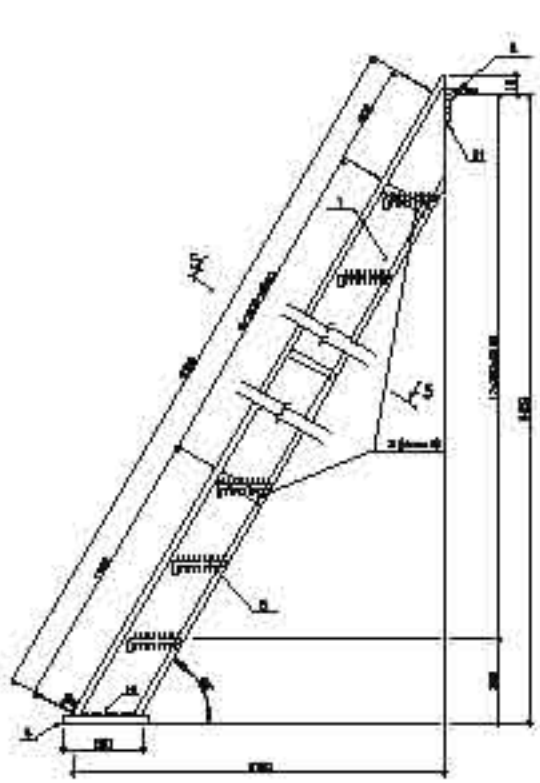
1-1



2-2



3-5



LIST OF STEEL EXPENDITURE, KG

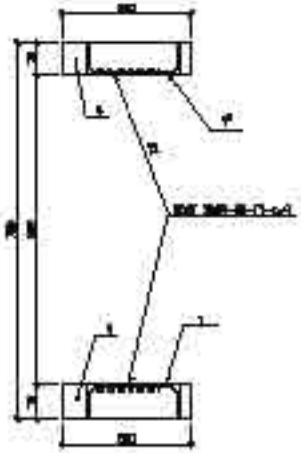
Type of element	Rolled metal of grade							Mass, kg
					Total			
1-1								

SPECIFICATION OF L1

Pos.	Designation	Name		Mass of 1 unit, kg	Note
1					
2					
3*					
4					
5					

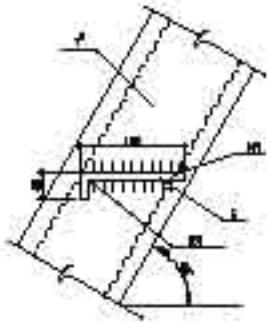
* see "List of parts"

4-4



5-5





LIST OF PARTS

Pos.	Sketch
3	

1	0	CONSTRUCTION			
Alterations No.	No.	Description	Scale	Date	Basic sheet No.

NUCLEAR POWER CORPORATION OF INDIA LIMITED

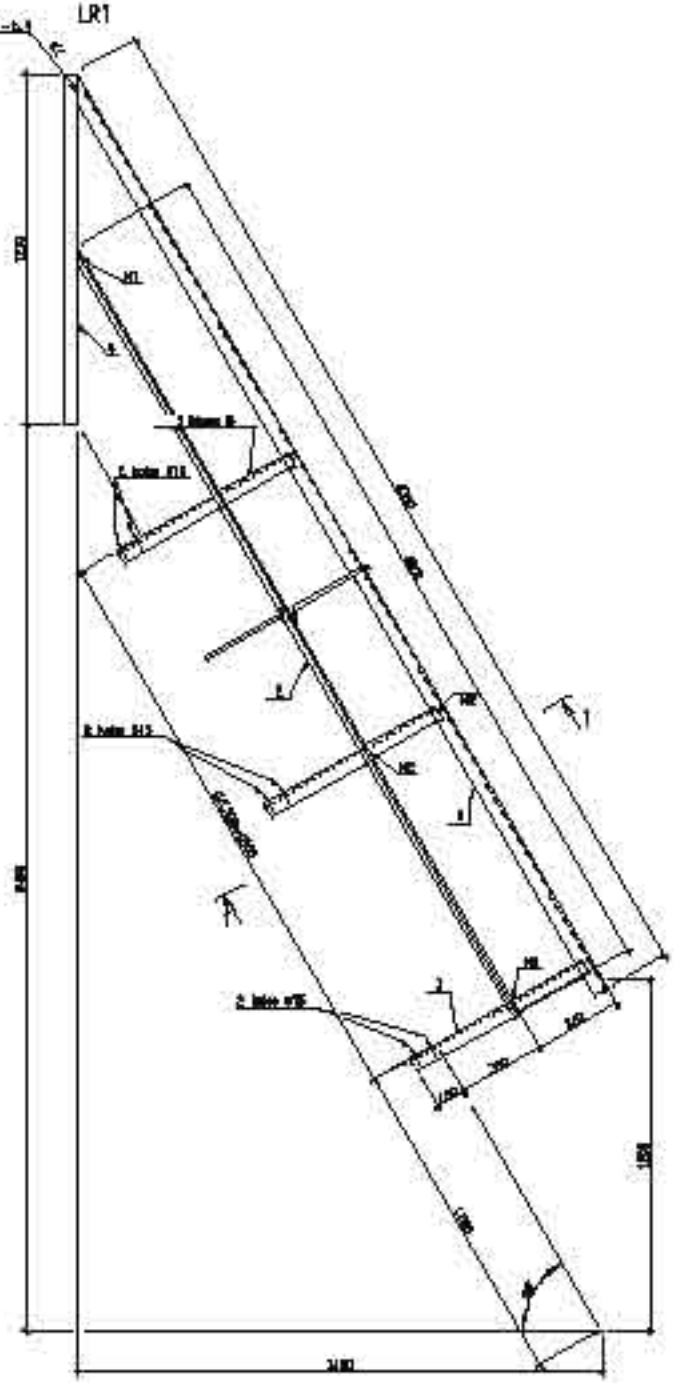
KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6

POWER OUTPUT STATION 500 CF BYEPRODUCT TUNNELS (BYTUNL) STRUCTURES, GEOMETRY LEVEL L1

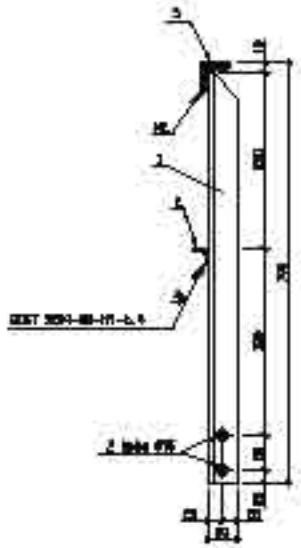
Drawn	Checked	Approved
Engineer	Engineer	Engineer
Project		Scale – 1:100
KUDANKULAM NUCLEAR POWER PROJECT 5&6		Progress
Spec. No.		Sheet No. 0

POWER OUTPUT SYSTEM 500 KV BUSDUCT TUNNELS (BTUAZ) STRUCTURES. GEOMETRY

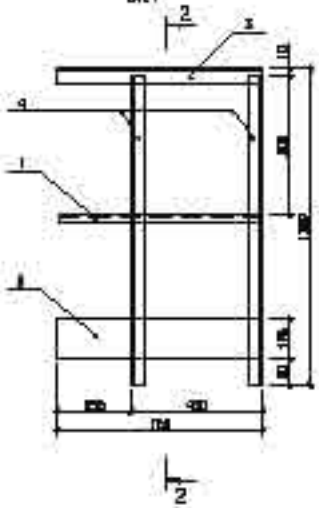
LR1



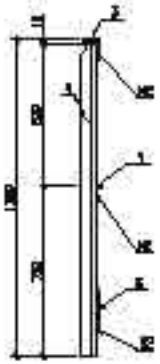
1–1



CR1



2–2



SPECIFICATION OF LR1, CR1

Pos.	Designation	Name	Q-ty LR1	CR1		Add.	Mass of one unit, kg	Note
		Details						
1		L-100	–	1		1	3,8	
2		L-4700	1	–		1	6,3	
3		L-400	5	1		6	3,8	
4		L-800	1	2		3	6,3	
5		L=4200	1	–		1	113,9	
8								
			–	1		1	5,7	

LIST OF STEEL EXPENDITURE, KG

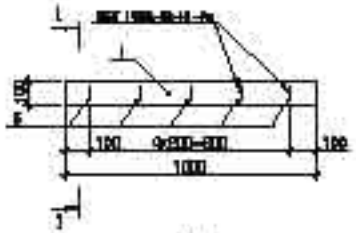
Type of element	Rolled steel: Rolled metal of mark: ВСт3пс2 ГОСТ 380-2005		Rolled steel: Rolled metal of mark: 09Г2С-12 ГОСТ 19281-2014		Total
	No. of units	Total	No. of units	Total	
LR1	33,4	33,4	–	–	97,4
CR1	18,2	18,2	8,7	4,7	113,9

NUCLEAR POWER CORPORATION OF INDIA LIMITED

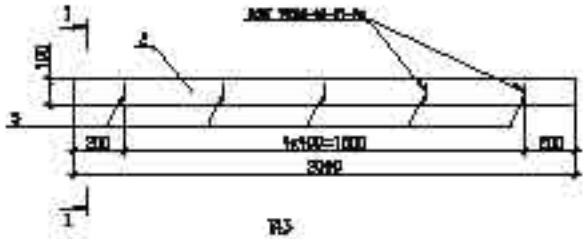
EGYPTIAN NUCLEAR POWER PROJECT EAB

POWER OUTPUT STATION 400 KV BASEDUCT TUNNELS (BTUAZ) STRUCTURES. GEOMETRY

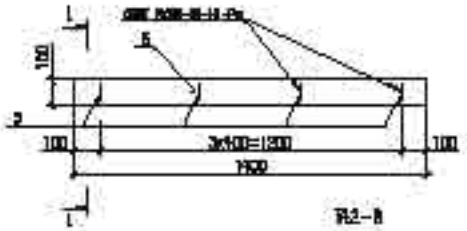
TA1



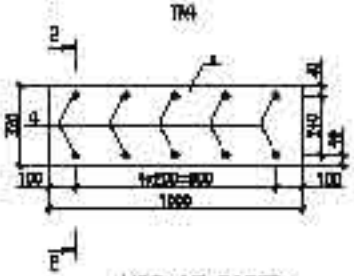
TA2



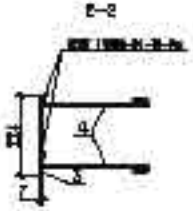
TA2-A



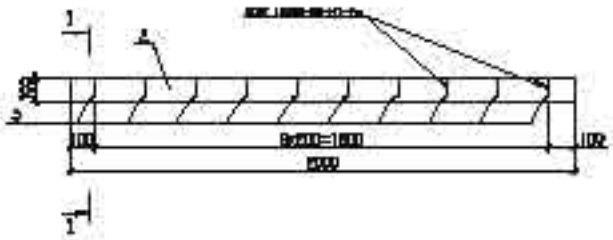
TA4



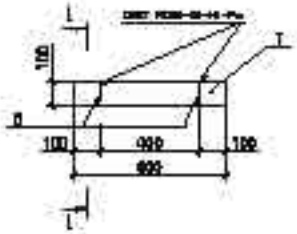
E-2



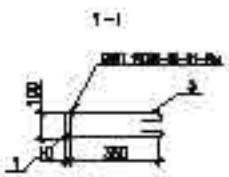
TA3



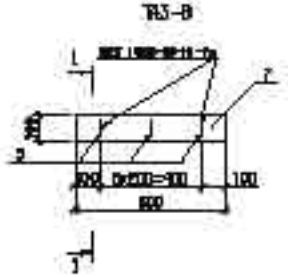
TA2-B



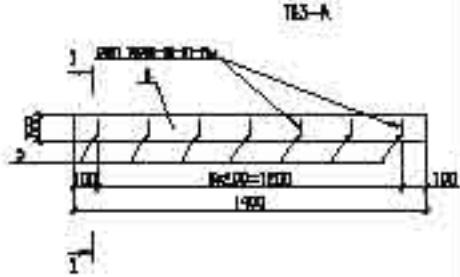
1-1



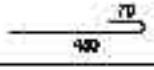
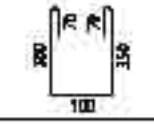
TA3-B



TA3-A



LIST OF PARTS

Pos.	Sketch
4	
5	

SPECIFICATION OF EMBEDDED PARTS TA1, TA2, TA3, TA4,TA1D-1,TA2-A,TA2-B,TA3-A & TA3-B.

Pos.	Designation	Name	Q-ty TA1	TA2	TA3	TA4	TA2-A	TA2-B	TA3-A	TA3-B	Total	Mass kg	Note
		TU St 61/52-1993 Code: GOST 535-88											
1		100x1000	1	–	–	–	–	–	–	–	1	7,8	
2		100x1900	–	1	1	–	–	–	–	–	2	18,8	
3		350x1900	–	–	–	1	–	–	–	–	1	35,1	
6		100x1400	–	–	–	–	1	–	1	–	2	10,9	
7		100x600	–	–	–	–	–	1	–	1	2	4,7	
		Rod Al St 5T-1988 Code: GOST 535-88											
11		L=320	–	–	–	19	4	–	7	–	21	1,3	
04		L=910	6	8	10	–	–	8	–	5	28	5,4	

4 – See "List of parts"

LIST OF STEEL EXPENDITURE, KG

Type of element	Reinforcing articles: Reinforcement of deformed metal of grade GOST 535-88					Total
TA1	12,0		12,0	7,8	7,8	19,8
TA2	15,0		15,0	15,8	15,8	27,8
TA3	20,0		20,0	15,8	15,8	35,8
TA4	13,0		13,0	22,1	22,1	35,1
TA2-A	6,8		6,8	10,8	10,8	17,7
TA2-B	4,8		4,8	4,7	4,7	9,5
TA3-A	0,1		0,1	10,0	10,0	10,0
TA3-B	7,2		7,2	4,7	4,7	11,8

1 For the general guidelines see sheet 1.
2 Welding has to be made with a continuous weld joint.
3 Electrodes for welding steel low of E-42 type as per GOST 9467-75.
4 The installation, corrosion protection, quality control, acceptance and installation of the embedded parts in the designed position shall be carried out as per the requirements of ORGRESS.RU.ELECTRONSTAL "Technical requirements for plate elements and reinforced concrete structures of buildings and constructions " and SNiP 3.03.01-87 " Bearing and enclosing structures ".
5 All welds shall be checked in compliance with GOST 23118-99 "Steel building structures. General specifications" – visual examination – 100 %.

NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6

POWER OUTPUT STATION 400 KV BASEDUCT TUNNELS (BTUAZ) STRUCTURES. GEOMETRY
EMBEDDED PARTS TA1, TA2, TA3, TA4, TA1D-1, TA2-A, TA2-B, TA3-A, TA3-B and TA5-B.

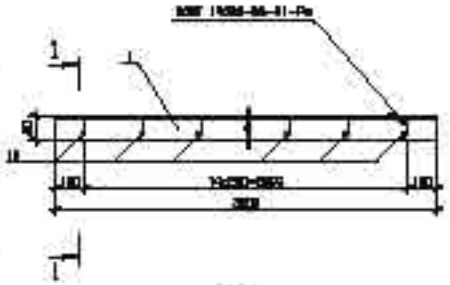
PROJECT: KUDANKULAM NUCLEAR POWER PROJECT 5&6

SCALE – NONE

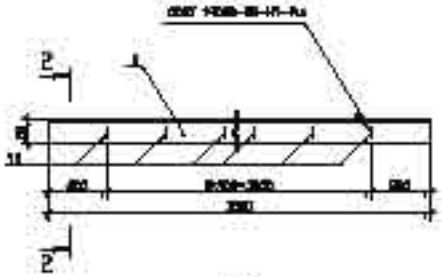
DRG. No. 0

POWER OUTPUT STATION 500 MT BASEDUCT TUNNELS (BTUAZ) STRUCTURES. GEOMETRY

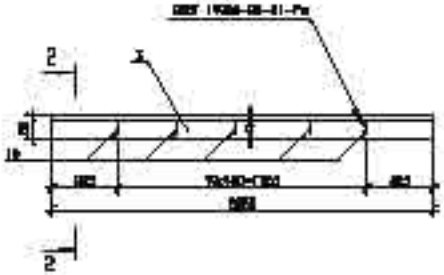
TA5



TA6



TA7



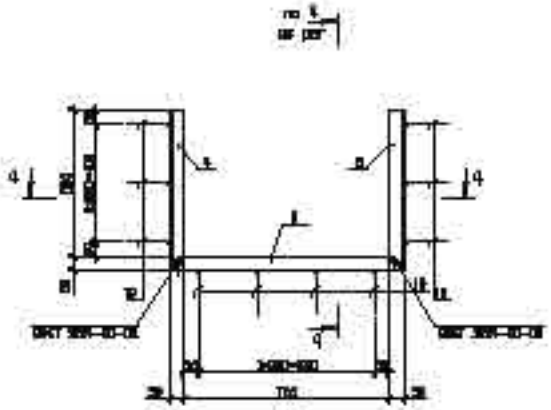
1–1



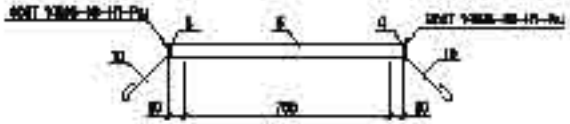
2–2



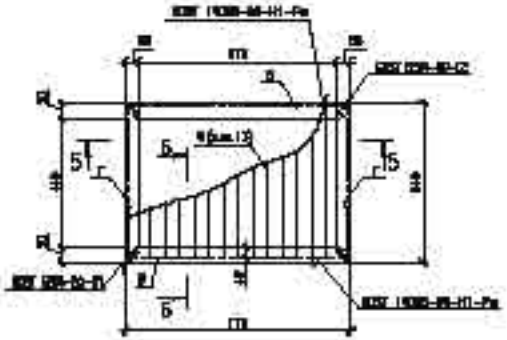
TA8



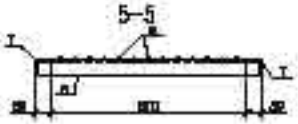
4–4



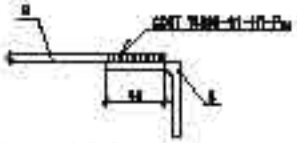
TA9



5–5



6–6

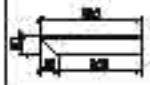
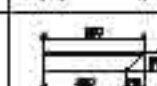
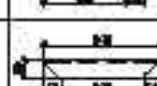
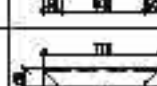
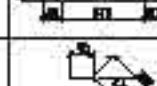


SPECIFICATION OF EMBEDDED PART TA5, TA6, TA7

Item	Designation	Name	Quant. TA5	TA6	TA7	TA8	TA9	Total	Mass of 1 unit, kg	Note
		[illegible]								
		[illegible]								
1		L=3080	1					1	21.8	
		[illegible]								
2		L=3080		1				1	19.4	
3		L=4080			1			1	26.7	
4*		L=450				1		1	2.8	
5*		L=800				1		1	3.5	
6*		L=850				1		1	2.8	
7*		L=914					8	8	4.5	
8*		L=770					8	8	4.0	
		[illegible]								
9		L=825				12	12	0.3		
10*		L=900	15	8	85	18		96	0.3	

* – See "List of parts"

LIST OF PARTS

Item	Sketch
4	
5	
6	
7	
8	
10	

LIST OF STEEL CONSUMPTION, KG

Type of element	Reinforcing articles						
	Reinforcement of class [illegible]			Rolled metal of grade [illegible]			
	[illegible]		Total	[illegible]		Total	Total
TA5	9.5		9.5	21.8	–	21.8	33.5
TA6	8.7		8.7	–	19.4	19.4	28.1
TA7	6.8		6.8	–	26.7	26.7	33.7
TA8	4.8		2.8	–	4.8	11.8	16.6
TA9	2.8		2.8	–	15.0	15.0	17.8

1. For the general guidelines see sheet 1.
2. Welding has to be made with a continuous weld joint.
3. Dimensions not shown here are as in A-A type in per sheet [illegible].
4. For fabrication, corrosion protection, safety control, acceptance and installation of the embedded parts in the shipyard position and to comply with as per the requirements of [illegible] "Technical requirements for plate materials and rolled-out materials structures of buildings and constructions" and [illegible] "Welding and connection of metals".
5. All cables shall be cleaned in acceptance with [illegible].
– rivet connection – 100 %

NUCLEAR POWER CORPORATION OF INDIA LIMITED

KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6

POWER OUTPUT STATION 500 MT BASEDUCT TUNNELS (BTUAZ) STRUCTURES. GEOMETRY

EMBEDDED PART TA5, TA6, TA7, TA8, TA9

KUDANKULAM NUCLEAR POWER PROJECT 5&6

SCALE – 1:10

0

DWG. NO.	TITLE
[illegible]	POWER OUTPUT SYSTEM 400 KV BUSDUCT TUNNELS (3&4UAC,3&4UAC,3&4UAC) STRUCTURES GEODETIC

LIST OF WORKING DRAWINGS OF THE MAIN SET

Sheet	Name	Note
1	General data	
4	Specification of plan of units C-1, C-2	
3	Unit C-1	
4	Unit C-2. Plan 1-1. Sections 2-2...3-3	
5	Unit C-2. Sections 5-5...6-6	
6	Details A, B, C	
7	Embedded parts [illegible]	

LIST OF SPECIFICATIONS

Sheet	Name	Note
2	Specification of plan of units C-1, C-2	
7	Specification of embedded parts [illegible]	

LIST OF STEEL CONSUMPTION, KG

Type of element	Embedded parts								Total
	Reinforcement of class [illegible]				Rolled metal of grade [illegible]				
	[illegible]				[illegible]				
	[illegible]	[illegible]	[illegible]	Total	[illegible]	[illegible]	Total		
C-1	–	–	[illegible]	[illegible]	–	[illegible]	[illegible]		[illegible]
C-2	[illegible]	–	[illegible]	[illegible]	–	[illegible]	[illegible]		[illegible]

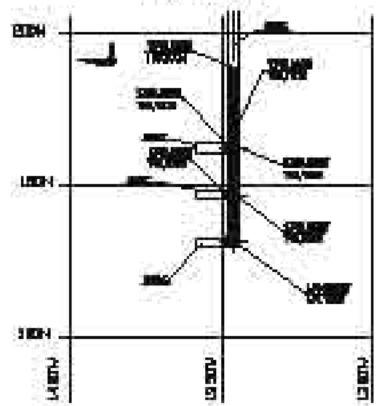
LEGEND

- Concrete, class [illegible]
- Concrete, class [illegible]
- Backfilling [illegible] (see general guidelines item 11, sheet 1)
- Backfilling [illegible] (see general guidelines item 11, sheet 1)

LIST OF VOLUMES OF MAIN CIVIL WORKS

Name		Scale	Quantity	Note
Concrete bed made of concrete of class [illegible]	m^3	–	87,0	
Fine-aggregate concrete of class [illegible]	m^3	–	[illegible]	
Cast-in-place reinforced concrete of class [illegible]	m^3	–	[illegible]	
Surface waterproofer – [illegible]	m^2	–	[illegible]	
Cement-sand mortar [illegible]	m^3	–	30,0	
Concrete blocks of class not less than [illegible]	m^3	–	130,0	
Centre-fold [illegible] water-proof seal	m	–	50,0	
Fibreplate.	m^2	–	[illegible]	
Outer [illegible] water-proof seal	m	–	60,0	
Galvanized steel, thickness 2 mm,	kg	–	420,0	
Figured metal components,	kg	–	[illegible]	
Rubber cord [illegible] mm.	m	–	180,0	
Water insulation tape	m	–	[illegible]	
Universal screw [illegible]	pc.	–	[illegible]	
Polyurethane sealant of "[illegible]",	m^3	–	[illegible]	
Polyethylene film,	m^2	–	[illegible]	
[illegible]	m^2	–	[illegible]	

KEY PLAN



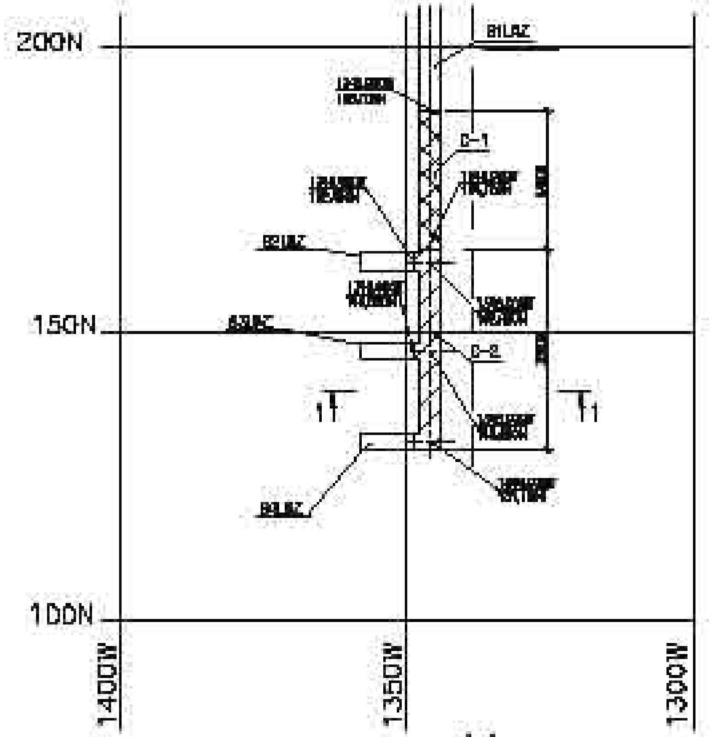
GENERAL GUIDELINES

1 The present set contains the working drawings designed for power output system 400 kV busduct tunnels [illegible].
2 The elevations of the structures are given with respect to the [illegible].
3 Groundwater level is assumed equal to [illegible].
4 Concrete, concrete structures and reinforced concrete structures shall meet the requirements of [illegible] "Technical requirements to performing the concrete and reinforced concrete structures of buildings and constructions".
5 The cast-in-place structures shall be made of concrete having compressive strength [illegible] and [illegible] not less than [illegible] as per [illegible] "High-density concrete".
6 Concrete mix shall be selected by [illegible], with regard to its [illegible], and have the minimum water-cement ratio for this class of concrete.
7 Addition to the concrete composition of calcium chloride, sodium chloride, or other salts causing corrosion of the reinforcement and embedded parts is prohibited.
8 Non-vibrated spots, [illegible], voids and cracks in the concrete of the structures are inadmissible. The spots with them shall be repaired in accordance with the repair and [illegible] documentation.
9 When placing concrete of class [illegible] to the bottom of the tunnels with [illegible] slope for the means of drainage water discharge, [illegible] of the [illegible] is to be provided. Concrete floor surface shall not have [illegible] and [illegible] that [illegible] the water discharge. Class of the [illegible] of the concrete surfaces is [illegible] ([illegible] "Corrosion protection of the structures and buildings").
10 Thoroughness of the waterproofing is to be provided when executing works. Waterproofing shall be carried out and checked as per [illegible] "Technical requirements to waterproofing of the underground parts of buildings and structures".
11 Backfilling [illegible] is to be placed after [illegible] of construction [illegible] supports.
12 Work execution and acceptance shall be carried out in compliance with [illegible] "Technical requirements to performing the concrete and reinforced concrete structures of building and constructions", [illegible] "Bearing and enclosing structures", [illegible] "Technical requirements to performing the reinforcement bars anchorage in the concrete structures and observing the safety engineering regulations.
13 Backfilling of excavation [illegible] is to be done after [illegible] of the floor [illegible] and the concrete of the structures gains [illegible] design strength.
14 Backfill is to be made of [illegible] with [illegible] density of not less than [illegible], size of coarse aggregate of the [illegible] shall be not more than [illegible] mm, size of fine aggregate – not less than [illegible] mm.

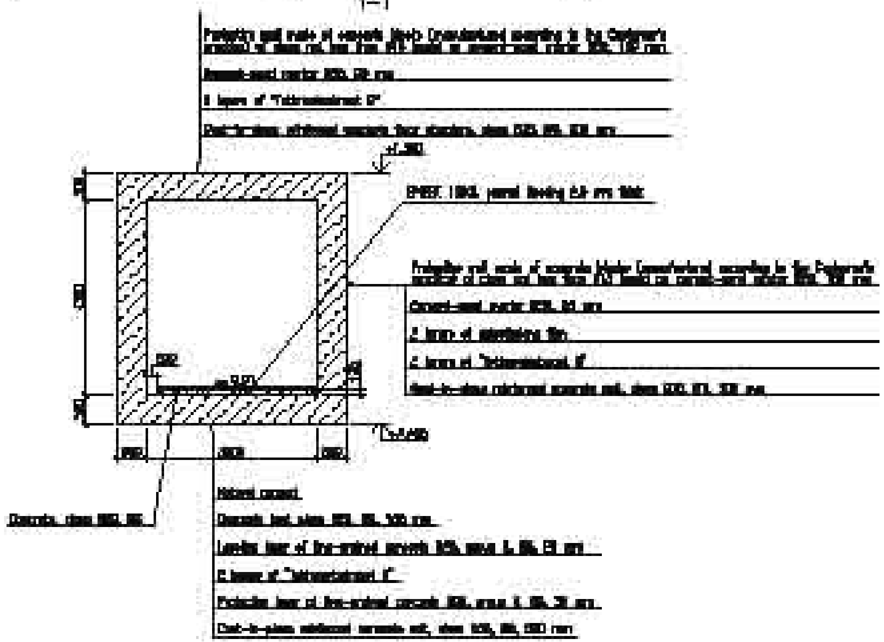
NUCLEAR POWER CORPORATION OF INDIA LIMITED	(A GOVERNMENT OF INDIA ENTERPRISE)
TITLE –	KUDANKULAM NUCLEAR POWER PROJECT UNITS 3&4 POWER OUTPUT SYSTEM 400 KV BUSDUCT TUNNELS [illegible] STRUCTURES GEODETIC GENERAL DATA
PROJECT	KUDANKULAM NUCLEAR POWER PROJECT 3&4
SCALE – N.T.S.	
DRG. No.	[illegible]
REV. No.	0

POWER OUTPUT SYSTEM 400 KV BUSDUCT TUNNELS (B0UPC, B3UBC, B4UAC) STRUCTURES DESIGN

PLAN OF UNITS C-1, C-2



1-1



LIST OF PARTS

Item	Sketch
14	

SPECIFICATION OF PLAN OF UNITS C-1, C-2

Item	Designation	Name	Quant. per unit C-1	C-2		All	Mass unit, kg	Note
		[illegible]						
2	steel T	[illegible]	—	13		14	[illegible]	
3	steel T	[illegible]	16	16		31	87,8	
4	steel T	[illegible]	[illegible]	[illegible]		113	[illegible]	
10	steel T	[illegible]	—	3		3	7,1	
		[illegible]						
		[illegible]						
14*		L=[illegible]	—	[illegible]		[illegible]	5,8	
15		[illegible]	18	[illegible]		[illegible]	4,71	
16**		[illegible]	18	[illegible]		[illegible]	7,85	
		[illegible]						
17	"HILTI"	Universal anchor HUS 7,5/[illegible]	[illegible]	180		[illegible]		[illegible]
		[illegible]						
		Concrete of class [illegible]	[illegible]	[illegible]		87,0		[illegible]
		[illegible]	[illegible]	[illegible]		1,6		[illegible]
		[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
		[illegible]	[illegible]	[illegible]		28,0		[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]		1190,0		[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
		[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
		[illegible]	[illegible]	[illegible]		[illegible]		[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]

* See "List of parts"
** See "List of [illegible]" sheet [illegible]

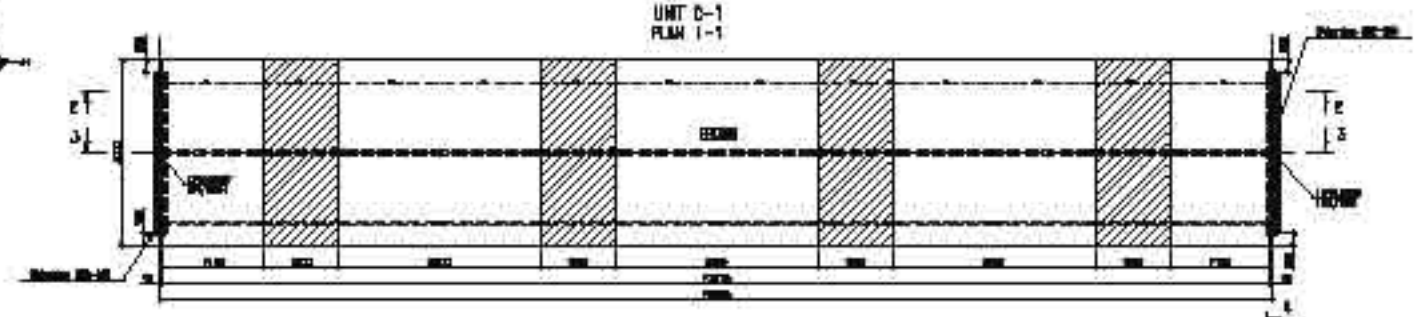
1. For the general guidelines see sheet 1.
2. For the legend see sheet 1.
3. For list of steel consumption see sheet 1.

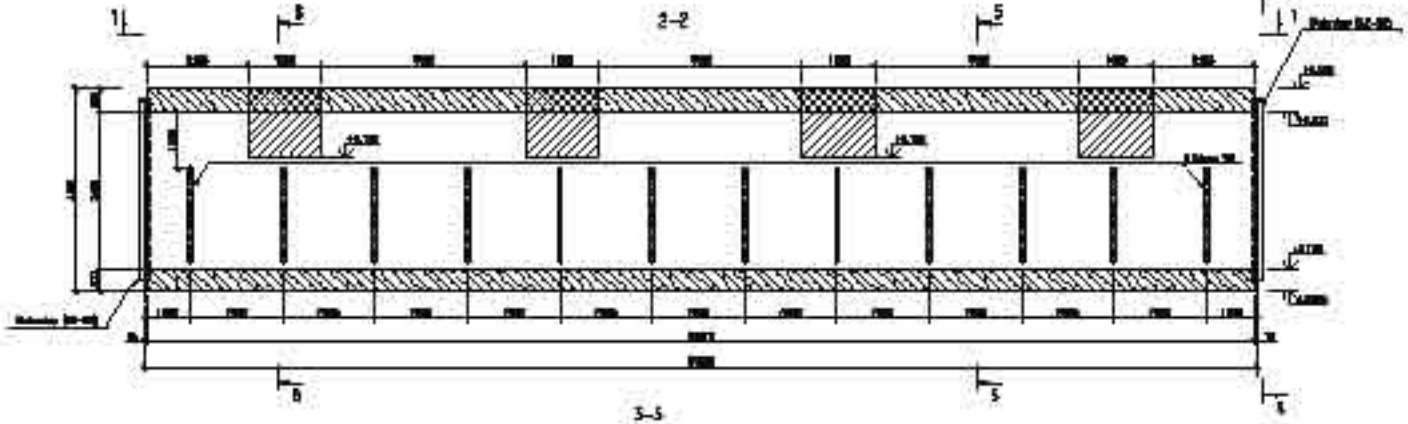
NUCLEAR POWER CORPORATION OF INDIA LIMITED

KUDANKULAM NUCLEAR POWER PROJECT [illegible]

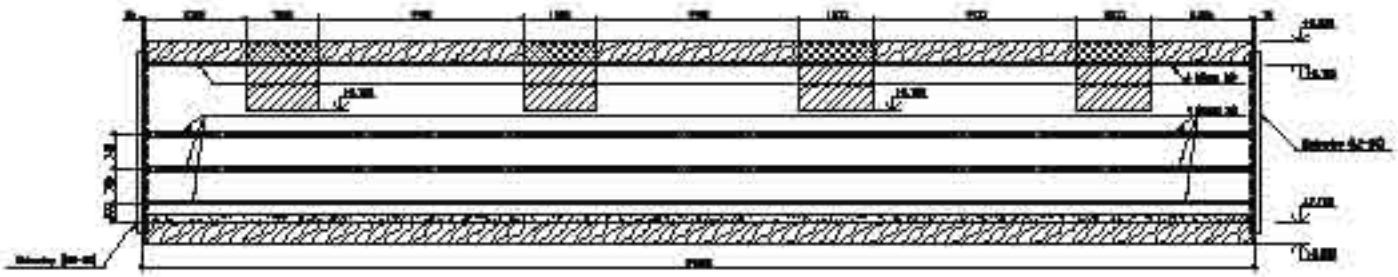
SCALE – N.T.S.

UNIT D-1
PLAN 1-1

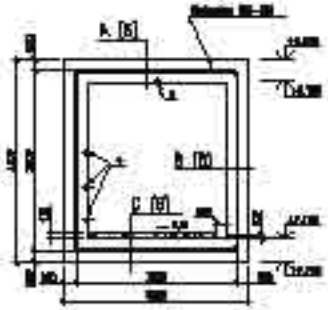




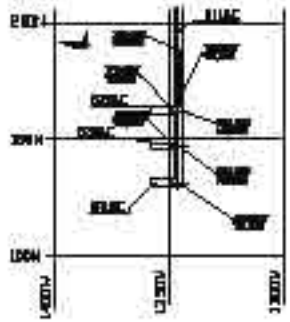
3-3



4-4

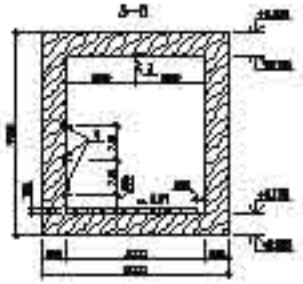


KEY PLAN

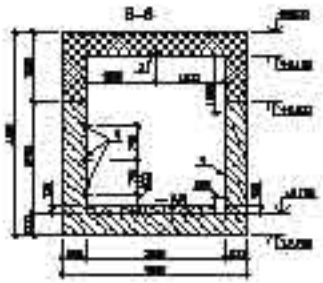


1. For the general guidelines see sheet 1.
2. For the legend see sheet 1.
3. For list of steel consumption see sheet 1.
4. For specifications see sheet 2.

5-5



6-6

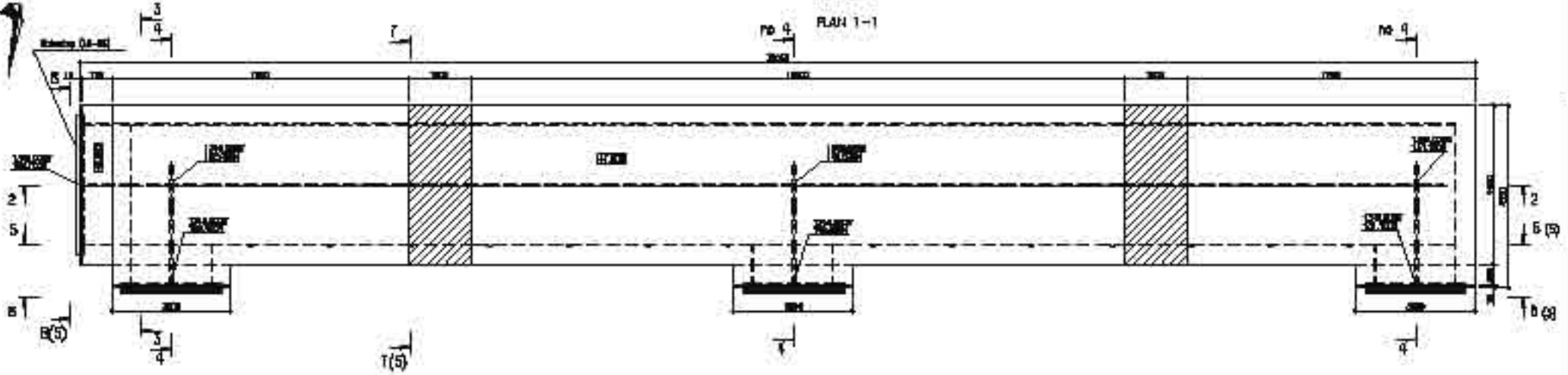


NUCLEAR POWER CORPORATION OF INDIA LIMITED

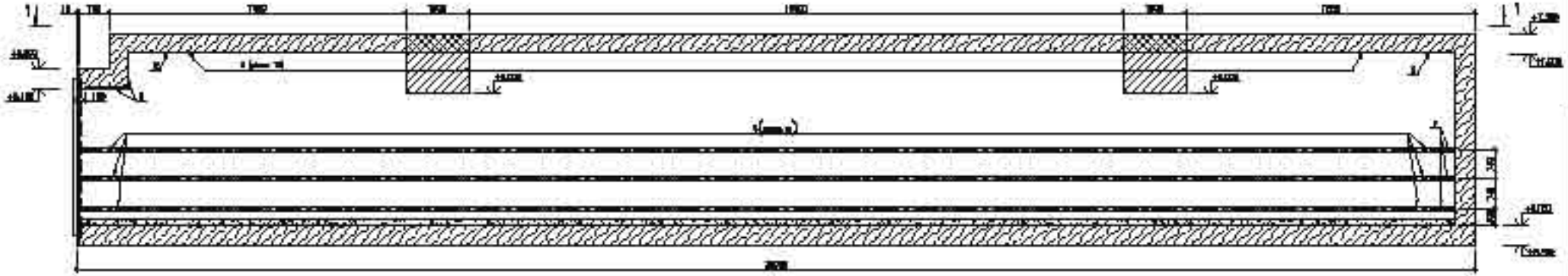
UNIT D-1

UNIT 0-2

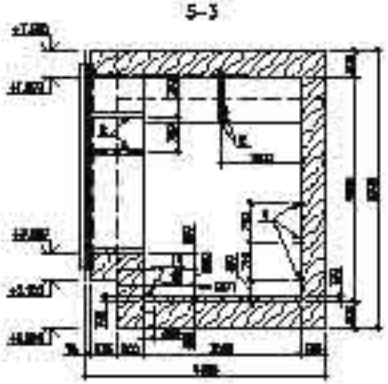
PLAN 1-1



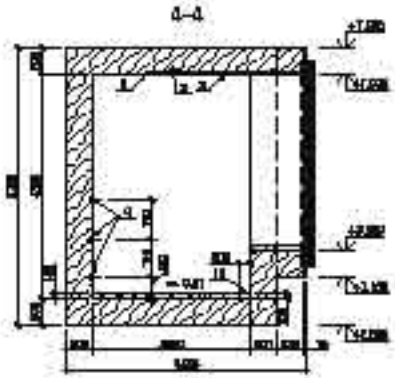
2-2



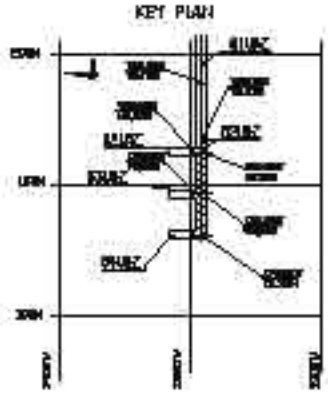
5-5



4-4



KEY PLAN



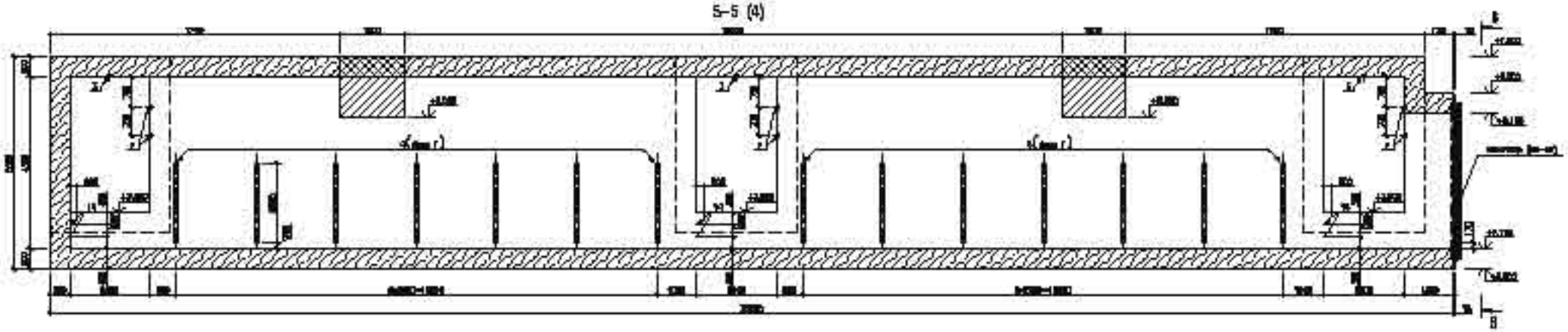
NUCLEAR POWER CORPORATION OF INDIA LIMITED

KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6

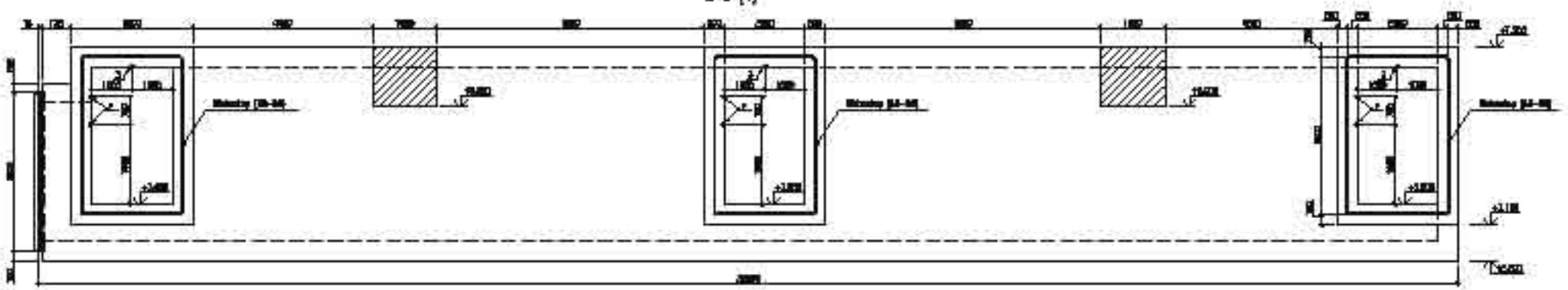
PROJECT KUDANKULAM NUCLEAR POWER PROJECT 5&6

TITLE: POWER OUTPUT SYSTEM 900 MV DUCT TUNNEL (SECTIONS) STRUCTURES GEOMETRY

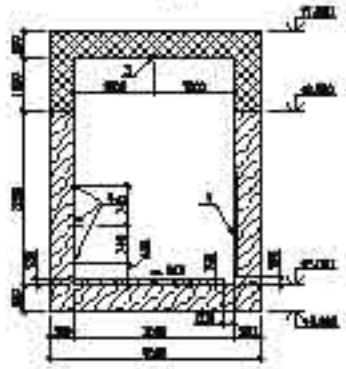
5-5 (4)



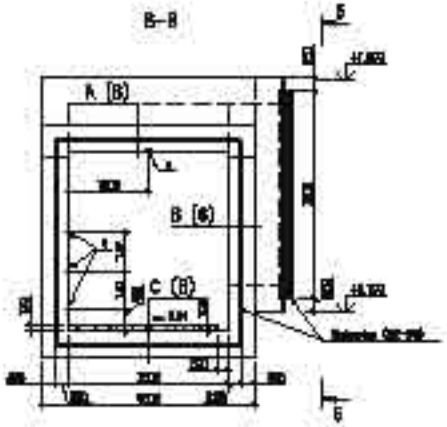
6-6 (4)



7-7 (4)



8-8

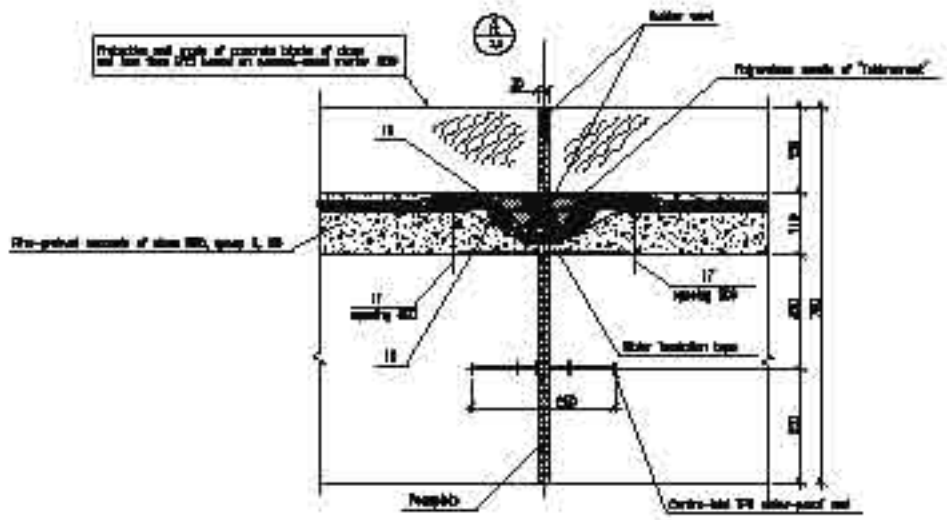


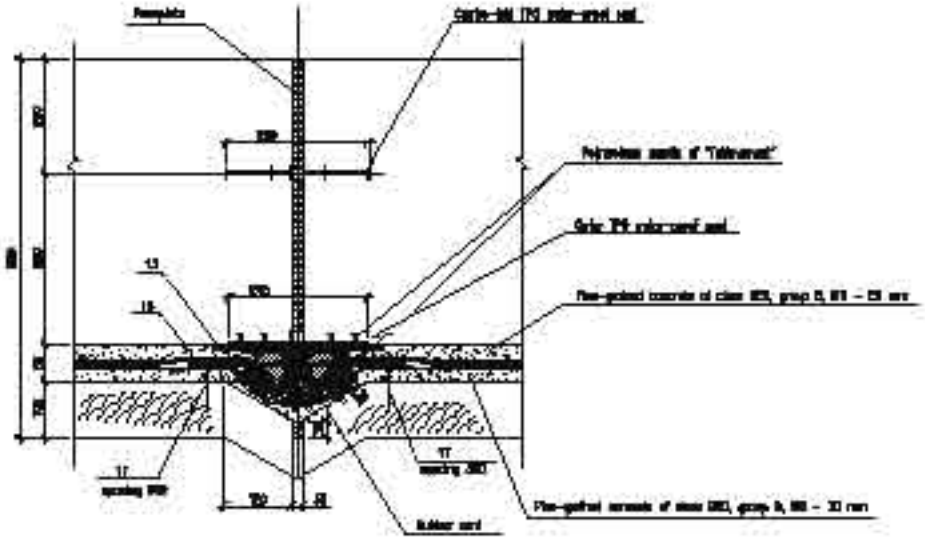
1 For the general guidelines see sheet 1.
2 For the legend see sheet 1.
3 For list of short acronyms see sheet 1.
4 For specifications see sheet 2.

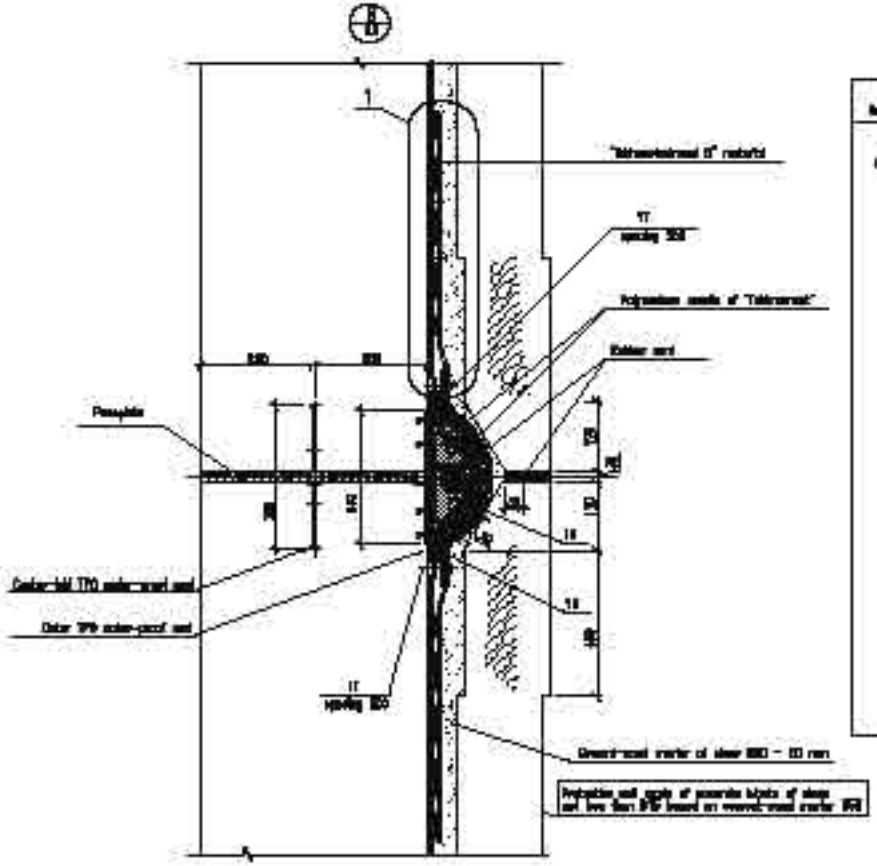
1			
0			
REVISIONS			
DRG. NO.	DESCRIPTION	DRAWN/CHD	BASIC SHEET NO.

NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

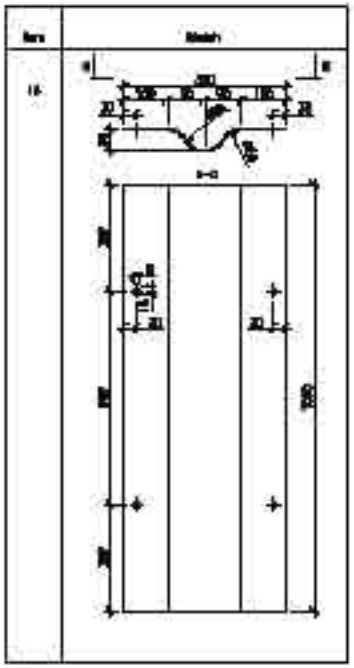
DESIGNED	DRAWN	CHECKED
CHECKED	APPROVED	SUPERVISED
PROJECT		SCALE - NTS
		PROJECTION
DRG. NO.		SHEET NO. / REV. NO.
		D

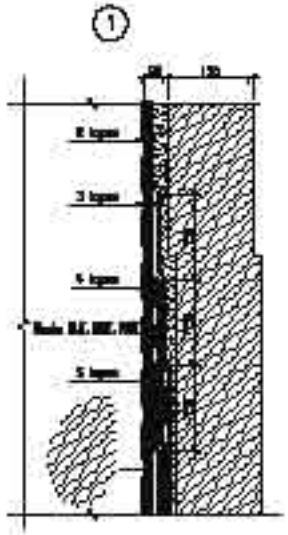






LIST OF PARTS





1. For the general guidelines see sheet 1.
2. For the legend see sheet 1.
3. For list of short nomenclature see sheet 1.
4. For specifications see sheet 2.

NUCLEAR POWER CORPORATION OF INDIA LIMITED

KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6

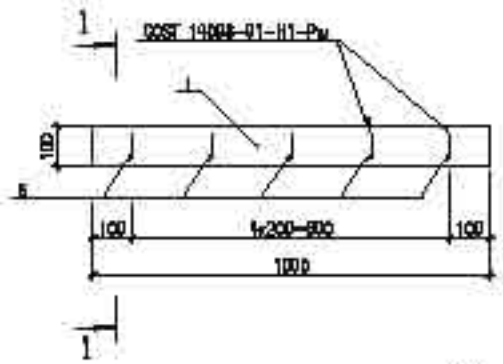
PROJECT: KUDANKULAM NUCLEAR POWER PROJECT 5&6

SPECIFICATION OF EMBEDDED PART TA1, TA2, TA3, MESH C1

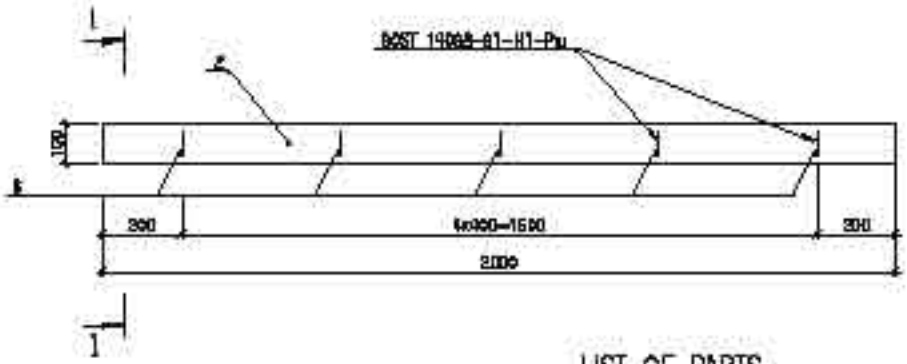
Mark of item	Item	Name	Q-ty	Mass, kg unit, total	Mass of assembly unit, kg
TA1	1	Ø10 GOST 5781-82 / Grade GOST 535-88 100x1000	1	7,8	19,8
	3*	Ø20 GOST 5781-82 / Grade GOST 535-88 L=940	5	2,4	
TA2	2	Ø10 GOST 5781-82 / Grade GOST 535-88 100x2000	1	15,8	27,8
	3*	Ø20 GOST 5781-82 / Grade GOST 535-88 L=940	6	2,4	
TA3	2	Ø10 GOST 5781-82 / Grade GOST 535-88 100x2000	1	15,8	39,6
	3*	Ø20 GOST 5781-82 / Grade GOST 535-88 L=940	10	2,4	
C1	5	Ø20 II GOST 5781-82 / Grade GOST 535-88 L=2000	2	1,2	7,4
	6	Ø20 II GOST 5781-82 / Grade GOST 535-88 L=545	65	0,2	

* See "List of parts"

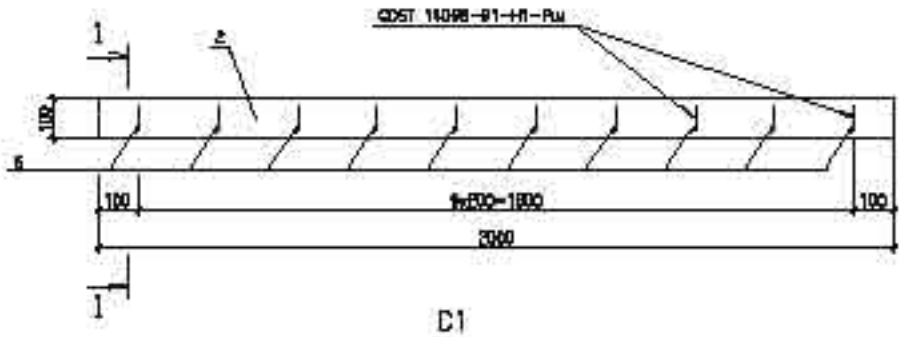
TA1



TA2



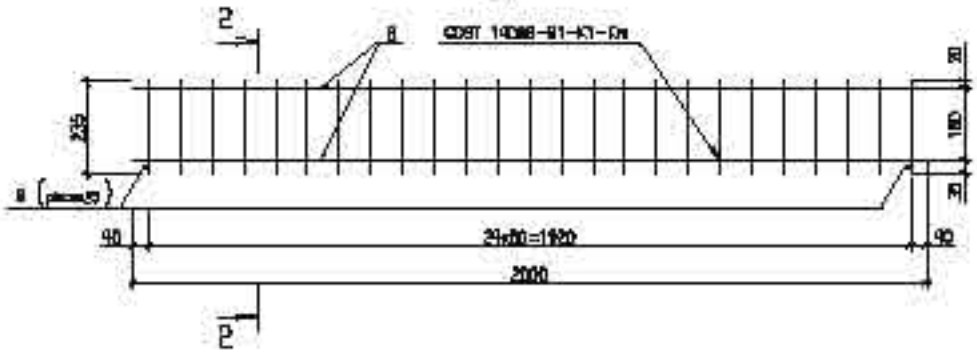
TA3



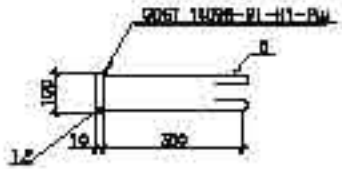
LIST OF PARTS

Item	Sketch
5	350, R 20, 350, 100
7	90, 45°, 45°

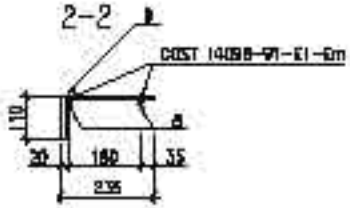
C1



1-1



2-2



1 For the general guidelines see sheet 1.
2 Welding has to be made with a continuous weld joint.
3 Electrodes for welding shall be of E-42 type as per GOST 9467-75.
4 The fabrication, corrosion protection, quality control, acceptance and installation of the embedded parts in the designed position shall be carried out as per the requirements of RB1.KK34.0.0.KZ.TT.BD001 "Technical requirements for plain concrete and reinforced concrete structures of buildings and constructions" and SNiP 3.03.01-87 "Bearing and enclosing structures".
5 All welds shall be checked in compliance with RB1.KK34.0.0.KZ.TT.BD001:
– visual examination – 100 %.

LIST OF STEEL CONSUMPTION, KG

Type of element	Reinforcing articles: Reinforcement of class GOST 535-88 Ø10	Ø20		Total	Rolled metal of grade GOST 535-88 Ø10		Total	Total
TA1	–	12,0		12,0	7,8		7,8	19,8
TA2	–	12,0		12,0	15,8		15,8	27,8
TA3	–	24,0		24,0	15,6		15,6	39,6
C1	7,4	–	–	7,4	–	–	–	7,4

1	0	Development	
Change No.	Sheet No.	Description	Date

NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A GOVERNMENT OF INDIA ENTERPRISE)

KUDANKULAM NUCLEAR POWER PROJECT UNITS 5&6

PROJECT: KUDANKULAM NUCLEAR POWER PROJECT 5&6

RB1.KK34.0.0.KZ.DK.BD001 | Sheet-1of1 | Rev. No. 0

NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A Government of India Enterprise)

2 x 1000 MWe KUDANKULAM NUCLEAR POWER PROJECT UNITS - 5&6

Title: Indicative QAP for 400 kV and 230kV GIS and GIBD

Reference specification: Doc. No. I02.KK56.0.0.ET.TS.PR051 and I02.KK56.0.0.ET.TS.PR053

This document indicates the requirements expected from the contractor / manufacturer of the above equipments, Subsequent to the placement of purchase order contractor / manufacturer shall submit for purchaser's approval, a quality assurance plan in line with this document incorporating specific document numbers for "format of records", "acceptance norms" and "reference documents".

Abbreviations :

		1	NPCIL QS / ENGINEER	TS	Technical Specification
R	Reviewed By	2	Prime Supplier / EPC Contractor	TR	Test Report
				IR	Inspection
				TTR	Report,TTR-Type Test
				MTC	Report
				TC	MTC-Manufacturer Test certificate
					TC- Test Certificate
P	Performed by	3	Main Vendor / Manufacturer QC	PS	Plant Standard
		4	Sub Vendor		
W	Witnessed by (After lapse of due notice to NPCIL, manufacturer may proceed with manufacture)	5	Third Party Lab (NPCIL Approved /NABL Accredited)	CHP	Customer Hold point (Customer is NPCIL)
				IS	Indian Standards
H	Hold	AD	NPCIL Approved Document such as Tender Document - Technical Specifications, Data sheets and Pre-bid & Post bid clarifications from NPCIL, Purchase order, Drawings,Test procedures & Approved Data Sheet.	IEC	International Electro technical commission Standard
				IEEE	Institute of Electronics and Electrical Engineers Standard
				ASTM	Americal Standard for Testing Materials

Notes:

i) Wherever V/R & W are both indicated, NPCIL QS to witness test or review TRs

ii) The mentioned tests need not be repeated if report of test conducted is not more than five-year-old from date of opening of bids and the same shall be reviewed for its acceptance by NPCIL. If it is not acceptable to NPCIL / otherwise, test shall be carried out at no extra cost to NPCIL.

iii) Minor: The characteristic of a component, process or operation whose failure neither materially reduce the usability of the product in operation, nor does it affect the aesthetic aspects.

iv) Major: The characteristic of a component, process or operation whose failure may cause operation failure which cannot be readily corrected at site or cause substandard performance, increased erection and maintenance cost, reduced life or seriously affect aesthetics or ergonomics.

v) Critical: The characteristics of a component, process or operation failure of which will surely cause operating failure or intermittent troubles which is difficult to rectify at site or render the unit unfit for use or safety hazards.

vi) ‘‘Failure ’’ of a characteristic means failure to meet the ‘acceptance norms ‘.

Title: Indicative QAP for 400 kV and 230kV GIS and GIBD

Reference specification: Doc. No. I02.KK56.0.0.ET.TS.PR051 and I02.KK56.0.0.ET.TS.PR053

vii) Thickness measurement shall be done in-house test facility found calibrated for 0.51mm wire with traceable to NPL and least count of 0.1 micron. Otherwise the same shall be tested at any NABL accredited/NPCIL approved laboratory.

viii) If 100% "witness" is carried out by "Prime contractor", NPCIL will witness on sample basis, or if 100% "witness" of tests is carried out by "sub-contractor", "Prime contractor" will witness on sample basis.

x) The material grade mentioned in IQAP are Indicative.

xi) In general, Ten (10) days advance intimation shall be given to NPCIL-QA wherever NPCIL appears under W or H column is indicated to enable NPCIL-QA to be present during the test. The Sub-Contractor may proceed with the work passed as a 'witness point' if NPCIL-QA representative is not present at the appointed time but the sub-vendor shall not proceed with work beyond a 'hold point' without a written clearance from NPCIL-QA.

1	2	3	4	5	6	7	8	10				11
SL.NO	**COMPONENT**	**CHARACTERISTICS CHECKED**	**CATEGORY**	**METHOD OF CHECK**	**EXTENT OF CHECK**	**REFERENCE DOCUMENT**	**ACCEPTANCE NORM**	**AGENCY**				**REMARKS**
								P	**R**	**W**	**H**	
1	**Incoming / Brought out Material Inspection**											
1.1	Aluminum Casting (Machined , Enclosures, Braket housing, busbar housing)	Visual & Dimensional	Major	Visual/ Measurement	ISO 2859-1-Special Inspection Level S2	Component Drawings/specifications, ISO 2768	Component Drawings/specifications, ISO 2768	4	1,2,3	-	-	
		Chemical & Mechanical Properties	Major	Chemical / Mechanical	One sample / Heat no.	Component Drawings/specifications DIN EN 1706 and HPDS4204,HPDS4206	Component Drawings/specifications DIN EN 1706 and HPDS4204,HPDS42	5,4	1,2,3	2	-	
1.2	Aluminum alloy Conductors (Extruded and casted)	Visual & Dimensional	Major	Visual/ Measurement	ISO 2859-1-Special Inspection Level S2	ISO 2768 and Component Drawings/specifications	ISO 2768 and Component Drawings/specifications	4	1,2,3	-	-	
		Chemical & Mechanical Properties	Major	Electrical	One sample /Heat No.	Component Drawings/specifications DIN EN 1706, EN 573-3, EN 755-2 and	Component Drawings/specifications DIN EN 1706, EN 573-3, EN 755-2 and	5,4	1,2,3	2	-	
		Visual & Dimension Inspection	Minor	Visual	ISO 2859-1-Special Inspection Level S2	Component Drawing specifications	Component's Drawing specifications	4	1,2,3	-	-	

1.3	Connecetor, Switching pin, Contact fingers (Copper and aluminum)	Hardness & Tensile (As applicable)	Major	Mechanical	ISO 2859-1 General Inspection Class I	EN 13601 & EN 755-2	EN 13601 & EN 755-2	4	1,2,3	-	-	
		Conductivity (As Applicable)	Major	Electrical	ISO 2859-1-Special Inspection Level S1	EN 13601 & EN 755-2	EN 13601 & EN 755-2	4	1,2,3	-	-	
		Chemical Composition test	Major	Chemical	One sample/ Heat No.	Component Drawing & specifications EN 13601, EN 573-3, EN 755-2	Component Drawing & specifications EN 13601, EN 573-3, EN 755-2	4	1,2,3	-	-	
		Silver / Tungsten Plating (Surface finish & Thickness)	Major	Surface Treatment	ISO 2859-1-Special Inspection Level S1	ISO 2819	ISO 2819	4	1,2,3	-	-	
1.4	Sheet metal for components and Cubicles (Steel) Panel support and structure(Angles and channels)	Visual & Dimensional	Minor	Visual/ Measurement	ISO 2859-1-Special Inspection Level S2	Component's Drawings/specifications, ISO 2768	Component's Drawings/specifications, ISO 2768	4	1,2,3	-	-	
		Chemical & Mechanical Properties	Minor	Chemical / Mechanical	One sample / Size	component Drawings/specifications, IS:2062, EN 10130, IS 513, EN 12329; ISO 2081	component Drawings/specifications, IS:2062, EN 10130, IS 513, EN 12329; ISO 2081	4	1,2,3	-	-	
		Thickness of Zinc coating (As Applicable)	Minor	Measurement	ISO 2859-1-Special Inspection Level S2			4	1,2,3	-	-	
		Paint Powder Coating thickness & Adhesion Test (As Applicable)	Major	Physical/Visual/ Measurement	ISO 2859-1-Special Inspection Level S2	Component Drawings/specifications	Component Drawings/specifications	4	1,2,3	-	-	
1.5	Hardware	Visual & Dimensional	Minor	Visual/ Measurement	One sample / Size /batch	Hardware Standards / EN ISO 898 / ISO 4762/ISO 4017/ DIN EN ISO 4014/ DIN EN ISO 10684/ ISO	Hardware Standards / EN ISO 898 / ISO 4762/ISO 4017/ DIN EN ISO	4	1,2,3	-	-	

		Chemical & Mechanical Properties	Minor	Chemical / Mechanical	One sample / Raw material batch	4014/ DIN EN ISO 10684/ ISO 8992, ISO 3506-1	4014/ DIN EN ISO 10684/ ISO 8992, ISO 3506-1	4/5	1,2,3	-	-	
1.6	Circuit Breaker Components											
1.6.1	CB interrupter assembly (As applicable)	Visual Inspection	Major	Measurement	100%	Manufacturers drawings and specifications	Manufacturers drawings and specifications	4	1,2,3	-	-	
		Contact resistance measurement	Major	Electrical	100%	Manufacturers drawings and specifications	Manufacturers drawings and specifications	4	1,2,3	-	-	
		Manual mechanical operation check	Major	Mechanical	100%	Manufacturers drawings and specifications	Manufacturers drawings and specifications	4	1,2,3	-	-	
		Torque application	Major	Electrical	100%	Manufacturers drawings and specifications	Manufacturers drawings and specifications	4,3	1,2,3	-	-	
		Fixed contact, moving contact, arcing contact and trag cylinder	Major	CoC	100%	Manufacturers drawings and specifications	Manufacturers drawings and specifications	4	1,2,3	-	-	
1.6.2	Moving Contact (As applicable)	Visual and Dimension	Major	Measurement	2 Sample / Lot	Component Drawings/specifications, ISO 2768	Component Drawings/specifications, ISO 2768	4	1,2,3	-	-	
		Hardness	Major	Mechanical	1 Sample / Lot	ASTM B702/ DIN 1787	ASTM B702/ DIN 1787	4	1,2,3	-	-	
		Conductivity	Major	Electrical	1 Sample / Lot	ASTM B702	ASTM B702	4	1,2,3	-	-	

		Chemical Composition test	Major	Chemical	1 Sample / Lot	Component Drawings/specifications, ASTM B702/ DIN 1787	Component Drawings/specifications, ASTM B702/ DIN 1787	4	1,2,3	-	-	
		Silver Plating (surface finish &Thickness), Roughness	Major	Chemical	1 Sample / Lot	ISO 2819	ISO 2819	4	1,2,3	-	-	Applicable for Finger contact
1.6.3	Fixed Contact (As applicable)	Visual and Dimension	Major	Measurement	2 Sample / Lot	Component Drawings/specifications, ISO 2768	Component Drawings/specifications, ISO 2768	4	1,2,3	-	-	
		Hardness	Major	Mechanical	1 Sample / Lot	ASTM B702/ EN 12163	ASTM B702/ EN 12163	4	1,2,3	-	-	
		Conductivity	Major	Electrical	1 Sample / Lot	ASTM B702/ EN 12163	ASTM B702/ EN 12163	4	1,2,3	-	-	
		Chemical Composition test	Major	Chemical	1 Sample / Lot	Drawings/specifications, ASTM B702/ DIN 1787/ EN12163	Component Drawings/specifications, ASTM B702/ DIN 1787/ EN12163	4	1,2,3	-	-	
		Silver Plating (surface finish &Thickness)	Major	Chemical	1 Sample / Lot	ISO 2819	ISO 2819	4	1,2,3	-	-	Applicable for Finger contact
1.6.4	Trag Cylinder (As applicable)	Visual & Dimensional	Major	Measurement	100%	Drawings / specifications, ISO 2768	Component Drawings / specifications, ISO 2768	4	1,2,3	-	-	
		Chemical & Mechanical Properties	Major	Chemical	1 Sample / Lot	Component drawings / specifications, EN 1706	Component drawings / specifications, EN 1706	4	1,2,3	-	-	

1.7	CB Drive Components											
1.7.1	Spring	Visual & Dimension	Major	Measurement	100%	Manufacturer's Drawings and specifications	Manufacturer's Drawings and specifications	4	1,2,3	-	-	
		Load test (compression test)	Major	Mechanical	100%	Manufacturer's Drawing & DIN 2096-1	Manufacturer's Drawing & DIN 2096-1	4	1,2,3	-	-	
		Chemical & Mechanical test	Major	Chemical & Mechanical	1 Sample / Lot	EN10089	EN10089	4	1,2,3	-	-	
1.7.2	CB Drive Housing	Visual Inspection	Major	Visual	100%	Manufacturer's Drawings and specifications	Manufacturer's Drawings and specifications	4	1,2,3	-	-	
		Dimensional Report	Major	Measurement	100%	Manufacturer's Drawings and specifications,	Manufacturer's Drawings and specifications,	4	1,2,3	-	-	
		Chemical & Mechanical Report	Major	Chemical & Mechanical	1 Sample / Lot	EN 1706	EN 1706	4	1,2,3	-	-	
1.7.3	CB Drive Close Latch	Visual Inspection	Major	Visual	100%	Manufacturer's Drawings and specifications,	Manufacturer's Drawings and specifications,	4	1,2,3	-	-	
		Dimensional Report	Major	Measurement					1,2,3		-	
		Chemical & Mechanical Report	Major	Chemical & Mechanical	1 Sample / Lot (Supplier Report)	EN 10083-3	EN 10083-3	4	1,2,3	-	-	
		Visual & Dimensional	Major	Visual / Measurement	ISO 2859-1-Special Inspection Level S2	component Drawings/specifications,	component Drawings/specifications,	4	1,2,3	-	-	

1.7.4	Actuating & operating rod (From drive to interrupter) SS431)	Chemical & Mechanical Properties	Major	Chemical / Mechanical	One sample / Size	component Drawing specifications EN 10088-3. ASTM A276	component Drawing specifications EN 10088-3. ASTM A276	4	1,2,3	-	-	
1.7.5	CB drive assembly	Visual inspection	Minor	Visual	100%	Manufacturer's Drawings and specifications	Manufacturer's Drawings and specifications	4	1,2,3	-	-	
		Fitment and Setting check	Minor	Mechanical	100%	Manufacturer's Drawings and specifications	Manufacturer's Drawings and specifications	4	1,2,3	-	-	
		Torque application	Minor	Mechanical	100%			4	1,2,3	-	-	
1.8	Motors	Visual, Terminal marking inspection	Major	Visual/ Measurement	100%	Manufacturer's Drawing	Manufacturer's Drawing	4/3	1,2,3	-	-	1. Documents evidencing similarity between the motors in product and used during type testing will be submitted. OR 2. Type test certificate will be submitted
		Make & model	Major	Visual	100%	NPCIL Accepted Type test Reports of GIS module System	NPCIL Accepted Type test Reports	4/3	1,2,3	-	-	
		Winding resistance	Major	Electrical	100%	IEC 60034-1/ IS 12615	IEC 60034-1/ IS 12615	4/3	1,2,3	-	-	
		Direction of rotation	Major	Electrical	100%	IEC 60034-1/ IS 12615	IEC 60034-1/ IS 12615	4/3	1,2,3	-	-	
		No load Test, Load test	Major	Electrical	100%	IEC 60034-1/ IS 12615	IEC 60034-1/ IS 12615	4/3	1,2,3	-	-	
		Insulation Resistance test	Major	Electrical	100%	Minimum 2 MOhm at 500 V DC	Minimum 2 MOhm at 500 V DC	4/3	1,2,3	-	-	
		Voltage Withstand Test 1.2 kV for 1 min	Major	Electrical	100%	IEC 60034-1/ IS 12615	IEC 60034-1/ IS 12615	4/3	1,2,3	-	-	
1.9	Gaskets	Visual and Dimensional inspection	Major	Visual	one Sample / Lot	Manufacturer Drawings, , ISO-2781	Manufacturer Drawings, , ISO-2781	4/5/3	1,2,3	-	-	
		Hardness, Elongation Tensile	Major	Mechanical	one Sample / Lot	Manufacturer Drawings, Specifications ASTM-D412, ASTM-D2240	Manufacturer Drawings, Specifications ASTM-D412, ASTM	4/5	1,2,3	-	-	

		Material property	Major	Chemical	one Sample / Lot	Manufacturer Drawings, Specifications & Standards and Compound EPDM	Manufacturer Drawings, Specifications & Standards and	4/5	1,2,3	2	-	
1.10	O Rings	Visual and Dimensional inspection	Major	Visual/ Measurement	Random sample/type	Manufacturer Drawings, Specifications & Standards	Manufacturer Drawings, Specifications & Standards	4/5/3	1,2,3	-	-	MTC shall be submitted otherwise test will be performed at IRMRA Lab
		Hardness , Density	Major	Measurement	Random sample/type	ISO 1183-1, ASTM-D2240	ISO 1183-1, ASTM-D2240	4/5	1,2,3	-	-	
		Elongation, Tensile	Major	Mechanical	Random sample/type	ASTM-D412	ASTM-D412	4/ 5	1,2,3	-	-	
		Material identification	Major	Polymer Name	Random sample/type	Manufacturer Drawings, Specifications and Compound EPDM, ISO 4650	Manufacturer Drawings, Specifications and Compound EPDM,	4/ 5	1,2,3	-	-	
1.11	Sf6 to Air Bushing	**Routine Tests**										
		Visual and Dimension	Major	Visual	100%	component Drawings/specifications, ISO 2768	component Drawings/specifications, ISO 2768	4	1,2,3	1,2	-	
		Check for Interface between fitting & housing	Major	Measurement	100%	Drawings/specifications,	Drawings/specifications,	4	1,2,3	1,2	-	
		Pressure Test	Major	Measurement	100%	component Drawings/specifications, IEC-61462	component Drawings/specifications, IEC-61462	4	1,2,3	2,3	-	
		Dissipation factor (Tan delta) and Capacitance measurement test	Major	Electrical	100%	IEC 60137	IEC 60137	4	1,2,3	1,2	-	
		High Voltage & Partial Discharge test	Major	Electrical	100%	IEC 60137	IEC 60137	4	1,2,3	1,2	-	
		Tightness Test	Major	Mechanical	100%	IEC 60137	IEC 60137	4	1,2,3	1,2	-	
		Type Tests										

1.11	Sf6 to Air Bushing	1. Dry Power frequency withstand Test 2. Lighting Impulse Voltage withstand Test 3. Thermal Stability Test 4. Temperature rise Test 5. STC Verification(calculation based on temperature rise test) 6. Cantilever load withstand Test 7. Internal Pressure Test 8. Dimension verification 9. RIV test	Major	Electrical /Mechanical	Sample	IEC 60137	IEC 60137	5	1,2,3,4	-	1	Type Test Reports will be submitted to NPCIL for acceptance,
1.12	Current Transformer	**Routine Tests**										
		Core - Dimensional & Magnetizing characteristics	Major	Visual/Measurement	100%	Technical Instruction and Drawing/specification	Technical Instruction and Drawing/specificati	4	1,2,3	-	-	
		Winding - Proper laying of conductor, dimensional check	Major/critical	Visual/Measurement	100%	Technical Instruction and Drawing/specification	Technical Instruction and Drawing/specificati	4	1,2,3	-	-	
		Inter-turn voltage Test	Major	Electrical	100%	IEC 61869-1&2 (2007) / IS 16227 P-1 & 2	IEC 61869-1&2 (2007) / IS 16227 P-1 & 2	4	1,2,3	1,2,3	-	
		Accuracy test (ratio error and phase error)	Major	Electrical	100%	IEC 61869-1&2 (2007) / IS 16227 P-1 & 2	IEC 61869-1&2 (2007) / IS 16227 P-1 & 2	4	1,2,3	1,2,3	-	
		ISF, ALF and Composite error test for applicable core type	Major	Electrical	100%	IEC 61869-1&2 (2007) / IS 16227 P-1 & 2	IEC 61869-1&2 (2007) / IS 16227 P-1 & 2	4	1,2,3	1,2,3	-	
		Turns Ratio, knee point Voltage (Vk) , Magnetizing Current (Im)	Major	Electrical	100%	IEC 61869-1&2 (2007) / IS 16227 P-1 & 2	IEC 61869-1&2 (2007) / IS 16227 P-1 & 2	4	1,2,3	1,2,3	-	
		Winding Resistance Measurement (Rct)	Major	Electrical	100%	IEC 61869-1&2 (2007) / IS 16227 P-1 & 2	IEC 61869-1&2 (2007) / IS 16227 P-1 & 2	4	1,2,3	1,2,3	-	
		Polarity check	Major	Electrical	100%	IEC 61869-1&2 (2007) / IS 16227 P-1 & 2	IEC 61869-1&2 (2007) / IS 16227 P-1 & 2	4	1,2,3	1,2,3	-	
		5 kV Power Frequency withstand Test on Secondary Winding for 1 min & Verification of Markings	Major	Electrical	100%	IS 16227 P-1 & 2 / Data Sheet/NPCIL TS	IS 16227 P-1 & 2 / Data Sheet/NPCIL TS	4	1,2,3	1,2,3	-	
		Gas tightness Test	Major	Measurement	100%	IEC- 62271-203	IEC- 62271-203	4	1,2,3	1,2,3	-	

1.12 Cont.	Current Transformer	Pressure test for the enclosures	Major	Measurement	100%	IEC- 62271-203	IEC- 62271-203	4	1,2,3	2,3		
		Type Tests										
		1. Dielectric Test 2. STC Test 3.Accuracy test (ratio error and phase error) 4. Temperature Rise Test 5. Pressure test for the enclosure 6. Lighting Impulse test 7.Electromagnetic Compatibility tests 8. Verification of the degree of protection by enclosures	Major	Electrical/Mechanical	Sample	IEC 61869-1&2 IS16227-2 IEC 62271-203	IEC 61869-1&2 IS16227-2 IEC 62271-203	5	1,2,3,4	-	1	Type Test Reports will be submitted to NPCIL for acceptance,
1.13	Voltage Transformer	**Routine Tests**										
		Core - Dimensional & Magnetizing characteristics	Major	Visual/Measurement	100%	component Drawings/specifications, ISO 2768	component Drawings/specifications, ISO 2768	4	1,2,3	-	-	
		Winding - Proper laying of conductor, dimensional check, drawing & impregnation test	Major/critical	Visual/Measurement	100%	component Drawings/specifications, ISO 2768	component Drawings/specifications, ISO 2768	4	1,2,3	-	-	
		Power Frequency Test on Primary & Measurement of Partial Discharge.	Major	Electrical	100%	IEC 61869-1&3 (2012) /IS 16227 P-1 & 3	IEC 61869-1&3 (2012) /IS 16227 P-1 & 3	4	1,2,3	1,2	-	
		Measurement of Accuracy	Major	Electrical	100%	IEC 61869-1&3 (2012) /IS 16227 P-1 & 3	IEC 61869-1&3 (2012) /IS 16227 P-1 & 3	4	1,2,3	1,2	-	
		3 kV Power frequency test on Secondary Winding	Major	Electrical	100%	IEC 61869-1&3 (2012) /IS 16227 P-1 & 3	IEC 61869-1&3 (2012) /IS 16227 P-1 & 3	4	1,2,3	1,2	-	
		Verification of Terminal Marking & Check of rating Plate	Major	Electrical	100%	IEC 61869-1&3 (2012) /IS 16227 P-1 & 3	IEC 61869-1&3 (2012) /IS 16227 P-1 & 3	4	1,2,3	1,2	-	
		Tightness Test	Major	Electrical	100%	IEC 61869-1&3 (2012) /IS 16227 P-1 & 3	IEC 61869-1&3 (2012) /IS 16227 P-1 & 3	4	1,2,3	1,2	-	
		Pressure test for the enclosures	Major	Measurement	100%	Drawings and specifications IEC- 62271-203	Drawings and specifications IEC- 62271-203	4	1,2,3	2, 3	-	

		Type Tests										
		1. Dielectric Test 2.STC Test 3.Accuracy test (ratio error and phase error) 4. Temperature Rise Test 5. Pressure test for the enclosure 6. Lighting Impulse test 7.Electromagnetic Compatibility tests 8. Verification of the degree of protection by enclosures	Major	Electrical/Mechanical	Sample	IEC 61869-1&3 IS16227-1&3 IEC62271-203	IEC 61869-1&3 IS16227-1&3 IEC62271-203	5	1,2,3,4	-	1	Type Test Reports will be submitted to NPCIL for acceptance,
1.14	Surge Arrester	**Routine Tests**										
		Pressure Test of the enclosure	Major	Measurement	100%	Drawings and specifications IEC 62271-203	Drawings and specifications IEC 62271-203	4	1,2,3	-	-	Supplier MTCs will be submitted for review.
		Visual & Dimensions	Major	Visual/measurement	100%	IEC 60099-4 : 2009	IEC 60099-4 : 2009	4/3	1,2,3	2	-	
		Residual Voltage Measurement test	Major	Electrical	100%	IEC 60099-4 : 2009	IEC 60099-4 : 2009	4	1,2,3	-	-	Supplier MTCs will be submitted for review.
		Reference Voltage Measurement Test	Major	Electrical	100%	IEC 60099-4 : 2009	IEC 60099-4 : 2009	4	1,2,3	-	-	
		High Voltage & Partial Discharge test	Major	Electrical	100%	IEC 60099-4 : 2009	IEC 60099-4 : 2009	4	1,2,3	-	-	
		Tightness Test	Major	Electrical	100%	IEC 60099-4 : 2009	IEC 60099-4 : 2009	4/3	1,2,3	2	-	
		Type Tests										

		1. Insulation withstand Test 2.Residual Voltage Measurement test 3. Impulse voltage withstand Test 4. Operating duty test 5. Internal partial discharge 6. SC test 7. Seal Leak rate Test 8.Bending Test 9.Environment Test	Major	Electrical/Mechanical	Sample	IEC 60099-4 : 2009	IEC 60099-4 : 2009	5	1,2,3	-	1	Type Test Reports will be submitted to NPCIL for acceptance,
1.15	Circuit Breaker	**Routine Tests**										
		Visual checks	Major	Visual	100%	Manufacturer Drawing & Standards	Manufacturer Drawing &	3	1,2	1,2	-	
		Operational Test at under (70% for Opening & 85% for closing) & over (110%) of Control	Major	Electrical	100%	IEC 62271-100(2001) /IEC 62271-1	IEC 62271-100(2001) /IEC	3	1,2	1,2	-	
		Closing and opening time measurement at 100% control voltage	Major	Electrical	100%	IEC 62271-100(2001) / IEC 62271-1	IEC 62271-100(2001) /IEC	3	1,2	1,2	-	
		Dielectric test in Motor (1.2 kV) & Control Circuit 2 kV for 1 min.	Major	Electrical	100%	IEC 62271-100(2001) /IEC 62271-1	IEC 62271-100(2001) /IEC	3	1,2	1,2	-	
		Duty Cycle Check	Major	Electrical	100%	IEC 62271-100(2001) /IEC 62271-1	IEC 62271-100(2001) /IEC	3	1,2	1,2	-	
		Spring Charging Time & Motor Current Consumption measurement, Operating Coils	Major	Electrical	100%	IEC 62271-100(2001) /IEC 62271-1	IEC 62271-100(2001) /IEC	3	1,2	1,2	-	
		Loss of SF6	Major	Electrical	100%	IEC 62271-100(2001) /IEC 62271-1	IEC 62271-100(2001) /IEC	3	1,2	1,2	-	
		SF6 General Lock out	Major	Electrical	100%	IEC 62271-100(2001) /IEC 62271-1	IEC 62271-100(2001) /IEC	3	1,2	1,2	-	
		Antipumping & pole discrepancy Check	Major	Electrical	100%	IEC 62271-100(2001) /IEC 62271-1	IEC 62271-100(2001) /IEC	3	1,2	1,2	-	
		Pressure test	Major	Measurement	100%	Drawings and specifications IEC 62271-203	Drawings and specifications	4	1,2,3	-	-	MTC will be submitted for
1.15	Circuit Breaker	**TYPE TESTS**										
		1 Dielectric tests 2. Extended Mechanical Endurance test 3. Temp. rise test 4. SC current making and breaking test 5. Ingress protection 6. Measurement of resistance on main ckt 7. Short-time withstand current and peak withstand current tests . 8.Tightness test 9. Mechanical operation test 10.cable-charging current breaking tests	Major	Electrical/Mechanical	Sample	EC 62271-100 IEC 62271-203 IEC 62271- 1 and Approved Specification	EC 62271-100 IEC 62271-203 IEC 62271- 1 and Approved Specification	5	1,2,3	-	1	Type Test Reports will be submitted to NPCIL for acceptance

Title: Indicative QAP for 400 kV and 230kV GIS and GIBD

Reference specification: Doc. No. I02.KK56.0.0.ET.TS.PR051 and I02.KK56.0.0.ET.TS.PR053

1.16	Disconnector, Earth switch and Make proof / Work in progress Earth switch	**ROUTINE TESTS**										
		Visual checks	Major	Visual	100%	IEC 62271-102	IEC 62271-102	3	1,2	1,2		
		Tightness test	Major	Electrical	100%	IEC 62271-102	IEC 62271-102	3	1,2	1,2		10% Gas tightness will be done with Transport Unit assembly during Routine GIS testing during FAT of GIS bays
SL.NO	**COMPONENT**	**CHARACTERISTICS CHECKED**	**CATEGORY**	**METHOD OF CHECK**	**EXTENT OF CHECK**	**REFERENCE DOCUMENT**	**ACCEPTANCE NORM**	**AGENCY**				**REMARKS**
								P	**R**	**W**	**H**	
1.16	Disconnector,earthswitch and make proof /work in progress earth switch	Pressure tests of enclosures	Major	Mechanical	100%	IEC 62271-102	IEC 62271-102	3,4	1,2,3	2	-	
		Closing & Opening Operation at 85%, 100% &110% of Control Voltage(5 times)	Major	Electrical	100%	IEC 62271- 102 & 203(2011)/IEC 62271-1	IEC 62271- 102 & 203(2011)/IEC 62271-1	3	1,2	1,2	-	
		Measurement of Motor Operating Time during Close & Open operation at 100% of Control Voltage	Major	Electrical	100%	IEC 62271- 102 & 203(2011)/IEC 62271-1	IEC 62271- 102 & 203(2011)/IEC 62271-1	3	1,2	1,2	-	
		Motor Current Consumption Measurement of Open & Close Operation at 100% of Control Voltage	Major	Electrical	100%	IEC 62271- 102 & 203(2011)/IEC 62271-1	IEC 62271- 102 & 203(2011)/IEC 62271-1	3	1,2	1,2	-	
		Measurement of the resistance of the main circuit	Major	Electrical	100%	IEC 62271- 102 & 203(2011)/IEC 62271-1	IEC 62271- 102 & 203(2011)/IEC 62271-1	3	1,2	1,2	-	
		Dielectric test on Motor(1.2kV) & Control Circuit 2kV for 1 min.	Major	Electrical	100%	IEC 62271- 102 & 203(2011)/IEC 62271-1	IEC 62271- 102 & 203(2011)/IEC 62271-1	3	1,2	1,2	-	
		TYPE TESTS										

1.16	Disconnector,earthswitch and make proof /work in progress earth switch	1. Dielectric withstand test 2. Measurement of the resistance of circuits 3.Temperature-rise tests 4. Short-time withstand current and peak withstand current tests 5.Verification of the protection	Major	Electrical/Mechanical	Sample	IEC 62271-102 IEC 62271-203 IEC IEC62271-1	IEC 62271-102 IEC 62271-203 IEC IEC62271-1	5	1,2,3	-	1	Type Test Reports will be submitted to NPCIL for acceptance,
SL.NO	**COMPONENT**	**CHARACTERISTICS CHECKED**	**CATEGORY**	**METHOD OF CHECK**	**EXTENT OF CHECK**	**REFERENCE DOCUMENT**	**ACCEPTANCE NORM**	**AGENCY**				**REMARKS**
								P	**R**	**W**	**H**	
1.17	Bus duct Support Structure (Angles, plates & Channels)	Visual & Dimensions	Major	Visual/ Measurement	ISO 2859-1-Special Inspection Level S2	component Drawings/specifications, ISO 2768	Component Drawings/specifications, ISO 2768	4	1,2,3	-	-	
		Chemical & Mechanical Properties	Major	Chemical / Mechanical	one Sample / Production Lot	component Drawings/specifications, EN10025/ IS 2062	component Drawings/specifications, EN10025/ IS 2062	4,5	1,2,3	2	-	
1.18	Bellows (SS-316L as per TS)	Visual and Dimensions	Major	Visual/ Measurement	ISO 2859-1-Special Inspection Level S2	Component Drawings / Specification ISO 2768	Component Drawings / Specification ISO 2768	4,3	1,2,3	-	-	
		Chemical & Mechanical Properties & Intergranular corrosion test	Major	Chemical / Mechanical	Sample / Lot	For SS Sheet: EN 1.4541/ 1.4404/ EN 10027/ ASTM A240 or Equivalent; For Flanges: EN 485-2; EN 573-3 Or equivalent; ASTM-A262 (For	For SS Sheet: EN 1.4541/ 1.4404/ EN 10027/ ASTM A240 or Equivalent; For Flanges: EN 485-	4	1,2,3	-	-	
		Paint / Powder Coating thickness & Adhesion Test (As Applicable)	Major	Visual/ Measurement	ISO 2859-1-Special Inspection Level S2	component Drawings/specifications	component Drawings/specifications	4	1,2,3	-	-	
		Pressure & Leak test	Major	Mechanical	100%	Component Drawing	Component Drawing	4	1,2,3	-	-	
		Visual check	Major	Visual	100%	Manufacturer Drawing	Manufacturer Drawing	4	1,2,3	-	-	

1.19	Density monitor	Set point (Calibration) test	Major	Mechanical	100%	Manufacturer Drawing	Manufacturer Drawing	4	1,2,3	-	-	
		Tightness Test	Major	Leak Test	100%	Manufacturer Drawing	Manufacturer Drawing	4	1,2,3	-	-	
		Insulation Resistance test	Major	Measurement	100%	Greater than 2 M Ohm at 500V DC	Greater than 2 M Ohm at 500V DC	3/4	1,2,3	-	-	
1.20	SF6 Gas	Chemical Composition test, Purity, Dew Point, Air, Hydrolysable fluorides & Water content	Major	Chemical / Mechanical	100%	IEC 60376 / TS Cl. No. 6.22.6	IEC 60376 / TS Cl. No. 6.22.6	4	1,2,3	-	-	
		Test for color, odour, toxicity & Non flammability	Major	Property of gas	-	IEC 60376 / TS Cl. No. 6.22.6	IEC 60376 / TS Cl. No. 6.22.6	4	1,2,3	-	-	Material Safety Data Sheet (MSDS) shall be reviewed
1.21	Epoxy insulators (gas tight, gas permeable bushing)	**Routine Tests**										
		Visual check	Major	Visual	100%	IEC 62271-203 Cl.7.1	IEC 62271-203 Cl.7.1	4	1,2,3	-	-	
		Dimensions & Creepage distance	Major	Measurement	100%	IEC 62271-203 Cl.7.1	IEC 62271-203 Cl.7.1	4	1,2,3	-	-	
		Power frequency withstand voltage test	Major	Electrical	100%	IEC 62271-203 Cl.7.1	IEC 62271-203 Cl.7.1	4	1,2,3	-	-	
		Pressure Test and Tightness test (applicable for Gas tight Insulator)	Major	Mechanical	100%	IEC 62271-203 Cl.7.1	IEC 62271-203 Cl.7.1	4	1,2,3	-	-	
		Partial discharge measurement Test	Major	Electrical	100%	IEC 62271-203 Cl.7.1	IEC 62271-203 Cl.7.1	4	1,2,3	-	-	
		TYPE TESTS										
		Dielectric test (High Voltage, Lightning impulse, Partial discharge test) Test on Partitions(Burst test, Thermal cycling, Gas tightness)	Major	Electrical/ Mechanical	Sampling	IEC 62271-203	IEC 62271-203	3	1,2	-	1	This is part of GIS, Type Test Reports will be submitted to NPCIL for acceptance,
		Visual appearance check	Minor	Visual	Sample/batch	As per product standard	As per product standard	4	1,2,3	-	-	

1.22	Filter material (Absorbent)	Water content test	Major	Mechanical	Sample/batch	As per product standard	As per product standard	4	1,2,3	-	-	
		Absorption Capacity test	Major	Mechanical	Sample/batch	As per product standard	As per product standard	4	1,2,3	-	-	
		Packing Check	Minor	Visual	Sample/batch	As per product standard	As per product standard	4	1,2,3	-	-	
1.23	Rupture disc	Burst Testing	Major	Mechanical	As per suppliers inspection plan (Approx. 3% to 5% of lot quantity)	Manufacturer's Drawing/specification & Standards	Manufacturer's Drawing/specification & Standards	4	1,2,3	-	-	
		Leakage test	Major	Leak Test	100%	Manufacturer's Drawing/specification & Standards	Manufacturer's Drawing/specification & Standards	4,3	1,2,3	1,2	-	Leakage test will be performed during routine testing of GIS bays/.
		Chemical and Mechanical properties of material	Major	Chemical / Mechanical	one per lot	Manufacturer's Drawing/specification & Standards	Manufacturer's Drawing/specification & Standards	4	1,2,3	-	-	
1.24	Filling Valves	Visual and dimensional check	Minor	Mechanical	ISO 2859-1-Special Inspection Level S2	Manufacturer's Drawing/specification & Standards	Manufacturer's Drawing/specification & Standards	4	1,2,3	-	-	
		Chemical and Mechanical	Major	Chemical / Mechanical	One Sample/Lot	Manufacturer's Drawing/specification & Standards EN 573-3, EN 755-2	Manufacturer's Drawing/specification & Standards EN 573-3, EN 755-2	4	1,2,3	-	-	
		Tightness test	Major	Leak Test	100%	Manufacturer's Drawing/specification	Manufacturer's Drawing/specification	4	1,2,3	-	-	

1.25	Portable SF6 Leak Detector	Functional tests	Minor	Functional	100%	Manufacturer's Drawing/specification	Manufacturer's Drawing/specification	4	1,2,3	-	-	
1.26	Dew point meter	Functional tests	Minor	Functional	100%	Manufacturer's Drawing/specification	Manufacturer's Drawing/specification	4	1,2,3	-	-	
1.27	Portable Partial Discharge Monitor system	Functional tests and Calibration	Minor	Functional	100%	Manufacturer's Drawing/specification	Manufacturer's Drawing/specification	4	1,2,3	-	-	
1.28	CONTROL CABLES	Routine Tests	Major	Electrical/Mechanical	100%	IEC 60754-2 and FR-LSZH tests, IEC 60228, DIN VDE 0203-363-7, EN 50363-7, HD.22.10 S1 & A1,	IEC 60754-2 and FR-LSZH tests, IEC 60228, DIN VDE 0203-363-7, EN 50363-7, HD.22.10	4	1,2,3	-	-	
		Acceptance Tests	Major		Sampling as per IS	EC 60754-2 and FR-LSZH tests, IEC 60228, DIN VDE 0203-363-7, EN 50363-7, HD.22.10 S1 & A1,	IEC 60754-2 and FR-LSZH tests, IEC 60228, DIN VDE 0203-363-7, EN 50363-7, HD.22.10	4	1,2	3/2	-	
		Type Tests	Major		Sample of Each type and size	IEC 60754-2 and FR-LSZH tests, IEC 60228, DIN VDE 0203-363-7, EN 50363-7, HD.22.10 S1 & A1,	IEC 60754-2 and FR-LSZH tests, IEC 60228, DIN VDE 0203-363-7, EN 50363-7, HD.22.10	4	1,2,3	-	-	
1.29	Control Wires	Routine Tests	Major	Electrical/Mechanical	100%	IS 17048: 2018	IS 17048: 2018	4	1,2,3	-	-	
		Acceptance Tests	Major		Sampling as per IS	IS 17048: 2018	IS 17048: 2018	4	1,2	3/2	-	
		Type Tests	Major		Sample of Each type and size	IS 17048: 2018	IS 17048: 2018	4	1,2,3	-	-	

Title: Indicative QAP for 400 kV and 230kV GIS and GIBD

Reference specification: Doc. No. I02.KK56.0.0.ET.TS.PR051 and I02.KK56.0.0.ET.TS.PR053

1.30	Annunciator (if Applicable)	Visual and Functional	Minor	Electrical/Mechanical	100%	Manufacturer's Drawing/specification & Standards	Manufacturer's Drawing/specification & Standards	4/3	1,2,3	-	-	
1.31	Meters (if Applicable)	Visual, Calibration & Accuracy	Minor	Electrical/Mechanical	100%	Manufacturer's Drawing/specification & Standards	Manufacturer's Drawing/specification & Standards	4	1,2,3	-	-	
1.32	Selector switch, MCB, Timers, LED indicators, TBs etc. of LCC	Verification of Make ,Rating and Model	Minor	Visual	100%	As per approved BOQ	As per approved BOQ	4/3	1,2,3	-	-	
	Note:-	**Painting of sheet steel surface OF LCC and CB Cubicles needs to satisfy the requirements of ISO-12944 C5M grade for minimum life of 15**										
1.33	**Bay Control Unit(BCU)**	**Routine Tests**										
		a) Visual (Model, Make & No. BI,BO)	Major	Visual	100%	As per Approved Document BOM / GTP / Schematic/Catalogue/Relay Manual/ Approved Routine Test Procedure for BCU-230 KV GIS	As per Approved Document BOM / GTP / Catalogue/Relay Manual	4/3	1,2	-	-	
		b)Burn in Test for 100 Hrs.	Major	Electrical	100%	BCU will be kept energized for 100 Hrs at ambient temp/Approved Routine Test Procedure for BCU-230 KV GIS:	BCU healthy LED shall have healthy indication before and after test/Approved Routine Test	3	1,2	-	-	
		c) Function's Tests, Algorithms Checks(Cofiguration using Gate logics) and Software Verification (Version Checks)	Major	Electrical	100% by Manufacturer, 1 random sample selected by NPCIL	NPCIL Approved Routine Test Procedure for BCU-230 KV GIS	NPCIL Approved Routine Test Procedure for BCU-230 KV GIS	3	-	1,2	-	
		TYPE TESTS										
		1) Clearance and creepage distances	Major	Physical	Sample 1 No	IEC 60255-5, IEC 60255-27, IEC 60870-2-1, IEE std C37.90	IEC 60255-5,IEC 60255-27,IEC 60870-2-1,IEE	3	1,2	-	-	Valid type test Reports shall be submitted to NPCIL for
		2)Dielectric test	Major	Electrical	Sample 1 No	IEC 60255-5,IEC 60255-27,IEC 60870-2-1,IEE std C37.90	No flashover ,No breakdown	3	1,2	-	-	

		3) Impulse volatge withstand test	Major	Electrical	Sample 1 No	IEC 60255-5,IEC 60255-27,IEC 60870-2-1,IEE std C37.90	IEC 60255-5,IEC 60255-27,IEC 60870-2-1,IEE	3	1,2	-	-	review and acceptance
		Protection against electrical shock										
		1) Measurement of insulation resistance	Major	Electrical	Sample 1 No	IEC 60255-5,IEC 60255-27	for new >100MOhms,After damp heat test	3	1,2	-	-	Valid type test Reports shall be submitted to NPCIL for review and acceptance
		2) Protective bonding test	Major	Electrical	Sample 1 No	IEC 60255-5,IEC 60255-27	<=0.1 ohms	3	1,2	-	-	
1.33 Cont.	Bay Control Unit(BCU)	Flammability										
		1) Equipment temperature limits and protection against spread of fire	Major	Physical	Sample 1 No	IEC 60255-1, IEC 60255-27	IEC 60255-1, IEC 60255-27	3	1,2	-	-	Valid type test Reports shall be submitted to NPCIL for review and acceptance
		2) Flammability of material and components	Major	Physical	Sample 1 No	IEC 60255-27	IEC 60255-27	3	1,2	-	-	
		g) Wrong Polarity	Major	Electrical	Sample 1 No	IEC 60255-27	IEC 60255-27	3	1,2	-	-	
		h) Laser and IRED Devices	Major	Electrical	Sample 1 No	IEC 60825 -1 -2	IEC 60825 -1 -2	3	1,2	-	-	
		i) Mechanical resistance against shock and impact										
		1) Rigidity test	Major	Mechanical	Sample 1 No	IEC 61010-1	IEC 61010-1	3	1,2	-	-	
		2) Impact hammerr test	Major	Mechanical	Sample 1 No	IEC 61010-1	IEC 61010-1	3	1,2	-	-	
		j) Protection degree provided by enclosure	Major	Physical	Sample 1 No	IEC 60529	IEC 60529	3	1,2	-	-	
		k) Load capacity										
		1) Current circuits, thermal short time ratings	Major	Electrical	Sample 1 No	IEC 60255-27	IEC 60255-27	3	1,2	-	-	
		2) Standard inputs (Protection class current transformers)	Major	Electrical	Sample 1 No	IEC 60255-27	IEC 60255-27	3	1,2	-	-	
		3) Ins-Input for high sensitive earth fault detection (instrument transformers)	Major	Electrical	Sample 1 No	IEC 60255-27	IEC 60255-27	3	1,2	-	-	

		4)Voltage circuits	Major	Electrical	Sample 1 No	IEC 60255-27	IEC 60255-27	3	1,2	-	-	
		5) Output relays Contact performance (standard relay Type S, Fast relay: Type F, High speed relay with semiconductor	Major	Electrical	Sample 1 No	IEC 60255-1, IEEE std C37.90	IEC 60255-1, IEEE std C37.90	3	1,2	-	-	
		6) Power Relays (for Direct control of motor switches)	Major	Electrical	Sample 1 No	IEC 60255-1, IEEE std C37.90	IEC 60255-1, IEEE std C37.90	3	1,2	-	-	
		7) Binary inputs	Major	Electrical	Sample 1 No	IEC 60255-1	IEC 60255-1	3	1,2	-	-	
		l) Surge Current withstand test										
		1) Standard inputs (Protection class current transformers	Major	Electrical	Sample 1 No	IEC 60255-1	IEC 60255-1	3	1,2	-	-	
		2) Input for high sensitive earth fault detection (instrument transformers)	Major	Electrical	Sample 1 No	IEC 60255-1	IEC 60255-1	3	1,2	-	-	
		m) Temperature and climatic stress during operation										
		1) Dry cold	Major	Phsical	Sample 1 No	IEC 60068, IEC 60255-1	IEC 60068, IEC 60255-1	3	1,2	-	-	
		2) Dry heat (Burn in test)	Major	Phsical	Sample 1 No	IEC 60068-2-1	IEC 60068-2-1	3	1,2			
		3) Slow temperature change	Major	Phsical	Sample 1 No	IEC 60068-2-14	IEC 60068-2-14	3	1,2	-	-	Valid type test Reports shall be submitted to NPCIL for review and acceptance
		4) Damp heat, steady state	Major	Phsical	Sample 1 No	IEC 60068-2-78	IEC 60068-2-78	3	1,2	-	-	
		5) Damp heat,cyclic	Major	Phsical	Sample 1 No	IEC 60255-1, EC 60068-2-30	IEC 60255-1,EC 60068-2-30	3	1,2	-	-	
		n) Temperature and climatic stress during storage and										
1.33	Bay Control	1) Cold	Major	Phsical	Sample 1 No	IEC 60068-2-1	IEC 60068-2-1	3	1,2	-	-	

1.33 Cont.	Bay Control Unit(BCU)	2) Dry heat	Major	Phsical	Sample 1 No	IEC 60068-2-2	IEC 60068-2-2	3	1,2	-	-
		3) Fast temperature change	Major	Phsical	Sample 1 No	IEC 60068-2-14	IEC 60068-2-14	3	1,2	-	-
		o) Industrial atmosphere									
		1) Gas test, selective	Major	Phsical	Sample 1 No	IEC 60068-2-42	IEC 60068-2-42	3	1,2	-	-
		2) Mixed gas test	Major	Phsical	Sample 1 No	IEC 60068-2-60	IEC 60068-2-60	3	1,2	-	-
		p) Mechanical dynamic stress tests									
		1) Vibration response test ,sinusoidal, stationary use	Major	Mechanical	Sample 1 No	IEC 60068-2-6, IEC 60255-21-1	IEC 60068-2-6, IEC 60255-21-1	3	1,2	-	-
		2) Vibration endurance test, sinusoidal, transport stress	Major	Mechanical	Sample 1 No	IEC 60068-2-6, IEC 60255-21-1	IEC 60068-2-6, IEC 60255-21-1	3	1,2	-	-
		3) Seismic stress, stationary use	Major	Mechanical	Sample 1 No	IEC 60068-2-57, IEC 60068-3-3, IEC 60255-21-3	IEC 60068-2-57, IEC 60068-3-3, IEC 60255-21-3	3	1,2	-	-
		4) Shock response test, stationary use	Major	Mechanical	Sample 1 No	IEC 60068-2-27, IEC 60255-21-2	IEC 60068-2-27, IEC 60255-21-2	3	1,2	-	-
		5) shock withstand test, transport stress	Major	Mechanical	Sample 1 No	IEC 60068-2-27, IEC 60255-21-2	IEC 60068-2-27, IEC 60255-21-2	3	1,2	-	-
		6) Bump test (Continuous shock),transport stress	Major	Mechanical	Sample 1 No	IEC 60068-2-27, IEC 60255-21-2	IEC 60068-2-27, IEC 60255-21-2	3	1,2	-	-
		q) Electromagnetic compatibility (EMC)									
		q.1) Immunity tests									
		1) 1 Mhz burst disturbance test	Major	Electrical	Sample 1 No	IEC 60255-26,IEC 61000-4-18, IEC 60255-22-1	IEC 60255-26,IEC 61000-4-18, IEC 60255-22-1	3	1,2	-	-
		2) Electrostatic discharge (ESD) Test	Major	Electrical	Sample 1 No	IEC 60255-26,IEC 61000-4-2, IEC 60255-22-2	IEC 60255-26,IEC 61000-4-2, IEC 60255-22-2	3	1,2	-	-

1.33 Cont.	**Bay Control Unit(BCU)**	q.2) Radited electromagnetic field disturbance test										Valid type test Reports shall be submitted to NPCIL for review and acceptance
		1) RF Field, amplitude moduated frequency sweep test (IEC)	Major	Electrical	Sample 1 No	IEC 60255-26,IEC 61000-4-3, IEC 60255-22-3	IEC 60255-26,IEC 61000-4-3, IEC 60255-22-3	3	1,2	-	-	
		2) RF Field, amplitude moduated spot frequency test (IEC)	Major	Electrical	Sample 1 No	IEC 60255-26,IEC 61000-4-3, IEC 60255-22-3	IEC 60255-26,IEC 61000-4-3, IEC 60255-22-3	3	1,2	-	-	
		3) RF Field, amplitude moduated frequency sweep test (IEEE)	Major	Electrical	Sample 1 No	IEE std C37.90.2	IEE std C37.90.2	3	1,2	-	-	
		4) RF Field, amplitude moduated spot frequency test (IEEE)	Major	Electrical	Sample 1 No	IEE std C37.90.2	IEE std C37.90.2	3	1,2	-	-	
		5) RF-field, pulse modulated Spot frequency test (IEEE)	Major	Electrical	Sample 1 No	IEE std C37.90.2	IEE std C37.90.2	3	1,2	-	-	
		6) RF-field, pulse modulated keying test (IEEE)	Major	Electrical	Sample 1 No	IEEE Std C37.90.2	IEE std C37.90.2	3	1,2	-	-	
		q.3) Electrical fast transient disturbance test (EFT)	Major	Electrical	Sample 1 No	IEC 60255-26,IEC 61000-4-4, IEC 60255-22-4	IEC 60255-26,IEC 61000-4-4, IEC 60255-22-4	3	1,2	-	-	
		q.4) Surge immunity test	Major	Electrical	Sample 1 No	IEC 60255-26,IEC 61000-4-5, IEC 60255-22-5	IEC 60255-26,IEC 61000-4-5, IEC 60255-22-5	3	1,2	-	-	
		q.5) Fast transient surge withstand capability tesst (IEEE)	Major	Electrical	Sample 1 No	IEEE std C37.90.1	IEEE std C37.90.1	3	1,2	-	-	
		q.6) Conducted disturbances induced by radio frequency fields amplitude modulated frequency test	Major	Electrical	Sample 1 No	IEC 60255-26,IEC 61000-4-6, IEC 60255-22-6	IEC 60255-26,IEC 61000-4-6, IEC 60255-22-6	3	1,2	-	-	
		q.7) Conducted disturbances induced by radio frequency fields amplitude modulated spot frequency test	Major	Electrical	Sample 1 No	IEC 60255-26,IEC 61000-4-6, IEC 60255-22-6	IEC 60255-26,IEC 61000-4-6, IEC 60255-22-6	3	1,2	-	-	
		q.8) Power frequency magnetic field test	Major	Electrical	Sample 1 No	IEC 60255-26,IEC 61000-4-8, IEC 60255-22-8	IEC 60255-26,IEC 61000-4-8, IEC 60255-22-8	3	1,2	-	-	
		q.9) Pulsed magnetic field test	Major	Electrical	Sample 1 No	IEC 61000-4-9	IEC 61000-4-9	3	1,2	-	-	
		q.10) Damped oscillatory magnetic field immunity test	Major	Electrical	Sample 1 No	IEC 61000-4-10	IEC 61000-4-10	3	1,2	-	-	

		q.11) DC Ripple	Major	Electrical	Sample 1 No	IEC 60255-26, IEC 61000-4-17	IEC 60255-26, IEC 61000-4-17	3	1,2	-	-	
		q.12) Damped oscillatory waves test	Major	Electrical	Sample 1 No	IEC 61000-4-18	IEC 61000-4-18	3	1,2	-	-	
		q.13) Power frequency immunity test	Major	Electrical	Sample 1 No	IEC 60255-28, IEC 61000-4-16, IEC 60255-22-7	IEC 60255-28, IEC 61000-4-16, IEC 60255-22-7	3	1,2	-	-	
		q.14) Up and down raming of auxilary supply voltage	Major	Electrical	Sample 1 No	IEC 60255-26	IEC 60255-26	3	1,2	-	-	
1.33 Cont .	**Bay Control Unit(BCU)**	q.15) voltage dips	Major	Electrical	Sample 1 No	IEC 60255-26,IEC 61000-4-11 (ac Voltages) ,IEC 61000-4-29 dc voltages)	IEC 60255-26,IEC 61000-4-11 (ac Voltages) ,IEC 61000-4-29 dc	3	1,2	-	-	Valid type test Reports shall be submitted to NPCIL for review and acceptance
		q.16) short interruptions	Major	Electrical	Sample 1 No	IEC 60255-26,IEC 61000-4-11 (ac Voltages) ,IEC 61000-4-29 dc voltages)	IEC 60255-26,IEC 61000-4-11 (ac Voltages) ,IEC 61000-4-29 dc	3	1,2	-	-	
		s) Emission (Radio frequency interference, RFI) test										
		1) Conducted emission at mains port	Major	Electrical	Sample 1 No	IEC/EN 60255-26/ EN 55011 Group 1/Class A	IEC/EN 60255-26/ EN 55011 Group 1/Class A	3	1,2	-	-	
		2) Conducted emission at telecommunication port	Major	Electrical	Sample 1 No	IEC/EN 60255-26/ EN 55011 Group 1/Class A	IEC/EN 60255-26/ EN 55011 Group 1/Class A	3	1,2	-	-	
		3) Radiated Emission (30-1000 Mhz)	Major	Electrical	Sample 1 No	IEC/EN 60255-26/ EN 55011 Group 1/Class A	IEC/EN 60255-26/ EN 55011 Group 1/Class A	3	1,2	-	-	
		4) Radiated Emission (1-6 Mhz)	Major	Electrical	Sample 1 No	IEC/EN 60255-26/ EN 55011 Group 1/Class A	IEC/EN 60255-26/ EN 55011 Group 1/Class A	3	1,2	-	-	
2	**INPROCESS INSPECTION**											
		Visual, Surface Finish & Dimensions	Major	Measurement	100%	Drawings and specifications / Quality Plan	Drawings and specifications / Quality Plan	4	1,2,3	-	-	Applicable to Bus Duct Only.
		Electrical Conductivity	Major	Measurement	one sample / Bay	Drawings and specifications / Quality Plan	Drawings and specifications / Quality Plan	3	1,2	-		
2.1	Bus Duct Pipe/tube & Bay Enclosure	Radiography testing on Base metal of head piece (Casting)	Major	NDT test	Two Samples / Bay	component Drawings / Written Practice/Specification , NPCIL Approved Procedure	component Drawings / Written Practice/Specification , NPCIL	4/3	1,2,3	2	1	

		Welding (Electrode Qualifications)	Major	Mechanical	Batch qualification	ASME SECTION IIC & IX,	ASME SECTION IIC & IX,	4,5	1,2,3	2	1	
		Welding (WPS/PQR/WPQ)	Major	Mechanical	Samples	ASME SECTION IX	ASME SECTION IX	4,5	1,2,3	2	1	
		Edge preparations & Welding of Joints	Major	Visual	100%	Drawings and specifications	Drawings and specifications	4	1,2,3	-	-	
2.1	Bus Duct Pipe/tube & Bay Enclosure	PT(Penetration test) on welding	Major	NDT	100%	ASME Section V	NPCIL Approved procedure	4	1,2,3	2	1	
		Radio graphy on welded portion	Major	Mechanical	25% of BUTT weld section	ASME SECTION V/ Tech spec. HPDS 4206	NPCIL Approved procedure	4	1,2,3	2	1	
		Pressure & Leak test	Major	Mechanical	100%	Drawings and specifications	Drawings and specifications	4	1,2,3	-	-	
		Painting Pre- treatment	Major	Mechanical and Visual	100%			4	1,2,3	-	-	
		Salt spray test for painting	Major	Chemical and Visual	One test coupon	720 hrs. IS0 12944-C5-M	720 hrs. ISO 12944-C5-M	5 / 4	1,2,3	2	-	
		Painting Test- Thickness, Adhesion	Major	Visual	100%	ISO 2409	ISO 2409	4	1,2,3	-	-	
2.2	Conductor(Bus Duct & Bay)	Visual, Surface Finish & Dimensions	Major	Visual/ Measurement	ISO 2859-1-Special Inspection Level S2	ISO 2768 and component Drawings/specifications	ISO 2768 and component Drawings/specifications	4	1,2,3	-	-	
		Electrical Conductivity	Major	Electrical	Sample	component Drawings/specifications	component Drawings/specifications	4	1,2,3	-	-	
		Silver Plating Surface Finish & Thickness	Major	Visual/ Measurement	One sample / lot	component Drawings/specifications	component Drawings/specifications	4	1,2,3	-	-	
		Copper spray _ Surface Finish & Thickness	Major	Visual/ Measurement	One sample / lot	Component Drawings/specifications	Approved Drawing	4	1,2,3	-	-	
		Visual	Major	Visual	100%	Drawing/specification & Standards	Manufacturer's Drawing/specification & Standards	4	1,2,3	-	-	

2.3	SUPPORT STRUCTURE	Welding (WPS/PQR/WPQ)	Major	Mechanical	100%	ASME SECTION IX	ASME SECTION IX	4	1,2,3	-	1	Qualification certificate will be submitted
		Welding joint verification	Major	Visual	100%	Drawings and specifications	Drawings and specifications	4	1,2,3	-	-	
		Thickness verification	Major	Visual	25%	Drawings and specifications	Drawings and specifications	4	1,2,3	-	-	
		PT on welds Joints	Major	NDT	10%	ASME section V	NPCIL Approved procedure	4	1,2,3	2	-	
2.3	SUPPORT STRUCTURE	Surface Pre- treatment	Major	Mechanical	100%	Pretreatment Drawings/specifications		4	1,2,3	-	-	
		Galvanizing Mass of coating, Coating thickness & Adhesion Test	Major	Physical/Visual/ Measurement	ISO 2859-1-Special Inspection Level S2	As per TS	As per TS	4	1,2,3	-	-	
2.4	Main assembly of GIS Bay (Main transport Unit with CB)	Assembly as per the Bay Drawing(HZ Drawing) and HSA (BOM).	Minor	Visual	100%	Drawings and specification /Approved Drawing	Drawings and specification /Approved Drawing	3	1,2	-	-	
		Check for Color shade	Minor	Visual	100%	Drawings and specification /Approved Drawing	Drawings and specification /Approved Drawing	3	1,2	-	-	
		Clearance according to assembly Drawing	Minor	Visual	100%	Drawings and specification /Approved Drawing	Drawings and specification /Approved Drawing	3	1,2	-	-	
		Check for cleanliness	Minor	Visual	100%			3	1,2	-	-	
		Torque application for hardware	Minor	Mechanical	100%	Manufactures drawings and specification of GIS/	drawings and specification of GIS/	3	1,2	-	-	
		Visual and Dimensions inspection	Major	Visual/ Measurement	100%	As per Approved Drawing	As per Approved Drawing	4	1,2,3	-	-	
		Welding of Joints	Major	Visual	100%			4	1,2,3	-	-	
		Paint Powder Coating thickness & Adhesion Test, Color shade	Major	Physical/Visual/ Measurement	ISO 2859-1-Special Inspection Level S2			4	1,2,3	-	-	

2.5	LOCAL CONTROL CUBICLE (LCC)	Mounting of components and Bill of Material Verification	Major	Mechanical	100%	As per Approved Drawing /Document	As per Approved Drawing /Document	4	1,2,3	-	-	
		Dielectric test for circuits(2kV) for 1 min.	Major	Electrical	100%	IEC 62271 -203 cl. 7-2 / 2 KV 50 HZ for 1 Minute withstand	IEC 62271 -203 cl. 7-2 / 2 KV 50 HZ for 1 Minute withstand	4	1,2,3	-	-	
		Continuity Check as per Scheme	Major	Electrical	100%	As per Approved Drawing	As per Approved Drawing	4	1,2,3	-	-	
3	**TYPE TESTS**											
3.1	Type Tests	Test to verify the insulation level of the equipment including partial discharge test and dielectric test viz. (i) Lightning impulse test (ii) One min. power frequency test (iii) Partial discharge test	Critical	Electrical	As per IEC/IS	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 a	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 a	5/3	1,2	-	1	Type Test Reports will be submitted to NPCIL for acceptance,
		Measurement of the Resistance of the Main Circuit & Earthing Circuit	Major	Electrical	As per IEC/IS	IEC 62271-1	IEC 62271-1	5/3	1,2	-	1	
		Mechanical Operation test at ambient temperature	Major	Electrical	As per IEC/IS	IEC 62271-1	IEC 62271-1	5/3	1,2	-	1	
		Tests to prove the temperature rise of any part of the equipment	Major	Electrical	As per IEC/IS	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 b	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 b	5/3	1,2	-	1	
		Test to prove the ability of the main and the earthing circuits to carry the rated peak and the rated short time withstand current for a line bay.	Critical	Electrical	As per IEC/IS	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 c	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 c	5/3	1,2	-	1	

Title: Indicative QAP for 400 kV and 230kV GIS and GIBD

Reference specification: Doc. No. I02.KK56.0.0.ET.TS.PR051 and I02.KK56.0.0.ET.TS.PR053

3.1	Type Test	Test to verify the making and breaking capacity of the included switching devices on a line bay(Circuit Breaker, Disconnector, HSES)	Critical	Electrical	As per IEC/IS	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 d	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 d	5/3	1,2	-	1	Type Test Reports will be submitted to NPCIL for acceptance,
		Test to prove the satisfactory operation of the included switching on a line bay	Critical	Electrical	As per IEC/IS	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 e	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 e	5/3	1,2	-	1	
		Tests to verify the protection of persons against contact with live parts and moving parts.	Major	Electrical	As per IEC/IS	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 f	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 f	5/3	1,2	-	1	
		Tests to prove the strength of enclosures (Bursting Test).	Critical	Electrical	As per IEC/IS	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 g & 5.11.2	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 g & 5.11.2	5/3	1,2	-	1	
		Short time withstand current and peak withstand current test	Critical	Electrical	As per IEC/IS	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 h	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 h	5/3	1,2	-	1	
		Test to verify the protection of the equipment against external effects due to weather and atmospheric agents.	Critical	Electrical	As per IEC/IS	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 i	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 i	5/3	1,2	-	1	

SL.NO	**COMPONENT**	**CHARACTERISTICS CHECKED**	**CATEGORY**	**METHOD OF CHECK**	**EXTENT OF CHECK**	**REFERENCE DOCUMENT**	**ACCEPTANCE NORM**	**AGENCY**				**REMARKS**
								P	**R**	**W**	**H**	
		Tests to prove the Radio Interference Voltage(RIV) Level	Major	Electrical	As per IEC/IS	Cl. No. 6.3 of IEC 62271-203 /NPCIL Spec. Clause No. 7.4.2 j	Cl. No. 6.3 of IEC 62271-203 /NPCIL Spec. Clause No. 7.4.2 j	5/3	1,2	-	1	Type Test Reports will be submitted to NPCIL for acceptance.
		Electro-Magnetic Compatibility Test (As per clause of 6.9.1.2 of IEC 62271-203/IEC 62271-1 emission tests are applicable to devices with electronic equipment)	Major	Electrical	As per IEC/IS	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 K	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 K	5/3	1,2	-	1	Type Test Reports will be submitted to NPCIL for acceptance.

3.1	TYPE TESTS	Tests to assess the effects of arcing due to an internal fault.	Critical	Electrical	As per IEC/IS	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 l	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 l	5/3	1,2	-	1	Type Test Reports will be submitted to NPCIL for acceptance,
		Tests to prove the thermal stability of solid insulation.	Critical	Electrical	As per IEC/IS	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 m	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2 m	5/3	1,2	-	1	
		Tests to prove satisfactory operation at limit Temperature(CB, DS, ES)	Critical	Electrical	As per IEC/IS	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2n	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2n	5/3	1,2	-	1	Type Test Reports will be submitted to NPCIL for acceptance,
		Gas Tightness test(CB, DS, ES, HSES)	Major	Electrical	As per IEC/IS	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2o	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2o	5/3	1,2	-	1	
		Salt Fog Test on outdoor insulators for pollution level specified in data sheet	Major	Electrical	As per IEC/IS	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2p	IEC 62271-203/ NPCIL Spec. Clause No. 7.4.2p	5/3	1,2	-	1	
SL.NO	**COMPONENT**	**CHARACTERISTICS CHECKED**	**CATEGORY**	**METHOD OF CHECK**	**EXTENT OF CHECK**	**REFERENCE DOCUMENT**	**ACCEPTANCE NORM**	**AGENCY**				**REMARKS**
								P	**R**	**W**	**H**	
4.0	**ROUTINE TESTS OF GIS(Transport Units)**											
4.1	GIS Bay and other modules (Circuit breaker, Current transformer, Earthing switches, Disconnectors, and Passive Modules)	Visual checks	Major	Visual	100%	Approved Drawings and specifications / Approved FAT	Approved Drawings and specifications /	3	1,2	-	-	
4.2	All Transport units of Each typical bay	Overall Dimension check	Major	Measurement	All Transport units of Each typical bay	Drawings and specifications / Approved FAT Procedure	Drawings and specifications / Approved FAT Procedure	3	1,2	-	-	

4.3	GIS Bay and other modules (Circuit breaker, Current transformer, Earthing switches, Disconnectors, and Passive Modules)	Gas tightness check in all shipments	Major	Mechanical	100%	IEC 62271-203-7.4/ Approved FAT Procedure	IEC 62271-203-7.4/ Approved FAT Procedure	3	1,2	-	-	
4.4	GIS Bay and other modules (Circuit breaker, Current transformer, Earthing switches, Disconnectors, and Passive Modules)	Voltage Drop Measurement (contact resistance) for the Bay & other shipments	Major	Electrical	100%	IEC 62271-203-7.3/ Approved FAT Procedure	IEC 62271-203-7.3/ Approved FAT Procedure	3	1,2	-	-	
4.5	GIS Bay and other modules (Circuit breaker, Current transformer, Earthing switches, Disconnectors, and Passive Modules)	Resistance verification of main circuits	Major	Electrical	10%	IEC 62271-203 Approved FAT Procedure	IEC 62271-203 /Approved FAT Procedure	3	1,2	-	-	Resistance of main circuit shall be calculated from Voltage drop
4.6	GIS Bay and other modules (Circuit breaker, Current transformer, Earthing switches, Disconnectors, and Passive Modules)	High Voltage Test for the Bay & other shipments & 2kV for Auxiliary circuits	Major	Electrical	100%	IEC 62271-203-7.1 / Approved FAT Procedure	IEC 62271-203-7.1 /Approved FAT Procedure	3	1,2	-	-	
4.7	GIS Bay and other modules (Circuit breaker, Current transformer, Earthing switches, Disconnectors, and Passive Modules)	Partial Discharge Measurement for the Bay & other shipments,	Major	Electrical	100%	IEC 62271-203// Approved FAT Procedure	IEC 62271-203// Approved FAT Procedure	3	1,2	-	-	
		Visual and Dimensions	Major	Visual/ Measurement	100%	As per Approved Drawing and Quality plan	As per Approved Drawing and Specification	3	1,2	-	-	

4.8	LCC	Bill of Material Verification	Major	Visual	100%	As per Approved Drawing / Document	As per Approved Drawing / Document	3	1,2	-	-	
		Dielectric test for circuits (2kV) for 1 min.	Major	Verification/Interlocks	100%	IEC 62271 -203 cl. 7-2 / 2 KV 50 HZ for 1 Minute withstand	IEC 62271 -203 cl. 7-2 / 2 KV 50 HZ for 1 Minute withstand	3	1,2	-	-	
		Continuity Check as per Scheme	Major	Electrical	100%	As per Approved Drawing/Approved FAT	As per Approved Drawing / Approved FAT Procedure	3	1,2	-	-	
		Coating Thickness	Major	Mechanical	100%	As per Approved Drawing and Speifications	As per Approved Drawing and peifications	3	1,2	-	-	
		Operational checks & interlock checking, Functional tests of auxiliaries including Alarm & trip circuit with BCU	Major	Electrical	100%	As per Approved Drawing and Specification	As per Approved Drawing and Specification	3	1,2	-	-	
		Insulation Resistance test	Major	Electrical	100%	500 V DC, IR > 1 M ohm	500 V DC, IR > 1 M ohm	3	1,2	-	-	
5.0	**FACTORY ACCEPTANCE TESTS**											
5.1	GIS Bay and other modules (Circuit breaker, Current transformer, Earthing switches, Disconnectors, and Passive Modules)	Design and visual checks	Major	Visual / Measurement	10%	Approved Drawings and specifications /Approved FAT Procedure	Approved Drawings and specifications /Approved FAT Procedure	3	-	1,2	-	
5.2	GIS Bay and other modules (Circuit breaker, Current transformer, Earthing switches, Disconnectors, and Passive Modules)	Resistance verification of main circuits and earthing circuit	Major	Electrical	10%	IEC 62271-203 / NPCIL Spec Cl. 7.4.4 g//Approved FAT Procedure	IEC 62271-203 / NPCIL Spec Cl. 7.4.4 g /Approved FAT Procedure	3	-	1,2	-	

5.3	GIS Bay and other modules (Circuit breaker, Current transformer, Earthing switches, Disconnectors, and Passive Modules)	Gas tightness check in all Shipments	Major	Mechanical	10%	IEC 62271-203-7.4, Manufacturer Document AA0921//Approved FAT Procedure	IEC 62271-203-7.4, Manufacturer Document AA0921//Approved FAT Procedure	3	-	1,2	-	
5.4	GIS Bay and other modules (Circuit breaker, Current transformer, Earthing switches, Disconnectors, and Passive Modules)	Voltage Drop Measurement for the Bay & other Shipments	Major	Electrical	10%	IEC 62271-203-7.3, Manufacturer Document AA1060//Approved FAT Procedure	IEC 62271-203-7.3, Manufacturer Document AA1060//Approved FAT Procedure	3	-	1,2	-	
5.5	GIS Bay and other modules (Circuit breaker, Current transformer, Earthing switches, Disconnectors, and Passive Modules)	High Voltage Test for the Bay & other shipments	Major	Electrical	10%	IEC 62271-203-7.1//Approved FAT Procedure	IEC 62271-203-7.1//Approved FAT Procedure	3	-	1,2	-	
5.6	GIS Bay and other modules (Circuit breaker, Current transformer, Earthing switches, Disconnectors, and Passive Modules)	Partial Discharge Measurement for the Bay & other shipments	Major	Electrical	10%	IEC 62271-203//Approved FAT Procedure	IEC 62271-203//Approved FAT Procedure	3	-	1,2	-	
		Visual and Dimensions	Major	Visual/ Measurement	10%	As per Approved Drawing and Qualitity plan	As per Approved Drawing and Specification	3	-	1,2	-	
		Bill of Material Verification	Major	Visual	10%	As per Approved Drawing / Document	As per Approved Drawing / Document	3	-	1,2	-	
		Dielectric test for circuits(2kV) for 1 min.	Major	Verification/Interlocks	10%	IEC 62271 -203 cl. 7-2 / 2 KV 50 HZ for 1 Minute withstand / Approved FAT Procedure	IEC 62271 -203 cl. 7-2 / 2 KV 50 HZ for 1 Minute withstand / Approved FAT Procedure	3	-	1,2	-	

5.7	LOCAL CONTROL CUBICLE (LCC) including BCU	Continuity check as per Scheme	Major	Measure	10%	As per Approved Drawing / and Qualitity plan/ Approved FAT Procedure	As per Approved Drawing / Approved FAT Procedure	3	-	1,2	-	
		Insulation Resistance test	Major	Electrical	10%	IEC 60204 -1 cl. 18.3 / 500 V DC, IR > 1 M ohm	IEC 60204 -1 cl. 18.3 / 500 V DC, IR > 1 M ohm	3	-	1,2	-	
		Functional tests of all auxiliaries including Alarm & trip circuit with BCU	Major	Measure	1 random sample selected by NPCIL	Approved Routine Test Procedure for BCU-230 KV GIS	Approved Routine Test Procedure for BCU-230 KV GIS	3	-	1,2	-	
5.8	GIS Bay and other modules (Circuit breaker, Current transformer, Earthing switches, Disconnectors, and Passive Modules)	Interchangeability of bay components	Major	Certificate	Same part codes	As per approved drawing	Similar parts/components shall be interchangable	3	1,2	-	-	Manufacturer's declaration for interchangeability of components having same part codes
	Note:-	**Factory Acceptance Tests and Routine Tests shall be performed on Transport Shipment Units**										
6.0	**Special Test**											
6.1	Seismic analysis report	Seismic analysis report	Critical	Analysis	Report	IEC 62271-203/ NPCIL Specification	IEC 62271-203/ NPCIL Specification	3	1,2	-	-	
7.0	**END DOCUMENTS**											
7.1	Packing list	-	Major	Visual	100 % Materials	Manufacturer Standards	Manufacturer Standards	2	1	2	-	

7.2	Routine Test Certificates	-	Major	Visual	As per approved QAP	As per approved QAP	As per approved QAP	3	1,2	-	-	
7.3	Acceptance Test Certificates	-	Major	Visual	As per approved QAP	As per approved QAP	As per approved QAP	3	1.2	1.,2	-	
7.4	Type Test Reports	-	Major	Visual	As per NPCIL Specifications	As per NPCIL Specifications/As per approved QAP	As per NPCIL Specifications/As	3	1,2	-	-	
7.5	Inspection Report	-	Major	Visual	-	PSQM-Supply	PSQM-Supply	2	1.2	1.,2	-	
7.6	Shipping Release note	-	Critical	Visual	-	PSQM-Supply	PSQM-Supply	2	1	-	1	
7.7	Shipping Relase		Critical	Visiual	-	NPCIL Formate	NPCIL Formate	1	-	-	-	
7.7	PACKING	-	Major	Visual	Sampling	Manufacturer Standards	Manufacturer Standards	3	-	2	-	
7.8	TRANSPORTATION	-	Major	Visual	Sampling	Manufacturer Standards	Manufacturer Standards	3	-	2	-	
7.9	DOCUMENTATION	-	Major	Visual	Sampling	Manufacturer Standards	Manufacturer Standards	3	1	2	-	

Sl. No.	Item / Parameter	Unit	Value
1.0	**GUARANTEED OPEARATING CONDITIONS**		
1.1	Nominal system voltage	kV (rms)	400
1.2	Highest system voltage	kV (rms)	420
1.3	Rated frequency	Hz	50
1.4	Rated continuous current (Bus bars)	A	5000
1.5	Grounding		Effectively earthed
1.6	No of phases		3
1.7	Earthing conductor size and material		As per approved drawing
1.8	Rated power frequency withstand voltage (1min) as per IEC:62271-203		
i	Phase-to-earth and between phases (Ph-Ph : As applicable)	kV (rms)	650
ii	Across open switching device and/or isolating distance	kV (rms)	815
1.9	Rated lightning impulse withstand voltage (1.2/50 μsec.) as per IEC:62271-203		
i	Phase to earth and between phases (Ph-Ph : As applicable)	kV_P	1425
ii	Across open switching device and/or isolating distance	kV_P	1425 (+240)
1.10	Rated switching impulse withstand voltage (250/2500 μsec.) as per IEC:62271-203		
i	Phase to earth and across open switching device	kV_P	1050
ii	Between phases (Ph-Ph : As applicable)	kV_P	
iii	Across the isolating distance	kV_P	900 (+345)
1.11	Rated short time withstand current	kA (rms)	Minimum 63
1.12	Rated peak withstand current	kA_P	170
1.13	Rated duration of short circuit	s	1 sec
1.14	Altitude above MSL	m	Not more than 1000m
1.15	Humidity	%	90
1.16	Seismic category		As per TS for 400kV GIS and GIBD (I02.KK56.0.0.ET.TS.PR051)
1.17	Maximum ambient temperature	°C	41.85
1.18	Minimum ambient temperature	°C	16.21
1.19	Design ambient temperature	°C	45

NOT FOR PUBLICATION/PRESENTATION OUTSIDE NPCIL

Sl. No.	Item / Parameter	Unit	Value
1.20	Environment		Humid, tropical, corrosive and polluted
1.21	Service life		Not less than 30 years
2.0	**GENERAL DATA**		
2.1	Installation	Type	GIS -Indoor GIBD- Indoor + Outdoor
2.2	Type of Construction		Modular design with complete phase isolation
2.3	Reference Standards		IEC 62271-203, IEC 62271-209, IEC 62271-211, IEC 62271-1 etc.
2.4	Rated service current		
i	Bus bar	A	5000
ii	Transmission line feeder	A	2000
	Switchable line reactor feeder	A	1000
iii	Generator transformer feeder	A	2000
iv	Shunt reactor feeder	A	1000
2.5	Bus bar conductor material Enclosure material		Al Alloy
2.6	Internal fault withstand time without burn through	s	≤ 0.1 as per IEC 62271-203
	Internal fault withstand time (No fragmentation but burn through is acceptable)		≤ 0.3
2.7	Temperature rise at rated service current over 45ºC		As per IEC 62271-203 / 62271-1
i	Conductor	°C	≤ 60
ii	Enclosure	°C	≤ 25
2.8	Rated SF_6 filling pressure		
i	Circuit breaker	MPa	
ii	Other compartments	MPa	
2.9	Alarm pressure (Lower and upper)		
i	Circuit breaker	MPa	
ii	Other compartments	MPa	
2.10	Minimum pressure at which the rated insulation level is retained (with tolerances)		
i	Circuit breaker	MPa	
ii	Voltage Transformer	MPa	

NOT FOR PUBLICATION/PRESENTATION OUTSIDE NPCIL

Sl. No.	Item / Parameter	Unit	Value
iii	Other compartments	MPa	
	Gas Refill Pressure CB compartment Other Compartment	 MPa MPa	
2.11	Bus bar SF_6 gas pressure at 20° C		
i	Maximum (bursting disc operating pressure)	MPa	
ii	Rated	MPa	
iii	Minimum	MPa	
2.12 i ii	Design pressure of enclosures Circuit breaker Other compartments	 MPa MPa	
2.13	Maximum SF_6 leakage rate (for whole equipment and any individual gas compartment)	% / year	< 0.5(IEC 62271-203)
2.14 i ii	Type test pressure of enclosures Circuit breaker Other compartments	 MPa MPa	
2.15 i ii	Routine test pressure of enclosures Circuit breaker Other compartments	 MPa MPa	
2.16 i ii	Operating pressure of pressure relief device Circuit breaker Other compartments	 MPa MPa	
2.17	Internal fault short circuit current	kA	
2.18	Quantity of SF_6 gas of complete GIS at filling pressure	kg	
2.19	Quantity of SF_6 gas of largest compartment at filling pressure	kg	
2.20	Maximum permissible gas dew point	°C	
2.21	Number of gas compartments		
2.22	Length of longest section for transportation	m	
2.23	Weight of the heaviest piece of equipment to be handled during installation on-site	kg	
2.24	Maximum partial discharge level	pC	≤ 10
2.25 i ii	Dielectric Testing Factory dielectric routine test 50Hz Site dielectric test	 kV kV	 650 520 (As per IEC 62271-203)

NOT FOR PUBLICATION/PRESENTATION OUTSIDE NPCIL

Sl. No.	Item / Parameter	Unit	Value
iii	Rated test voltage of secondary circuit	kV	2 (As per IEC 62271-203/ 62271-1)
2.26	Painting of GIS - GIBD enclosures		
i	Coating design and execution		Epoxy based paint.
ii	Top coat colour	RAL	7032
iii	Surface protection of steel frames and supports		Hot-dip Galvanizing The minimum thickness of Zinc coating shall be120 microns for elements of thickness 5mm and more The minimum thickness of Zinc coating shall be 85 microns for elements of thickness less than 5mm.
2.27	Auxiliary voltages		
i	For motor drive of disconnectors and earthing switches	V DC/AC	
ii	For circuit breakers	V DC/AC	
iii	For disconnectors and earthing switches	V DC/AC	
iv	For controlling and signalling	V DC/AC	
v	For remote control	V DC/AC	
vi	For heating (LCC only)	V DC/AC	
2.28	Material of insulator		Epoxy resin
2.29	Type of joints between adjacent sections		Flanged, with high pressure O-ring seals
2.30	O-Ring Material		
3.0	**CIRCUIT BREAKER**		
3.1	Type of drive mechanism (Refer ** below for requirements/ essential parameters of drive mechanism)		Spring charged mechanism
**	i. Shall be housed in a dust proof cabinet and shall have IP42 degree of protection. ii. Shall be strong, rigid, not subject to rebound or to critical adjustments at site and shall be readily accessible for maintenance.		Vendor to confirm

Sl. No.	Item / Parameter	Unit	Value
	iii. Shall be suitable for high speed reclosing and other duties specified. During reclosing the breaker contacts shall close fully and then open. iv. Shall be anti-pumping and trip free (as per IEC definition) under every method of closing. v. Shall be such that the failure of any auxiliary spring will not prevent tripping and will not cause trip or closing operation of the power operating devices. vi. Working parts of the mechanism shall be of corrosion resisting material, bearings which require grease shall be equipped with pressure type grease fittings. Bearing pin, bolts, nuts and other parts shall be adequately pinned or locked to prevent loosening or changing adjustment with repeated operation of the breaker. vii. A mechanical indicator shall be provided to show open/close positions of the breaker.		
3.2	No. of circuit breakers		Refer SLD I02.KK56.0.0.ET.OKP.WD004
3.3	No. of poles		3
3.4	No. of interrupters per pole		1
3.5	Type of circuit breaker		SF_6
3.6	Rated voltage	kV (rms)	420
3.7	Rated current at design ambient temperature	A	3150
3.8	Short-circuit breaking current	kA	63
3.9	Rated short circuit making current	kA_P	170

Sl. No.	Item / Parameter	Unit	Value
3.10	Rated line charging interrupting current at 90 degree leading power factor angle	A rms	400 as per IEC 62271-100
3.11	Reclosing		Single phase & Three phase auto reclosing
3.12	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz at 156kV	μV	≤1000 as per IEC 62271-1 (Applicable for SF6 to air bushing)
3.13	Max. difference in the instants of closing/ opening of contacts at rated control voltage and rated operating/ quenching media pressure for:	ms	
i	(within a pole not applicable for CBs with Single break interrupter)		
ii	between poles		
3.14	Trip coil and closing coil voltage	V DC	220
3.15	No. and rating of potential free auxiliary contacts		Each circuit breaker pole shall be provided with an auxiliary switch with 20% spare NO & 20% spare NC contacts for use in future (Min. 6 NO & 6 NC).
3.16	Rated power frequency withstand voltage (1min.) as per IEC 62271-203		
i	Phase-to-earth and between phases (Ph-Ph : As applicable)	kV (rms)	650
ii	Across open switching device and/or isolating distance	kV (rms)	815
3.17	Rated lightning impulse withstand voltage (1.2/50μsec.) as per IEC 62271-203		
i	Phase to earth and between phases (Ph-Ph : As applicable)	kV_P	1425
ii	Across open switching device and/or isolating distance	kV_P	1425 (+240)
3.18	Rated switching impulse withstand voltage (250/2500μsec.) as per IEC 62271-203		
i	Phase to earth and across open switching device	kV_P	1050

NOT FOR PUBLICATION/PRESENTATION OUTSIDE NPCIL

Sl. No.	Item / Parameter	Unit	Value
ii	Between phases (Ph-Ph : As applicable)	kV_P	
iii	Across the isolating distance	kV_P	900 (+345)
3.19	Short circuit DC component time constant	ms	As per IEC 62271-100 (% of DC component corresponds to minimum opening condition)
3.20	% DC component at contact separation		To be decided based on minimum opening time as declared by manufacturer
3.21	First-pole-to-clear factor (for terminal fault) as per IEC 62271-100		1.3
3.22	Rated breaking time	ms	
3.23	Rated opening time	ms	
3.24	Rated closing time	ms	
3.25	Dead time at high speed automatic reclosing	ms	
3.26	Open – Close time at automatic reclosing	ms	
3.27	Time difference of poles' operation of the CBs		
i	at closing	sec.	
ii	at opening	sec.	
3.28	Operating sequence		O-0.3s-CO-3min-CO
3.29	Operating sequence without auxiliary supply		O-CO
3.30	Coil for opening circuit		2
3.31	Coil for closing circuit		1
3.32	Current of the tripping coil		
3.33	Current of the closing coil		
3.34	Material for main contacts		
3.35	Material for arcing contacts		
3.36	Transient recovery voltage (TRV)		As per IEC 62271-100
i	First pole to clear factor		
-	at terminal fault		1.3
-	short line fault		1
-	out of phase fault		2
ii	Peak value Uc	kVp	
-	at terminal fault		624
-	short line fault		480
-	out of phase fault		857

NOT FOR PUBLICATION/PRESENTATION OUTSIDE NPCIL

Sl. No.	Item / Parameter	Unit	Value
iii	Rate of rise: at terminal and short line fault	kV/µs	2 and 2/1.8
iv	Rate of rise: at out of phase	kV/µs	1.54
3.37	Short line fault		As per IEC 62271-100
i	Surge impedance	Ω	450
ii	Peak factor		1.6
3.38	Out of phase breaking current (Please specify voltage factor also)	kA	As per IEC 62271-100
3.39	Rated line charging breaking current (Please specify voltage factor also)	A	
3.40	Small inductive breaking current (Please specify voltage factor also)	A	
3.41	Fixed trip/ Trip free		Trip free
3.42	SF_6 gas pressure at 20°C		
i	Maximum	MPa	
ii	Rated	MPa	
iii	Minimum	MPa	
3.43	Operation counter (non-settable)	Five digit	Required
3.44	Auxiliary contacts (auxiliary switch shall also comply with requirements as given independent single pole reversible contacts)		Each circuit breaker pole shall be provided with an auxiliary switch with 20% of spare NO and 20% spare NC contacts for use in future.
3.45	Rating of Auxiliary contacts		
3.46	Breaking capacity of aux contacts		
3.47	System neutral earthing		Effectively earthed
3.48	Reference Standard		IEC 62271-100
4.0	**DISCONNECTOR (ISOLATOR)**		
4.1	Rated voltage (rms) Un	kV	420
4.2	Rated frequency	Hz	50
4.3	No. of Poles	Nos.	3
4.4	Type		SF_6 insulated
4.5	Operation		Single pole gang operated (Electrical)
4.6	No. of isolators with rating		Refer SLD I02.KK56.0.0.ET.OKP.WD004

NOT FOR PUBLICATION/PRESENTATION OUTSIDE NPCIL

Sl. No.	Item / Parameter	Unit	Value
4.7	Rated continuous current at design ambient temperature	A	3150
4.8	Rated short time withstand current, 1 sec.	kA	63
4.9	Rated dynamic short circuit withstand current	kAp	170
4.10	Rated mechanical terminal load	As per IEC 62271-102	Vendor to indicate
4.11	No. of spare auxiliary contacts on each isolator	No.	4 NO & 4 NC
4.12	Withstand voltages as per IEC 62271-203		
i	at power frequency, 1 min.		
-	Phase-to-earth and between phases (Ph-Ph : As applicable)	kV (rms)	650
-	Across open switching device and/or isolating distance	kV (rms)	815
ii	at lightning impulse (1.2/50 μs wave)		
-	Phase to earth and between phases (Ph-Ph : As applicable)	kV_P	1425
-	Across open switching device and/or isolating distance	kV_P	1425 (+240)
iii	at switching impulse (250/2500 μs wave)		
-	Phase to earth and across open switching device	kV_P	1050
-	Between phases (Ph-Ph : As applicable)	kV_P	
-	Across the isolating distance	kV_P	900 (+345)
4.13	Inductive current switching capacity (If applicable)	A	
4.14	Capacitive current switching capacity	A	
4.15	Auxiliary power supply voltage	V DC	220
4.16	Bus transfer switching capacity		
4.17	Magnetizing current (If applicable)		
4.18	Capacitive current make and break capacity (Please specify voltage factor also)		
4.19	Operating time		
i	Opening time	sec.	
ii	Closing time	sec.	
4.20	Minimum cumulative mechanical operation duty in cycles without maintenance		

NOT FOR PUBLICATION/PRESENTATION OUTSIDE NPCIL

Sl. No.	Item / Parameter	Unit	Value
4.21	SF_6 gas pressure at 20°C		
i	Maximum	MPa	
ii	Rated	MPa	
iii	Minimum	MPa	
4.22	Operation counter	5 digit	Required
4.23	Reference Standard		IEC 62271-102
5.0	**SAFETY EARTHING SWITCH**		
5.1	Rated voltage (rms) Un	kV	420
5.2	Rated frequency	Hz	50
5.3	No. of Poles	Nos.	3
5.4	Type		SF_6 insulated
5.5	Operation		Single pole gang operated (Electrical)
5.6	No. of safety earthing switches with rating		Refer SLD I02.KK56.0.0.ET.OKP.WD004
5.7	Rated short time withstand current rating	kA	63
5.8	Rated duration of short circuit	s	1
5.9	Rated peak withstand current	kA_P	170
5.10	Withstand voltages as per IEC 62271-203		
i	at power frequency, 1 min.		
-	Phase-to-earth and between phases (Ph-Ph : As applicable)	kV (rms)	650
-	Across open switching device and/or isolating distance	kV (rms)	815
ii	at lightning impulse (1.2/50 μs wave)		
-	Phase to earth and between phases (Ph-Ph : As applicable)	kV_P	1425
-	Across open switching device and/or isolating distance	kV_P	1425 (+240)
iii	at switching impulse (250/2500 μs wave)		
-	Phase to earth and across open switching device	kV_P	1050
-	Between phases (Ph-Ph : As applicable)	kV_P	
-	Across the isolating distance	kV_P	900 (+345)
5.11	Mechanical endurance class		Class M2 (10000 cycles)
5.12	No. of spare auxiliary contacts on each earth switch	No.	6 NO & 6 NC

NOT FOR PUBLICATION/PRESENTATION OUTSIDE NPCIL

Sl. No.	Item / Parameter	Unit	Value
5.13	Type of motor drive		As per type tested design
5.14	Auxiliary power supply for control, interlock, motor drive	V DC	220
5.15	SF_6 gas pressure at 20°C		
i	Maximum	MPa	
ii	Rated	MPa	
iii	Minimum	MPa	
5.16	Operation counter	5 digit	Required
5.17	Reference Standard		IEC 62271-102
5.18	Type and scope of interlock with the circuit breaker and disconnector Electrically interlocked with its associated disconnector and circuit breaker such that it can only be closed if both the circuit breaker and disconnector are in open position.		
6.0	**HIGH SPEED, MAKE PROOF EARTHING SWITCH (To be provided on transmission lines)**		
6.1	Rated voltage (rms) Un	kV	420
6.2	Rated frequency	Hz	50
6.3	No. of Poles	Nos.	3
6.4	Type		SF_6 insulated
6.5	Operation		Single pole gang operated (Electrical)
6.6	No. of high speed earthing switches with rating		Refer SLD I02.KK56.0.0.ET.OKP.WD004
6.7	Rated short time withstand current rating	kA	63
6.8	Rated duration of short circuit	s	1
6.9	Rated peak withstand current	kA_P	170
6.10	Rated making current	kA	170
6.11	Rated electromagnetic induced current	A (rms)	160 (As per IEC 62271-102)
6.12	Rated electromagnetic induced voltage	V (rms)	10 (As per IEC 62271-102)
6.13	Rated electro static induced current	A (rms)	18 (As per IEC 62271-102)
6.14	Rated electro static induced voltage	V (rms)	20 (As per IEC 62271-102)
6.15 i -	Withstand voltages as per IEC 62271-203 at power frequency, 1 min. Phase-to-earth and between phases (Ph-Ph : As applicable)	kV (rms)	650

NOT FOR PUBLICATION/PRESENTATION OUTSIDE NPCIL

Sl. No.	Item / Parameter	Unit	Value
-	Across open switching device and/or isolating distance	kV (rms)	815
ii	at lightning impulse (1.2/50 μs wave)		
-	Phase to earth and between phases (Ph-Ph : As applicable)	kV_P	1425
-	Across open switching device and/or isolating distance	kV_P	1425 (+240)
iii	at switching impulse (250/2500 μs wave)		
-	Phase to earth and across open switching device	kV_P	1050
-	Between phases (Ph-Ph : As applicable)	kV_P	1575
-	Across the isolating distance	kV_P	900 (+345)
6.16	Mechanical endurance class		Class M1
6.17	Short circuit making capability		Class E2 (5 making operations)
6.18	No. of spare auxiliary contacts on each earth switch	No.	6 NO & 6 NC
6.19	Type of motor drive		As per type tested design
6.20	Auxiliary power supply for control, interlock, motor drive	V DC	220
6.21	SF_6 gas pressure at 20°C		
i	Maximum	MPa	
ii	Rated	MPa	
iii	Minimum	MPa	
6.22	Operation counter	5 digit	Required
6.23	Reference Standard		IEC 62271-102
6.24	Type and scope of interlock with the circuit breaker and disconnector Electrically interlocked with its associated disconnector and circuit breaker such that it can only be closed if both the current breaker and disconnector are in open position. Provision shall be made for padlocking the earthing switches in their open/ closed position)		
7.0	**CURRENT TRANSFORMERS**		
7.1	Standard		IEC 61869
7.2	Type designation		
7.3	Rated voltage Un	kV (rms)	420
7.4	Rated frequency	Hz	50
7.5	System neutral earthing		Effectively earthed
7.6	Type		SF_6 insulated
7.7	No. of Cores	Nos.	5/Split core

Sl. No.	Item / Parameter	Unit	Value
7.8	No. of current transformers with rating		Refer SLD I02.KK56.0.0.ET.OKP.WD004
7.9	Rated short time thermal current for 1 sec.	kA	63
7.10	Rated dynamic current for 1 sec.	kA_P	170
7.11	Rated insulation levels		
i	1.2/50 micro second impulse voltage for primary winding	kV_P	1425
ii	1 minute power frequency withstand voltage for primary winding	kV (rms)	650
iii	250/2500 micro second switching impulse voltage (dry & wet)	kV_P	1050
7.12	One minute power frequency withstand voltage for secondary winding	kV (rms)	3
7.13	Rated primary current	A (rms)	Please refer Table-1
7.14	Secondary core details		Please refer Table-1
i	Ratio		
ii	No. of secondary cores		
iii	Rated secondary current	A	
iv	Rated VA burden on each core	VA	
v	Accuracy class		
vi	Accuracy limit factor		
vii	Knee point voltage (volts)	V	
viii	Magnetizing current (mA) at 100% of knee point voltage or reduced knee point voltage	mA	
ix	Secondary resistance at 75 °C (ohms)	Ohms	
x	Secondary limiting voltage	Volts	
7.15	Maximum temperature rise of windings over an ambient temperature of 41.85°C	°C	As per IEC 61869 Table–5 Cl.no. 6.4.1
7.16	Radio interference voltage at $1.1Un/\sqrt{3}$ and frequency range 0.5 to 2 MHz	µV	If applicable
7.17	One minute power frequency withstand voltage between secondary terminal and earth	kV (rms)	5
7.18	Partial discharge level	pC	<=10
7.19	SF_6 Gas Pressure in CT compartment		
i	Maximum	MPa	
ii	Minimum	MPa	

NOT FOR PUBLICATION/PRESENTATION OUTSIDE NPCIL

Sl. No.	Item / Parameter	Unit	Value
iii	Rated	MPa	
7.20	Permissible SF_6 gas leakage per year	%	< 0.5
7.21	Winding insulation class		'E' As per IEC 60085
7.22	Material of core		
7.23	Material of winding		
7.24	Instrument Security Factor (ISF) for metering core		< 5
7.25	Dimension factor (K) of winding for protection		
7.26	Total error value at limit factor current	%	≤ 10
7.27	Test voltage withstood duration of 1 minute by secondary windings		
8.0	**VOLTAGE TRANSFORMERS**		
8.1	Rated system voltage Un	kV (rms)	420
8.2	Type		Electromagnetic with SF_6 gas insulation
8.3	Rated frequency	Hz	50
8.4	System neutral earthing		Effectively earthed
8.5	No. of voltage transformers with rating		Refer SLD I02.KK56.0.0.ET.OKP.WD004
8.6	System fault level (for 1 sec.)	kA	63
8.7	Rated insulation levels		
i	1.2/50 micro second impulse voltage for primary winding	kV_P	1425
ii	1 minute power frequency withstand voltage for primary winding	kV (rms)	650
iii	250/2500 micro second switching impulse voltage (dry & wet)	kV_P	1050
8.8	One minute power frequency withstand voltage for secondary winding	kV (rms)	3
8.9	Radio interference voltage at 1.1Un/√3 and frequency range 0.5 to 2 MHz	µV	If applicable
8.10	Rated total thermal burden	VA	400
8.11	Partial discharge level	pC	<=10
8.12	Rated primary voltage	kV	400/sqrt 3
8.13	Secondary winding details		Please refer Table-2
i	Ratio	kV/V	

Sl. No.	Item / Parameter	Unit	Value
ii iii iv v vi vii viii	No. of secondary windings Rated secondary voltage Accuracy class VA burden Accuracy at rated burden Method of connection Secondary cable type and size Ultimate output of the transformer	Nos. V VA	
8.14	Rated voltage factor and time		1.2 continuous/ 1.5 for 30 sec
8.15	Class of winding insulation		'E' As per IEC 60085
8.16 i ii iii	SF_6 Gas Pressure in VT compartment Maximum Minimum Rated	 MPa MPa MPa	
8.17	Permissible SF_6 gas leakage per year	%	< 0.5
8.18	Max. temperature rise of winding		As per IEC 61869
8.19	Reference Standard		IEC 62271-203, IEC 62271-209, IEC 62271-211, IEC 62271-1 ,etc. IEC 61869
9.0	**GAS INSULATED BUSDUCT (CONNECTION BETWEEN GIS AND TRANSFORMERS)**		
9.1	Installation		Indoor/ Outdoor
9.2	Type		Isolated Phase, Metal Clad bus duct
9.3	Insulation		SF_6 gas
9.4	Rated voltage	kV	420
9.5	Rated service/ normal current	A	2000
9.6	Rated short time withstand current for 1 sec.	kA (rms)	63
9.7	Rated peak withstand current	kV_P	170
9.8	Cooling		Forced ventilation is provided in tunnels only.
9.9	Material		Aluminium based
9.10	Ingress Protection class as per IEC 529		IP54 (Min)
9.11	Lightning impulse withstand voltage (Up) :		

Sl. No.	Item / Parameter	Unit	Value
i	Phase to Earth and between phases (Ph-Ph : As applicable)	kV_P	1425
9.12 i	Switching impulse(Us): Phase to earth	 kV_P	 1050
9.13 i	Power frequency withstand voltage (Ud) dry/ wet: Phase to earth and between phases	 kV rms	 630
9.14	Heat dissipation at the rated current of 2000A and ambient temperature of 40 °C for unit length of one phase (not more than)	kW/m	0.045
9.15	Fire load (not more) (per sq. meter of floor area)	MJ/m^2	160
9.16	Creepage distance for end terminal insulators (IEC 815), (not less than)	cm/kV	3.1
9.17	Partial discharge intensity for rms voltage		
9.18	Enclosure design pressure		
9.19	Enclosure design code		
9.20	Permissible SF_6 gas leakage per year	%	< 0.5
9.21 i ii iii iv v	Material Bus duct Enclosure Supports Conductor Insulator		
9.22	Thickness of enclosure wall (For GIS, GIBD and GIBD flange)		
9.23	Approx. diameter of the enclosure/ conductor		
9.24	Burn through time		
9.25	Expansion/ compensation bellows		Required for erection as well as thermal expansion
9.26	Capacitance, Inductance and Surge Impedance		
9.27	Painting for the enclosure	RAL	7032
9.28	Degree of protection of enclosure		IP65 (Min)
9.29	Type of grounding		
9.30	Type of joints between adjacent sections		
9.31	Service life in years		

NOT FOR PUBLICATION/PRESENTATION OUTSIDE NPCIL

Sl. No.	Item / Parameter	Unit	Value
9.32	Bus duct length	m	
9.33	90^o bends	Nos.	
9.34	Intended maximum parameters		
	Maximum diameter of bus duct	mm	400 (To be finalized during detail engineering)
	Maximum distance between phases (not more)	mm	740 (To be finalized during detail engineering)
	Mass per meter	kg/m	150 (To be finalized during detail engineering)
	Load on each support on tunnel slab (for 3 phases)	kg	1000 (To be finalized during detail engineering)
	Total length (sum of the lengths of three phases for Unit 3)	m	2100 (To be finalized confirmed during detail engineering)
	Total length (sum of the lengths of three phases for Unit 4)	m	1500 (To be finalized during detail engineering)
10.0	**SF_6 TO AIR BUSHING**		
10.1	Make		
10.2	Model		
10.3	Type		SF6 gas filled Silicon composite/condenser
10.4	Rated voltage	kV	420
10.5	Rated normal current	A	2000
10.6	Rated short time withstand current (1 sec)	kA	63
10.7	Rated peak withstand current	kAp	170
10.8	Material of the enclosure		Al
10.9	Material of the insulator		Ceramic/Composite
10.10	Insulating Medium		SF_6
10.11	Lightning impulse withstand voltage	kV_P	1425
10.12	Switching impulse withstand voltage	kV_P	1050
10.13	One minute power frequency withstand voltage	kV rms	650
10.14	Creepage distance at rated voltage	mm	13020 (31 mm/ kV)
10.15	Possible impact from wire stress, vertically		
10.16	Cantilever test load		10kN

NOT FOR PUBLICATION/PRESENTATION OUTSIDE NPCIL

Sl. No.	Item / Parameter	Unit	Value
			(Vendor shall submit design calculations in support of the cantilever strength chosen, for NPCIL review and approval)
10.17	Min. phase to phase terminal clearance in air	mm	5500
10.18	Min. phase to earth clearance	mm	5000
10.19	Min. clearance from bottom of insulator to ground	mm	2500
10.20	Min. bare conductor height above ground	mm	8200
10.21	Min. sectional clearance	mm	6500
10.22	Electrical clearances: The above clearances are minimum requirements. However, if design requires higher values, the same shall be provided at no extra cost to the Purchaser.		
11.0	**GAS INSULATED SURGE ARRESTOR**		
11.1	Voltage Class	kV	420
11.2	Nominal discharge current (Wave 8/20 µs)	kAp	20
11.3	High impulse current (4/10 µs)	kA_P	100
11.4	Continuous current (wave 2000 µs)	kA	
11.5	System neutral		Solidly earthed neutral
11.6	Maximum (continuous) operating voltage (not less)	kV	288
11.7	Rated voltage (not less)	kV	360
11.8	Ingress protection as per IEC 529		IP54
11.9	Maximum residual voltage at lightning surge impulse (wave 8/20 µs) and current values of:		
i	5 kA	kV_P	As per IEC 60099-4
ii	10 kA	kV_P	As per IEC 60099-4
iii	20 kA	kV_P	As per IEC 60099-4
iv	Maximum switch surge residual voltage at 2 kA		As per IEC 60099-4
11.10	Test voltages of outer insulation: - test voltage of lightning pulse 1.2/50 µs (not less) - test voltage switching impulse 250/2500 µs (not less)	kV kV	As per IEC 60099-4

Sl. No.	Item / Parameter	Unit	Value
11.11	Maximum residual voltage for steep current impulse (front time 1/2 μs) at 20 kA	kV	As per IEC 60099-4
11.12	Low current long duration discharge class		5
11.13	Switching impulse (front time 30/60 μs) at current of 1 kA	kV	As per IEC 60099-4
11.14	Current for pressure relief test		
11.15	Weight		Vendor to indicate
11.16	RIV at 1.1 Un/1.73 kV RMS		
11.17	Pressure relief class		
11.18 i ii iii	SF_6 gas pressure Maximum Rated Minimum	MPa (kg/cm^2)	
11.19	Intensity of partial electric discharges in insulation of the bus ducts with AC voltage, equal to $1,1 \cdot U_{н.р.}/\sqrt{3}$ ($U_{н.р.}$- maximum operating voltage).	Coulomb	$<=10^{-11}$
11.20	Specific absorbed power (power-intensity) for one impulse	kJ/kV	8.0
11.21	Height, width, depth (not more)	mm	4000, 2000, 2000
11.22	Mass , not more	kg	190 (To be finalized during detail engineering)
11.23	Quantity (third unit)	pcs	
11.24	Quantity (fourth unit)	pcs	
11.25	Iref	mA	
11.26	Reference Voltage at Iref	kV	
12.	**ONLINE AND PORTABLE PD MONITORING SYSTEM**		All necessary technical details, documents/proof and references for Online and Portable PD Monitoring System as indicated in the Technical Specification shall be furnished by the bidder

NOT FOR PUBLICATION/PRESENTATION OUTSIDE NPCIL

Sl. No.	Item / Parameter	Unit	Value
13.	**BAY CONTROL UNIT WITH LCC**		Model no. and catalogue of BCU to be submitted Design instruction sheet for LCC Panel inline with DIS for CMRP panels to be provided during execution.
14.	**CONTROLLED SWITCHING SCHEME**		Necessary technical details, documents/proof and references for Controlled Switching Scheme as indicated in the Technical Specification shall be furnished by the bidder along with the offer.
15.	**SF6 LEAKAGE DETECTION SYSTEM**		Catalogue of leakage detector/sensor and portable sniffer type SF6 detectors to be provided

Sl. No.	Technical Parameter	Minimum Requirements /scope	Bidder's Data
16	**SF6 GAS HANDLING PLANT**		
16.1	**SF_6 GAS STORAGE TANK (**Model No: **B176R01/ Equivalent better make)**		
i.	Should have liquid or gaseous storage or withdrawal of gas.	Yes	
ii.	Digital weighing scales	Measuring accuracy ± 0.5 kg	
iii.	Additional tool box for hoses and accessories	Yes	
iv.	Steerable and fixing rollers for comfortable transportation	Yes	
v.	Max. operating overpressure	50bar	

NOT FOR PUBLICATION/PRESENTATION OUTSIDE NPCIL

Sl. No.	Technical Parameter	Minimum Requirements /scope	Bidder's Data
16.2	**GIS SERVICE CART** (Model No: **L170R01/ Equivalent better make)**		
i.	Devices for liquid storage of SF_6 gas	Yes	
ii.	SF_6 gas recovery down to < 1 mbar	Yes	
iii.	Should have automatic control with 10" touch panel	Yes	
iv.	Reversing switch for direction of rotation	Yes	
v.	Digital weighing scales for SF_6 bottles	Yes	
vi.	Residual gas recovery down to 1 mbar during filter change	Yes	
vii.	Reduction to transport pressure as integrated special function	Yes	
viii.	Oil free compressor rating	17 m^3/h [at 50 Hz], 50 bar	
ix.	Oil free suction pump for recovery of SF_6 rating	35 m^3/h, final vacuum < 1 mbar	
x.	Vacuum Pump for evacuation of air	60 m^3/h, final vacuum <1 mbar	
xi.	Should come with Evaporator, Dry Filter and Particle Filter	Yes	
16.3	**PORTABLE SERVICE CART (**Model No: **3-001-4-R002/ Equivalent better make)**		
i.	Accuracy of the weighing scales ±50 g, 0.05 kg increments	Yes	
ii.	No emissions by self-closing couplings	Yes	
iii.	Should come with SF_6 bottle connection	W 21.8 x 1/14"	
iv.	vacuum pump for air	16 m^3 , vacuum capacity: < 1 mbar	
v.	Pressure reducer for SF6 (0 up to 10 bar)	Yes	
vi.	Weight	Should not be more than 85 kg	
16.4	**VACUUM/FILLING PORTABLE MACHINE (**Model No: **B048R03/ Equivalent better make)**		
i.	16 m^3/h vacuum pump, final vacuum < 1 mbar	Yes	
ii.	Digital vacuum indication ratting	0 - 100 mbar	

NOT FOR PUBLICATION/PRESENTATION OUTSIDE NPCIL

Sl. No.	Technical Parameter	Minimum Requirements /scope	Bidder's Data
iii.	Adapters for other nominal widths are available	Yes	
16.5	**WEIGHING MACHINE (**Model No**: K091R54/ Equivalent better make)**		
i.	Weighing range	up to 1,500 kg with tare function	
ii.	Digit increment	0.5 kg	
iii.	Should have large removable LCD display	Yes	
iv.	Power supply unit and internal accumulator to 90 h	Yes	
v.	Weight indication reversible	kg / lbs	
16.6	**SF_6 PURITY MEASUREMENT KIT (**Model No**: 3-027-R002/ Equivalent better make)**		
i.	Measuring media	SF6 / N2 or SF6 / air-gas mixtures	
ii.	Measuring range	0 - 100 volume-% SF	
iii.	Measuring accuracy	± 0.5 volume-% for SF_6 / N2-gas mixture or SF_6 / air-gas mixture	
iv.	Measuring pressure	The measuring process is effected under atmospheric pressure.	
v.	Operating temperature	temperature compensation of -20 °C to +50 °C (-4 °F up to +122 °F) ambient temperature	
vi.	Ambient moisture	up to 90 % relative moisture, non condensing during operation	
vii.	Flow rate	max. 1.2 g / min. (0.04 oz / min) at 100 % SF6 gas	

NOT FOR PUBLICATION/PRESENTATION OUTSIDE NPCIL

Sl. No.	Technical Parameter	Minimum Requirements /scope	Bidder's Data
		and an operating pressure of p (absolute) = 10 bar(p [effective] = 130.5 psi	
16.7	**MOISTURE MEASUREMENT KIT (Model No: 3-037-R001/ Equivalent better make)**		
i.	Measuring range	-60 to +20 °C dew point	
ii.	Measuring accuracy	±2 °C	
iii.	Input pressure	P_e 0.5 - 10 bar	
iv.	Operating temperature	0 - 50 °C	
v.	Ambient moisture	up to 90 % relative moisture, non condensing during operation	
vi.	Moisture measuring device with digital display	Yes	
vii.	Should have 2 precise regulating valves and electronic flow meter	Yes	
16.8	**SF6 LEAK DETECTION KIT (**Model No**: 3-033-R002/Equivalent better make)**		
i.	Sensitivity	5 g SF_6 / year	
ii.	Operating temperature	-20 °C to +50 °C	
iii.	Ambient moisture	up to 90 % relative moisture, non condensing during operation	
iv.	Measuring principle	high voltage ionisation	
v.	Response time T90	approx. 1s	
vi.	Recovery time	approx. 1s	

NOTES: (Data marked ****** shall be furnished by Contractor/ Vendor during detail engineering stage and shall be subject to review and approval by Purchaser):

1. In case the offered current ratings are higher than the specified ratings, the manufacturer shall provide test certificates for the higher rating.
2. Vendor shall furnish a list of minimum start up spares required for 400kV GIS and GIBD.
3. The Essential/ Mandatory spares for 400kV GIS and associated components shall be as per the List of Mandatory Spares attached with the Tender.
4. Vendor shall furnish a list of recommended spares for five years of normal operation of GIS and GIBD along with itemised unit prices. This list shall include such spares, which the Vendor feels are not included in the List of Mandatory Spares, but are required for five years of normal operation of the equipment.
5. ****** The dimensional and clearance requirements for the metal enclosure of outdoor SF_6 to oil bushings/ SF_6 to air bushings shall be the responsibility of the manufacturer and their dimensions must be coordinated with the switchgear and connecting equipment (transmission line/ transformer/ shunt reactor, switchable line reactor). Bushings shall generally be in accordance with the requirements of IEC publication 60137 as applicable. Vendor shall also indicate the interface parameters of SF6 to oil bushing required on the Transformer/ Shunt Reactor/ switchable line reactor side.
6. Local Control Cabinet (LCC) for 400kV GIS shall meet the requirements specified under Technical Specification for 400kV GIS and GIBD
7. ****** Vendor shall furnish the complete technical details/ data sheets of SF_6 gas handling/ evacuating/ vacuuming/ gas filling/ servicing plant with adequate storage tank required for the desired operations, along with the details of the hoses and couplings required. Vendor shall include in their Offer, 'Mega series SF_6 gas service cart' of DILO/ equivalent make which can do the above jobs in a expeditious manner.
8. ****** Vendor shall indicate the SF_6 gas parameters and requirements of SF_6 gas cylinder capacity to be supplied along with equipment.
9. ****** Vendor shall furnish the data sheet giving the details of type of HV testing equipment/ CB analyser/ partial discharge analyser etc. or any other instruments necessary for HV testing (to be brought by the Manufacturer on hiring basis to site to carry out the HV testing), its important parameters etc.
10. ****** The grounding system shall be designed and provided as per IEEE-80-2000 and CIGRE-44 to protect operating staff against any hazardous touch voltages and electro-magnetic interferences. The GIS supplier/Contractor must supply the entire material for grounding bus of GIS viz. conductor, clamps, joints, operating and safety platforms etc. The GIS supplier/Contractor is also required to supply all the earthing conductors and associated hardware material for connecting all GIS equipment, bus ducts, enclosures, control cabinets, supporting structure etc. to the ground bus of GIS. Refer Technical Specification for 400kV GIS and GIBD for details. Vendor shall submit separate data sheet on the type of grounding of enclosures as well as supports, giving the details of type of conductor/ size etc.
11. ****** Vendor shall submit details of operating mechanism for the CB, based on details given in the data sheet.
12. ****** Data sheets for all the instruments such as density gauge, SF_6 gas handling instruments such as leak detector/ dew point meters/ purity checker/ decomposition product analyser etc. required for the GIS shall be furnished by the Contractor/ Vendor.The same shall be duly filled-in by the Contractor/ Vendor. In addition, Contractor shall indicate the following:
    i. Operating minimum and maximum value of measure variable and design data (pressure/ temperature) along with material of construction of the equipment for each required instrument

NOT FOR PUBLICATION/PRESENTATION OUTSIDE NPCIL

ii. Instrument hook up, connection sizes/ isolation valve requirement and utility requirement.

13. Vendor shall list the type of assemblies, i.e. individual component assembly or bay wise, in the data sheet.
14. Vendor shall fill all unfilled data in the datasheet.
15. Necessary technical details, documents/proof and references for Online PD Monitoring System shall be furnished by the bidder along with the offer. Only vendors satisfying this requirement shall be further considered.
16. Necessary technical details, documents/proof and references for Controlled Switching Scheme shall be furnished by the bidder along with the offer.

NOT FOR PUBLICATION/PRESENTATION OUTSIDE NPCIL

TABLE-1: CT DETAILS OF 400kV GIS

CT KKS No.	Core no.	Application	CT ratio (A)	Output Burden (VA)	Accuracy class as per IEC:44-1	Accuracy limit factor	Min. knee point voltage Vk	Max. excitation current at Vk (in mA)	Max. CT sec. wdg. Resistance (ohm)	Secondary limiting voltage
ACQ11GT401 R(Y,B)	1	Bus duct Diff. Protection 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	2	Bus duct Diff. Protection 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					
	4	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
ACQ10GT401 R(Y,B)	1	Bus duct Diff. Protection 2, LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	2	Bus duct Diff. Protection 1, LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					
	4	Bus duct Diff. Protection 2, LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Bus duct Diff. Protection 1, LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	

ACQ12GT401 R(Y,B)	1	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	2	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					
	4	Bus duct Diff. Protection 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Bus duct Diff. Protection 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
ACL11GT401 R(Y,B)	1	Bus duct Diff. Protection 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	2	Bus duct Diff. Protection 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					
	4	Distance Prot. 1, Line differential 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Distance Prot. 2, Line differential 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
ACL12GT401 R(Y,B)	1	Bus duct Diff. Protection 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	

NOT FOR PUBLICATION/PRESENTATION OUTSIDE NPCIL

	2	Bus duct Diff. Protection 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					
	4	Distance Prot. 1, Line differential 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Distance Prot. 2, Line differential 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
ACQ21GT401 R(Y,B)	1	Bus duct Diff. Protection 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	2	Bus duct Diff. Protection 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					
	4	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
ACQ20GT401 R(Y,B)	1	Bus duct Diff. Protection 1 LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	2	Bus duct Diff. Protection 2, LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					

	4	Bus duct Diff. Protection 1, LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Bus duct Diff. Protection 2, LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
ACQ22GT401 R(Y,B)	1	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	2	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					
	4	Bus duct Diff. Protection 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Bus duct Diff. Protection 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
ACL21GT401 R(Y,B)	1	Bus duct Diff. Protection 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	2	Bus duct Diff. Protection 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					
	4	Distance Prot. 1, Line differential 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	

	5	Distance Prot. 2, Line differential 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
ACQ31GT401 R(Y,B)	1	Bus duct Diff. Protection 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	2	Bus duct Diff. Protection 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					
	4	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
ACQ30GT401 R(Y,B)	1	Bus duct Diff. Protection 1 LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	2	Bus duct Diff. Protection 2, LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					
	4	Bus duct Diff. Protection 1, LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Bus duct Diff. Protection 2, LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	

ACQ32GT401 R(Y,B)	1	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	2	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					
	4	Bus duct Diff. Protection 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Bus duct Diff. Protection 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
ACQ41GT401 R(Y,B)	1	Bus duct Diff. Protection 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	2	Bus duct Diff. Protection 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					
	4	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
ACQ40GT401 R(Y,B)	1	Bus duct Diff. Protection 1 LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	

	2	Bus duct Diff. Protection 2, LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					
	4	Bus duct Diff. Protection 1, LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Bus duct Diff. Protection 2, LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
ACQ42GT401 R(Y,B)	1	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	2	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					
	4	Bus duct Diff. Protection 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Bus duct Diff. Protection 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
ACL22GT401 R(Y,B)	1	Bus duct Diff. Protection 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	2	Bus duct Diff. Protection 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					

	4	Distance Prot. 1, Line differential 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Distance Prot. 2, Line differential 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
ACQ51GT401 R(Y,B)	1	Bus duct Diff. Protection 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	2	Bus duct Diff. Protection 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					
	4	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
ACQ50GT401 R(Y,B)	1	Bus duct Diff. Protection 1 LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	2	Bus duct Diff. Protection 2, LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					
	4	Bus duct Diff. Protection 1, LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	

	5	Bus duct Diff. Protection 2, LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
ACQ52GT401 R(Y,B)	1	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	2	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					
	4	Bus duct Diff. Protection 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Bus duct Diff. Protection 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
ACL31GT401 R(Y,B)	1	Bus duct Diff. Protection 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	2	Bus duct Diff. Protection 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					
	4	Distance Prot. 1, Line differential 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Distance Prot. 2, Line differential 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	

ACQ61GT401 R(Y,B)	1	Bus duct Diff. Protection 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	2	Bus duct Diff. Protection 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					
	4	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
ACQ60GT401 R(Y,B)	1	Bus duct Diff. Protection 1 LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	2	Bus duct Diff. Protection 2, LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					
	4	Bus duct Diff. Protection 1, LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Bus duct Diff. Protection 2, LBB	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
ACQ62GT401 R(Y,B)	1	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	

	2	Breaker Failure Prot., Bus bar Diff. Prot., End Fault Prot.	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					
	4	Bus duct Diff. Protection 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Bus duct Diff. Protection 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
ACL32GT401 R(Y,B)	1	Bus duct Diff. Protection 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	2	Bus duct Diff. Protection 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					
	4	Distance Prot. 1, Line differential 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Distance Prot. 2, Line differential 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
Spare Line Feeder R(Y,B)	1	Bus duct Diff. Protection 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	2	Bus duct Diff. Protection 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	3	Metering	2000/1	20 **(##)**	Class 0.2S					

	4	Distance Prot. 1, Line differential 1	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
	5	Distance Prot. 2, Line differential 2	2000/1		Class PX#		4000/3000/2000 **(##)**	15 on 4000/1 tap. 20 on 3000/1 tap. 30 on 2000/1 tap **(##)**	16/12/8 **(##)**	
50ACE01GT401 R (Y,B)	1	Metering	2000/1	20 **(##)**	Class 0.2S					
60ACE01GT401 R (Y,B)	1	Metering	2000/1	20 **(##)**	Class 0.2S					

TABLE-2: PT DETAILS OF 400kV GIS

Sl. No.	**Particulars**		
1	Rated primary voltage	420/√3 kV	
2	Type	Electro -magnetic VT	
3	No. of secondaries	2	
4	Rated voltage factor	1.2 for continuous, 1.5 for 30 sec	
5	Phase angle error	±20 minutes	
		Sec I	Sec II
6	Rated voltage (V)	110/√3	110
7	Application	Metering	Protection
8	Accuracy	Class 0.2	3P
9	Output burden (VA) (Minimum)	50VA (##)	50VA (##)

NOTES:

1. **#:** All protection Cores shall be of accuracy class PX as per IEC: 61869. However, if a higher accuracy class CT is required for protection, the same shall be provided by the Contractor during detail engineering at no extra cost and time to NPCIL.
2. ##: The values are typical, depend on the type of relay to be used and shall be finalized during detailed engineering with approval from the Purchaser.

Abbreviations:

GIS	:	Gas Insulated Switchgear
GIBD	:	Gas Insulated Bus duct
AC	:	Alternating Current
AERB	:	Atomic Energy Regulatory Board
ASTM	:	American Society for Testing and Materials
BIS	:	Bureau of Indian Standards
BS	:	British Standard
CEA	:	Central Electrical Authority
CT	:	Current Transformer
DC	:	Direct Current
FRP	:	Fibre-Reinforced Plastic
GI	:	Galvanized Iron
HV	:	High Voltage
IEC	:	International Electrotechnical Commission
IEEE	:	Institute of Electrical and Electronics Engineers
IP	:	Ingress Protection
IS	:	Indian Standard
ITP	:	Inspection and Test Plan
kA	:	Kilo Ampere
kV	:	Kilo Volt
LED	:	Light Emitting Diode
LV	:	Low Voltage
MV	:	Medium Voltage
NC	:	Normally Close
NEMA	:	National Electrical Manufacturer’s Association
NO	:	Normally Open
PVC	:	Polyvinyl Chloride
SS	:	Stainless Steel
SWG	:	Standard Wire Gauge
V	:	Volts
VDE	:	Verband DerElectrotechnik, Elecktronik und Information Stechnik
VT	:	Voltage Transformer

NOT FOR PUBLICATION/PRESENTATION OUTSIDE NPCIL

न्यूक्लियर पॉवर कॉर्पोरेशन ऑफ इंडिया लिमिटेड
(भारत सरकार का उद्यम)
NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A Govt. of India Enterprise)
(CIN : U40104MH1987GOI149458)

संविदा एवं सामग्री प्रबंधन निदेशालय
नाभिकीय ऊर्जा भवन,
ए-'O' ब्लॉक, तलमाला,
अणुशक्तिनगर, मुंबई - 400 094.
दूरभाष: 2599 3000 / 2599 1000
फैक्स: 91-22-2558 0741

ISO 9001:2015 Certified

DIRECTORATE OF CONTRACTS & MATERIALS MANAGEMENT
Nabhikiya Urja Bhavan,
A-'O' Block, Ground Floor,
Anushaktinagar, Mumbai - 400 094.
Tel.: 2599 3000 / 2599 1000
Fax : 91-22-25580741

Pre-Bid Clarifications – Response-1 to Tender No. CMM/MEQ/91-21-2-1219

Ref.: CMM/MEQ/1219 Date: 24 APR 2026

To,

All the Concerned Bidders

Dear Sirs,

Sub: Tender No. CMM/MEQ/91-21-2-1219 for **Main Plant Electrical System Package for KKNPP-5&6** (CPPP Tender ID: 2026_NPCIL_269561_1) – reg.

Ref: 1) Pre-Bid Meeting held on 26.03.2026.

This has reference to the subject Tender.

Please find attached herewith **"Pre-Bid Clarifications – Response-1"** to the queries received before/during or after the Pre-bid meeting.

Above shall form a part of the Tender, which may please be taken note of. All the other terms and conditions of the subject Tender remain unchanged.

This is, however, issued without prejudice to our rights under the terms and conditions of the subject Tender.

Thanking You,

Yours faithfully,

Sd/-

Addl. General Manager(C&MM)
For and on behalf of Nuclear Power Corporation of India Limited.
(The Purchaser)

Encl: 1. Pre-Bid Clarifications – Response-1

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
1	Dineshchandra R Agarwal Infracon Pvt Ltd.	1	Section A	Appendix X, Clause 2.1	The bidder shall be an Indian Company, registered under Companies Act of India. Consortium/Joint Venture (Unincorporated) are not allowed to participate in the Tender.	As per Tender No. CMM/MEQ/91-21-2-1192 dated 18th April 2024, issued for the same scope of work, bids from Consortium / Joint Venture entities were permitted. For a large value project, Consortium / Joint venture bids allows wider participation and promote healthy competition among capable **bidders**, we kindly request you to allow participation of bidders in the form of Consortium / Joint Venture **for the** present tender as well, similar to the provisions made in the earlier tender.	Consortium/Joint Venture(Unincorporated) is disallowed in this tender considering the nature of work envisaged which is better to be executed by a responsible & capable single contractor. Tender condition shall prevail.
2	BHEL	1	Section-A, ITT	Cl. 14	**Validity of Bids** Bids shall be kept valid for acceptance for a period of 120 (one hundred and twenty) days from the date of opening of PART-II (Financial bid) of the tender. Bids with shorter validity period will be liable for rejection.	NPCIL is requested to change the validity of e-Bids to 120 days from the date of opening of Part-I (Techno-Commercial) of the tender. As experienced in Previous NPCIL tenders, the time from Bid Submission to Contract award is substantial and consequently Quoted Prices become difficult to maintain.	Tender conditions shall prevail.
3	BHEL	2	Section B, GCC	Clause no.3.4.1 d)	The value of the bank guarantees submitted towards security of advance payments as per GCC subclause 3.4.3 herein below may be reduced once in six months to the extent of receipt of.....	The reduction in BGs on quarterly basis should be allowed inline with previous NPCIL contracts at Kakrapara, Rawatbhata etc.	Tender conditions shall prevail.
4	BHEL	3	Section B, GCC	Clause no.3.4.2	Contractor shall furnish a Performance Security Bond for 10% of the total value of all the contracts in respective contract currencies...	The Performance Bank Guarantees (PBG) are requested to be maintained @3% on the base contract value (excluding taxes and duties) inline with previous NPCIL contracts.	Tender conditions shall prevail.
5	BHEL	4	SCC	Cl No. 7	The price adjustment will be allowed up-to a ceiling of +/- thirty percent (+/- 30%) of the total DAP price (including packing & forwarding charges, however, excluding transportation, transit insurance, spares, value of free issue material if any and GST) component in INR.	Since this is a long cycle project, NPCIL is request to remove the ceiling on the price adjustment for supply portion within CDD. This is in line with the available industry practices (NTPC, NHPC Contracts).	Tender conditions shall prevail.
6	BHEL	5	Section B, GCC SCC	Cl. 5.4.5 Cl No. 7	Clause No. 5.4.5 of GCC is hereby amended and replaced as below: No adjustment of prices is allowed on tools, tackles and accessories,Spares, Engineering charges, Testing, charges, analysis charges etc shown/payable separately.	Since the said items are part of the Supply Portion and equally exposed to market fluctuations as Main Supply, NPCIL is requested to provide price adjustment on said items as well.	Tender conditions shall prevail.
7	BHEL	6	Section B, GCC SCC	Cl. No. 5.5.6, Cl. 5.6.3 Cl. 5.8.10 Cl No. 7	Time for Completion (Delivery Schedule) Price Adjustment As per tender specification: In case dispatches are delayed ... due ...Contractor and / or Force Majeure events	NPCIL is requested to allow for Price Variation for Force Majeure events. In case of major geopolitical events, COVID like situations etc. Supply Chain gets affected, input costs such as Raw Material/ Fuel/ Other consumables fluctuate substantially. Prices in such cases become difficult to maintain.NPCIL may kindly review .	Tender conditions shall prevail.
8	BHEL	7	Section B, GCC	Cl. 5.13.1	Interest to be paid only for payments delayed against GCC sub-clause nos. 5.9.1 (c), (d) & (e), 5.9.4 (c), (d) & (e), 5.9.6 (b), 5.9.7 (d) & (e) and 5.9.8 (d). 5.13.2 The Purchaser shall pay to the Contractor interest on the amount of such delayed payment for the period as stated herein below:	NPCIL is requested to allow for "Interest on Delayed Payment" on all the applicable payment to Contractor beyond a period of 30 days from submission of invoices. This is inline with previous NPCIL contracts.	Tender conditions shall prevail.
9	BHEL	8	Section B, GCC	Cl. 5.15.2	Recovery of Sums Due	NPCIL is requested not to link claims of one contract with the other contract. NPCIL may kindly review.	Tender conditions shall prevail.

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
10	BHEL	9	Section B, GCC SCC	Cl. No. 7.6 Cl. No. 14	Clause No. 7.6 of GCC is hereby amended and replaced as below: Hindrances: The Contractor is required to maintain Hindrance Registers module wise, as per format provided Section C Notes.....	Following Methodolgy of is requested to be adopted for recognizing of Hiderances. This is in line with industry practices(NTPC,NHPC) : 1. The joint recordings in "Hindrance Register" and "Weekly Review Register". 2. Records of Technical Coordination Meetings. 3. Records of Contract Review meetings. 4. Written notices issued by the "Project Manager" or his authorized representative to Contractor in the relevant period. NPCIL may kindly consider.	Tender conditions shall prevail.
11	BHEL	10	Section B, GCC SCC	Cl no 21.5 Cl no 78	Termination/Cancellation of Contract	It is requested that in case the contract is terminated for reasons not attributable to the Contractor, the contractor should be paid due compensation in addition to the commitment by the contractor. NPCIL to kindly review and confirm.	Tender conditions shall prevail.
12	BHEL	11	Section B, SCC	Cl no 10	To be read in conjunction with GCC clause 5.9: Note 1: a) According to the above Payment Terms, advance payments will be interest-bearing at the applicable rate	Intrest bearing advance will pass on the Cost of Project Funding to the Contractor. It is requested that the Advance may kindly be interest free till CDD.	Tender conditions shall prevail.
13	BHEL	12	IIT & SCC	IIT Cl. 24	Payment of EMD (Rs 3,00,00,000/-). The EMD/Bid security amount may be paid by the Bidder/Tenderer in any of the modes described below: (a) Credit / Debit Card (b) RTGS / NEFT (c) Online transfer.	NPCIL is requested to accept Bank Guarantee of equivalent amount as EMD against the options as made available in the tender.	Tender Conditions shall prevail
14	BHEL	13	SCC	Cl No. 7	5.4.10 Invoices containing Price adjustment shall be submitted by the Contractor once in a quarter and the same shall be paid by the Purchaser once in a quarter.	Applicable PVC shall be paid along with each Invoice raised by the contractor. This is inline with previous NPCIL contracts.	Tender conditions shall prevail.
15	BHEL	14	GCC	Cl 3.4	Securities	NPCIL is requested to accept Corporate Gaurantee in place of requirement of Bank Guaranties.	Tender conditions shall prevail.
16	BHEL	15	GCC	Cl 3.4.7	Latent Defect Security The Contractor shall submit a Bank Guarantee for 1% (one percent) of the total value of goods sold, in the respective contract currencies, as security against latent defect. This Bank Guarantee shall be valid for a period of 5 (five) years from the date of successful completion of the defect liability period as per the contract.	NPCIL is requested to accept 1% Corporate Guarantee in place of 1% Bank Gaurantee during for the latent defect period. The same is in line with the existing NPCIL practice.	Tender conditions shall prevail.
17	BHEL	16	GCC	Cl 19.4.2 (a)	In case the new items are such that their rates cannot be derived from item rates in the PO, such new items shall be priced at mutually acceptable rate.	NPCIL is requested to consider the prices of the new items for additional work on cost plus 15% basis. The same is in line with the terms of the new items in Supply Portion	Tender conditions shall prevail.
18	BHEL	17	GCC & SCC	GCC Cl. 20.2.1 & SCC Cl. 26	.....the Contractor shall be entitled to compensation for additional expenditure for extended stay at site to the extent required for such reasons in addition to extension of time as per GCC clause no. 20.1. The amount of compensation will be arrived at through mutual consultation between the Purchaser and the Contractor taking into account fixed idle period rate quoted by the Contractor as per ITT clause no. 10.5.4 and following the other procedures as per GCC sub-clause no. 19.2.2 and 19.2.3.	NPCIL is requested to incorporate compensation methodology/formula in tender specification itself.	Tender conditions shall prevail.

C & MM Mumbai

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
19	BHEL	18	GCC	GCC Cl. 6.4.1	Defect liability period shall be 18 months from the date of completion of facilities (satisfactory erection and pre-commissioning) or 12 months from the date of Operational Acceptance of Facilities (Commissioning), whichever occurs first, for each reactor unit.	NPCIL is requested to consider the defect liability period as18 months from the date of receipt of items for Main Supply (last consignment) at site or 18 months from the date of completion of facilities (satisfactory erection and pre-commissioning) or 12 months from the date of Operational Acceptance of Facilities (Commissioning), whichever occurs first, for each reactor unit.	Tender conditions shall prevail.
20	BHEL	19	GCC	GCC Cl. 3.6.2	The corresponding Annexure (List of Approved Subcontractors) to the Contract specifies major items of supply or services and a list of approved Subcontractors against each item, including vendors.	NPCIL is requested to Clarify the section/module in which approved vendor list is provided. We were able to find only "Suggested Vendor List".	Please refer Section- C of the tender. Doc no. I02.KK56.0.0.AP.REP.PR003
21	BHEL	20	GCC SCC	GCC Cl. 21.5 SCC Cl. 78	Cancellation / Termination of Contract in Full or Part	In line with Industry Practice (NTPC,NHPC etc.), Right for termination of the Project has to be available with both Purchaser and Contractor subject to specific conditions. Accordingly, NPCIL is requested to extend the right of termination to the Contractor under the following conditions : "The Contractor is unable to carry out any of its obligations under the Contract for reason(s) attributable to the Purchaser (failure to provide site possession or access, make payments, any statutory approval etc.)	Tender conditions shall prevail.
22	BHEL	21	GCC	GCC Cl 17	Completion of Facilities	NPCIL is requested to close the contract & settle associated payment on Unit wise basis.	Tender conditions shall prevail.
23	BHEL	22	Section B, GCC	Cl. No. 1.7.1	Priority of Documents	Contractor's offer, pre-bid clarifications and agreements reached during post-bid discussions shall also form part of the list of Priority of Documents. NPCIL to kindly review and confirm.	Tender conditions shall prevail.
24	BHEL	23	NIT	Sl. No. 1.9	Due Date & Time of Online Bid Submission	The present due date for submission of the bid is 06.05.2026. For thorough preparation & submission of the bid, NPCIL is requested to extend the due date of bid submission by atleast 02 months.	Tender conditions shall prevail at present.
25	MEIL	1	SPECIFICATION NO: I02.KK56.0.0.ET.TS.PR099_R3_TS	1.5		In Technical specification, 300kVA, 0.415/0.415kV transformer is mentioned under Category 1. In BOQ the same is mentioned under Category 2. However, in line description it is mentioned as "CAT-I". Hence, we are considering 300kVA, 0.415/0.415kV transformer to be under Category 1. Kindly verify & confirm.	Please read the description provided against the 300 kVA isolation transformer in BOQ : "300kVA,0.415/0.415 kV Isolation Dry type Transforemer (SUPPLY) -:Supply & delivery of isolation Dry type Auxiliary Transformer **CAT-I** along with all accessories as per the TS and IS-2026/IEC-60076-11". This clarifies the query.Consider **Cat I.**
			BOQ	2.3.3			Please read the description provided against the 300 kVA isolation transformer in BOQ : "300kVA,0.415/0.415 kV Isolation Dry type Transforemer (SUPPLY) -:Supply & delivery of isolation Dry type Auxiliary Transformer **CAT-I** along with all accessories as per the TS and IS-2026/IEC-60076-11". This clarifies the query.Consider **Cat I.**
26	MEIL	2	SPECIFICATION NO: I02.KK56.0.0.ET.TS.PR099_R3_TS	1.5	1.5 Notes -: 1) "Type" as mentioned in Category III type transformer is as per the location of the LVbus bar exit from the transformer and should be as per GA drawings. 2) For category I and II the type of the LV bus bar exit shall be based as per the finallayout drawings provided to the successful bidder during the execution of contract .	Kindly provide the termination details for Category I & II transformers. These detail will have impact on the design & overall dimenions of the transformer.	Maximum overall dimensions of cat I and II transformer shall comply to the table provided at page 36 ET.TS.PR099,R3.Location of LV bus bar exit either on left,right or top does not and shall not have any impact on tranformer dimensions.Details of LV bus bar exits will be provided to the succesfull bidder at the appropriate stage.

Nuclear Power Corporation of India Limited
C & MM Mumbai

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
27	MEIL	3	SPECIFICATION NO: I02.KK56.0.0.ET.TS.PR099_R3_TS	1.5	Rating of above equipment (Cat I and II both) is minimum indicative i.e. based on the process requirement and design margin (10%),future expansion margin (10%) etc. the CONTRACTOR shall prepare equipment sizing calculation document based on applicable National /International standard agreed to the PURCHASER OR as per established industrial practice agreed to the PURCHASER. 2) If the rating comes higher than the above, then equipment of that calculated rating OR higher shall be supplied without any price implication to PURCHASER.	Since this is BOQ contract NPCIL will be take care of this,	The ratings specified in the technical specifications for Cat I & Cat II types has been arrived based on the available process inputs and design margin (10%), future expansion margin (10%) etc. However, the same need to be re-confirmed by successful bidder during finalization of GTPs based on the inputs available regarding the loads/KKNPP 3&4 experience, as provided by NPCIL regarding sufficiency of tranformers ratings. Based on the same and as per NPCIL review and approval, ratings shall be finalized at the stage of GTP approvals.Increased ratings of transformers (if any, based on calcualtions) will be executed only through BOQ as provided in section E by increase in numbers (Quantity) of transformer of higher rating.
28	MEIL	4	SPECIFICATION NO: I02.KK56.0.0.ET.TS.PR099_R3_TS	3.7.1	3.7.1 The core shall be paintedwith suitable resin to protect it against corrosion and other parts shall be hot dip galvanised.	We are offering core with PU painted type construction for protection against to corrosion.	Not acceptable,Tender condition shall follow.
29	MEIL	5	SPECIFICATION NO: I02.KK56.0.0.ET.TS.PR099_R3_TS	3.7.5	3.7.5 The core clamping structure shall be designed to minimise eddy current loss and bolts shall not pass through the lamination for any purpose whatsoever. Fibre glass or equivalent tapes of adequate strength shall be used for clamping the core through an approved procedure.	For effective core-clamping core bolts insulated with Fibre glass tubes is provided.	Core bolts insulated with fibre glass tubes OR the construction as mentioned in the TS both are acceptable.
30	MEIL	6	SPECIFICATION NO: I02.KK56.0.0.ET.TS.PR099_R3_TS	5.3	Primary off-circuit tap changer shall be provided and shall have a range as specified in the data sheet. Under conditions of external short circuit, the tap changing device shall be capable of carrying the same current as the windings.	We are providing transformer with off circuit tap links	Agreed with a condition that the offered tap links shall comply to the Short circuit requirement as per the TS.
31		7	SPECIFICATION NO: I02.KK56.0.0.ET.TS.PR099_R3_TS	6.9.3	6.9.3 vii Off circuit tap changer		Agreed with a condition that the offered tap links shall comply to the Short circuit requirement as per the TS.
32	MEIL	8	SPECIFICATION NO: I02.KK56.0.0.ET.TS.PR099_R3_TS	5.4	5.4 Windings shall be brought out on suitable nickel-plated copper terminals for cable termination.	We are providing tinned busbars for HV & LV terminations where customer side connections are made.	Not acceptable,Tender condition shall follow.

Nuclear Power Corporation of India Ltd. सी एवं एम.एम. मुंबई C & MM Mumbai

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
33	MEIL	9	SPECIFICATION NO: I02.KK56.0.0.ET.TS.PR099_R3_TS	5.4.1	5.4.1 The HV/ LV cable termination arrangement, as applicable, shall be complete with cable box and bolted type undrilled cable gland plates. Non-magnetic gland plate shall be provided for single core cables.	For Category III transformers, HV terminations are provided with cable entry from bottom and LV side is provided with flange arrangement as shown in Annexure II of the specification. Kindly confirm required HV & LV termination details for Category I & II	HV cable entry will be typically from bottom. For LV side for the switchgear under this package scope details are to be furnished by the sucessful bidder and reviewed and accepted by NPCIL.For LV switchgears not in this package scope details will be provided during detailed Engg. stage by NPCIL.
34	MEIL	10	SPECIFICATION NO: I02.KK56.0.0.ET.TS.PR099_R3_TS	5.4.10	5.4.10 The neutral CT (for auxillary transformers) shall be mounted as below:-. i. CT for 51G shall be located in the earth path . CT shall be provided with the transformer panels under the scope of subject contract. Supporting arrangement for GI strip/cable, as applicable, shall be provided for connection of neutral bushing to earth/NGR. Neutral earthing scheme and connection to the transformer and LV switchgear shall be as recommended by the Purchaser.Protection of isolation transformer shall be as per approved protection scheme.	Kindly provide NCT technical details for each rating.	Please refer Clause R3 of TS 5.4.10 ET.TS.PR099." The neutral CT (for auxiliary transformers) shall be mounted as below:-. I. CT for 51G shall be located in the earth path . CT shall be provided with the transformer panels under the scope of subject contract. Supporting arrangement for GI strip/cable, as applicable, shall be provided for connection of neutral bushing to earth/NGR. Neutral earthing scheme and connection to the transformer and LV switchgear shall be as recommended by the Purchaser. Details of CT shall be as per document no. I02.KK56.0.0.ET.TS.PR078. Protection of isolation transformer shall be as per approved protection scheme.Ratings of the CTs will be provided to the successful bidder during detail Engg. however tentetive ratings are as follows -: NCT details for dry type transformer of 1000 kVA -: 1500/5A,20VA,5P10 400 kVA -: 600/5A,20VA,5P10 1250 kVA -: 2000/5A,20VA,5P10 1600 kVA -: 2500/5A,20VA,5P10 2000 kVA -:3000/5A,20VA,5P10
35	MEIL	11	SPECIFICATION NO: I02.KK56.0.0.ET.TS.PR099_R3_TS	6.9.3	ix. Two temperature Sensing devices in limb	2 numbers of PT100 sensors are provided in each phase of LV winding.	Noted.
36		12	SPECIFICATION NO: I02.KK56.0.0.ET.TS.PR099_R3_TS	6.12	6.12 Temperature monitoring system shall be supplied with temperature sensors fitted in each limb. Temperature monitoring system shall initiate alarm and trip for winding over temperature. Alarm and trip temperatures shall be site settable. The monitoring system shall also have an indicating device.		Noted.

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
37	MEIL	13	SPECIFICATION NO: I02.KK56.0.0.ET.TS.PR099_R3_TS	6.9.3	6.9.3 Xiii Outside terminal box with connector assembly indicating Platinum resistance type thermometer with contacts.	We are providing marshalling box with WTI mounted inside it.	Noted.
38	MEIL	14	SPECIFICATION NO: I02.KK56.0.0.ET.TS.PR099_R3_TS	6.16	6.16 Microprocessor based Winding Temperature Indicator shall be provided for taking the inputs from RTDs in all the phases and display locally. Winding Temperature Indicator shall be capable of operating at high ambient temperature up to 70°C. Temperature sensing and indication range shall be 0°C to 200°C. WTI shall be capable of storing the maximum temperature of the windings and it shall not be erased during power failure and a manual maximum temperature reset feature shall be provided. It shall have at least three C/O contacts which indicates Temperature high, temperature very high and trip conditions. Set points for Temperature high and very high and trip shall be user settable. Accuracy of WTI shall be ±1°C. Signal and disconnecting «dry» contacts sensors should be taken to the transformer terminal block. Temperature sensors contacts are used for direct (-220 V) and alternating (~220 V) operational current. Minimum current of commutation should not more than 10 mA. Microprocessor based Winding Temperature Indicator shall meet the IV&V requirement of the PURCHASER. As mentioned above it is preferred that microprocessor based WTI shall be used, however, if the anufacturer/CONTRACTOR feels that there are some genuine difficulties in fulfilling such requirements mentioned above with microprocessor based WTI, the same shall be addressed to the Purchaser with appropriate technical justification for an informed resolution to use Analog WTI sensor meeting the technical requirements. In all such cases Purchaser's decision shall remain binding on the Contractor.	We are providing WTI with Alarm, Trip, Fan control & Fault indication contacts.	Details as asked in the TS shall be complied.Any deviation shall be specifically broughout by the bidder.
39	MEIL	15	SPECIFICATION NO: I02.KK56.0.0.ET.TS.PR099_R3_TS	6.17.1	6.17.1 The core and coil assembly shall be enclosed on the four sides and as well as on the top by a sheet metal enclosure. The purpose of having the enclosure is to provide safety from live parts and prevent ingress of dust, vermin and rodents. Sufficient louvers may be provided on the side enclosure for cooling purposes. No louvres should be provided on the enclosure which is towards the switchgear side. The louvres should be covered with stainless steel wire mesh. The enclosure should have structural steel frame work with lockable hinged door on front and back of the transformer. Width of the back door shall be restricted to one metre. The doors shall be provided to facilitate the inspection of the transformers. Door should be fitted with suitable gaskets.	We are offering the transformer enclosure with Sand trap construction. For our construction, wire mesh is not required.	IP shall be complied.Sand trap construction or wire mesh construction as mentioned in the TS both are acceptable.

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
40	MEIL	16	SPECIFICATION NO: I02.KK56.0.0.ET.TS.PR099_R3_TS	6.7	6.7 The transformers shall be designed such that maximum efficiency is achieved at 50% loading. Design calculation of maximum efficiency shall be submitted to Purchaser for approval.	The efficiency levels given for Category I & II transformers and Isolation transformers are very high and practically very difficult to achieve. To achieve efficiency as per Clauses 6.19.2 & maximum efficiency at 50% load as per Clause 6.7, transformers has to be designed for below losses: 1600kVA: 1800 / 7200W 1250kVA: 1550 / 6200W 1000kVA: 1000 / 5800W 200kVA: 320 / 1280W 100kVA: 160 / 640W Please note that above mentioned losses are very low and practcally very difficult to achieve. Hence we propose to provide losses as per ECBC for Category I, II & Isolation transformers. Load applicable for Maximum efficiency will be as per the Guaranteed values which are in compliance with ECBC. Transformer losses as per ECBC are as below (for transformer Category I & II): For Category III transformers, we will consider losses as per Clause 6.19.9 of the specification. Kindly confirm.	Tender Condition shall prevail.No deviation accepted.
41	MEIL	17	SPECIFICATION NO: I02.KK56.0.0.ET.TS.PR099_R3_TS	6.19.2	6.19.2 Efficiency of the transformers offered should be greater or equal to a) 98.5% for transformers rated 1MVA and above up to and including 1.25MVA b) 99% for transformers rated > 1.25MVA at full load 120 degree for 0.8 Power factor. The losses offered should consider this requirement for cat I and II transformers .For cat III transformers efficiency shall be as per losses provided in clause 6.19.9.For isolation transformer 0.415/0.415 kV efficiency shall be equal to or greater than 98% at full load 0.8 power factor		Tender Condition shall prevail.No deviation accepted.
42		18	SPECIFICATION NO: I02.KK56.0.0.ET.TS.PR099_R3_TS	6.19.9	6.19.9 Heat emissions of transformers for cat III transformers (Value of total losses by no load and S/c test): - at rated power 400 kV·A shall not exceed 5,2 kW; - at rated power 1000 kV·A shall not exceed 11,5 kW. This data will be used for designing of ventilation system of the rooms locating transformer. Hence vendor is requested to provide the calculation results for complying to these values.		Tender Condition shall prevail.No deviation accepted.
43	MEIL	19	SPECIFICATION NO: I02.KK56.0.0.ET.TS.PR099_R3_TS	3.6.12	3.6.12 Enclosure for 2000kVA and 1600kVA transformers shall be identical. It should be possible to put core coil assembly of either 2000kVA or 1600kVA into this enclosure. All 1250kVA and 1000kVA transformers and their enclosures shall also be identical. Further similar parts, particularly removable ones, shall be interchangeable for all transformers.	As per Clause 3.6.12, it is recommended to maintain same enclosure dimensions for 1000kVA & 1250kVA transformers. However, different requirements of the overall dimensional limitations are mentioned for 1000kVA & 1250kVA for different categories. It will be difficult to maintain same enclosure dimensions considering the different overall dimensional requirements. Hence we will maintain enclosure dimensions based on our design for each category & rating.	Different dimensions of enclosure for different rating is acceptable provided that the maximum overall dimension allowed for transformer shall be complied.
44	MEIL	20	SPECIFICATION NO: I02.KK56.0.0.ET.TS.PR099_R3_TS	Annexure I			Different dimensions of enclosure for different rating is acceptable provided that the maximum overall dimension allowed for transformer shall be complied.

Nuclear Power Corporation Of India Limited
सी एवं एम एम
मुंबई
C & MM
Mumbai

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
45	MEIL	21	SPECIFICATION NO: I02.KK56.0.0.ET.TS.PR099_R3_TS	Annexure I			Different dimensions of enclosure for different rating is acceptable provided that the maximum overall dimension allowed for transformer shall be complied.
46	MEIL	22	SPECIFICATION NO: I02.KK56.0.0.ET.TS.PR099_R3_TS 9	QAP	Type test and Routine tests shall be coduct as per IS 11171	Type test and Routine tests shall be coduct as per IS 11171 where as this standrad was supesended	IS 2062-11/IEC 60076 shall be used.
47	MEIL	23	230kV GIS and I02.KK56.0.0.ET.TS.PR053_R3_TS	1.6.4 pg no. 6	HV Test Equipments: The scope also includes mobilisation/ arrangement of High Voltage Testing equipment with due calibration, necessary test certificates and manufacturer's specialists for carrying out HV test of GIS/ GIBD system at site, complete in all respects for all sections of the GIS/ GIBD, at no extra cost.	We shall provide HV Testing equipments on returnable basis Kindly confirm	Confirmed.
48	MEIL	24	1)I02.KK56.0.0.PR.TT.PR008_R3_Electrical Scope of works-KKNPP S6_04.08.2023	230kV SLD Page no. 72		we would like to inform that , for trafo bay it shown 2 connections in given SLD , kindly provide more details like is it spare trafo etc Also we presume termination for this bays with Sf6 to Air bushings our GIS scope is only upto SF6 to Air bushing rest of equipments will be in scope of NPCIL Kindly clarify the scope of Bushing transformers shown in GIBD	The connection is not for spare transformer. As per KKNPP S&6 scheme and SLD, a single feeder is bifurcated to feed 2 no. of Reserve Auxiliary Transformers. The transformers are identical and act as a standby for Unit auxiliary transformers. The transformers, bushing CTs and SF6-Oil bushing are excluded from the scope of this Tender. Termination of GIBDs on the SF6-Oil Bushing flange is included in the scope of this tender.
49	MEIL	25	I02.KK56.0.0.ET.TS.PR053_R3_TS	4.7 pg no. 11	Preferably, busbar disconnecting switches, sectionalizers and earthing switches shallbe housed in separate gas compartments	As per our standard type tested model we shall provide busbar DS & ES in single gas compartment	Type tested arrangement (as per relevant IEC standards) is acceptable.
50	MEIL	26	I02.KK56.0.0.ET.TS.PR053_R3_TS	4.38.1 Page 20	It shall be possible to extend the GIS switchgear by adding future feeders and the existing feeders remaining in service continuously. The Manufacturer shall clearly demonstrate inhis bid documents the suitability of the switchgear design in this respect	We shall provide the extention module on both sides of busbars , generally when Future extension required the adjacent bay to extension module need to take shutdown and all other bays remain in service Kindly accept	Acceptable
51	MEIL	27	I02.KK56.0.0.ET.TS.PR053_R3_TS	S.27.2 pg no. 51	The GIS supplier is also required to supply all the earthing conductors and associated hardware material for connecting all GIS equipment	We shall provide earthing materials for GIS, GIS Base Frame to GIS module. Supply of Earthing materials on GIS body shall be in Hyosung Scope. GIS to riser shall be EPC's scope. Balance Earthing under the finishes floor level up to the riser shall be done by EPC. The location and no of risers shall be informed by hyosung	Supply of Earthing materials on GIS/GIBD body shall be in OEM Scope. GIS/GIBD to riser and earthing grid (over and above Purchaser's earthing grid) can be under EPC's scope and shall be based on OEM recommendation. Purchaser's grounding grid drg is attached for reference.
52	MEIL	28	I02.KK56.0.0.ET.TS.PR053_R3_TS	4.7	4.7 Preferably, busbar disconnecting switches, sectionalizers and earthing switches shall be housed in separate gas compartments	Offered 220kV GIS have Earthing and disconnector in same compartment. The design is accepted by many utilities in india & Abroad and is type tested as per IEC 62271-203 .	Type tested arrangement (as per relevant IEC standards) is acceptable.

C & MM Mumbai

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
53	MEIL	29	I02.KK56.0.0.ET.TS.PR053_R3_TS	4.11	2. In case of maintenance of any of the bus disconnector switches, one of the buses shall remain energized	We confirm the service continuity of one busbar during the time of maintenance activity in Bus disconnector , however the bay on which maintenance activity is performed will remain shutdown .	Acceptable
54	MEIL	30	I02.KK56.0.0.ET.TS.PR053_R3_TS	5.25.8	Mechanical interlocks, in addition to electrical is a preferred method such that it will not be possible to close the earthing switch when the isolator is closed or vice-versa.. In specific cases of non-provision of the same it shall demonstrated that safety, in case on lack of electrical interlock, is not compromised.	Offer 220kV GIS have electrical interlock for Disconnector and earth switch, We Request your kind acceptance on the same .	Acceptable
55	MEIL	31	I02.KK56.0.0.ET.TS.PR053_R3_TS	8.1	The data of electronic Impact recorders shall be downloaded at site and a soft copy of it shall be handed over to Engineer-in-charge.	Boxes consisting of critical boxes shall be provided with Mechanical (Shockwatch type) impact recorders. We request an approval on the same.	The type of impact recorders and the units where these need to be used shall be as per OEM reccomendation. However, it may be noted that the Contractor scope includes safe transport, delivery, storage, handling, erection and commissioning of the equipment. Any damages to the equipment prior to succesful commissioning shall be rectified/replaced at no extra cost to the Purchaser.
56	MEIL	32	I02.KK56.0.0.ET.TS.PR053_R3_TS	8.5	The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains, heavy corrosive atmosphere and high ambient temperature.	Storage of Equipment for longer period is not recommended	The Contractor scope is inclusive of equipment storage until erection. The storage arrangement shall be as per OEM reccommendation. The packaging of the units shall be suitable for the duration and type of storage envisaged by the Contractor.
57	MEIL	33	I02.KK56.0.0.ET.TS.PR051 Rev 4 Annexure A to C and IQAP	4.6 page no.14	While extending one feeder module of the GIS, it shall be possible to operate all the running feeders either from one bus or both the buses, in stages	We shall provide the extention module on both sides of busbars, generally when Future extension required the adjacent bay to extension module need to take shutdown and all other bays remain in service Kindly accept	Acceptable
58	MEIL	34	I02.KK56.0.0.ET.TS.PR051 Rev 4 Annexure A to C and IQAP	4:12 page no.15	In case of maintenance of any other disconnector switches (besides bus disconnector switches), only one feeder of that diameter shall be affected.	While maintenance on line side disconnector all three phases of particular bay will be out of service	Acceptable. However, as mentioned in the subject clause, other bays and feeder shall remain in service during maintanence of DS (besides bus disconnector switches)
59	MEIL	35	I02.KK56.0.0.ET.TS.PR051 Rev 4 Annexure A to C and IQAP	4.38.2 pg no. 21	In the event of a fault in any bay of the GIS/ GIBD, it is a firm requirement thatsubsequent repairs/ testing shall be possible to be carried out without outage of any otherbay or bus bar	We would like to inform that in One and half breaker system , if busbar disconnector goes under maintenance then particular busbar needs to take shutdown and another busbar remains in service we understood that same is mentioned in mentioned clause	Noted. Confirmed.

Nuclear Power Corporation Of India Limited
सी एवं एम एम मुंबई
C & MM Mumbai

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
60	MEIL	36	I02.KK56.0.0.ET.TS.PR 051 Rev 4 Annexure A to C and IQAP	5.15.3 pg no. 51	The power & control cables supplied by OEM (all cables within GIS equipment including LCC) shall be copper conductor, flame retardant and low smoke type as per OEM's standard practices.	We shall provide only control cables required for GIS , Power cables will be in EPC scope of supply	Tender clause shall prevail
61	MEIL	37	I02.KK56.0.0.ET.TS.PR 051 Rev 4 Annexure A to C and IQAP	5.16.1 pg no. 52	The System shall operate unattended and be structured to allow future expansion. The system may also be required to be expanded, by addition of appropriate hardware and software, to monitor other parameters relevant to plant condition in future. The system shall be structured so as to allow and accommodate for future expansion. The bidder shall advise in their offer any limitation on such expansion capability .The	We would like to Inform that For Online PD monitoring system it is very crucial to identify the future bays requirement which impacts on size & cost of monitoring system panel we request you to please provide future bay details	The online PD monitoring shall be designed with spare ports/provisions to incorporate one additional dia in future. The no. of sensors/ports required for one dia can be determined only after OEM finalisation. These details shall be worked out during execution along with the OEM.
62	MEIL	38	I02.KK56.0.0.ET.TS.PR 051 Rev 4 Annexure A to C and IQAP	1.6.3	All spare parts, special tools and tackles required for smooth completion of the works, as specified but not limited to that mentioned in the data sheets and technical specifications are deemed to be a part of the supply, at no extra cost to the Purchaser.	Request to share the BOQ for the spares and Tools and tackles to be supplied as a part of mandatory supply.	Kindly refer Mandatory spare list attached along with the Tender. For Tools and Tackles to be supplied, please refer the respective Technical Specifications of the Tender.
63	MEIL	39	I02.KK56.0.0.ET.TS.PR 051 Rev 4 Annexure A to C and IQAP	1.6.7	i. Circuit Breaker	Kindly confirm the requirement of Pre insertion resistors(PIR) and Controlled switching devices (CSD) for 400kV GIS bay requirement.	Pre Insertion Resistors are not acceptable. All the 400kV Circuit breakers shall be provided with Controlled Switching Devices.
64	MEIL	40	I02.KK56.0.0.ET.TS.PR 051 Rev 4 Annexure A to C and IQAP	1.6.7	Vii Isolated (Single) phase bus duct for line termination from line side isolator and earthing switch flange up to SF6-Air bushing	We request to kindly quantify the busduct requirement in meters, any changes to the length of busduct during detailing shall be paid at per meter rates derived from the calculations of total busduct rates.	Kindly refer item no. 1.1.8 of Supply BoQ for 400kV Gas Insulated Bus duct quantity.
65	MEIL	41	I02.KK56.0.0.ET.TS.PR 051 Rev 4 Annexure A to C and IQAP	4.2	One and half breaker configuration has two buses, both of which are energised during normal operation	Kindly confirm if the arrangement of the proposed scheme can be done in I-Type configuration	The tentative layout of GIS hall is attached as annexure C along with the tender specification (I02.KK56.0.0.ET.TS.PR051 Rev 4) . Layout arrangement compatible within the building layout will be acceptable.

Nuclear Power Corporation Of India
सी एवं एम एम
मुंबई
C & MM
Mumbai

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
66	MEIL	42	I02.KK56.00.ET.TS.PR051 Rev 4 Annexure A to C and IQAP	4.8	Preferably, busbar disconnecting switches, sectionalizers and earthing switches shall be housed in separate gas compartments.	The Earth swicthes for sections between CB and Line disconnectors/Bus disconnectors shall be part of the individual gas compartmets precceding Earth switch modules, please note that this does not have any detrimental effect on the functional performance of the GIS equipments. Request to kindly accept.	Type tested arrangement (as per relevant IEC standards) is acceptable.
67	MEIL	43	I02.KK56.00.ET.TS.PR051 Rev 4 Annexure A to C and IQAP	4.13	Gas barrier insulators and support insulators shall have the same basis of design. The support insulators shall have open cone type insulators on both sides for proper flow of gas. Each type of gas barrier Insulators and support insulators shall be supplied as spare (as per Mandatory spare list)	Kindly share the list of spares for this project	Kindly refer Mandotory spare list attached along with the Tender.
68	MEIL	44	I02.KK56.00.ET.TS.PR051 Rev 4 Annexure A to C and IQAP	4.19	The connection between GIBD and transformer bushing shall be in accordance with standard flange details as per IEC 62271- 211 and with tolerances that are practically achievable in the manufacturing/assembly of the transformer and the GIBD .	The scope of supply of Termination kits for Transformer/Cable shall be excluded from Siemens scope of supply	The termination module (The module which will be terminated on the SF6-Oil bushing flange) shall be provided by the OEM. Supply of Termination kits for Transformer/Cable is under the scope of this tender.
69	MEIL	45	I02.KK56.00.ET.TS.PR051 Rev 4 Annexure A to C and IQAP	4.36.3	The design shall include glass endoscope/observation windows for viewing the position of switches of disconnector and earthing switch and separate piece for the same shall be provided (if applicable).	As the Disconnectors and Earth switches already provided with observation windows for visual inspection of contacts, the provision of additional endoscope is not envisaged.	Acceptable
70	MEIL	46	I02.KK56.00.ET.TS.PR051 Rev 4 Annexure A to C and IQAP	4.38.4	It must be generally possible to remove a circuit element (breaker interrupter , disconnect switch etc), without removing another element.	We infer this requirement calls for the removal of CB interruptors and not the complete CB enclosures for maintainance, please confirm	Confirmed.
71	MEIL	47	I02.KK56.00.ET.TS.PR051 Rev 4 Annexure A to C and IQAP	5.1.6 b	Details regarding each gas compartment, quantity of SF6 gas in each compartment, operating and lockout pressure etc., need to be provided appropriately for every bays. SF6 Kyoto label shall be provided Circuit breaker Cubicle.	Kindly share the details for the Label required	Name plate and rating plate shall be as per OEM standard practice. Indicative kyoto label plate is shared below for reference.

Nuclear Power Corporation of India Ltd. एन पी सी आई एल मुंबई C & MM Mumbai

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
72	MEIL	48	I02.KK56.0.0.ET.TS.PR 051 Rev 4 Annexure A to C and IQAP	5.2.1 b	Electric motor shall be suitable for use on 220V DC/ 240V AC/ 415V AC system and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over current and short circuit.	The Motors for Disconnectors,Earth Switches and High Speed Earth Switches will be DC type for both 220 and 400kV GIS	Acceptable as already mentioned in the subject clause.
73	MEIL	49	I02.KK56.0.0.ET.TS.PR 051 Rev 4 Annexure A to C and IQAP	5.2.5 m	If the power supply to Isolators/ earthing switch initially off and open/ close command is given, Isolators/ earth switch which cannot be carried out to non-availability of power at that moment, operation of Isolator/ Earth switch shall not take place when AC supply is restored subsequently.	All the drives for Disconnectors, WIP Earth switches and Fast Acting earth switches shall be DC operated type.	Acceptable. The subject clause is regarding the operational logic requirement and not related to the type of supply. The operational logic requirement as elaborated in the subject clause shall be complied with.
74	MEIL	50	I02.KK56.0.0.ET.TS.PR 051 Rev 4 Annexure A to C and IQAP	5.3.2	Three-pole, group operated, safety earthing switches shall be operated by electric motor. Electric motor shall be suitable for use on 220V DC/ 240V AC/ 415V AC system and shall be equipped with a manual operating mechanism for emergency use. The motor shall be protected against over current and short circuit.	The Motors for Disconnectors,Earth Switches and High Speed Earth Switches will be DC type for both 220 and 400kV GIS	Acceptable as already mentioned in the subject clause.
75	MEIL	51	I02.KK56.0.0.ET.TS.PR 051 Rev 4 Annexure A to C and IQAP	5.4.1	Earthing switches located at the beginning of the line feeder bay modules shall be of the high speed, make-proof type and will be used to discharge the respective charging currents, in addition to their safety earthing function. High speed earthing switch shall be class E2.	Offered Make proof ES shall confirm to class E1	Tender clause shall prevail
76	MEIL	52	I02.KK56.0.0.ET.TS.PR 051 Rev 4 Annexure A to C and IQAP	5.6.3	Necessary interim/ temporary arrangements of sealing of these openings shall also be made during the construction phase to prevent any ingress of water/ dust etc. without any extra cost.	Supply of Wall sealings is excluded from GIS OEM scope of supply	Noted. However, sealing of the wall openings (for GIBDs) with required fire rating and OEM concurrence, is included in the scope of Contractor.
77	MEIL	53	I02.KK56.0.0.ET.TS.PR 051 Rev 4 Annexure A to C and IQAP	5.6.6	The quantity of SF6 switchgear and bus duct to be offered shall be in accordance with the requirements based on single line diagram (I02.KK56.0.0.ET.OKP.WD004).	We request to kindly quantify the busduct requirement in meters, any changes to the length of busduct during detailing shall be paid at per meter rates derived from the calculations of total busduct rates.	Kindly refer item no. 1.1.8 of Supply BoQ for 400kV Gas insulated Bus duct quantity.

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
78	MEIL	54	I02.KK56.0.0.ET.TS.PR051 Rev 4 Annexure A to C and IQAP	5.8.3	Bay Control Unit (BCU) - BCUs shall be utilised for control, interlocks (as applicable), monitoring of circuit breakers, isolators and earth switches. BCUs shall be located in the local panel as envisaged in the tender.	BCUs are made a part of the CRP/SAS panels provided in the Contol room, LCC application is for Local mainatainance and repair; we request an acceptance of the above.	Not acceptable. BCUs shall be provided as mentioned in the tender.
79	MEIL	55	I02.KK56.0.0.ET.TS.PR051 Rev 4 Annexure A to C and IQAP	5.19.6	Manufacturer shall provide an independent pressure switch this level for isolation of the particular zone. This alarm level shall be provided to indicate abnormal pressure rise in the gas compartment.	As the GIS modules operate at a pressure lower that maximum filling pressure, the provision of high pressure alarm on GDM is not envisaged. Also note that a bursting disc provision is also provided on each gas compartment.	Tender clause shall prevail
80	MEIL	56	I02.KK56.0.0.ET.TS.PR051 Rev 4 Annexure A to C and IQAP	8.1	All transport packages containing critical units viz. voltage transformers, surge arrestor shall be provided with sufficient number of electronic impact recorders (on returnable basis)during transportation to measure the magnitude and duration of the impact in all three directions. The acceptance criteria and limits of impact in all three directions which can be withstood by the equipment during transportation and handling shall be submitted by the vendor during detailed engineering.	Boxes consisting of critical boxes shall be provided with Mechanical (Shockwatch type) impact recorders. We request an approval on the same.	The type of impact recorders and the units where these need to be used shall be as per OEM reccomendation. However, it may be noted that the Contractor scope includes safe transport, delivery, storage, handling, erection and commissioning of the equipment. Any damages to the equipment prior to succesful commissioning shall be rectified/replaced at no extra cost to the Purchaser.
81	MEIL	57	I02.KK56.0.0.ET.DS.PR045_R3_DS	6.17	Short circuit making capability Class E2 (5 making operations)	For high speed earth switch the short circuit making capability shall be of class E1	Tender clause shall prevail
82	MEIL	58	10_I02.KK56.0.0.ET.TS.PR079_R3_TS for MV isolated Phase Bus duct	3.4.1 (vii)	At the location of insulators, flexible joints, etc. inspection covers shall be provided for periodic inspection of interior parts. The inspection covers shall be large enough to permit maintenance and renewal of interior parts. These shall be provided with flanged ends with neoprene rubber/ EPDM or equivalent gaskets and shall be bolted type. These covers and assemblies shall be rust proof, dust and weatherproof. The design of the assembly shall be such that water shall not enter under any circumstance even under failure of the gasket. Also, arrangement shall be made to avoid accumulation of rain water at flanges.	Our Bus Duct design is such that the Insulators can be accessible from outer periphery of Bus Duct Enclosure and hence Inspection covers are not required. However, we will provide Inspection covers in Bus Duct at every equipment ends to access the disconnecting links, bus connections and terminations.	The provisions as mentioned in the TS or the arrangement proposed here by the bidder-MEIL both are acceptable
83	MEIL	59	10_I02.KK56.0.0.ET.TS.PR079_R3_TS for MV isolated Phase Bus duct	3.4.1 (xiv)	In order to facilitate earthing of the bus duct enclosure, suitable earthing pads shall be provided on the enclosure for shorting connections.	We have offered our standard design for IPBD where we use electrically continuous bus enclosure as earth bus. hence separate earth bus is not envisaged.	The provisions as mentioned in the TS or the arrangement proposed here by the bidder-MEIL both are acceptable. However, suitable earthing pads are to be provided for earthing of the bus duct enclosure at both the equipment ends.

Nuclear Power Corporation of India Limited
सी एवं एम एम
C & MM
Mumbai

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
84	MEIL	60	10_I02.KK56.0.0.ET.TS.PR079_R3_TS for MV isolated Phase Bus duct	5.1.1	Entire length of the busducts are to be provided with all-welded (electrically continuous) enclosure. Entire bus duct shall be designed for indoor/outdoor installation with adequate protection against dust and vermin. MV Bus duct shall have degree of protection better than or equal to IP 55. Additional canopy shall be provided for outdoor horizontal portion of the bus duct.	We have not considered separate rain hood as busduct is continuous type and welded at joints.	Flange joints such as insulator flange, heater flange etc. should be adequtely protected against ingress/accumulation of water & dust. Canopies shall be provided at all such flange joints except to the flange joints which are located/oriented at the bottom of the bus duct enclosure.
85	MEIL	61	10_I02.KK56.0.0.ET.TS.PR079_R3_TS for MV isolated Phase Bus duct	5.1.8	The busbar clamps and insulators shall be designed to withstand the forces due to short circuit current and other loads as defined earlier 3.4.1(v). They shall permit free longitudinal movement of the busbars during expansion and contraction. The material of the clamps shall be copper or as specified in the data sheet. Suitable copper spacers or material specified in the data sheet shall be provided wherever necessary.	Please note that as per our standard type tested design, busbar clamps are not envisaged.	The provisions as mentioned in the TS or the arrangement proposed here by the bidder-MEIL both are acceptable subject to meeting the qualification requirements specified in TS.
86	MEIL	62	10_I02.KK56.0.0.ET.TS.PR079_R3_TS for MV isolated Phase Bus duct	5.3.5	Bus bar chamber Bus ducts shall be provided with adequate number of space heaters rated at 240V and shall be complete with MCB and thermostat having variable setting. Suitable connectivity between different sections of the bus duct shall be provided for the space heaters power supply.	Please note that busduct is natural air cooled type and moreover after shut dowm period the busduct is completely filled with hot air through HAB system to absorb the moisture from the busduct, hence separate space heater is not envisaged.	Tender specification shall prevail.
87	MEIL	63	10_I02.KK56.0.0.ET.TS.PR079_R3_TS for MV isolated Phase Bus duct	5.6	All metal surfaces shall be thoroughly cleaned and de-greased to remove mill scale, rust, grease and dirt. The under- surface shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. After preparation of under surface, the bus duct shall preferably be powder coated or spray-painted with two coats of epoxy based final paint. The colour shade shall be 631 as per IS 5 or RAL 7032.	As per our plant standard we will provide air dried PU paint as per your approved shade. Painting procedure enclosed for your reday reference	Tender specification shall prevail.
88	MEIL	64	10_I02.KK56.0.0.ET.TS.PR079_R3_TS for MV isolated Phase Bus duct	7.10	7.10 Type Test : 7.10.1 Test for temperature rise on an assembly of representative section and fittings 7.10.2 Short circuit withstand test. 7.10.3 Verification of degree of protection The representative section of the bus duct assembly tested shall include bolted connection and flexible connection.	Similar test report shall be submitted during detailed engineering for all the test for your acceptance. If further testing is required, shall be conducted for 1 specimen for each rating at extra cost only.	Please refer clause 7.6 of the document I02.KK56.0.0.ET.TS.PR079. Type tests will be reviewed by NPCIL and if found not acceptable then the tests to be performed without additional cost to Purchaser. Please refer scope of work document (I02.KK56.0.0.PR.TT.PR008) also for better calrity.
89	MEIL	65	10_I02.KK56.0.0.ET.TS.PR079_R3_TS for MV isolated Phase Bus duct	7.15	Seismic qualification requirement	Similar test report shall be submitted during detailed engineering.	Bus duct supporting arrangement and layout are different in KKNPP 5&6 with respect to KKNPP 3&4. FRS is also expected to be different in KKNPP 5&6 with respect to KKNPP 3&4. Hence the seismic qualification/analysis will have to performed as actual arrangement applicable to KKNPP 5&6.

Nuclear Power Corporation of India Limited C & MM Mumbai

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
90	MEIL	66	11_I02.KK56.0.0.ET.DS.PR074_R1_DS MV IPBD	3.24	Material for Insulator	We have considered Epoxy cast resin insulator	The provisions as mentioned in the TS or the arrangement proposed here by the bidder-MEIL both are acceptable subject to the condition that the offered insulators qualifies the design requirements including the forces mentioned in the technical specifications.
91	MEIL	67	General			GT,UAT,SUT & Shunt Reactor erection & commissioning in contractor scope, commissioning delay due to the manufacturing defect or support require by the supplier delayed.	This query is incomplete. However, any delay will be assessed as per Contract/Tender condition. Please note that GT, UAT, CSAT, RAT and Shunt Reactors will be Free issue items and commissioning & erection will be in Contractor's scope.
92	MEIL	68	Annexure_1_Project document-Execution of site works	52	In sum, all the erection & commissioning works shall be done as per the relevant working drawings, manufacturers guidelines /tender specifications, standards / codes / approved erection & commissioning procedures and as directed by the Engineer – in – charge.	for estimation please specify the modification require in civil for erection of equipment's	The modifications envisaged are as follows: a) Embedded part extensions wherever applicable b) Fixing of intermediate plates/members to match the equipment footing to EPs wherever applicable c) Supply and Fixing of Anchor plates wherever Eps are not available etc. The EP layout of 400kV and 230kV GIS hall are attached as annexure to the respective tender specifications. The same may be used for estimating the requirement of EP extension/ Intermediate plate fixing/Anchor plate fixing etc. The requirement & implementation of above said modifications can be finalised only during detailing/Site erection and the same shall be under Contractor's scope. For other equipment, EP modification shall be carried out if mismatch occours in exisiting EP layout and supplied equipment footprint/GA
93	MEIL	69				contractor is responsible for the vendor drawings all the erection drawings will be issued by client Please confirm	Preparation of Erection drawings is included under the Contractor Scope.
94	MEIL	70				Switch yard supporting structure drawings NPCIL will provide. Please confirm	The Switchyard supporting structure design depends on the equipment load and GA, Site Conditions etc. Once these details are available during execution, NPCIL will evaluate the adequacy of existing support structure drawings. If not, the support structures will have to be designed by the Contractor under respective item (no. 1.1 to 1.6 and 2.1 TO 2.6) of Engineering BoQ.
95	MEIL	71	I02.KK56.0.0.PR.TT.PR009_R5_Job specification	8.5	In addition to the above, NPCIL reserves its rights to insist on the same make of equipment as in KKNPP 3&4 which the Contractor shall comply with no additional cost and time implication to NPCIL.	requesting you to provide the list of equipment to be require as per the KNNPP3&4	It is not the intent to just replicate the make/manufacturer of each and every items of KKNPP 3&4 in KKNPP 5&6. The matter to be reviewed on case to case basis during execution/detailed engineering taking into account of the project timeline and time schedule of engineering, qualifications and tests of the offered equipment, their delivery schedules, services & support guarantees of the OEM, etc. by successful contractor for the subject package and NPCIL reserves its rights to insist on the same make of equipment as in KKNPP 3&4 which the Contractor shall comply with no additional cost and time implication to NPCIL.

सी एवं एम एम मुंबई C & MM Mumbai

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
96	L&T	1	Section-A ITT		-	Considering the high volume of the work, dead line fixed for submitting the Prebid query (ie 26th Mar 2026) appears to be unrealistc..We will receive any Prebid inquiries from suppliers only after we have initiated our own inquiries to them. In view of the above, We propose the following, 1. We request NPCIL to accept queries 21 days prior to the date of bid submission date.. 2. Specific queries arising out of detailed engineering and market response shall be responsed by NPCIL after the Prebid meeting also progressively till 15 days before the submission of the bid.	Request to expedite the submission of Pre-bid queries sufficiently before the bid submission due date so that, pre-bid response on the same can be issued well in time, with suitable time gap between issue of Pre-Bid clarification and bid submission due date.
97	L&T	2	Section-A ITT	4	-	As per clause "The EMD / Bid Security is to be submitted by the bidder through SBI ePay on CPP Portal." We request NPCIL to kindly accept the EMD payment in the form of a Bank Guarantee. Further, we propose that the same Bank Guarantee may also be treated as the Integrity Pact BG. Kindly confirm.	Tender conditions shall prevail
98	L&T	3	Section-B SCC	4	-	As per SCC clause "Tenderers shall note that, the total price of 'Site works i.e. Sum of the total price given against Erection works, Commissioning works, given in the Erection & Commissioning Schedule (i.e. Site Works Schedule) shall not be less than 20% of the total price of Supply given in Supply Schedule (The total price of Supply is inclusive of total price for Supply of Mandatory Spares also for above purpose). Similarly, for Commissioning of Electrical Equipment / Systems included under Commissioning Schedule of Section - E, the total price shall not be less than 3% of total price of Erection Works / Items of Electrical Equipment / Systems included under Erection works Schedule of Section - E..." It is important to highlight that the Supply Price Schedule under Section-E is to be executed on an EPC basis, wherein the predominant scope of work falls under the vendor's supply responsibilities. Only system integration activities are required to be carried out at site. Given this scope distribution, it is not feasible to adhere to the requirement that erection cost be mandated to 20% of the total supply price indicated in the Supply Schedule. Such an allocation does not reflect the actual nature of the work and may result in an unbalanced bid. This, in turn, could lead to significant financial and cash-flow challenges for bidders during project execution. We are presently executing the KKNPP 3 & 4 project, wherein the supply of major equipment has already been completed. However, the erection activities have been substantially delayed. Due to the mandated requirement of loading 20% of the supply value into the erection portion, we initiated the erection prices accordingly. As a result, the project is currently operating under significant negative cash flow. Hence, we respectfully request NPCIL to remove the mandatory 20% loading requirement on services/erection to ease the cash-flow burden and enable smoother execution of the project. Also, this will enable bidder to avoid the loading of financial charges in the Bid.	Tender conditions shall prevail

Nuclear Power Corporation Of India Limited
सी एवं एम एम
मुंबई
C & MM
Mumbai

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
99	L&T	4	Section-B SCC	7	Price Adjustment	As per SCC/GCC Clause "No adjustment of prices is allowed on spares, tools, tackles and accessories. Engineering charges, testing charges, analysis charges etc. shown/payable separately shall also not be eligible for Price Adjustment." We would like to bring the following points to NPCIL's attention: 1. As per the tender requirements, Mandatory spares are supposed to be delivered along with the main products. 2. To ensure timely and compliant delivery, bidders are required to order Mandatory spares along with the main products. 3. Mandatory spares also finished product like main items. Therefore, denying Price Adjustment for Mandatory Spares does not align with the overall contractual intent, especially considering that Mandatory Spares form an integral part of the Supply Package and are subject to the same market fluctuations as the main equipment. In view of this, we kindly request NPCIL to extend the applicability of the Price Adjustment clause to include Mandatory Spares as well, ensuring consistency, fairness, and equitable cost compensation throughout the contract period.	Tender conditions shall prevail
100	L&T	5	Section-B SCC	7	Price Adjustment	"Main Plant Electrical System Package of KKNPP 5&6" is a Unit Rate Contract with a total duration of 60 months. Over the tenure of the contract, the raw material composition varies significantly across the individual BOQ items. Due to this variability, deriving a single weightage coefficient through a unified price variation formula is not feasible, considering the following: 1. The quantities of individual items are likely to change during project execution. Any such variation will alter the derived (quoted) weightage factors, resulting in unreliable and inconsistent Price Variation calculations. 2. For Electrical Packages in India, IEEMA Price Variation Indices are widely adopted by Government, Utilities, and Private Sector entities. IEEMA indices comprehensively cover key electrical materials and equipment—including transformers, cables, cable trays, switchgear, batteries, structural steel, etc.—providing a transparent, uniform, and industry-accepted mechanism for Price Variation. The Price Variation formula provided in the tender is generic in nature and does not accurately capture the actual price movement of several major equipment categories included in the scope. We would like to highlight that the weightage factors for Price Variation are fundamentally dependent on the raw material composition of each equipment type. These compositions vary significantly across various items listed in the BOQ. For example: Transformers comprises of Copper, CRGO Steel, Structural Steel, Insulating Oil, Insulation Materials; Cables includes Copper, PVC, XLPE, Insulation & armour materials; Switchgears, HT/LT Panels, Structures etc. has unique raw material weightages (e.g., steel, copper, aluminum, insulating components etc), differing widely from one another. Hence, arriving at the single material, labour, constant weightage factor for entire contract is not realistic. In this regards, we request you to kindly consider applicable IEEMA formula for Transformers, Cables, Switchgears and other equipments covered under IEEMA without any ceiling.	Tender conditions shall prevail

Nuclear Power Corporation of India Limited
सी एवं एम एम
मुंबई
C & MM
Mumbai

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
101	L&T	6	Section-B SCC	7	Price Adjustment	**As per clause 5.4.6** "In case of delay in deliveries, completion of Erection & Commissioning and Civil works, as the case may be, due to reasons attributable to Force Majeure and/or Contractor, LD will be applicable as per Clause 6.2 of the GCC on the Price Adjustment amount." We understand from the above that LD on the Price Adjustment portion shall be levied in case of delays attributable to the Contractor and/or Force Majeure events. In this regard, we wish to submit that Force Majeure events are beyond the control of the Contractor and Purchaser, therefore, levy of LD on the PV portion for delays arising out of Force Majeure is not justified. Accordingly, we request NPCIL to kindly: **Remove the applicability of LD on the PV portion for delays arising due to Force Majeure,** Further, we understand that LD for **contract price** shall be applicable only for delays attributable to the Contractor and not for delays arising due to Force Majeure. We request NPCIL to kindly confirm the same.	Tender conditions shall prevail
102	L&T	7	Section-B SCC	7	Price Adjustment	**As per clause 5.4.7** "NO Price Adjustment will be payable if the total amount of Price Adjustment against the Contract sums up to less than 2% (Two percent) of the total Contract Price. However, if the total amount of Price Adjustment against the Contract sums to more than 2% (Two percent) of the total Contract Price, the total Price Adjustment shall be payable to the Contractor." Price variation in any indices is inherently uncertain and cannot be predicted accurately at this stage. Introducing a minimum threshold of 2% effectively creates a dead band that exposes the Contractor to unmanageable commercial risk. This risk is especially significant in long-duration EPC contracts, where even minor fluctuations in commodity prices significantly impact project costs. Applying a threshold may lead to quoting inflated base prices to safeguard against unpredictable fluctuations, this is mandating to load 2% in the quoted price in the bid, which ultimately will increase the bid value and thereby cost to the Purchaser. In view of the above, we kindly request NPCIL to remove the 2% threshold condition and allow Price Adjustment to be applied from the first rupee of variation, ensuring fairness and transparency in cost compensation.	Tender conditions shall prevail
103	L&T	8	Section-B SCC	7	Price Adjustment	**As per clause 5.4.9** "Where advance or stage payment are made, NO Price Adjustment shall be admissible on such portion of price. Accordingly, Price Adjustment shall be paid only on the remaining portion of the Price." We request NPCIL to allow applicability of Price Variation on the advance payment portion as well, in line with the prevailing practice being followed in other ongoing NPCIL contracts. We request NPCIL to clarify the stage payment terms under this contract.	a. Tender conditions shall prevail. B. Please refer Relevant SCC Clauses for stage payment.

Nuclear Power Corporation Of India Limited
सी एवं एम एम
मुंबई
C & MM
Mumbai

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
104	L&T	9	Section-B SCC	7	Price Adjustment	**As per clause 5.4.10** "Invoices containing Price adjustment shall be submitted by the Contractor once in a quarter and the same shall be paid by the Purchaser once in a quarter." We would like to highlight that the Contractor is required to release the price adjustment payments to the respective suppliers immediately upon receipt of materials at site. Deferring reimbursement to quarterly intervals creates a significant cash-flow burden on the Contractor, as the adjustment amounts must be paid upfront to vendors. In view of the above, we kindly request NPCIL to allow submission and payment of Price Adjustment invoices monthly basis after receipt of the respective materials at site.	Tender conditions shall prevail.
105	L&T	10	Section-B SCC	7	Price Adjustment	**As per clause 5.4.11** "Even if there is no price adjustment claim, the Contractor must submit all relevant data to prove that there is no downward variation. In any case, he must submit a declaration as follows.."	Query is not clear / incomplete and tender conditions shall prevail
106	L&T	11	Section-B SCC	7	Price Adjustment	**As per clause 5.5** "Price Adjustment Formula for Supply Portion: The price adjustment formula to be applied to the DAP price (including packing & forwarding charges, however, excluding transportation, transit insurance and GST) / FOB price-component..." We would like to bring to NPCIL's attention that, in the KKNPP 3&4 Contract, the Price Adjustment was applicable on the FOR Price, i.e., inclusive of packing & forwarding charges, transportation, transit insurance, GST, and all other indirect taxes. In line with the earlier contractual practice and to ensure consistency and fairness in price adjustment across comparable packages, we kindly request NPCIL to amend the applicability of Price Adjustment to the DAP price including packing & forwarding charges, transportation, transit insurance, and GST.	Tender conditions shall prevail.
107	L&T	12	Section-B SCC	7	Price Adjustment	**As per clause 5.5** "Subscript "1" refers to the indices/ exchange rates as on: ... b) the expiry of 2/3rd period from the date of purchase order to the date of dispatch". However, major items in this package like Cable, Cable trays & supports shall be delivered in phased manner as per approved schedule by NPCIL. Hence, the 2/3rd period from Purchase order to delivery shall not compensate the real price variation. For eg; In a 60 month contract, PO issued by NPCIL is Month 1 and part time PO for cable is issued by Contractor in Month 12, whereas actual requirement may be in Month 18, 24, 36, 48. However manufactiring time for cable is 2 months and Manufcaturing Clearance shall also be issued by NPCIL/Contractor in phased manner. As per existing condition for the supply of cable at 60th month, PV will be calculated as on 40th Month insted of calculating for 60th Month. **We kindly request NPCIL to modify the condition as "subscript "1" shall be calculated 30 days prior to the date of dispatch". Kindly confirm.**	Tender conditions shall prevail

Nuclear Power Corporation of India Limited
सी एंड एम एम
मुंबई
C & MM
Mumbai

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
108	L&T	13	Section-B SCC	7	Price Adjustment	**As per clause 5.5.3** "Index of Imported Raw Materials / Components: The indices for such material and labour subjected to Price Adjustment shall be clearly named in the offer submitted. The indices shall be well established and nationally recognized in the country of manufacture. If any other index is proposed full justification for its use shall be provided. Preferably only Government indices shall be used." We understand that during execution, if Contractor proposes to import raw materials or components, in that case Contractor shall submit the applicable Price Adjustment formula and corresponding coefficients, including provisions for currency variation, to NPCIL for approval. The approval shall be mutual and granted within the specified time frame to avoid delays in project execution. We also understand that no ceiling shall be applicable to such imported materials under the Price Adjustment mechanism.	Tender conditions shall prevail and please note that, by & large, it is understood that, all the BoQ items are indigeneously available and import content, if any, is bare minimum wrt to entire quantum of supplies to be done and hence, the proposed change is not envisaged.
109	L&T	14	Section-B SCC	10	Terms of Payment	**As per clause 5.9** "NOTE 1: a) According to the Payment Terms, Advance payments will be interest bearing at the **applicable rate as notified** by NPCIL on the first of April each year. The rate of interest for the current financial year FY 2025 – 26 is 10.14% p.a. b) Upon completion of the activity of the milestone, payments will be released after adjusting advance payments and interests accrued. c) Unless otherwise stipulated, interest shall be calculated on advances from the date of release until the preceding day of recovery from the bills. Interest rates applicable in future financial years are inherently unpredictable and therefore cannot be reasonably considered in our working or cost assumptions. **Unlike the arrangement followed for KKNPP Units 3 & 4, we request NPCIL to release the advance payment on an interest-free basis till CDD against submission of the Bank Guarantee, without linking it to the completion of the milestone activity specified in the SCC.**	Tender conditions shall prevail
110	L&T	15	Section-B SCC	10	Advance Payment	**As per clause 5.9.4 & 5.9.7** "10% as advance of Basic Price, inclusive of P & F charges and exclusive of taxes and duties....." Since GST becomes payable by us immediately upon receipt of advance from NPCIL, we humbly request NPCIL to kindly consider the following: **10% advance shall be given for basic price (inclusive of P&F charges) along with GST value for the advance collected.**	Tender conditions shall prevail
111	L&T	16	Section-B SCC	10	Terms of payment	As per clause S.9.4.b) "60% of Basic Price, inclusive of P&F charges and 100% applicable taxes and duties and payment of 10% advance and penalties & recovery if any, to be paid as scheduled in Section–E, as applicable, on pro rata basis, upon receipt of materials at site (against issue of 'Received Delivery Challan – RDC).." Unlike the arrangement followed for KKNPP Units 3 & 4, we request NPCIL to release the 60% upon dispatch to site against dispatch documents & shipping release.	Tender conditions shall prevail

Nuclear Power Corporation of India Limited
सी एम एम एम
मुंबई
C & MM
Mumbai

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
112	L&T	17	Section-B SCC	16	Training	**As per the SCC clause** "Training needs for NPCIL personnel described in the various technical specifications shall be binding on the contractor. All the expenses towards training programmes held shall be borne by the contractor. This clause of SCC shall be read in conjunction with the referred clauses No. 9.8 of GCC." We request NPCIL to confirm the requirements of Training on applicable Equipments along with No of Person & Duration of Training at Manufacturer works to be clarified in pre-bid stage. We also understand that NCPIL shall bear boarding, lodging and travelling expenses of its personnel deputed for such training and Contractor will **bear the** Trainer charges.	1. Training at Manufacturer Works and/or in their Collaborator's works shall be for minimum of 7 working days. 2. Training at Site shall be for minimum of 7 working days. 3. Number of person to be trained shall be minimum of 8 Nos for Training at Manufacturer Works and/or in their Collaborator's works. Similarly, minimum 10 personnel of site shall be trained. Further, it may be noted that all the expenses towards the training except travel & lodging expenses shall be borne by the Contractor.
113	L&T	18	Section-B SCC	S0	Undertakings from OEM	**As per SCC clause** "Bidder shall provide proof of testimony (along with Part – I Bid submission) of having entered **into an agreement**/MOU with the corresponding OEMs respectively for supply, design, detailed engineering, manufacturing and factory testing, including clearly defined agreement for deputation of respective / corresponding OEM representatives to site during the period of Erection, Testing & Commissioning, or any other execution stage, as desired by the OEM Manufacturer. ..." Suppliers are generally not willing to provide support or commitments during the bid stage for NPCIL projects, making it difficult for bidders to finalize makes and prepare accurate quotations. Since the procurement responsibility lies with the EPC contractor, this creates unnecessary risk and uncertainty during bidding. Considering the long duration of these projects and frequent geo-political changes that affect global supply chains, it is not practical to finalize new suppliers or subcontractors at the bid stage. Therefore, we request NPCIL to remove the "MoU" requirement and allow bidders to propose and get approval for new suppliers or subcontractors during the execution stage.	Tender conditions shall prevail. As such, this requirement is applicable only to major equipment such as 230kV & 400kV GIS / GIBD and 6kV Switchgear, as specified in the SCC clause.
114	L&T	19	Section-B SCC	50	Undertakings from OEM	**As per SCC Clause** "For major equipment mentioned above, Bidder shall thus confirm unconditional acceptance that they shall furnish the following undertakings from the Original Equipment Manufacturer(s) (OEM) along with Part – 1 Bid submission:.." We would like to clarify the following: 1. During tender preparation, the bidder collects quotations from various technically qualified / NPCIL-suggested vendors and makes a judicious assessment to quote item-wise prices. At this stage, suppliers are not finalized, as the process is limited to budgetary quotations and technical feasibility checks. Therefore, it is not practically possible for the bidder to obtain an undertaking from the OEM during the bidding stage. 2. The clause requires the bidder to obtain an undertaking from the OEM to enter into an Annual Maintenance Contract (AMC). However, without a detailed commercial evaluation of AMC-related obligations, deliverables, and long-term cost implications, neither the bidder nor the OEM can commit to such an undertaking at the tender stage. This requirement is therefore commercially not viable or enforceable during bid submission. 3. The tendering process is intended for estimation and competitive bidding, not for finalization of OEM contractual obligations. Mandating OEM undertakings at this stage imposes requirements that are practically unattainable and procedurally inconsistent with standard tender practices. Hence, we respectfully request NPCIL to kindly delete this clause and also remove the O&M Scope from the EPC Biddder.	Tender conditions shall prevail. As such, this requirement is applicable only to major equipment such as 230kV & 400kV GIS / GIBD and 6kV Switchgear, as specified in the SCC clause.

Nuclear Power Corporation of India Limited
C & MM
Mumbai

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
115	L&T	20	Section-B SCC	56	Performance Security	**As per the clause** "Contractor shall furnish a Performance Security Bond / Insurance Surety Bond for 10% of the total value of all the contracts in contract currency, for due performance of the said contracts and performance of the Facility(s), in the form of a Bank Guarantee within 30 days from the date of award of contracts and it shall be valid till satisfactory completion of defect liability period covering warranty/guarantee of the equipment/ facilities supplied by the Contractor and its Sub-contractors plus a claim period of three months for lodging of claims, if any." Time of completion for Unit **5 = 48** Months & Unit 6 = 60 Months. Hence, Bidder need to submit to submit two seperate Performance **BGs against** each reactor unit valid till completion of respective unit as mentioned above covering **defect** liability period & additional claim period of three months. Kindly confirm our understanding is correct.	Clause is self explanatory & Tender conditions shall prevail.
116	L&T	21	Section-B GCC	3.4.7	Latent DLP Bank Gurrantee	**As per the clause** "The Contractor shall submit a Bank Guarantee for 1% (one percent) of the total value of goods sold, in the **respective** contract currencies, as security against latent defect. This Bank Guarantee shall be valid for a **period of 5 (five)** years from the date of successful completion of the defect liability period as per the contract." NPCIL has introduced new requirement of Bank Guarantee for the Latent defect liability period 1% Bank Guarantee. No other Central or State Government/Private customer insisting for the EPC contract. No manufacturers ready to provide BG since the time period is exorbitantly high (considering 5 years Latent defect liabity period will start after completion of DLP). We request NPCIL to remove the Bank Guarantee requirement. This will enable us to partcipate in the bid.	Tender conditions shall be prevall.
117	L&T	22	Section-B SCC	44	Land for Staff and Labour Camp	**As per the clause** "Contractor in his bid document shall indicate the optimum requirement of area to setup his site facilities and labour camp along with the **tentative** layout plan. The type of construction shall be aesthetically pleasing" Bidder will submit the layout as mentioned above after award of the contract, Kindly confirm.	Acceptable
118	L&T	23	Section-B GCC	13.12	Plantation and Protection of Trees	**As per the GCC clause** "The Contractor shall plant trees as mentioned in the Contract of different species suitable for the soil condition at site in an area identified by the Engineer-in-charge and shall maintain the same including periodic watering till completion of work at no extra cost to the Purchaser. The tree plantation work shall be completed within six months from the date of site mobilisation by the Contractor.." We request NPCIL to remove the clause considering EPC Bidder not quoting the tender for landscaping or forest development work. If it is manadatory requirements, we request NPCIL to confirm the number of trees to be planted within six months of mobilization within battery limit.	Tree plantation clause is not applicable for the subject tender.
119	L&T	24	Section-B GCC	3.4(c)	Securities	**As per the clause** "All bank guarantees are to be sent by the bankers directly to the Purchaser." Kindly confirm the Bank details for SFMS confirmation during issuance of BG.	Payment of EMD to be done online. No Bank Details are required at this stage.
120	L&T	25	Section-B SCC	28	BOCW ACT	**As per the SCC clause** "The above Act, as understood, is applicable to only to Civil Works Schedule of Site Works for KK – 5 & 6. However, since civil works are not included in the subject package, BOCW Act is not applicable for subject EPC Package" Since Civil works in scope, we understand that 1% BOCW shall be applicable on Civil works only. Kindly confirm.	BoCW act shall be applicable. A separate civil Works schedule is provided in the BOQ and BOCW Act is applicable for the Civil works covered under that schedule of Section - E. Kindly note Tender conditions are self explanatory & continue to prevail.

Nuclear Power Corporation Of India Limited
सी एम एम
मुंबई
C & MM
Mumbai

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
121	L&T	26	Section-B SCC	67	End Use Certificate	Plants, as well as the constraints arising from nuclear-related embargoes, only a limited number of OEMs are willing to participate and submit their offers. Furthermore, certain OEMs may require an End Use Certificate (EUC) from NPCIL to facilitate the import of their raw materials or finished goods into India. In view of this, and unlike the arrangements followed for the KKNPP 3 & 4 Contract, we kindly request NPCIL to issue the End Use Certificate as and when required. This will support timely procurement and ensure the smooth progress of the project.	Clause is self explanatory & Tender conditions shall prevail.
122	L&T	27	Section-B SCC	57	GST Applicability on LD	As per clause 9.1.6 "GST on Liquidated Damages (LD), as applicable, shall be to the account of the Contractor and shall be recovered from payments due to the Contractor." In this regard, we would like to inform NPCIL that vide Circular No. 178/10/2022-GST dated 3rd Aug, 2022, issued by Ministry of Finance-GOI it has been clearly indicated that GST portion of contract shall not attract LD. Hence, we request NPCIL to revise the conditions.	Tender conditions are self-explanatory and shall prevail
123	L&T	28	Section-B SCC	7	Price Adjustment Formula for Supply Portion	As per the clause "Subscript '0' refers to indices/exchange rates as prevailing on the seventh day prior to the due date of submission of bid [Submission of both Part - I (Technical & Commercial except Price) and Part – II (Price Bid)]." We request to change the same by 30 days, since all the organization are issuing indices on monthly basis only.	Tender conditions shall prevail
124	L&T	29	Section-B SCC	33	TEMPORARY APPROACH ROADS WITHIN PLANT SITE	As per the SCC clause "Contractor shall repair the damage(s) if any, caused to the road formed by NPCIL as directed by EIC." The road can be damaged by any other package contractor also, hence we suggest for modification of clause as "Contractor shall repair the damage(s), if any, caused to the road formed by NPCIL due to the Contractor's activities/actions, as directed by EIC." Kindly confirm.	Noted, However Tender Conditions shall prevail.
125	L&T	30	Section-B GCC	5.1	Job Supervision at site	As per the GCC clause "The contractor must ensure adequate job supervision through educated, qualified and experienced supervisors - at least one supervisor for each hazardous job activity to ensure safety during work execution." We request NPCIL to kindly clarify the hazardous areas to be considered in KKNPP Unit 5&6.	Hazardous area definition will be governed as per industrial Standards. As such, this issue will be informed / examined further during the execution of Contract, on a case to case basis, by an assessment of hazard associated with the job.
126	L&T	31	Section-B GCC	15.5	Material accounting	We presume that the actual cut lengths with cable schedule will be provided by NPCIL to issue clearance for the Cable manufacturing to minimize scrap and cable Jointing. Kindly confirm.	Cable logs shall be issued in a phased manner during execution of Contract. Based on length of Cable as per Cable logs, Cable drum details are to be prepared by EPC Contractor. However responsibility of effective use of Cable as per tender conditions lies with EPC Contractor.
127	L&T	32	Section-B GCC	15.5.d	Material accounting	We presume that the FIM quantity shall be issued by NPCIL based on the site actual requirement to avoid both accountable and unaccountable Scrap/wastage. In this context, Contractor will take atmost care to utilize maximum quantity issued by NPCIL. However, we request NPCIL to take accountability of scrap generated and the same shall not be deducted from contractor. Kindly confirm.	Tender conditions shall prevail.
128	L&T	33	Section-B GCC	15.7.1	Permissible limits of wastage/ Scrap	We presume that the permissible waste / scrap percentage mentioned in the table shall be on the total quantity on the items mentioned in the table and not on the individual size or on the individual packings. Kindly confirm.	Tender conditions shall prevail
129	L&T	34	Section-B GCC	15.9	Return of surplus material to the purchaser	We presume that the purchaser stores shall be located inside Kudankulam Plant premises only. Kindly confirm.	Purchaser's stores shall be inside KKNPP Unit 1-6, Plant Premises.

Nuclear Power Corporation of India Limited एन पी सी आई एल एम एम मुंबई C & MM Mumbai

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
130	L&T	35	Section-B SCC	42	ENTRY PASSES	As per clause ".. The Police verification must be carried out by the Police under the Police Station area(s) where the contract person was staying for the last two to three years. The police verification shall be valid for only three years. " Considering project duration of 60 months, we request to accept one time police verification for the project. Once the person is engaged by the contractor, that person will be under the custody of contractor's HR or IR person till completion of the project. Kindly confirm.	Tender condition shall prevail
131	L&T	36	Section-B GCC	15.5.2	Surplus material of FIM	As per the clause, contractor need to return the surplus FIM with no detoriation in such material. We presume that, NPCIL will take back the surplus FIM immediately after intimation by contractor in written response. In case of delayed taking over, Contractor shall not be penalized. Kindly confirm.	Tender condition shall prevail
132	L&T	37	Section-B GCC	15.7.1 (f)	Permissible limits of wastage/ Scrap	Percentage wastage for cable permissible accountable value is mentioned as 2%, which is very minimal considering the practical and executional challanges. We request NPCIL to modify the percentage of cable to 4% considering the executional challenges. Kindly confirm.	Tender condition shall prevail
133	L&T	38	Section-B GCC	6.12	Definition of Force Majeure	We request you to include "Pandemic, Epidemics, Quarantine restrictions, Freight embargo" in Force Majeure defination and confirm.	Tender condition shall prevail
134	L&T	39		General		Based on our past experience with KKNPP 3&4, we understand that it would take min. 10 days to complete NPCIL formalities to engage any workmen at site work such as screening, Safety training, medical fitness checkup and then applying pass to NPCIL-HR and Texco/CISF security etc., (Apart from workmen daily wages we will have to bear cost of Police verification certificates / workmen, Medical fitness Rs 500/- per workmen, Radio frequency identity card by NPCIL Rs 500/- workmen being charged). Since, the Charges are not specified in KKNPP 5&6 tender document, kindly confirm whether these charges shall be reimbursed by NPCIL at actual or Bidder to include in the bid price.	Tender condition shall prevail
135	L&T	40	Section-C		Spare	As per the clause, spares to be supplied along with main equipment. We presume that the spares shall be taken over by NPCIL immediately upon receipt and verification of spares by Purchaser. Kindly confirm.	Tender condition shall prevail
136	L&T	41	Section-A	14	Validity of e-Bids	As per the referred clause, it has been mentioned that E-bids shall be kept valid for acceptance for a period of 120 (one hundred and twenty) days from the date of opening of **PART II (Price e-bid)** of the tender. With the present market scenario, most suppliers are not willing to accept indefinite price validity from the date of offer submission, primarily due to the ongoing geo-political situation, fluctuations in commodity prices (including oil and LPG), and various cargo and logistics restrictions. In view of these factors, we kindly request NPCIL to revise the price validity period to 60 days from the date of opening of the Technical Bid.	Tender condition shall prevail
137	L&T	42	Section-C	2.0 VENDOR DATA REQUIREMENTS	03) I02.KK56.0.0.TH.REP.PR001_R0_Electrical- VDR	The requirement of submission of performance certificate is only for the new suppliers/Manufactureres/OEMs. We understand that the same is not applicable for the approved suppliers. Kindly confirm Bidder's understanding is correct.	Tender condition shall prevail



TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
138	L&T	43	Section-C	2.0 VENDOR DATA REQUIREMENTS	03) I02.KK56.0.0.TH.REP.PR001_R0_Electrical- VDR	**Vendor Data Requirements** "Catalogues and brochures for all equipment's; Certificates from previous purchasers regarding satisfactory performance & Data on failure of equipment supplied in the past, if any" We would like to inform that Suppliers/Manufacturers/OEMs are not willing to support during bidding stage and also increasing the documentation work more than the technical work. Considering the same we kindly request to allow the submission of performance certificates of non-approved make during the vendor approvals stage, instead of the bidding stage. Kindly confirm.	Tender condition shall prevail
139	L&T	44		General	Repetition of Type Test & Special Test	In line with the technical specifications, we understand that certain Type Tests and Special Tests are required to be repeated/conducted for the present project. Considering the Government of India's accelerated push towards Renewable and Clean Energy targets up to 2030, most major manufacturers are currently operating at full capacity. As a result, OEMs are unable to commit to repeating tests on already validated and proven designs. Consequently, several Suppliers/Manufacturers/OEMs are reluctant to submit their offers under these conditions. Additionally, suppliers are not willing to undertake certain Special Tests, such as the IV&V (Independent Verification & Validation) test, LOCA (Loss of Coolant Accident) test etc. In view of the above, we request NPCIL to kindly accept the validity of existing Type Test Reports in accordance with the latest Central Electricity Authority (CEA) guidelines. Further, for Special Tests, we request NPCIL to consider that if vendors possess valid test reports for similar NPCIL projects, and if the same equipments are proposed to be used in the KKNPP Units 5 & 6 project, repetition of testing is not required. We kindly request NPCIL confirmation on this matter. Further, in case NPCIL still requires certain Type/Special Tests to be re-conducted despite the availability of valid reports, we propose that such tests be compensated separately on an actual-cost basis. This approach will facilitate better cooperation from OEMs and enable EPC bidders to submit the most competitive techno-commercial offers.	Carrying of Type tests/submission of valid type test reports is part of the scope of the subject tender as per the respective TS/tender. Hence bidder need not provide the unit rates for type tests separately. In case NPCIL wish to repeat any of the type test over and above the availability of the valid type test report, the same will be dealt separately through additional works. Please refer the clause no. 19 of document no. I02.KKS6.0.0.PR.TT.PR008 -The validity of type test report in general will be as per latest CEA guidelines on the validity and extension of type tests except for cases specifically brought in respective TS/DS e.g. cables etc. TS/DS shall govern in such exceptions where specifically specified. However, the contractor and their sub-vendor/manufacturer shall provide necessary evidence in all the cases as per industry standard/practice that the product has not undergone any change after the type test. Para number 7 of Clause no. 19 of document number I02.KK56.0.0.PR.TT.PR008 shall be read as "The type tests, especially for all major equipment Like **230kV GIS & 400kV GIS, 6kV Switchgears, LV Switchgears & MCCs, Dry Type Transformers, DCDBs, Panels, Boards, ACDBs, Batteries and outdoor switchyard equipments** should have been conducted at any one of the reputed International/Indian Test Laboratories mentioned below or any internationally accredited test laboratory subject to verification of accreditation certificate issued by international accreditation board only or **Indian Test Lab. accreditation certificate issued NABL. In case of inhouse facility of Manufactuerers, testing instruments used in testing shall have valid calibration cerificates traceable to National standards/NABL Lab.** a) KEMA, Holland b) EDF, France c) Hydro-Quebec, Canada d) CESI, Italy e) CPRI, Bangalore f) IPH Germany

Nuclear Power Corporation of India Limited
C & MM Mumbai

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
140	L&T	45	Section-B SCC	7	Price Adjustment	Diesel's retail prices fluctuations in our country are depends on various factors such as Rupee depreciation against Dollar, Trade policies etc. Further, we have plotted the variation of HSD indices published by RBI and found that 67% variation from Feb-21 to Jan-26, and in turn, increase of transportaion cost. Hence, we request you to kindly include price adjustment mechanism for freight charges. Kindly confirm.	Tender conditions shall prevail
141	L&T	46	Section-B SCC	7	Price Adjustment	NPCIL Price adjustment formula for Erection doesn't contain HSD, however the same is part of erection cost and it is covered in IEEMA Price Variation formula and Central Govt. Utilities like PGCIL. Hence, we request NPCIL to include HSD as part of Price variation formula and confirm.	Tender conditions shall prevail
142	L&T	47	Section-B SCC	37	QA Supervision in case of Sourcing of Items from abroad	As per the clause "In case of Sourcing of any item/s from abroad, preferably NPCIL will depute NPCIL QA Engineer for witnessing the inspection and testing as per Approved QAP and/or otherwise, NPCIL may appoint Third Party Inspector (TPI) for witnessing the inspection and testing on behalf of NPCIL." We understand that NPCIL will appoint TPI and bear all the necessary expenses witnessing the inspection and testing on behalf of NPCIL.	Tender clauses are self explanatory and the same shall prevail
143	L&T	48	Section-B SCC	14	Hindrances	We wish to highlight that the clause does not specify any timeline for endorsement by the Purchaser's representative. In the absence of a defined timeline, delays in endorsement may affect delay analysis and EOT entitlement despite timely submission by the Contractor. Therefore, we propose the following condition to be considered : **The Purchaser's representative shall endorse or provide comments on hindrance records within 7 days of submission. In case of no response within this period, the hindrance shall be deemed accepted for delay analysis and EOT evaluation.** **All hindrances irrespective of whether it is impacting the critical path or not shall be recorded and approved by the Purchaser. During the delay analysis and EOT, the impact can be assesed by both parties mutually.** Kindly confirm.	Tender conditions shall prevail
144	L&T	49	Section-B SCC	15	General Design Obligation	**As per Clause 8.1 (c),** it is stated that no extra claim shall be entertained for variations between "Tender Drawings" and "Approved Drawings." In this regard, we understand that the said provision applies to variations arising out of normal detailed engineering and design development within the overall scope as per tender specifications. However, in case of any changes proposed by purchaser in execution stage which result in modification of design or change in specifications, or any deviation beyond the original tender requirements, the same shall be treated as a Change under GCC 4.1.5 read with GCC Clause 19.2, and and accordingly, the provisions of GCC Clause 19.4 shall be applicable for determination of the corresponding revised price . Kindly confirm whether our above understanding is correct.	Tender conditions shall prevail

Nuclear Power Corporation Of India Ltd
सी एम एम
मुंबई
C & MM
Mumbai

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
145	L&T	50	Section-B GCC	15.4.7	Method of Measurement	As per the clause "If the Contractor objects to any of the measurements recorded on behalf of the Purchaser, a note to that effect shall be made with reasons and such note shall be signed and dated by both parties engaged in taking the measurements. **The decision of Engineer- in-Charge on such dispute or difference or interpretation shall be final and binding on both the parties and shall be beyond the scope of the settlement of dispute by Arbitration in respect of all contract items, substituted items, extra items and deviations."** We respectfully request NPCIL to kindly amend this clause to provide that **any dispute relating to measurements, including interpretations, deviations, substituted items, and extra items, shall be subject to arbitration in accordance with the dispute resolution provisions of the contract.** Kindly confirm.	Tender conditions shall prevail
146	L&T	51	Section-B GCC	21.4.1	Foreclosure of Contract	**As per the clause** "If at any time after acceptance of the tender / during execution of work the Purchaser shall decide to abandon or reduce the scope of the work for any reason whatsoever and hence not require the whole or any part of the work to be carried out, the Purchaser or Engineer-in-charge shall give notice in writing to that effect to the Contractor and the Contractor shall have no claim to any payment of compensation or otherwise whatsoever, on account of any profit or advantage which he might have derived from the execution of the work in full but which he did not derive in consequence of the foreclosure of the whole or part of the Contract." We request NPCIL for addition of the loss of expected profit on the balance portion of works in case of any foreclosure of works. Kindy confirm.	Tender conditions shall prevail
147	L&T	52	Section-B GCC	21.5.3	Cancellation / Termination of Contract in Full or Part	**As per the clause** "In case the Contract is terminated under GCC sub-clause no. 21.5.1 or 21.5.2 above the Contractor shall not be entitled to recover or be paid any sum for any work thereof or actually performed under this Contract unless and until the Project Manager / Engineer-in-Charge has certified in writing the performance of such work and the value payable in respect thereof and he shall only be entitled to be paid so certified." We request NPCIL to specify the clear timelines within which the Project Manager / Engineer-in-Charge should certify the value of works payable to the Contractor.	Tender conditions shall prevail
148	L&T	53	Section-B SCC	79	Liquidated Damages	**As per the SCC clause** "...This right shall be without prejudice to the right of the Purchaser, to recover the damages for breach of Contract by the Contractor as provided in the Contract or under the general law." In the interest of contractual clarity, predictability, and balanced risk distribution, we request NPCIL to kindly delete the above-referred portion of the SCC clause and confirm that: **The liquidated damages stipulated in the Contract shall constitute the sole and exclusive compensation payable by the Contractor for delays, and no further damages shall be sought under contract, tort, or general law for the same cause.**	Tender conditions shall prevail



TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
149	L&T	54	Section-B GCC	General	Rights to suspension and Termination by Contractor	We request NPCIL for addition of the below clause: Suspension Rights- If Purchaser fails or delays to release any due payments and or perform any other obligations under this Contract, the Contractor may, after giving not less than [21] days' notice to Purchaser, suspend work (or reduce the rate of work) unless and until the Contractor has received the Payment or the breach of Purchaser is remedied. The Contractor's action shall not prejudice its other rights and entitlements including interest on delayed payments. If the Contractor suffers delay and/or incurs Cost as a result of suspending work (or reducing the rate of work), it shall be entitled to : (a) an extension of time for any such delay, if completion is or will be delayed, and (b) payment of any such Costs incurred as a result thereto. Termination Rights: The Contractor shall be entitled to terminate the Contract if: a) the Purchaser has failed to pay the Contractor any sum due under the Contract within the specified period, has failed to approve any invoice or supporting documents without just cause pursuant to the Payment terms to the Contract Agreement and/or the Contractor is unable to carry out any of its obligations under the Contract for any reason attributable to the Purchaser b) Purchaser assigns, sublets or transfers this Contract in contravention to the terms of this Contract. c) Purchaser becomes bankrupt, insolvent, goes into liquidation (voluntary or otherwise), has a receiving or administration order made against him, compounds with his creditors, or carries on business under a receiver, trustee or manager for the benefit of his creditors, an order for corporate insolvency resolution process or liquidation is passed by a court/ tribunal, change of Control, or if any act is done or event occurs which (under applicable Laws) has a similar effect to any of these acts or events. ; Except in events under (c) where the termination shall be immediate, the Contractor may upon giving 14 days' notice to Purchaser, terminate this Contract in any of the other events listed out hereinabove, without prejudice to its other rights under contract or otherwise; The contractor shall be entitled to: i) return of all performance securities furnished by the Contractor under this Contract ii) payments which shall include: (a) the amounts payable for any work carried out for which a price is stated in the Contract; (b) the Cost of Plant and Materials ordered for the Works which have been delivered to the Contractor, or of which the Contractor is liable to accept delivery; (c) any other Cost or liability which in the circumstances was reasonably incurred by the Contractor in the expectation of completing the Contract (d) reasonable loss of profit.	Tender conditions shall prevail
150	L&T	55	Section-B GCC	General	Change in Law	Non-availability of Change in Laws and Regulations. We request to incoporate the below change in law clause in the subject contract: If, after the date seven (07) days prior to the date of Bid Opening, any law, regulation, ordinance, order or by-law having the force of law is enacted, promulgated, abrogated or changed in India (which shall be deemed to include any change in interpretation or application by the competent authorities) that subsequently affects the costs and expenses of the Contractor and/or the Time for Completion, the Contract Price shall be correspondingly increased or decreased, and/or the Time for Completion shall be reasonably adjusted to the extent that the Contractor has thereby been affected in the performance of any of its obligations under the Contract.	Tender conditions shall prevail

TENDER NO. CMM/MEQ-91-21-2-1219

NUCLEAR POWER CORPORATION OF INDIA LIMITED

Main Plant Electrical System Package for KKNPP Units - 5 & 6: Detailed Engineering, Manufacture, Procurement, Inspection & Testing, Supply, Erection / Construction, Pre-Commissioning, Commissioning & Testing, Trial Operation, Performance Guarantee (PG), Handing over of Systems and Equipment.

Pre- Bid Clarifications-Response-1

NPCIL S.No	NAME OF THE BIDDER	QUERY NO	TENDER SECTION NO	REFERENCE CLAUSE NO	REFERENCE DRAWING No. / TECHNICAL SPECIFICATION No. / VALVE SPECIFICATION No. / INSTRUMENTATION SHEET No. / DATA SHEET No.	DESCRIPTION OF THE QUERY	RESPONSE FROM NPCIL
1	4	5	6	7	8	9	10
151	L&T	56	Section E - Price Schedule	5.5 B_Supply	2.11 VENTED LEAD ACID PLANTE BATTERY (SUPPLY)	BOQ Sr. No. 2.11.1 / 2.11.2 / 2.11.3 having main description of Battery banks having quantities in Price Schedule. Apart from that BOQ Sr. No. 2.11.1.1, 2.11.1.2 / 2.11.2.1, 2.11.2.2 / 2.11.3.1, 2.11.3.2 carries break-up of main items having quantities in Price Schedule. We request NPCIL to correct the duplication.	Qty in BoQ item no. 2.11.1 , 2.11.2 , 2.11.3 (main item) shall not be considered for evaluation of the bid and bidders may please ensure that price for BoQ item no. 2.11.1, 2.11.2, 2.11.3 is not entered at their end duing the bidding. Any Price value / rates entered by bidders for BoQ item no. 2.11.1 , 2.11.2 , 2.11.3 shall not be considered durng the evaluation & processing of the bid. **Qty & Price entered in BoQ item no. 2.11.1.1, 2.11.1.2 , 2.11.2.1, 2.11.2.2 ,2.11.3.1, 2.11.3.2 shall only considered for evaluation & processing of the bid.**

TABLE OF CONTENTS

1.0	INTRODUCTION	9
2.0	PROJECT AND SITE DATA	13
3.0	SYSTEM DESCRIPTION	14
4.0	SCOPE OF WORK	19
5.0	ADDITIONAL INFORMATION/REQUIREMENT	27
6.0	BRIEF DESCRIPTION OF WORKS INCLUDED	27
7.0	PROCUREMENT	54
8.0	RESOURCE MOBILIZATION	55
9.0	WAREHOUSE MANAGEMENT	55
10.0	COMMISSIONING AND TESTING	56
11.0	HEALTH AND SAFETY	56
12.0	EXCLUSIONS	56
13.0	FREE ISSUE MATERIALS AND SERVICES	57
14.0	TERMINAL POINTS	57
15.0	DOCUMENTATION	57
16.0	CODES AND STANDARDS	58
17.0	AVAILABILITY REQUIREMENTS	59
18.0	SAFETY AND SEISMIC REQUIREMENTS	59
19.0	QUALITY ASSURANCE PROGRAM	60
20.0	DESIGN / ENGINEERING CONTROL	61
21.0	CONSTRUCTION CONTROL	63
22.0	TRAINING OF PURCHASER'S PERSONNEL	63
23.0	PAINTING	64
24.0	COMMISSIONING, TRIAL OPERATION AND HANDING OVER	64
25.0	SPARES	64
26.0	HOUSE KEEPING & WASTE DISPOSAL	65
27.0	PERFORMANCE GUARANTEE	65
28.0	PROJECT EXECUTION AND MANAGEMENT	65
29.0	REAL TIME INTEGRATED COMPUTERIZED PROGRESS MONITORING SYSTEM	66
30.0	REFERENCE DOCUMENTS	67
31.0	STATUTORY REQUIREMENTS	67
32.0	ABBREVIATIONS USED	68
33.0	LIST OF ATTACHMENTS	69

Annx. 1 List of Applicable Documents for Electrical Package for KKNPP- 5&6 70
Annexure-2 Safety and seismic requirements for BoP areas 73
Annexure-3 to 17

This document is an intellectual property of Nuclear Power Corporation of India

1.0 INTRODUCTION:

Nuclear Power Corporation of India Limited (hereinafter referred as NPCIL) is in the process of setting up of 2 x 1000 MWe Nuclear power plants at Kudankulam, Radhapuram Taluk, Tirunelveli District, Tamil Nadu located at a distance of 27 km from Kanyakumari. This Project is being constructed on a Technical collaboration basis with Russian Federation and is called Kudankulam Nuclear Power Project 5 & 6 (KKNPP-5 & 6).

Based on the division of responsibilities between NPCIL and Russian Federation side, the works under the subject tender can be categorized into the following three major categories (i.e. based on the works which are in NPCIL scope as per division of responsibilities between RF and NPCIL).

a) Design & supply in RF side scope and erection & commissioning in NPCIL scope: All such systems are a part of main plant systems. Examples of such systems are generator transformers, 24kV GCB, 24kV isolated phase bus ducts, 0.4kV switchgear & 0.4kV MCCs of main buildings, main plant electrical SCADA systems, protection panels of generators/unit auxiliary transformers/generator transformers, hermetic cable penetrations, associated cables, etc. in main plant areas/buildings. NPCIL scope works of such items (with respect to RF side) are covered under the scope of this contract including the associated cabling works. Equipment installation drawings, equipment layout, cable tray layout, cable schedules, cable termination details, lighting layout, etc. are developed by the Russian Federation designer for the main plant areas, reviewed/accepted by the Purchaser and issued to the Contractor for execution of the subject work. The contractor need to assess/review/workout the constructability/adequacy/completeness of the issued documents and drawings for erection & commissioning works and bring out the difficulty/mismatches/inadequacy, if any, on timely manner to NPCIL along with their suggested corrections/updates so as to take timely corrective actions to avoid delays in the execution. The contractor also needs to bring out the inadequacy, if any, in the BoQ of erection and commissioning on timely manner to NPCIL for corrective action.

b) Basic design in RF scope and detailed design, supply, erection and commissioning in NPCIL scope: All such systems are also a part of main plant systems. Examples of such systems are Diesel Generator Sets (DG sets) along with their auxiliaries, unit auxiliary transformers (UATs), 6kV isolated phase bus ducts (IPBDs), 6kV switchgear, 6/0.4kV auxiliary transformers, some of the 0.4kV switchgear & 0.4kV MCCs, rectifiers, DC boards, battery banks, inverters, AC boards, all associated power/control/FO cables, all associated cable carrier systems, all cable fire protection systems (passive), lightning & grounding protection systems, lighting and receptacles systems of entire main plant areas, etc. All such NPCIL scope works (with respect to RF side) are covered under the scope of this contract including the associated cabling works except all works of DG sets and their auxiliaries, supply of oil filled power transformers/reactors and rectifiers and inverters of Mainplant area. Supply of oil filled power transformers/reactors are covered under a separate contract but erection & commissioning of them including all interface related works for them are covered under the scope of this contract. Supply, erection and commissioning of DG sets along with their auxiliaries are covered under a separate contract. However, all interface of DG sets with other systems are covered under the scope of this contract. Supply and commissioning of rectifiers and inverters are covered under a separate contract, but erection, cable termination and other interface related works for commissioning of these rectifiers and inverters are covered the scope of this contract.

This document is an intellectual property of Nuclear Power Corporation of India

Documents/drawings developed by the package contractor and their sub-vendors & manufacturers as part of the scope of the supply of the equipment as per respective TS/DS (no separate item envisaged in the BoQ for such documents/drawings development as they are deemed part of the scope of either supply or erection, as the case may be, of equipment itself) will go as design input to RF side who in-turn will develop the final working documentation (WDs) taking into account equipment inputs/manufacturer's inputs. Hence the package contractor's documents/drawings and sub-vendor's/manufacturer's documents/drawings and equipment inputs developed in accordance with the requirement of respective TS & DS need to be provided in a timely manner to NPCIL for review, approval and further sharing with RF side by NPCIL (both editable autocad/word, etc. version and pdf version). All observations/comments on the manufacturer's documents and equipment input from NPCIL and RF side need to be addressed by the Contractor. Final WDs submitted by the Russian side will be issued to the Contractor for execution of the execution of works. However, some of the package contractor's documents/drawings and sub-vendor's/manufacturer's documents/drawings will still be useful for site execution e.g. individual equipment installation drawings etc. The contractor need to assess/review/workout the constructability/adequacy/completeness of the issued documents and drawings for erection & commissioning works and bring out the difficulty/mismatches/inadequacy, if any, on timely manner to NPCIL along with their suggested corrections/updates so as to take timely corrective actions to avoid delays in the execution. The contractor also needs to bring out the inadequacy, if any, in the BoQ of erection and commissioning on timely manner to NPCIL for corrective action.

c) Design, supply, erection and commissioning in NPCIL scope: All such systems are generally a part of balance of plant (BOP) systems. However, some of the systems may be part of main plant systems also e.g. lighting systems, receptacle systems etc. Examples of such systems in BOP are 400kV gas insulated switchgear along with outdoor termination equipment, 230kV gas insulated switchgear along with outdoor termination equipment, 400kV gas insulated bus ducts (GIBDs), 230kV GIBDs, 400kV shunt/line reactors, reserve auxiliary transformers, common station auxiliary transformer, complete control, monitoring & relay protection systems (CMRP systems) for entire 400kV & 230kV equipment, 6kV isolated phase bus ducts (IPBDs), 6kV switchgear, 6/0.4kV auxiliary transformers, 0.415kV switchgear & 0.415kV MCCs, rectifiers, DC boards, battery banks, inverters, AC boards, switchyard SCADA systems covering the entire electrical systems of BOP areas, all associated power/control/FO cables, all associated cable carrier systems, all cable fire protection systems, lightning & grounding protection systems, lighting & receptacle systems of entire BOP areas, etc. All such NPCIL scope works (with respect to RF side) are covered under the scope of this contract including the associated cabling works except for the supply of oil filled power transformers such as RATs, CSATs, shunt/line reactors and the rectifiers and inverters in switchyard control building (UAC). Supply of oil filled power transformers/reactors are covered under a separate contract but erection & commissioning of these power transformers/reactors including all interface related works for them are covered under the scope of this contract. Similarly, supply and commissioning of rectifiers and inverters of switchyard control building are covered under a separate contract, but erection, cable termination and other related interface jobs for commissioning is covered under the scope of this contract. The documents and drawings developed by the package contractor's and their sub-vendor's/manufacturer's and the equipment documents itself will become final working documents (WDs). Neither NPCIL nor the Russian side will make any document/drawing for such works and instead the package contractor themselves will be responsible for

This document is an intellectual property of Nuclear Power Corporation of India

development of all required documents and drawings for such works within the scope of this contract as per the methodology described below. All manufacturer's documents/drawings, package contractor's documents/drawings, sub-vendor's documents/drawings and equipment inputs developed in accordance with the requirement of respective TS and DS need to be submitted/provided in a timely manner with NPCIL for review and approval (both editable autocad/word, etc. version and pdf version). Any observations/comments of NPCIL on the manufacturer's documents/drawings, package contractor's documents/drawings, sub-vendor's documents/drawings and equipment input needs to be addressed by the Contractor and required revisions/updates in documents/drawings needs to be submitted. Format and contents of the documents/drawings shall be in the form acceptable to NPCIL as manufacturer's documents/drawings, package contractor's documents/drawings, sub-vendor's documents/drawings itself will become final working documents. Mostly works of BOP areas (both electrical and mechanical BOP areas) works fall into this category. There are interfaces of BoP areas with main plant areas and hence the Contractor will have to provide required inputs for equipment/items supplied by them for further development of interface related designs (beyond BoP battery limits) such as interface cable logs, interface cable carrier systems, etc. by the Purchaser or RF side designer.

For the buildings in BoP area (non RF design scope), the Purchaser will provide the relevant cable tray layout, electrical equipment layout, lightning protection & earthing layout, lighting layout, external cable connection diagram/connection schedule, etc. PDF drawings of the relevant buildings/floors of KKNPP34 (sample drawing - one of each type is included in the tender) as input for development/preparation of the drawings/documents for KKNPP 5&6 taking into account actual requirements of KKNPP 5&6. The Purchaser will also provide the 'as designed' (ACAD) civil architectural drawings of the relevant buildings/floors of KKNPP56. Based on the above, TS/DS requirements, individual equipment GA/isometric/installation drawings by equipment manufacturer/sub-vendor and directions if any from the Purchaser, the Contractor under the relevant item of the BoQ (for preparation of drawings), shall prepare cable tray layout, electrical equipment layout, lightning protection & earthing layout, lighting layout ACAD drawings, external cable connection diagram/connection schedule of the relevant buildings/floors of KKNPP 5&6 for review and approval by the Purchaser. These drawings are to be used by the Contractor for execution of the work. Contractor to note that these works are not just drafting works but involves development of engineering documents/drawings based on the said design inputs provided by NPCIL and actual equipment to be supplied under the subject contract taking into account all mismatches between civil drawings and electrical drawings. Contractor to also note that this work is different from the individual equipment GA, installation and isometric drawings to be developed by the equipment manufacturer/sub-vendors as part of the scope of supply of the equipment as per respective TS/DS. 70% of the payment will be released under relevant item in the BoQ on first R0 approval of drawing/document and the balance 30% payment will be done only after submission and approval of final site as-built drawings/documents. Contractor will have to carry the required revisions or changes or issue DCNs or issue FCNs as required for execution of works before site as built stage. However, such revision made or change issued or DCNs issued or FCNs issued based on the requirement of the works between R0 version and the final site 'as-built' version will not be measured/billed separately and is included in the measurement of the original drawing and is to be done by the Contractor. Final WDs developed as per above methodology and approved by NPCIL shall be issued to the Contractor for execution of the works. The contractor need to assess/review/workout the constructability/adequacy/completeness of the issued documents and drawings for erection

This document is an intellectual property of Nuclear Power Corporation of India

& commissioning works and bring out the difficulty/mismatches/inadequacy, if any, on timely manner with required revisions to NPCIL to avoid delays in the execution. The contractor also needs to bring out the inadequacy, if any, in the BoQ of erection and commissioning on timely manner to NPCIL for corrective action.

Cable schedules (cable logs) of KKNPP 3,4 of BoP building/ areas would be provided by the Purchaser as input for development/preparation of the cable log for KKNPP 5&6 taking into account actual cable route, actual coordinates, actual equipment location at from and To ends, cable lengths, number of cables, etc. Final cable schedules (cable logs) shall be developed by the Contractor for the BoP buildings/areas taking into account these and inputs (if any) provided by the Purchaser, subsequently reviewed/accepted by the Purchaser and issued to the Contractor for execution. Separate items have been envisaged in Section-E (supply part) of this Tender for preparation of all these cable schedule (cable logs) of BoP building/ areas. 70% of the payment will be released under relevant item in the BoQ on first R0 approval of drawing/document and the balance 30% payment will be done only after submission and approval of final site as-built drawings/documents. Contractor will have to carry the required revisions or changes or issue DCNs or issue FCNs as required for execution of works before site 'as built' stage. However, such a revision made or change issued or DCNs issued or FCNs issued based on the requirement of the works between R0 version and final site as-built version will not be measured/billed separately and is included in the measurement of the original drawing and is to be done by the Contractor.

Scope of work includes survey (including field) of all the connected interfaces with other SSCs, providing of solutions in case of any incompatibility, preparation of requisite changes in documents in the form of drawings for FCNs/DCNs/Other equivalent documents, for formal release by NPCIL and subsequent execution of the works based on the same meeting all technical requirements. This work is deemed to be included as a part of revision of drawings under BoQ for preparation of drawings or cable log as applicable and no separate payment will be made on account of this. In case the field solution requires change in the connected interface instead of electrical systems, relevant input is to be provided to NPCIL by Contractor for needful with the concerned agency (s).

The above categories cover the entire electrical systems of KKNPP 5&6 and only i) DG sets & their auxiliaries ii) chlorination plant package are not covered under the scope of the subject tender and supply of oil filled power transformers UATs, CSAT, RATs & shunt/line reactors is not covered under the scope of the subject tender (but erection & commissioning is covered). However, all interfaces of DG sets, chlorination plant package and oil filled power transformers/reactors with other systems of plant are covered under the scope of this tender. In addition, all interface related works between main plant systems and BoP systems are also covered under the subject tender.

This document provides a brief description of the scope and systems/ facilities related to Electrical works under the subject contract. This shall be read in conjunction with all other documents in the Tender document like Job specification (I02.KK34.0.0.PR.TT.PR009) & its annexures, respective technical specification documents, respective data sheets, SLDs, layouts, installation drawings, etc. along with their annexures (as per clause 9.0 of job specification- I02.KK34.0.0.PR.TT.PR009 and annexure-1 of this document).

Technical Specification and data sheets for various systems and equipment are included in the

This document is an intellectual property of Nuclear Power Corporation of India

tender document. The specifications and data sheets form the basis for Engineering, Procurement, Supply, Fabrication, Construction, Inspection, Testing, Pre-Commissioning, Commissioning of the facilities. The data sheets, QAP, test procedures, erection procedures, etc. prepared and submitted by Contractor are to be reviewed and approved by the Purchaser or his representative based on which work shall be executed.

Any discrepancy related to scope of work between this document and other documents (included in this tender) shall be brought out by the bidder during pre-bid stage for clarification from the Purchaser. **After award of contract, if such discrepancies arise during execution, the Purchaser's decision will be final and no additional claim can be asked from the Purchaser by the Contractor on account of the same.**

2.0 PROJECT AND SITE DATA:

2.1 Location of the Site:

KKNPP site is a coastal site on the shores of Gulf of Mannar located on the South-Eastern tip of India near Kanyakumari. It is located in Radhapuram taluk of Tirunelveli District of Tamil Nadu state. It is about 27 kms by road from Kanyakumari. The nearest Railway Stations are the one at Kanyakumari, and the other at Vadakku-Valliyoor which is about 27kms away, both having broad gauge railway track. There is a Major District Road (MDR) from Kanyakumari to Tiruchendur passing through Kudankulam village at a distance of 2-3 kms from the site. The MDR joins National Highway No.7 at about 8 kms north of Kanyakumari. The site is accessible by road from Nagercoil (approx. 35 kms) and from Kanyakumari.

2.2 Meteorological Data:

The site experiences a tropical climate with humidity ranging from 40% to 90% (as per Kaniyakumari Met data) depending on the seasons and is subjected mainly to the winter monsoon during the months of October, November & December. The air masses are mainly of tropical nature with typical wind flow mainly from the west. Temperatures range from 19 deg. C to 39.6 deg. C. The yearly average rain fall is around 700 mm. Meteorological data such as maximum and minimum temperature in the year, relative humidity, rainfall, etc. will be available in the office of the Purchaser for study by tenderer, if required.

2.3 Seismology:

KKNPP site falls under zone II and corresponds to an earthquake of intensity VI as per the Modified Mercalli Intensity scale. The peak ground acceleration under safe shutdown earthquake condition is 0.2g and under operating basis earthquake condition is 0.05g. These co-efficients correspond to zero period ground acceleration in the acceleration response spectra.
However for the subject work, the following will be applicable: Generalised response spectra and ASW requirements are provided in document no. R01.KK56.0.0.DS.RR.PR001 (part 01 and part 02) and guidance provided in NPCIL document no. R01.KK56.0.0.AP.PZ.PR001, applicable version of which will be provided by the Purchaser to the Contractor during execution. Specific floor response spectra can be provided by the Purchaser during execution of the work, if applicable.

This document is an intellectual property of Nuclear Power Corporation of India

2.4 **Site Inspection:**

Interested tenderers should visit the site to familiarize themselves thoroughly with site conditions before submitting their tenders. Non-familiarity with site conditions will not be considered a reason for extra contractual claims and shall not be an excuse for not carrying out the work in strict conformity with the drawings, time schedule and specifications. For any clarification regarding specifications, conditions of contract, schedule of quantities, scope of work, etc., the tenderer(s) should contact the authorized official of the Purchaser.

2.5 **Site Conditions:**

The overburden soil over highly weathered charnokite rock varying from 2 M to 5 M depth forms the rock structure. It mainly consists of coarse sands /silts and is variable. Just below the overburden lies highly weathered friable rock upto depths of 20 M. By examining these subsurface sections, the sub-surface strata may be generalized as below:
0.0 to 2.0 - Topsoil
2.0 to 5.0 m - Sandy/gravelly soil
5.0 to 20.0 m - Weathered rock of WIV/W III grade with joints at less than 1.0 m interval.
Below 20.0 m - Moderately weathered/ fresh rock/WII/WI.

3.0 SYSTEM DESCRIPTION:

Irrespective of the scope within the tender, the systems are described to provide a feel of the scheme/arrangement in the plant and to facilitate better understanding and execution.

3.1 **Power Output System:**

The Electrical system for the two units of Kudankulam Nuclear Power Plant (KKNPP 5&6), each of 1000 MWe, mainly consists of Power Output System and Auxiliary Power Supply System. The Power Output System is designed for evacuation of power generated at NPP. The Auxiliary Power Supply System provides electric power to NPP auxiliaries to carry out their assigned functions, in all operating modes of the NPP.

The electrical power, generated by the turbo-generators of both the units at 24 kV, 3 phase, 50 Hz, is stepped up to 400kV by the respective generator transformers and is evacuated through 400 kV transmission lines. For reserve source of power to auxiliaries, KKNPP is connected through 230kV lines. The generator of the Kudankulam NPP is rated with a power capacity of 1000MWe at 24kV, 3-phase, 50Hz, power factor of 0.9.

The generator is connected to generator transformer through 24kV isolated phase bus duct with the provision of a 24kV, 28kA generator circuit breaker connected in the run of IPBD. The generator is synchronized with the grid using GCB. The provision of GCB allows scheduled start-up and shutdown of power unit from the 400 kV grid. Facility is provided for synchronization of generator through 400kV GTCB also.

The generator transformer capacity of 1250MVA (3 single-phase units of 24/420 kV 417MVA each) is designed for evacuation of the full power output of the generator. One single-phase unit of generator transformer is envisaged as a common spare for both the units of NPP is located near the GTs of Unit-5 and installed without connecting into the system. The spare transformer is maintained as per the recommendations of the manufacturer, so that

This document is an intellectual property of Nuclear Power Corporation of India

it is ready to be put in service whenever required.

400 kV and 230 kV switchgear are of SF6 gas insulated type housed indoors considering the saline atmosphere at Kudankulam site. 400kV switchgear is designed as one and half circuit breaker scheme. 230kV switchgear is designed as two main bus scheme.

Switchyard control room is provided and electrical SCADA systems facilitates control and monitoring functions of power output systems including common systems of the plant.

The major components of power output system are given as below:

- 1000MWe, 24kV Turbo-generator
- 24kV GCB
- 24kV IPBDs
- 400/24kV, 3X417MVA generator transformers
- 400kV GIBDs
- 400kV gas insulated switchgear
- 400kV shunt reactors
- 400kV line reactors
- 400kV transmission line equipment
- 230kV gas insulated switchgear
- 230kV transmission line equipment
- SCADA systems
- Cabling and cable carrier systems
- 1000 kVA & 400kVA, 6/0.4kV and 6/0.433kV Auxiliary transformers
- 0.38kV and 0.415kV switchgear / MCCs/ power distribution board
- Rectifiers
- 220 V DC Batteries
- Inverters
- 220 V DC Distribution Boards (DCDB)
- 230 V, 240 V Distribution Boards (ACDB)
- Lighting system
- Grounding and lighting protection

3.2 Auxiliary power supply system:

The main function of the auxiliary power supply system is to ensure the availability of sufficient and reliable power supply to the auxiliary system equipment during all modes of plant operation i.e. normal plant operation, shutting down the reactor, maintaining the reactor in safe shut-down state, containment isolation, reactor core cooling, preventing significant release of radioactive material to the environment and any other necessary functions, without exceeding the design limits and conditions.

For start-up as well as for normal shutdown of both units of the plant, station auxiliary power is drawn from the 400 kV network through generator transformer and unit auxiliary transformers with the generator circuit breaker open. During normal plant operation, station auxiliary power is drawn from the main generator from the tap-off to 24 kV bus duct through unit auxiliary transformers. The reserve power supply is derived from 230 kV grid through 230/6.3-6.3 kV reserve auxiliary transformers and is used as backup power during non-availability of power supply from unit auxiliary transformers.
The common station auxiliary power supply feeding the common station auxiliary loads is

This document is an intellectual property of Nuclear Power Corporation of India

derived from 230kV grid through 230kV/6.3-6.3kV common station auxiliary transformers and is backed up by the reserve auxiliary transformers.

Key SLDs for power output systems and station auxiliary power supply systems provided elsewhere in the tender may be referred for understanding the scheme of power supply system at KKNPP 5&6. The system mainly consists of 6 kV, 0.433 kV, 0.4 kV, 240 V AC, 230 V AC and 220V DC power supply sources to supply power to unit auxiliary loads and common station auxiliary loads. Main plant SCADA systems is provided for control and monitoring functions of station auxiliary power supply systems of units through respective main control rooms.

The major components of auxiliary power supply system are given as below:

- 63MVA, 24/6.3-6.3kV Unit Auxiliary Transformer (UAT)
- 63MVA, 230/6.3-6.3kV Reserve Auxiliary Transformer (RAT)
- 230/6.3-6.3kV Common Station Auxiliary Transformer (CSAT)
- 6.3MW, 6kV Diesel Generator
- 6kV switchgear
- 1000 kVA & 400kVA, 6/0.4kV and 6/0.433kV Auxiliary transformers
- 0.38kV and 0.415kV switchgear / MCCs/ Power Distribution Board
- Rectifiers
- 220 V DC & 110 V DC Batteries
- Inverters
- 220 V DC and 110V DC Distribution Boards (DCDB)
- 230 V, 240 V and 380 V AC Distribution Boards (ACDB)
- Cabling and cable carrier systems
- Hermetic Cable Penetrations
- SCADA systems
- Lighting system
- Grounding and Lightning protection system

3.2.1 Classification of Auxiliary Power Supplies:

Depending on the degree of reliability for requirement of safety, the power supplies are classified into three groups: Group-1, Group-2, and Group-3, as defined below:

Group-3:
Power supply to the plant auxiliary loads normally required under all modes (operation, shutdown, safety / emergency conditions etc.) of plant, but which can tolerate prolonged interruption in the power supply, without affecting the safety of the plant, and do not require obligatory availability of power supply even after the actuation of reactor trip system is classified as Group-3 power supply.

Loads of this group requiring power supply for generation of power at NPP are supplied from 6kV, 380 V and 220 V AC, 50 Hz supply derived from unit auxiliary transformers or reserve auxiliary transformers and common station auxiliary transformer and can tolerate interruption of power for long duration without affecting the safety of NPP.

Group-2:
Alternating current power supply to the plant auxiliary loads which can tolerate short interruption for a time defined by the conditions without affecting safety of the reactor, (ranging from 20s to 60 s) under all modes (operation, shutdown, safety / emergency

This document is an intellectual property of Nuclear Power Corporation of India

conditions, etc.) of the plant, including the condition of loss of supply from all off-site sources, is classified as Group-2 power supply.

Loads of this group are supplied from 6kV, 380V and 220V AC, 50 Hz supplies normally derived from Group-3 power supply and whose backup source of power is from onsite diesel generator sets.

Group-1:

The power supply to the plant auxiliary loads which require un-interruptible direct current power or alternating current power with very short interruption of not more than 20 ms as defined by safety conditions, under all modes (operation, shutdown, safety / emergency conditions etc.) of the plant, including the condition of loss of supply from all alternating current sources is classified as Group-1 power supply.

Loads of this group are supplied from 220V DC, 380V and 220 V AC, 50Hz power supplies normally derived from Group-3 or Group-2 power supply sources and whose backup source of power is from the battery banks.

Normally DC Group-1 power is derived from Group-2 power supply through AC to DC Rectifier and AC Group-1 power is derived through DC to AC Inverter from DC Group-1 power supply. Battery bank provides direct current backup power so that Group-1 power supply is available even when Group-2 power supply is not available or rectifier is not available. The interruption of AC Group-1 power supply for 20 ms is allowed for the changeover of supply to the loads from one power supply to another power supply in Group-1 AC auxiliary power supply system.

Based on the above groups of power supply, the auxiliary power supply systems are designated as follows:

- **Normal auxiliary power supply system including common station auxiliary power supply system (Group-3)**

- **Reliable auxiliary power supply system**
  - Group-2 Reliable auxiliary power supply system
  - DC Group-1 Reliable auxiliary power supply system
  - AC Group-1 Reliable auxiliary power supply system
- **Emergency auxiliary power supply system**
  - Group-2 Emergency auxiliary power supply system
  - DC Group-1 Emergency auxiliary power supply system
  - AC Group-1 Emergency auxiliary power supply system

From the safety consideration and seismic requirement, these systems have been designed for following classes as per Russian standards NP-001-15 (OPB-88/15) and NP-031-01 respectively.

Normal auxiliary power supply system:

- Safety class - 3N, 4N
- Seismic category – IIb

Reliable auxiliary powers supply system of normal operation:

- Safety class - 3N
- Seismic category - IIb

This document is an intellectual property of Nuclear Power Corporation of India

Emergency auxiliary power supply system:

- Safety class - 2S
- Seismic category – I

Safety and seismic categorization of SSCs in BOP areas and some main plant area equipment and their qualification spectra requirements is provided in the table in annexure-2. Apart from the table in annexure-2, the requirements mentioned in relevant technical specifications/tender document shall be followed (higher of of the two in case of conflicting requirements)

3.3 Control, monitoring and relay protection systems (CMRP):

This system consists of control and monitoring, relay protection of the electrical equipment of power generating unit (Generator, GCB, GT, etc.), GIS, transmission lines, normal auxiliary power supply system, common station auxiliary power supply system, reliable auxiliary power supply system and emergency auxiliary power supply system.

The design is based on the concept of relay protection, control and monitoring of the electrical equipment used in the Russian practice and Indian/International practice in designing and operating thermal and atomic power stations, including the reference station and the concept are realized essentially on the microelectronics units of relay protection and automatics.

The control and monitoring of electrical equipment is realized through two separate SCADA systems, one for power output systems and common power supply systems through switchyard control room and another for station auxiliary power supply systems through respective units main control rooms. Features of the modern numerical relays/IEDs are fully exploited for SCADA systems.

3.4 Cabling:

Laying of main cable routes in KKNPP is through cable tunnels, trestles, trenches, over the roof structures and in cable bridges. Cable routes of the safety systems are run in underground tunnels. Cable structures of normal operation are designed earthquake resistant with respect to OBE and for safety systems with respect to OBE, SSE & ASW (AC inclusive for RB).

Generally, Low smoke fire retardant cables for non-safety systems, fire survival cables for safety systems and halogen free cables (for confined areas like Reactor Building) are used in KKNPP. The main features of cabling in KKNPP are:

- Cables of each safety system train are made along separate routes with fire partitions of fire rating not less than 3 hours.
- Cables of mutually redundant groups of the same channel are routed separately, with a partition between them of fire rating not less than 0.75/1 hours.
- Routing of cables through the Reactor Building containment is through sealed penetrations which can meet emergency environmental parameters.
- Automatic fire detection and firefighting systems are provided in cable spreader rooms, tunnels and shafts.
- Fire partitions with a fire rating of not less than 0.75/1 hour are provided all along the tunnels at every 30 m interval.

The type of cables envisaged for KKNPP mainly comprise:

This document is an intellectual property of Nuclear Power Corporation of India

a) Power Cables
   i) EHV CABLES
   ii) HV CABLES
   iii) LV CABLES
b) Control cable
c) Fiber optic cables
d) Instrumentation cables
e) Communication & computer system cables

3.5 Lighting & Receptacle System:

Lighting for Normal, emergency and evacuation purpose is provided at Kudankulam nuclear power plant. Lighting & receptacle system is designed for 415/240 V, 50 Hz.

- Normal lighting
- Emergency lighting
- Evacuation lighting

3.6 Grounding and lightning protection:

Grounding in KKNPP has been provided with a view to ensure:

- Personnel safety assurance in case insulation failure
- Neutral earthing to operate earth fault protection
- Protection of equipment against over-voltages
- Resistance of the grounding system does not exceed 0.5 ohms at any time of the year.
- Touch voltage does not exceed the permissible value.
- Special grounding is provided for grounding of instrumentation and computer based systems.

4.0 SCOPE OF WORK:

As mentioned in clause 1.0, scope under the subject contract includes works of entire electrical systems and equipment of KKNPP 5&6 in entire areas and buildings such as main plant buildings as well as BOP buildings/areas except DG sets & their auxiliaries, chlorination plant and supply of oil filled power transformers/reactors. The scope basically falls into two categories, viz:

A) Installation, testing, pre-commissioning and commissioning and handing over of the equipment supplied (by the Purchaser) as free issue items/material including fabrication work where ever called for is included. All the free issue items/material, shall be drawn from the Purchaser's store/warehouse by the Contractor. The scope also includes material receipt at the above said locations, as the case may be, material handling from the stores to the erection point and carrying out necessary checks to ascertain the healthiness and completeness of the materials for erection works, preservation until erection/commissioning and handover, etc.

B) Supply of items as detailed in the respective TS and DS documents and its installation, testing, pre-commissioning and commissioning and handing over. The scope of installation also includes preparation of drawings, delivery to site/erection point including all material handling, material receipt at site/erection point, unpacking, incoming-inspection, storage at site & performance guarantee, etc. Installation work also includes field engineering in some areas like cabling, lighting, grounding, fire barrier, etc. Items under this category are generally as per respective TS and DS documents and fall into

This document is an intellectual property of Nuclear Power Corporation of India

classification as per clause 1.0 (b) and 1.0 (c).

For systems/equipment of category (B) above, respective TS and DS covers only basic design requirements and basic engineering details. Scope includes development of detailed manufacturer documents and drawings taking into account TS and DS requirements, including:
- detailed design calculations and analysis,
- preparation of single line diagrams,
- control & protection schematic drawings,
- protection calculations and relay settings documents,
- general arrangement layout & isometric drawings,
- intra panel cable schedule and terminal list of each board,
- providing of engineering inputs to Purchaser to facilitate carrying out of detailed engineering under Purchaser's scope of design,
- procurement,
- fabrication/ manufacturing of equipment,
- quality control and assurance during all the above processes,
- factory inspection & testing,
- safe loading, insurance,
- safe transportation to site,
- safe unloading of the items at site,
- safe storage and safe shifting of the same to erection point,
- supply of all materials/ equipment (except those listed under works - excluded) including all the necessary tools and tackles, installation, field quality plans/ erection procedures, site testing, supervision by the manufacturer's specialists for erection and commissioning of all the major equipment,
- carrying out of special tests by the manufacturer's specialists, pre-commissioning, commissioning and performance guarantee,
- obtaining necessary statutory/ CEA clearances, wherever necessary, safe preservation till hand over and handing over of all electrical works including all essential/ mandatory and recommended spares, complete in all respects as per data sheets, drawings, specifications, standards etc., specified in the Tender Document for KKNPP-5&6.
-Scope also includes the following due to change e.g. terminal number as a result of manufacturer's specific design in the BoP areas: updating of NPCIL external cable termination document.

For systems/equipment of category (B) above which are part of works classified as per clause 1.0 (b), all the manufacturer's documents will go as design input to RF side who in turn will develop final working documents (WDs) taking into account equipment inputs/manufacturer's inputs. Hence all manufacturer's documents/drawings, package contractor's documents/drawings, sub-vendor's documents/drawings and equipment inputs developed in accordance with the requirement of respective TS and DS need to be provided in a timely manner to NPCIL for review and approval and further sharing the same with RF side by NPCIL (both editable autocad/word, etc. version and pdf version). Any observations/comments on the manufacturer's documents/drawings, package contractor's documents/drawings, sub-vendor's documents/drawings and equipment input from NPCIL or RF side need to be addressed by the Contractor.

For systems/equipment of category (B) above which are part of works classified as per clause 1.0 (c), all the manufacturer's documents/drawings, package contractor's

This document is an intellectual property of Nuclear Power Corporation of India

documents/drawings, sub-vendor's documents/drawings and equipment documents itself will become as final working documents (WDs). All manufacturer's documents/drawings, package contractor's documents/drawings, sub-vendor's documents/drawings and equipment inputs developed in accordance with the requirement of respective TS and DS need to be provided in timely manner to NPCIL for review and approval (both editable autocad/word, etc. version and pdf version). Any observations/comments on the manufacturer's documents/drawings, package contractor's documents/drawings, sub-vendor's documents/drawings and equipment input from NPCIL side need to be addressed by the Contractor. Format and contents of the document shall be in the form acceptable to NPCIL as manufacturer's documents itself will become final working documents.

For systems/equipment of category (B), Purchaser may ask the Contactor for incorporating some modifications/additions/deletions during the design, manufacturing and supply of the equipment/component. Refer clause no. (1.3) of Job Specification document I02.KK56.0.0.PR.TT009 for the same.

The layout and embedded part (EP) details of 400kV GIS and GIBD within the UAB building (I02.KK56.0UAB.0.ET.OK.WD001) is attached with the TS for 400kV GIS and GIBD (I02.KK56.0.0.ET.TS.PR051). Bidders are requested to take note of the same while finalising their sub-orders for 400kV GIS and GIBD. The bidder/Contractor shall ensure that the design of 400kV GIS and GIBD shall match the layout and EP drawings provided along with the tender.

The layout and embedded part (EP) details of 230kV GIS and GIBD within the UAD building (I02.KK56.0UAD.0.ET.OK.WD001) is attached with the TS for 230kV GIS and GIBD (I02.KK56.0.0.ET.TS.PR053). Bidders are requested to take note of the same while finalising their sub-orders for 230kV GIS and GIBD. The bidder/Contractor shall ensure that the design of 230kV GIS and GIBD shall match the layout and EP drawings provided along with the tender.

Transformers/reactors (oil filled) are being procured by the Purchaser through a separate contract but are intended to be installed through the subject tender. The Purchaser shall issue the transformers as a 'Free Issue Item' to the Contractor for installation, testing and commissioning. The Purchaser, on receipt of the input details from the transformer manufacturer, shall provide the inputs to the subject Contractor, during execution of the contract, based on which the Contractor shall design, procure, supply, install, test and commission the termination modules of GIBD at no extra cost and time to the Purchaser.

The documents/drawings annexed/attached as part of the respective TS/DS are based on the information of the previous project (s) with specific make/manufacturer and the same is provided for reference of the contractor for development of similar documents/drawings for the execution of works under this tender. Contractor need to prepare/develop specific document/drawing for KKNPP 5&6 project in similar manner taking into account of the equipment input of KKNPP 5&6 and development/updates in industry/regulations for such works, updated input if any from NPCIL etc. and carry our execution as per approved documents/drawings for KKNPP 5&6. In case of any change in the qualification requirements due to change in the installation arrangement, layout etc. of equipment of KKNPP 5&6, the required qualification for KKNPP 5&6 is deemed part of the scope of the contractor under this contract.

This document is an intellectual property of Nuclear Power Corporation of India

It is not the intent to specify completely herein, all details of the design, construction and erection of the materials. However, the material/work shall conform in all respects to high standards of engineering, design and workmanship and be capable of performing in a manner acceptable to the PURCHASER who will interpret the meaning of drawings and the specifications and shall be entitled to reject any work or material which is not in full accordance therewith.

Non-inclusion of any specific scope of work or item above do not absolve the Contractor of their responsibility to supply the same to meet the design intent as per the respective technical specifications and data sheets, taken together.
Some works which are interfaced with KKNPP34 will require the Contractor to go and work in KKNPP34 areas also. This will also require coordination with KKNPP34 authorities, permits, etc.

The Purchaser will be providing the relevant drawings during execution of the contract, in a progressive manner. The Contractor shall go through the drawings, compile data from various drawings & work out the total quantities of individual items required (taking into account the BoQ of the PO), drawing wise, item wise, in XL/MS Access format, update the same periodically at regular intervals, say once in a month, inform the Purchaser of the requirement of items to be procured also looking into manufacturing lead time, front release, etc. and seek clearances for manufacturing, after which detailed engineering and submission of drawings (by the Contractor/manufacturer) for the item shall commence. The cost towards this activity is deemed to be included in the respective supply items (already included in the tender) and will not be paid by the Purchaser separately.

The Purchaser will be providing the relevant cable logs for buildings under category mentioned at clause 1.0 (a)) document during execution of the contract, in a progressive manner and for the other buildings the Contractor is to prepare the cable logs as brought out in other paras. For all the cabling, the Contractor shall go through the drawings, compile data from various documents and work out the total quantities of individual cable items (cables, cable accessories like glands, lugs, etc.) required (taking into account the BoQ of the PO), drawing wise, item wise, in XL/MS Access format, update the same periodically at regular intervals, say once in a month, inform the Purchaser of the requirement of items to be procured also looking into manufacturing lead time, front release, etc. and seek clearances for manufacturing, after which detailed engineering and submission of drawings (by the Contractor/manufacturer) for the item shall commence. This document is envisaged to become the consolidated cable log (a compilation of all individual cable logs). A format of the same can be provided by the Purchaser, when asked for by the Bidder/Contractor. The cost towards this activity is deemed to be included in the respective supply items (already included in the tender) and will not be paid by the Purchaser separately.

4.1 Installation of items to be supplied by the Purchaser:

The erection works shall be supervised and controlled by the erection group of the Purchaser. Scope of installation at site of the systems / equipment and accessories for the items to be supplied by the Purchaser as specified in relevant sections of this tender are as follows:

a) All free issue material shall be issued to the Contractor at Purchaser's store/warehouse. The scope includes material receipt at the above said locations, as the case may be, material handling to the erection point and carrying out necessary checks to ascertain the healthiness and completeness of the materials for erection works, unpacking, disposal of

This document is an intellectual property of Nuclear Power Corporation of India

scrap/packing wood to scrap yard/stores as the case may be, preservation until completion of erection and commissioning.

b) Painting of materials including supply wherever required as per the instructions given in the working drawings and specifications as well as supply and application of touch paint of same colour code, wherever required.

c) Provision of identification/marking of equipment/systems such as cable trays, panels, Distribution boards, with designation, KKS code, danger sign boards/marks, etc.

d) Preparation and approval of all required procedures, QAPs, safety manuals, construction/erection methodologies, implementation of above after Purchaser's acceptance and preparation of inspection/test reports/records and recording implementation of the same and submission of the same for Purchaser's acceptance in hard and soft copy (in SSDs/HDDs).

e) Preparation and approval of procedures for all the erection activities such as fabrication, welding/brazing, cable tray erection, cable laying, cable termination, site testing, inspection, equipment/panel erection, pre-commissioning/commissioning etc. as per the instructions given in the working drawings and specifications and implementation of the same after PURCHASER's acceptance. All documentation shall be submitted in hard and soft copy form (in SSDs/HDDs).

f) Embedded parts for the cabling, equipment installation are generally included in civil construction. However, wherever EP is not available, the same shall be fixed using PURCHASER approved anchor fasteners such as HILTI, etc. including supply of anchor fasteners, accessories and machineries.

g) Preservation of all the equipment at the Contractor's storage yard/erection facility as per manufacturer's guidelines, till handing over to Purchaser. Any additional fire protection measures/devices, if deemed necessary, shall also be provided by the Contractor.

h) Carrying out all the necessary tests on Electrical equipment as required by Purchaser and as indicated in the relevant sections.

i) Obtaining necessary clearance from statutory authorities such as CEA for all installation works before putting the equipment/system in service.

j) Identification and sourcing of the material, equivalent to that of Russian material specification, required for the execution of the works, in the event of any contingencies.

k) Installation of electrical equipment/systems, site testing and pre-commissioning and commissioning of the equipment/sub systems as per SOQ and as mentioned but not limited to the list given below:

- Generator Transformers (GT)
- Unit auxiliary transformers (UAT)
- Reserve auxiliary transformers (RATs)
- Common station auxiliary transformer (CSAT)
- Shunt reactors
- Generator Circuit Breaker and its associated panels
- 24kV Isolated Phase Bus duct and its associated panels like CT/PT panels.
- 0.4 kV & 0.415kV Switchgear for main plant like UBA, UKD, UKC, UMA, etc.
- 380V/220 V AC Distribution Boards (ACDBs) of UBA & UKD building, and sub DCDBs of UBA building.
- Relay protection panels and measuring panels for TG, GT, UAT, etc.
- Electrical local control panels
- I/O panels, Work stations, VDU, Servers, CPU, Computers & peripherals, etc. for electrical SCADA system
- Rectifiers and Inverters of Mainplant buildings and switchyard control building (commissioning is excluded from Contractors scope, however, Commissioning

This document is an intellectual property of Nuclear Power Corporation of India

support shall be provided to the OEM)
- Cable Penetrations and terminations
- Installation of various power distribution boards, junction boxes for specific applications wherever required.

l) Preparation of inspection, erection, testing & pre-commissioning/commissioning reports and as - built documents/drawings/field drawings, etc. in hard & soft form in SSDs/HDDs.

m) House-keeping of the area wherever erection works is in progress, including that of the equipment erected by vacuum cleaning/mopping etc.

n) Display of relevant safety sign boards/posters/slogans at Contractor's works area in order to implement all safety practices/measures to promote safety culture and safety consciousness among his employees and labour force.

o) Preparation of 'as built drawings' by correcting the soft copies (to be made available by Purchaser) for the works carried out by the Contractor, where ever changes from the drawings have been implemented.

p) Preparation of construction completion certificate (CCC) by compiling all the relevant reports/records as per guidelines/formats to be approved by Purchaser.

q) Civil works: The subject tender also includes civil works as detailed under the relevant TS and DS documents.

4.2 Supply and Installation (by the Contractor) items:

The supply shall be made as per the requirements mentioned in relevant TS and DS. The methodology/procedure/requirements as mentioned at clause 4.1 above for installation is also applicable for this clause for installation, pre-commissioning, commissioning and handing over part of the works. Supply and installation of electrical equipment/systems in main plant as well as BOP areas, site testing and pre- commissioning and commissioning of the equipment/sub systems as per SoQ and mentioned but not limited to the list given below:

Main plant areas

- 3150A, 6kV isolated phase bus duct (IPBDs) for interconnecting the LV side of UATs in UBF to 6kV Switchgear in UBA buildings along with its supporting structures.
- 6kV switchgear
- GPS systems for IEDs of UKD buildings
- 6/0.4kV Dry type Auxiliary Transformers
- 6/0.415 kV Dry type Auxiliary Transformers for lighting
- 0.4 kV Switchgear for specific buildings like UQA, UQC, UPX, UKS, etc.
- 0.4 kV Motor control centre (MCC) for specific buildings like UQA, UQC, UPX, UKS, vent centre, etc.
- Lighting distribution boards (LDB), Lighting distribution panels (LDP) and Welding distribution boards (WDB), Power distribution boards (PDB), etc.
- Batteries, spare cell chargers, load banks and
- 220 V /110 V DC Distribution Boards (DCDBs) and sub-DCDBs
- 380V/240 V/ 230 V AC Distribution Boards (ACDBs)
- Cable carrier system
- HV and LV power cables
- LV bus ducts
- Control cables
- Instrumentation & communication and computer system cables
- Fiber optic cables

This document is an intellectual property of Nuclear Power Corporation of India

- Cable accessories like termination kits, jointing kits, flexible reducing cable coupling, FOC patch cords, lighting interface units, splicing boxes, etc.
- Outdoor & Indoor lighting
- Power receptacles
- Junction boxes
- Grounding and lightning protection
- Special grounding for grounding of instrumentation and computer based systems
- Fire barriers
- Fire protection coating on cables

Electrical BOP areas

- 400kV Gas Insulated Switchgear (GIS) along with gas insulated bus ducts connecting 400kV GIS and 400kV/24kV Generator Transformers (0 UAB building)
- 400kV outdoor switchyard (0 1UAK)
- 400kV Tie line – two lines - (D/C OH line) between KKNPP 5&6 and KKNPP 3&4.
- 230kV Gas Insulated Switchgear (GIS) (0 UAD building)
- 230kV outdoor switchyard (0 2UAK)
- Complete CMRP systems for 400kV and 230kV systems.
- Complete RTU/PLCC/SPS/PMU/Billing and metering systems for 400kV and 230kV systems.
- Complete SCADA systems for Entire BOP areas with GPS systems with centralized control room in switchyard building (0UAC building).
- 6kV Isolated Phase Bus Duct for interconnecting the LV side of RATs & CSAT in 04UBG to 6kV Switchgear along with its supporting structures.
- 6kV switchgear
- 6/0.415 kV Dry type Auxiliary Transformers
- 0.433 kV Switchgear.
- 0.433 kV Motor control centre (MCC).
- 0.415 kV Main lighting distribution boards (MLDB), lighting distribution boards (LDB), lighting distribution panels (LDP) and welding distribution boards (WDB), wall mounted power distribution boards (PDBs)etc.
- Batteries, spare cell chargers, load banks
- 220 V DC Distribution Boards (DCDBs) and sub DCDBs
- 240 V AC Distribution Boards (ACDBs)
- Cable carrier system
- EHV, HV and LV power cables
- LV bus ducts
- Control cables
- Instrumentation & communication and computer system cables
- Fiber optic cables
- Cable accessories like termination kits, jointing kits, flexible reducing cable coupling, FOC patch cords, lighting interface units, splicing boxes, etc.
- Power receptacles
- Junction boxes
- Grounding and lightning protection.
- Special grounding for grounding of instrumentation and computer based systems
- Fire barriers

This document is an intellectual property of Nuclear Power Corporation of India

- Fire protection coating on cables
- Outdoor & Indoor lighting

Mechanical BOP areas

- 6kV switchgear
- 6/0.415 kV Dry type Auxiliary Transformers
- 0.433 kV Switchgear
- 0.433 kV Motor control centre (MCC)
- 0.415 kV Main lighting distribution boards (MLDB), lighting distribution boards (LDB), lighting distribution panels (LDP) and welding distribution boards (WDB), wall mounted PDBs etc.
- 220 V DC Distribution Boards (DCDBs) and sub-DCDBs
- 240 V AC Distribution Boards (ACDBs)
- Cable carrier system
- HV and LV power cables
- LV bus ducts
- Control cables
- Instrumentation & communication and computer system cables
- Fiber optic cables
- Cable accessories like termination kits, jointing kits, flexible reducing cable coupling, FOC patch cords, lighting interface units, splicing boxes, etc.
- Interface equipment/accessories for integration with SCADA in switchyard control room.
- Power receptacles
- Junction boxes
- Grounding and lightning protection.
- Special grounding for grounding of instrumentation and computer based systems
- Part of lightning protection like test link box, etc.
- Fire barriers
- Fire protection coating on cables
- Outdoor & Indoor lighting

The TENDERER may please note that for the lighting and receptacles system, in addition to the supply and installation, the TENDERER shall also work out necessary detailing like installation arrangement layout of lighting distribution cables, GI rigid conduits, wire mesh type trays and its accessories, wires, receptacles, switch controls, junction boxes (JBs), etc. as a part of the respective installation item in the SOQ. Similarly, for cabling, some detailing/engineering for field routing, cable schedules for additional cables, etc. as a part of the respective installation item in the SoQ would have to be carried out by the Contractor as a part of the subject package.

Civil works: The subject tender also includes civil works as detailed under the relevant TS and DS documents.

4.3 Commissioning of electrical equipment:

This document is an intellectual property of Nuclear Power Corporation of India

Pre-commissioning and commissioning of electrical equipment after erection shall also be carried out by the Contractor under the subject tender. All the commissioning activities shall be supervised and controlled by the commissioning sub-group of Purchaser's O&M group. As brought out in detail in the Job Specification document, all required procedures shall be developed by the Contractor, for review and approval by the Purchaser.

For the already erected/installed equipment, Purchaser may also ask for modifications/addition of type/rating of feeder modules/incomer modules/components after the supply of the equipment at site. In that case, the Contactor shall incorporate the modifications/additions during the erection and commissioning stage. Refer clause no. (1.3) of Job Specification document I02.KK56.0.0.PR.TT009 for the same.

5.0 ADDITIONAL INFORMATION/REQUIREMENT:

a) Purchaser supplied equipment: During the execution of contract, full assistance and cooperation shall be provided to Purchaser's authorized representatives including Equipment manufacturer/supplier as well as Russian representatives present at KKNPP site during any supervision of erection/pre-commissioning/commissioning activities. Supervision by equipment supplier shall be arranged solely at the discretion of the Purchaser. Whenever and wherever deemed necessary by the Purchaser, the Purchaser shall arrange for supervision of the activities by the manufacturer's specialist.
b) For equipment supplied in this Contract: Supervision by equipment supplier shall be arranged by the Contractor under the respective installation and/or commissioning items as applicable, at no extra cost to the Purchaser.
c) The Contractor shall submit all the documentation such as approved drawings, procedures, documents, reports, etc. to Purchaser in Auto CAD/ MS office formats in SSDs/HDDs.

6.0 BRIEF DESCRIPTION OF WORKS INCLUDED:

Works as listed below, but not limited to the same to meet the design intent in full, are included in the scope of this Contract. It shall be the Contractor's single point responsibility, for completely covering all the equipment defined in this document and required for completion of the system for the plant.

The scope of work covered in the package is further detailed below under the respective sub-heads. The details of the equipment in this document are indicative (for Purchaser supplied only installation item) and would be available during actual work execution. Details of Supply & Installation items are available in the respective TS & DS documents.

However, some requirements on installation of the same are brought in this document.

6.1 Power output system:

6.1.1 24 kV Isolated Phase Bus duct (IPBD) – Installation

The Generator and the Generator transformer are connected with each other by a 24kV, 31.5 kA, Aluminium bus & casing, air forced Isolated Phase Bus duct with the Generator Circuit Breaker between them. The forced cooling system includes blower fans & motors, valves, air coolers and distribution pipelines for distribution of the cooling air. The approximate weight of the 24 kV IPBD is estimated to be 298000 kgs. IPBD supply mainly consists of horizontal

This document is an intellectual property of Nuclear Power Corporation of India

sections of lengths between 5.5 mtr and 3 Metre. Lengths. The indicative details of the IPBD are given below in Table 1.

The Bus duct consists of separate sections, connected with each other by welding. All joints (both the enclosure and the bus) of IPBD are welded except for the joints at the terminals of the generator, GT, UAT, surge protection cubicle and VT cubicle and expansion joints which are bolted, connected using flexible copper braids. To prevent strains from vibration and temperature impacts, between several sections of bus duct, compensators are installed both on the casings and buses. Grounding is made at one point, for each section before and after the GCB. To prevent bus duct temperature increase over the allowable level, forced air ventilation is provided for the main bus duct. Protection and measuring - current transformers and the voltage transformers, surge arrestors and surge capacitors for protection from over voltages are provided with the bus ducts.

Seismic compensating devices are installed between the turbine building and the outdoor transformer unit. The neutral bus duct is connected to the grounding transformer (NGT).

Table 1: Indicative Details for 24kV IPBD

Main parameters of 24kV bus duct	
Rated voltage, kV	24
Rated frequency, Hz	50
Rated current, A	31500
Buses and casing material	Al
Cooling	AF (Air forced)
Main bus duct external diameter, mm	1172
Casing thickness, mm	6
Bus diameter, mm	650
Bus duct thickness, mm	15
Approx. weight of Bus Duct per meter length, kg	245
Main parameters of tap bus duct to the UAT:	
Rated voltage, kV	24
Rated frequency, Hz	50
Rated current, A	3150
Buses and casing material	Al
Cooling	natural
Bus duct external diameter, mm	678
Casing thickness, mm	4
Bus diameter, mm	180
Bus thickness, mm	10
Approx. weight of Bus Duct per meter length, kg	95
24 kV IPBD Accessories	

This document is an intellectual property of Nuclear Power Corporation of India

Current transformers	
Rated voltage, kV	24
Rated current, A	30000/1
Main parameters of CT in the generator neutral	
Rated voltage, kV	24
Rated current, A	15000/1
Main parameters of CT provided between the neutral bridge	
Rated voltage, kV	24
Rated current, A	1500/5
Voltage Transformers, neutral grounding VT	
Voltage rating, kV	24/√3/ 100/√3 /100/√3
Surge Arrestors	
Type	Metal-oxide, gap less
Rated voltage, kV	24
Max. continuous operating voltage, kV	19.5
Nominal discharge current, kA	10
Maximum residual voltage at nominal discharge current, kV	72.8

6.1.2 Generator Circuit Breaker – Installation

GCB is provided between the Generator terminals and the Generator transformer (24kV side), in the Isolated Phase Bus Duct. The indicative details are provided below in Table 2. The GCB is of 24kV, 28kA, hydraulic/spring operated, AF cooled, SF6 type. The Generator Circuit breaker is tripped under following conditions:

- Under unit faults involving reactor and TG system.
- In case of GT or UAT faults, the 400 kV GT breaker, GCB and 6 kV UAT breakers trip
- In Case of Generator faults

Table 2: Indicative Details for GCB

SF6 Gas GCB	
Type	SF6 gas
Rated nominal voltage, kV	24
Maximum voltage, kV	30
Rated frequency, Hz	50
Rated current (at 40 degree C), A	28000
Rated short-circuit making current, kA	440
Rated sym. short-ckt breaking current, kA	160
Type of operating mechanism	Hydraulic/spring

This document is an intellectual property of Nuclear Power Corporation of India

Type of cooling	Air forced
Max. opening time till contact separation, ms	53
Control voltage for GCB auxiliaries, V	220 DC, 380 AC
Weight of the complete GCB system, Kgs.	15000

6.1.3 Generator Transformer - Installation

The Generator transformer of each unit consists of three single-phase units (forming Yn/d11) each of capacity 417 MVA, 420/24 kV for evacuation of the total power. The GT is provided with off circuit tap changer (+/- 2x2.5%), oil forced air forced type of cooling, effective grounding on the HV neutral, bushing CTs, VTs on the 24kV side and is connected to the IPBD on the 24kV side and to the 400 kV Gas insulated Bus Duct on the 400 kV side. Neutral formation is done at the GT through an arrangement of bare conductors, insulators, structural steel elements, etc.

GTs are provided with OFAF cooling system equipped with fan-motors, cooler control cabinets for automatic start-up and shut-down of fan. The indicative details are provided below in Table 3.

Table 3: Indicative Details for Generator Transformer

Rated Power, MVA	3 x 417
Rated Voltage at no-load, kV	
- High voltage, kV	420/√3
- Low voltage, kV	24
No. of Phases	1
Rated frequency, Hz	50
Impedance voltage at rated voltage tap, %	14
Circuit diagram and group of connections in the	
Three-phase group	Y_N / d-11
Cooling system (Oil Forced Air Forced without directed oil flow)	(OFAF)
Type of Tap changer/Range in %	Off-circuit Tap Changer, $\pm$5
Dimensions (length, width, height), mm	10000 x 6300 x 7300
Total mass, t	325
Transportation mass without oil, t	245
Current transformers for Generator Transformer (GT)	
Current transformers on the HV side	
Nominal voltage, V	400
Rated primary current, A	2000/1

This document is an intellectual property of Nuclear Power Corporation of India

Neutral Current Transformers	
Rated voltage, kV	35
Rated current, A	1500
Voltage Transformer on 24kV side	
Primary/secondary voltage, kV	24/ √3 / 100/√3

6.1.4 **Protection panels of GTs/UATs/Generators and generator excitation control panels along with excitation transformers -Installation**

Sets of protection panels are provided with numerical protection relays for protection of GTs/UATs/Generators. Also, sets of excitation system panels along with excitation transformers are provided for generator excitation control using electronic AVRs.

6.1.5 **Measurement panels of GTs/UATs/Generators including CT/PT local control panels, transducer panels of reactor coolant pumps - Installation**

Set of measurement panels are provided for GTs/UATs/Generators with electronic transducers and commercial energy meters including CT/PT local control panels. Also, sets of transducers panels are provided for RCP motors fed from 6kV switchgear for remote telemetry of active power and frequency.

6.1.6 **400 kV gas insulated bus duct (GIBD)-supply and installation**

400kV gas insulated bus duct (GIBD) is to be provided between 400/24kV GTs HV bushing and 400kV GIS. The route of the GIBD is through underground tunnel. 400kV gas insulated bus duct (GIBD) shall be supplied and installed as per respective TS, DS SLD and layout.

6.1.7 **400 kV gas insulated switchgear (GIS)-supply and installation**

400kV GIS shall be supplied and installed as per respective TS, DS, SLD and layout.

6.1.8 **400kV outdoor switchyard-supply and installation**

400kV outdoor switchyard shall be supplied and installed as per respective TS, DS, SLD and layout.

6.1.9 **400kV, 125MVAr shunt reactors- Installation**

Each shunt reactor is of capacity 125MVAr. Supply and installation of line reactors are envisaged by transmission agencies. Though installation of line reactors alone is not included in the scope of this contract, all interface related works with selected line reactors by transmission agencies, complete CMRP panels, SCADA etc. for line reactors are included in the scope of subject contract. Construction of civil foundation and other civil structures required for line reactors are also covered in the scope of this contract.

6.1.10 **400kV Tie line – double circuit - (D/C OH line) between KKNPP 5&6 and KKNPP 3&4.**

This document is an intellectual property of Nuclear Power Corporation of India

400kV Tie line (double circuit) between KKNPP 5&6 and KKNPP 3&4 shall be engineered, supplied, constructed and installed as per the respective TS, DS, SLD and layout.

6.1.11 230kV Gas Insulated Switchgear (GIS)- supply and installation

230kV GIS shall be supplied and installed as per respective TS, DS, SLD and layout.

6.1.12 230kV outdoor switchyard-supply and installation

230kV outdoor switchyard shall be supplied and installed as per respective TS, DS, SLD and layout.

6.1.13 230kV Tie line between KKNPP 5&6 and KKNPP 3&4

230kV lines to KKNPP34, KKNPP56 and 230kV Tie line between KKNPP 5&6 & KKNPP 3&4 is envisaged to be executed as per requirements brought out in I02.KK56.0.0. ET.TS.PR054 and Bill of Quantities.

6.1.14 Complete CMRP systems for 400kV and 230kV systems- supply and installation

Complete CMRP systems for 400kV and 230kV systems shall be supplied and installed as per respective TS, DS and SLD including supply, installation & commissioning of CMRP panels for shunt reactors, line reactors, 230kV Tie line between KKNPP 5&6 and KKNPP 3&4, RATs and CSATs. All protection setting calculations and submission of relay setting documents are also part of the scope of this tender. Relay setting calculation shall also takes into account NPCIL guidance in addition to the standard (s), OEM guidance and other guidance.

6.1.15 Complete RTU/PLCC/SPS/Billing and metering systems for 400kV and 230kV systems- supply and installation

Complete RTU/PLCC/SPS/Billing and metering systems for 400kV and 230kV systems shall be supplied and installed as per respective TS, DS and SLD.

6.2 Auxiliary Power Supply system:

6.2.1 Unit Auxiliary Transformers - Installation

Each UAT is of 63 MVA capacity with primary at 24kV, and two secondary windings of 31.5 -31.5 MVA capacities at 6.3 - 6.3kV. On the 24kV side, the transformer winding terminals are taken out through bushings for connection to the 24kV isolated phase bus duct and on 6kV side; winding terminals are brought out for connection to 6kV isolated phase bus duct. Neutral on 6kV side is grounded through a 100-Ohm resistor to limit the ground fault current.
On the 24kV side, the UAT voltage is controlled by on-load tap changer (OLTC).

UATs are provided with ONAF cooling system equipped with fan-motors, cooler control cabinets for automatic start-up and shut-down of fan. Coolers are started in groups, depending on the load on the transformer.

This document is an intellectual property of Nuclear Power Corporation of India

6.2.2 Reserve auxiliary transformers and common station auxiliary transformer- Installation

Each RAT and CSAT is of 63 MVA capacity with primary at 230kV, and two secondary windings of 31.5 -31.5 MVA capacities at 6.3 - 6.3kV. On the 230kV side, the transformer winding terminals are taken out through bushings for connection to the 230kV gas insulated phase bus duct (GIBD) and on 6kV side; winding terminals are brought out for connection to 6kV isolated phase bus duct. Neutral on 6kV side is grounded through a 100-Ohm resistor to limit the ground fault current.

On the 230kV side, the RAT and CSAT voltage is controlled by on-load tap changer (OLTC).

RATs and CSAT are provided with ONAF cooling system equipped with fan-motors, cooler control cabinets for automatic start-up and shut-down of fan. Coolers are started in groups, depending on the load on the transformer.

6.2.3 6kV Isolated Phase Bus duct – Supply and Installation

The bus-duct consists of cylindrical Aluminium current-conducting bus, installed on post insulators (installed through special hatches) and encased in an Aluminium shell.

Thermal expansion due to linear temperature changes of the bus duct shell and the conductor lengths are absorbed through special expansion joints, installed along the route.
To neutralize outdoor magnetic field (creation of symmetrical system of currents in ducts) as well as to enhance mechanical strength, Aluminium current conducting jumpers are welded between ducts of adjacent phases at the ends of all sections.

The bus duct is installed on support girders or fastened to the slabs/ portals as provided in the relevant drawings.

Electrical connections to transformers, switchgear cabinets, other equipment are through flexible and rigid connections as per TS/DS. 6kV bus ducts are to be supplied and installed as per respective TS and DS. The difference between the requirements of 6kV bus ducts connected to UATs and 6kV bus ducts connected to RATs/CSAT are provided in respective TS/DS.

6.2.4 6 kV Switchgear – Supply & Installation

The switchgear cabinets include bus bars, circuit breakers, voltage transformers, current transformers, relays etc. In the upper part of the switchgear cabinets, the relay with built-in devices of relay protection and automation, equipment of control, measurement and signal systems, terminal blocks and secondary connections circuits are installed.

The switchgear cabinets are of draw out type, in which the circuit breakers, voltage transformers and disconnecting links are located with a facility to put into service and control (test) positions and to draw out for inspection and repair.

If VCBs are used, then the vacuum bottles shall also be of the same make as that of the switchgear. For approximate dimensions of 6kV switchgear panels, refer the respective TS & DS. For other details refer the respective TS & DS.

This document is an intellectual property of Nuclear Power Corporation of India

6.2.5 **GPS for EPSS/RPSS – Supply & installation**

Relevant TS/DS provides only basic details/requirements of GPS systems for EPSS buildings IEDs. Detailed design to be done by Contractor for GPS systems and be supplied along with antenna, GPS receiver, lightning protection, amplifier, splitter, etc. for time synchronization with GPS output for Numerical relays of 6kV Switchgear EPSS, rectifiers & inverters of EPSS of this package as well for Numerical relays of Emergency and reliable Diesel Generator EPC package (i.e. Purchaser scope package) for 1-4 UKD buildings and 05UKD building respectively of KKNPP-5&6. For details refer the respective TS & DS.

6.2.6 **Auxiliary Transformers (6/0.433kV and 6/0.4kV) – Supply & Installation**

The transformers are of epoxy cast resin dry type, of insulation class F, air-cooled type, HV & LV windings of copper, etc.

For details refer the respective TS & DS.

6.2.7 **0.38/0.415 kV Switchgear/ MCCs/ACDBs – Installation / Supply & Installation as applicable**

0.38/0.415 kV switchgear buses are connected to the LV terminals of auxiliary transformers through circuit breakers on the incomer of the switchgear. MCCs are fed from switchgear. Transformer LV is either directly coupled through bus bar to incomer of 0.38/0.415kV switchgear or the same is connected through non segregated LV bus duct.

Switchgear and MCC boards are made of one or more number of vertical panels/cabinets in a modular construction.

0.38 kV switchgear cubicles are equipped with draw out type modules for feeding motors above 11 kW and up to 200 kW.

Generally, power supply for the loads/motors with a rating less than 11 kW (e.g. shut off valves, etc.) are provided from Motor Control Centres (MCC).
For details refer the respective TS along with annexure & DS.

6.2.8 **Wall mounted 415V/ 240V power distribution boards – Supply & Installation as applicable**

Wall mounted Lighting Distribution Panels (LDP), Lighting Distribution Boards (LDB), Welding Distribution Boards (WDB), AC and DC power distribution boards (ACPDB & DCPDB), wall mounted MCC. The above mentioned power distribution boards are used for distribution of power supply of normal lighting, evacuation lighting, emergency lighting, welding network, UPS network, DC network, etc.

For details refer the respective TS & DS.

6.2.9 **Rectifiers –Installation and commissioning support**

This document is an intellectual property of Nuclear Power Corporation of India

Rectifiers are of static type for rectification and control and have the capacity to supply all the loads on DC buses and charge the batteries in any of the modes i. e. float and boost charging.

The rectifier is provided with a control system. Depending on the incoming and outgoing parameters of the rectifier this system generates commands for tripping and blocking the rectifier, provides alarm signals and also information on protection actuation.

The front of the rectifier panel accommodates the following devices:
Voltmeter, Ammeter, failure indicating lamps, Failure data registered, light indication, current limiting mode signalling light indication, control system availability testing push button, current value governing potentiometer in current stabilization mode, etc

6.2.10 DC Distribution Boards (DCDB) – Supply & Installation

DC distribution boards include circuit breakers, devices of protection and control, automatics, measurement & signalling and generation of signals for I&C information.

A typical DCDB consists of the following:
Battery and rectifier incomer cabinets, Bus bars and other sectionalizer cabinets, Outgoing feeder cabinets, Insulation monitoring Devices, etc.

DCDB enclosures are made from steel sheet metal with equipment mounted inside the cabinet. The indication, measuring instruments are located on the front.

For details refer the respective TS & DS.

6.2.11 Batteries – Supply & Installation

The batteries are of stationary, lead acid Plante positive plate type, made of built-in positive and negative lead electrodes, placed in acid electrolyte in plastic containers with plastic covers. A battery bank typically consists of 106 cells for 220V and 54 cells for 110V.

Battery cells are to be delivered without electrolyte, dry-charged with tightly inserted filters-plugs, as per manufacturer’s instructions.
The containers are of transparent SAN material. Battery cells consist of a block of electrodes inserted into the containers, with a cover, sulphuric acid solution of specific gravity 1.240+ 0.005 g/cm3, at 20 deg. C serves as the electrolyte.

Batteries shall be as per respective technical specification of Battery. In addition, the cover has got one to three holes for filling in electrolyte and water, measurement of temperature and specific gravity of electrolyte, as well as for release of gas from the cells. These holes are covered with filter-plugs.

The battery cells are connected in series. The batteries are installed on special racks. Battery rack shall be welded to the embedded part provided in the respective locations. In case of non-availability of embedded parts, the required embedded part as per inputs from NPCIL, shall be provided by the Contractor
The batteries with their racks are qualified for seismic stability.

This document is an intellectual property of Nuclear Power Corporation of India

Supply of type and nos. of trolleys shall be based on final layout & location of batteries. Adequate nos. and types of trolleys for batteries shall be provided in each unit of KKNPP5&6 as per TS and DS.

Boost charging of battery may be required under certain conditions as brought out in the respective technical specification.

For details refer the respective TS & DS.

6.2.12 **Inverters –Installation & commissioning support**

Inverters consist of DC to AC static converters and bypass line with automatic switching. The automatic switching device provides the load switching over to power supply through bypass line at inverter output.

6.2.13 Control, Monitoring and Relay Protection (covered in the subject package) is provided for all major equipment/systems including 400kV GIS, 230kV GIS, shunt reactors, 400kV & 230kV transmission lines, RATs, CSAT, GTs, UATs, IPBDs, 6kV switchgear, 6kV bus ducts, dry type transformers, 0.4/0.415kV switchgear, 0.4/0.415kV MCCs, batteries, rectifiers, inverter, DCDBs, ACDBs etc. either on the equipment itself or in separate panels as envisaged in the respective item of the tender/respective TS & DS, and/or in the documentation to be provided during execution of the work.

6.3 **Electrical Automatics – Installation / Supply & Installation as applicable**

6.3.1 **Complete common SCADA systems for Entire BoP areas with GPS systems with centralized control room in switchyard building (0UAC building) - supply and installation**

Complete common SCADA systems for Entire BOP areas with GPS systems with centralized control room in switchyard building (0UAC building) shall be supplied and installed as per respective TS and DS. Scope include complete interface of signals of TLPS and GDC in the format and specifications specified by TLPS developers and GDC developers including all required software and hardware required for gateways for signal exchanges.

6.3.2 **Unit SCADA system -Installation**

Unit SCADA system is independent for unit-5 and unit-6 and they are separate from common switchyard SCADA systems mentioned at 6.3.1 above. Various electrical equipment to be supplied for main plant areas under the subject package is required to be interfaced with the unit SCADA system such as 6kV switchgear, 0.4kV switchgear, 0.4kV MCCs, 6/0.4kV auxiliary transformers, DC boards, AC boards, rectifiers, inverters etc. in addition to NPCIL (RF) supplied items. Unit SCADA systems consists various filed I/O (RTU) panels, gateway panels, server panels and upper level panels. The interface will require IEC 61850 compliant IEDs, potential free contacts and contacts at 24V/220V DC as the case may be from various field devices. Hence the equipment to be supplied for main plant areas shall take into account interface requirements of SCADA. Installation of panels, cabling, testing and commissioning of the unitised SCADA systems is included in the subject package. The scope also include

This document is an intellectual property of Nuclear Power Corporation of India

providing of design inputs for unit SCADA such as list of signals with their terminal details for hard wired signals, list of signals with their MMS address for soft signals, IEDs configuration files etc.

Features of unit SCADA are briefly as follows.

- Application-oriented, definable operating sequences for switching operations acknowledgement functions, etc.
- Chronological logging of events
- Archiving of measured / metered values and status indications etc.
- Configurable evaluation / processing of data stored in the archive in curve and tabular form etc.
- Relay analog and discrete information

6.3.3 Automatic switching-on of reserve auxiliary power supply – (Auto Transfer System)- Supply and installation

The system of automatic switching-on of reserve auxiliary power supply in case of loss of the normal power supply is provided for every 6 kV bus of normal auxiliary power supply system, reliable auxiliary power supply system and common station auxiliary power supply system.

For details refer the TS & DS of 6kV switchgear.

6.3.4 Automatic switching system of 0.38/0.415 kV standby power supply:

Automatic load transfer (ALT) is also provided for the 0.38/0.415 kV buses of the normal operation auxiliary power supply system having the normal and standby power supply incoming supplies similar to 6KV auto-transfer system. For details refer the TS & DS of 0.415/0.4kV switchgear.

6.4 Fire barriers/Fire protection coating: Supply & Installation

Cable fire barriers are passive fire protection systems which prevent propagation of fire from one fire compartment to the other through floor and wall penetrations for power and control cables. The construction consists of mineral wool board, with due structural supports through which cables are laid and gap sealed by fire proof sealant(s). Fire coating is applied on the end surfaces of partitions and cables coming out of the seal.
Detailed technical requirements of the fire barrier are brought out in the respective TS & DS.

Fire protection coating on cables:
As envisaged in the RF design, cabling with over 3.5/7 litres/running metre of combustible material are provided with fire retardant coating along the complete length of bunch of cables. Detailed requirements are brought out in the respective TS & DS and other relevant documents.

6.5 Cabling system:

6.5.1 Cable Penetrations - Installation

This document is an intellectual property of Nuclear Power Corporation of India

Special hermetically sealed penetrations are used to pass the cables through the containment. These penetrations provide gas-proof and leak-tight penetration for one or several circuits while passing through inner containment of reactor building. Thus, the integrity of containment with passage of electrical circuits through the containment under normal operation, seismic and LOCA conditions is maintained/ensured. It consists of Electrical conductors suitable for connection inside and outside the containment, insulation for these conductors, arrangement ensuring leak-tightness, gas tightness, thermal stability, Manometer/Pressure Gauges for recording gas leakage, connections to the cables on both sides.

Penetrations are delivered under dry nitrogen pressure that provides visual inspection / control of leak proofness of each penetration after its installation. Penetrations have lifetime not less than 50 years.
The factory built penetrations are to be welded with the already embedded EP in the IC wall (inside and outside the ICW). Typical details shall be provided to successful bidder.

6.5.2 Cable carrier system - Supply & Installation

The cable carrier/trays and supports are fabricated from non-combustible material and subsequently hot dip galvanized or painted or both. These are designed for tropical environment and are seismically qualified. Embedded parts have been provided in the walls/soffit/floors to support the trays. Cable tray mounting structures are to be welded to these EPs. Wherever the EPs are not available for welding of supports, concrete fasteners of the approved make, type and size shall be used to fasten the trays supports. The vertical supports are slotted for quick and reliable fastening of the horizontal supports through threaded fasteners. The fastening of the cable trays with the horizontal supports, horizontal supports with the vertical supports, etc. are through threaded fasteners.
For details refer the respective TS & DS.\

For the cable metal structure and cable trays (for field routing), layout is to be designed by the Contractor, Contractor shall design and develop the same based on the technical information/ inputs / general guidelines provided by the Purchaser to the Contractor, during execution of the work. The relevant erection item is deemed to include the cost towards this and no extra payment is envisaged for this. The salient features of the same are already covered in the relevant chapters/ sections of technical specification/ requirement documents.

6.5.3 Cables – Supply & Installation

The CONTRACTOR shall supply, install, test and commission - power, control, fiber optic and instrumentation cables as per the respective TS & DS documents, cabling guideline, working drawings (to be made available to the Contractor during actual erection work), etc. The quantities, sizes and types of cables shall be as indicated in Section-E of the tender.

Though not specifically brought out in the technical specification document all cable drums shall be made from anti -septic, chemically treated wood and painted to ensure long life of the cable drum without any significant deterioration.

This document is an intellectual property of Nuclear Power Corporation of India

Installation methodology/requirements

a) The cabling system installation work shall include drawing the required cables from the stores as applicable, safe loading / transportation to site, safe storage / preservation, uncoiling, cable pulling / laying, clamping / fixing, if required, cable dressing, check list preparation, termination, testing, commissioning and any other work items necessary for completing the job. Prior to carrying out the actual job, an erection procedure and field quality plan / check list shall be prepared for carrying out the actual works.

b) The Contractor shall provide all supervision, labour, tools, welding equipment, tackles and testing equipment as required for installation work.

c) The cables shall be laid in built-up trenches, tunnels, directly buried in ground, on cable trays, as per the relevant cabling guideline, cable logs (cable schedule) , standards, etc.

d) Standard cable grips and reels shall be utilised for cable pulling. In using grips, care shall be taken to avoid damage to the cable end seal, which shall be made up and maintained during cable installation. If unduly difficult pulling occurs, the CONTRACTOR shall check pull required and suspend further pulling until modified procedure is approved by the PURCHASER. Maximum pull tension measured by tension dynamometer shall not exceed recommended value for the cable. In general, any lubricant that does not injure the overall covering and not set up any undesirable conditions of electro static stress or electrostatic charge may be used in pulling insulated cables in conduits and ducts. In particular soap shall not be used as lubricant. It is not considered likely that all cables to be pulled from any pulling location can be pulled consecutively without moving and later backtracking, and it may be required that cable reels and equipment be moved from pulling locations when no actual pulling is in progress to allow performance of collateral work, and when so requested by the PURCHASER such reels and equipment shall be removed. When pulling cable from any pulling location, reels shall be laid out from locations, which will permit performance of collateral work without obstruction.

e) After pulling the cable, the CONTRACTOR shall record the cable identification and the date pulled, neatly with water-proof ink on linen tags on all cable ends. This is in addition to the cable identification tags at each end of the cable, all wall/floor crossings as shown in installation notes/drawings.

f) Cable take-off (as per the cutting schedule), from drums shall be so planned as to avoid using joints and splices in the run of the cable and wastage. Cable splices will be made only after obtaining permission of the PURCHASER/engineer. Splices where permitted, shall be made in a neat workmanlike and approved manner by men specialized in this class of work and special attention be paid to higher voltage splices and splices involving armoured constructions. Splices shall be made by the CONTRACTOR for each type of wire or cable in accordance with the instructions issued by the cable MANUFACTURER and the PURCHASER.

g) Cables shall be protected at all times from any mechanical injury and from absorption of moisture at the unprotected ends. Full length of the cables shall be replaced at the CONTRACTOR's expense in case of any damage. All the cable ends shall be provided with heat shrinkable caps immediately after laying to protect against moisture ingress till the termination of the cables. The Contractor shall supply and install these caps under the item of cable laying at no extra cost.

h) Sharp bends and kinks in cables shall be avoided. The bending radii for various types of cables shall not be less than those specified in cable specification/ guideline /drawings/manufacturer’s instructions. If shorter bending radius becomes necessary, no

This document is an intellectual property of Nuclear Power Corporation of India

bend shall be made until clearance and instructions are obtained from the PURCHASER/ENGINEER. All the special cables like optical fibre cables, etc. shall be strictly laid as per the manufacturer's instruction manuals/cable installation notes/directives of PURCHASER.

i) Where the cables cross roads/rail tracks and water/oil/gas/ sewage pipes, they shall be run in hume/steel pipes. The depth of burial of the pipes shall be as indicated in the drawings, however, it shall not be less than 600 mm. Wherever hume pipes/steel pipes are not laid/available, the same shall be supplied and installed by the CONTRACTOR as per the specifications. The scope for the same includes cutting of the already laid road for laying the hume/steel pipes as well as re-laying of cut portion of the road.

j) Installation of directly buried cables shall be carried out as per the drawings/ installation notes.

k) Cable in cable pans and cables emerging from conduits shall be routed to take care against edges of pans, racks, conduits or their supports upon entering or leaving pans or conduits. The cables in the trays/pans shall be clamped with the cable pans through clamps as detailed in the specification document. Sequence of cables transversely in pans shall avoid crossing of other cables when some of the cables make turns into lateral pans, or enter or leave a run of pan. From panels/motors, cables shall be laid in pans with allowance for angles, offsets and branches. Cables shall then be restrained temporarily in an approved manner on one side of each angle, branch or offset in turn, cables shall be formed to the change in the pan direction so that the finished cable will lie flat and straight in the pan in a neat and approved manner without restraint and without looping out of pans along straight runs of pans, on any change of direction. Where excess cable length has been fed into a tray, such excess length shall be backed out of pan as cable is formed at bends and is trained flat and straight in pans, and finally cut to correct length upto its terminal point. Where cabinet, cubicle, switchgear or other terminal points for cable are equipped with cable or wiring pans or through gutters, the CONTRACTOR shall pull sufficient length of each cable to permit neat arrangement of all entering cables, with leads formed and clamped as each conductor is brought to its terminal connection.

   The single core cables shall be run in a triangular configuration and shall be firmly fastened to the cable trays through trefoil clamps, which shall also be supplied by the Contractor.

l) The CONTRACTOR shall plan the sequence of cable laying in such a way to avoid criss-crossing of cables or jumping over the other cables, while taking out from main run. Taking cables in/out through bottom of pans is not acceptable.

m) On emerging out from the trenches, pans, embedded conduits, etc. cables shall be clamped along wall, ceiling, column, structures, etc. before they are connected at the equipment terminals and taken into junction boxes, etc.

n) The arrangement and interval of clamping of cables shall be as per the relevant cable installation drawings. Control and power cables shall be clamped separately. It will be the responsibility of the CONTRACTOR to check the neatness of such cable runs and to see that horizontal/vertical runs of cables are parallel to the fixed axes in respective plans.

o) Cables shall be routed in GI pipes from cable pans to the equipment terminals.

p) Jointing of cables is not permitted, generally. If any jointing is to be done for special reasons, it should have prior approval of PURCHASER and shall be carried out in accordance with relevant standard Codes of Practice and the MANUFACTURER's

This document is an intellectual property of Nuclear Power Corporation of India

special instructions. Hardware like clips, clamps and tools required for cable jointing work shall be supplied by Contractor and shall be firmly clamped on either sides of a straight through joint at not more than 300 mm away from the joints. Identification tags shall be provided at each joint and at all cable terminations. Single core cable joints shall be marked so that the phase identity at each joint is determined easily. The joints shall be located at the most suitable places. There shall be sufficient overlap of cables to allow for the cutting of damaged cable ends to make fresh joints. Joint pits, if any shall be of sufficient dimension to allow the jointers to work with as much freedom as possible. When two or more cables are laid together, joints need to be staggered by about three metres.

q) Before jointing, cable seals shall be examined to ascertain if they are intact and to ensure that the cable ends are not damaged. If the seals are found to be broken, the cable ends shall not be jointed until after due examination and testing by the PURCHASER. Before jointing, the IR of both the sections of cables to be jointed shall be checked by a megger to be satisfactory and the insulation values recorded.

r) Armour of the cable, if any, shall be bonded to the earthing system of the station. Bond shall be of at least 70 sqmm. Copper conductor unless otherwise specified.

Associated Work for Direct Burial of Cables, Conduits and Pipes

a) The CONTRACTOR's scope of work required for directly buried cables shall include excavation, preparation of riddled soil/brick bedding, supply and installation of protective covers, back-filling, ramming, supply and installation of route markers and joint markers. The details of construction work and provision of protective covers and markers shall be as indicated in the drawings of installation notes for directly buried cables. The type of soil and sizes of the trenches shall be as indicated in the typical drawings.

b) The CONTRACTOR's scope of construction work for directly buried pipes/conduits includes excavation and back filling, supply of all materials required for the above job, as per the depths/widths indicated in the drawings and as directed by the Engineer.

6.5.4 Cable Accessories - Supply and installation

a) The termination and straight through jointing kits for use on the systems shall be suitable for the type of cables offered as per this specification and shall meet requirements of IS 13573.

b) The accessories shall be supplied in a kit form. Each component of the kit shall carry the manufacturer's mark of origin.

c) The kit shall include all stress grading, insulating and sealing materials apart from conductor fittings and consumable items. Installation instruction sheet shall also be included in each kit.

d) The contents of the accessories kit including all consumables shall be suitable for storage without deterioration at a temperature of 45º C, with shelf life extending to more than 5 years.

This document is an intellectual property of Nuclear Power Corporation of India

e) Cable accessories/jointing kits shall be of Heat shrinkable type. The terminating kits shall be suitable for termination of the cables to indoor switchgear or to a weatherproof cable box of an outdoor mounted transformer/ motor. For outdoor terminations, weather shields/ sealing ends and any other accessories required shall also form part of the kit.

6.5.5 Cable Termination-Supply and installation

A. **General**

a) All cables laid by the Contractor shall be terminated and connected at both ends, to panels, equipment, local push buttons, instruments or junction/marshalling boxes terminals as the case may be. IR testing of cabling shall be carried out prior to cable termination work. All the cable glands shall be of single/double compression type suitable for the cable size. They shall have a screwed nipple with electrical threads and check nut. Bimetallic lugs shall be used to connect conductors of two dissimilar metals

b) The cables shall be identified close to their termination points at both the ends of cable (cable numbers shall be punched on aluminium/Lead straps 2mm thick and securely fastened to the cable) and also along the route at recommended intervals, by cable tag numbers.

c) The scope of termination at each end shall include dressing and connection of all the cores of the cables. The following shall be included in the scope of work.
   i) Drilling the requisite holes for cable boxes/glands, in the bottom/top gland plate of the switchgear DBs, Panels, etc.
   ii) Fixing the cable boxes/glands.
   iii) Terminating the cables in the cable boxes/glands.
   iv) Earthing the cable armour, if any.
   v) Crimping the cable lugs on each core neatly.
   vi) Clamping the cables inside switchgear/panels' cable alleys, wiring troughs
   vii) Connecting to correct terminals as per the PURCHASER wiring diagrams and cable schedules.
   viii) The cable and core identifying tags and ferrules respectively shall be supplied and installed by the CONTRACTOR as a part of the cable termination work.

d) The CONTRACTOR shall make connections to small electrically operated devices requiring two-wire or three-wire connections on equipment installed as accessories to or assembled with other equipment. Connections to recording instruments, float switches, limit switches, pressure switches, thermocouples, thermostats and other miscellaneous equipment shall be done as per the MANUFACTURER's/PURCHASER's drawings and schedules.

e) At the cable terminal points where the conductor and cable insulation is to be terminated, terminations shall be made in a neat, workmanlike and approved manner by men specialized in this class of work. Terminations shall be made by the CONTRACTOR, for each type of wire or cable, in accordance with the instructions issued by the cable MANUFACTURERs and the PURCHASER.

B. **Control Cable**

a) Control cable termination shall be made as per the guidelines given in the drawings/notes.

This document is an intellectual property of Nuclear Power Corporation of India

b) Control cable terminations shall be made in accordance with the wiring diagrams/cable interconnection diagram and cable schedules furnished to the CONTRACTOR for this purpose. It is the intent that the CONTRACTOR shall terminate all the cables installed by him. The work of testing and reconnecting where leads have been brought by the CONTRACTOR to terminal boards and connected, which on further testing, reversal or other rearrangement of lead turns out to be necessary, all the additional work of testing and reconnecting shall be performed by the CONTRACTOR at no extra cost to the PURCHASER.
c) When control cable cores are to be fanned out and cabled together with cord, the CONTRACTOR shall make connections to the terminal blocks and test before the cables are corded together. If case of a doubt, the CONTRACTOR shall make a temporary connection, with sufficient length of cable, so that the cable can be switched to another terminal if needed, without splicing the cable. After correct connections are established, the cables shall be cut to correct lengths, to be connected to the terminals in the specified manner and corded together where necessary to hold the cables in place in a workman-like manner. Splices will not be accepted, and any cable cut short shall be replaced and installed, at the CONTRACTOR'S expense.
d) All cable terminations shall be with solder less crimping type terminal lugs. Proper crimping tools used (Dowell or approved equivalent) shall be subject to the PURCHASER's approval.
e) Spare cores of control cables shall be connected to the spare terminal blocks, where available, with the appropriate ferrules. If there is no spare terminal block, the spare cores shall be bunched and taped together and shall be kept neatly inside the panel.
f) The cable, core identifying tags and ferrules shall be supplied and installed by the CONTRACTOR as a part of cable termination work.

C. **Fiber Optic cables and LAN cables: Refer respective TS/DS document.**

6.5.6 **GI Pipes, conduits & ducts - Supply & installation**

Generally, cables are intended to be used and run in either trays, or GI/SS wire mesh or on wall directly as brought out in the specifications/guideline documents. However, in some portions cables and/wires might have to be run in conduits/pipes, requirement for which are brought out below:

a) The CONTRACTOR shall install heavy duty GI pipes and ducts as specified and as shown in drawings. All accessories/ fittings required for making the installation complete, including but not limited to normal and inspection tees and elbows, check nuts, brass or galvanized steel end caps, PVC/brass bell mouths for water-proof/fire-proof sealing, pull boxes, saddles, spacers, couplers and required steel supporting work shall be supplied by the CONTRACTOR. Conduit fittings shall be of the same material as that of the conduit.
b) Each conduit run shall be marked with its designation as indicated in the drawings. Identification shall be by means of painting so located that each run of conduit is readily identified at each end. Where conduits terminate at flush mounted boxes, cabinets or other enclosures, the designations shall also be painted on the inside of the enclosure adjacent to the conduits.
c) Pipes shall be laid buried in ground, laid along the walls/structural members, along floors and ceilings. Pipe sleeves which are required to be embedded in walls, roof slabs, floors,

This document is an intellectual property of Nuclear Power Corporation of India

trench and tunnel walls, under roads and tracks etc., will in general be provided in place wherever necessary by the PURCHASER for the portion of civil work completed. However, in places, where such pipe sleeves have not been provided by the PURCHASER, the CONTRACTOR shall install pipe sleeves in place wherever necessary by drilling/breaking walls/floors as directed by the PURCHASER. All pipes shall have their ends closed by caps until cables are pulled.

d) The CONTRACTOR shall have available at site, all dyes and pipe bending machines for threading pipe or conduit of diameters and threads corresponding to the respective national standards. He shall thread or cut off and rethread pipe/ conduit and shall install adapters or reducer when required to connect sections conforming to different standards or specification. When cutting a conduit/pipe, it shall be firmly held in a vice or by other suitable means. They shall be cut square, preferably using cold-cut-off saw, power hacksaw or other approved tool for cutting conduit, without leaving larger inside burrs or damaged ends. Cut ends shall be reamed and all burrs and sharp edges shall be removed. Ends requiring threading shall have field-run threads cut clean and true with sharp, unworn dies to conform with pipe thread standards for thread dimensions, length and depth of thread and taper. All field threaded ends of metallic pipes shall be reamed after threading and anticorrosive paint applied.

e) Exposed conduits shall be adequately supported by clamps, straps or by other approved means. Conduit supports shall be erected square and true to line and grade with an average spacing between them as given below, unless shown otherwise in relevant drawings.

25 NB	-	1.2 M
32 NB	-	1.5 M
50 NB	-	2.0 M
65-85 NB	-	2.5 M
100 NB	-	3.0 M

The fabrication and installation of supports and the clamping/fastening of conduits to racks and supports is included in the scope of work by the CONTRACTOR. Drilled and tapped holes for screw fastening for conduits on galvanized or painted steel shall be touched up before making up the connections with red lead and epoxy Zinc rich finishing paint.

f) Pipes shall be entered into the terminal boxes at locations provided by equipment MANUFACTURER unless otherwise shown on the drawings, or as directed by the PURCHASER. In general, all equipment enclosures, cabinets and housings requiring conduit or cable entry will have pipe terminating above level of emergence from floor concrete. However, a reasonable amount of drilling cutting, reaming and relocating holes shall be considered as normal part of the work. Pull boxes, outlet boxes, terminal boxes other than standard items, standard pull sleeves, floor plates, plates terminating pipe runs at cable trays and other plates in the path of pipe runs should be initially furnished un-galvanised, without pipe or cable entry holes. The CONTRACTOR will be required to cut entry holes located to meet actual conduit locations after which boxes and plates shall be hot dip galvanised as required. After drilling of G.I. material, these shall be touched up with epoxy Zinc rich paint.

This document is an intellectual property of Nuclear Power Corporation of India

g) Gland plates (without entry holes) on the switchgear, motor terminal boxes shall be drilled or knock-outs removed during installation and touch up painting of the appropriate type done.

h) Water proof sealing shall be done for all the outdoor to indoor pipe inserts by means of bell mouth termination pieces and bitumen based cold set water proof compound. Fire-proof sealing shall be done for pipe inserts in the floor slabs wherever indicated in the drawings.

i) Where ever a thin walled conduit is specifically permitted, the conduit systems shall be made up in a neat manner, using compression type fittings, which do not require threading of the tubing. Fittings shall be made up with full thread engagement between nuts and expansion sleeves and where thin wall conduits enter boxes, shoulder of fitting shall bear tightly against box, with locknut inside drawn up tightly. If difficulty in attaining clamping action from both inside and outside of entry hole is encountered in bringing shoulder of fittings to bear, locknuts shall be used on the fittings both inside and outside of the box at the entry hole. All joints shall have structural rigidity and low electrical resistance across joints.

j) Junction boxes having volume less than 1600 cubic centimetre may be installed without any support other than that resulting from connecting conduits where two or more rigid metallic conduits enter and accurately position the rigid metallic conduits enter and accurately position the box. Junction boxes shall be installed so that they are level, plumb and properly aligned and present a pleasing appearance. Boxes with a volume equal to or greater than 1600 cubic centimetres and smaller boxes terminating on less than two rigid metallic conduits or for other reasons not rigidly held shall be adequately supported by auxiliary steel or standard steel shapes or plates to be fabricated and installed. The CONTRACTOR shall perform all drilling, cutting, welding, shimming and bolting required for attachment to supports. Holes in steel shall be touched up with epoxy based Zinc, welds shall be wire brushed or otherwise cleaned, and welds to galvanised steel shall be touched up in accordance with the MANUFACTURER's instructions. Other un-galvanised areas shall be primed with epoxy based Zinc. Where indicated by Drawings, boxes shall be mounted on masonry wall by means of anchor fasteners to be set by the CONTRACTOR for this purpose or shall be mounted on angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations. Where it is necessary to remove contents of boxes in order to install housings properly, or where housings are delivered separately from their intended contents, contents shall be restored to their housings before the installation is considered complete. Terminal blocks shall be mounted in boxes as required. The removable covers for boxes shall be gasketted.

k) All fittings on pipes having threaded connections shall be made tight, with full thread engagement and with a minimum of wrench work in order to avoid wrench cuts. Joints shall provide structural rigidity and low electrical resistance to ground across the joints. Metallic pipe runs into metal boxes without threaded hubs shall have two (2) locknuts and a bushing for connection unless otherwise shown in the drawings. All open pipe ends shall have bell mouths with water- proof/fire-proof sealings, unless other terminations are required. Threaded joints shall be made up by turning, if possible, from a point where a bend in the conduits occurs, or by using the offset in the conduits. All threads in steel conduits shall be cleaned and well painted with epoxy Zinc rich paint or approved equal. Wrench marks damaging galvanising or similar protective coating on steel pipe not to be embedded in concrete shall be smoothened and cleaned, after which they shall be painted,

This document is an intellectual property of Nuclear Power Corporation of India

touched up as specified by the ENGINEER. Slip joints other than approved expansions fittings shall not be used.

l) All conduit terminations shall be located as shown in the drawings. Accuracy of location shall be within 6mm of the Drawing dimensions except where greater accuracy may be required to avoid interference, to allow proper spacing and clearance for fitting or to permit proper insertion into terminating device.

m) A reasonable number of long radius bend and standard conduit elbows of 40 mm and over may be used only in permissible locations. All other bends in metallic conduits shall be field-bent. Long radius bends may be used in steel conduits runs to be embedded in concrete and standard radius bends may be used for turning outof thin slabs. Long radius bends and standard elbows may also be used in fabricating long runs of exposed steel conduits. Bends in embedded steel conduits runs and all bends in exposed runs where two or more conduits run parallel, shall be field bent to suitable radius to produce a neat appearance. All field-bends required in conduits runs shall have uniform long radius sweeps bent on a suitable power bender or with other approved bending tools. The radius of any conduit bend, measured from the centre of bend to the nearest external surface of the conduits shall be not less than 12 times the nominal diameter of conduits. It may be reduced upon approval of the ENGINEER.

n) Bends shall be free from cracks, crimps or other damage to the pipe or its coating and shall not have the pipe section unduly flattened. Bends having a minimum inside diameter ten (10) percent less than the true diameter of the conduit or a cross sectional area five (5) per cent less than the true cross sectional area shall be rejected.

o) When the CONTRACTOR is required to install conduits embedded in foundation or structural concrete they shall be run as directly as possible between two points with a minimum length and with a minimum of crossing, bending and cutting but without creating interferences with other installations.

p) For underground runs, depths required for major runs of conduits and ducts shall be determined by uniform pitch shown by drawings towards given elevations of ends of conduits and ducts and hand-holes. Where no such elevations are given for individual conduits, either in banks or run singly, the standards regarding depth established for these conduits and ducts for which elevations are shown shall be maintained.

q) Cable pipe chases shall be made in the floor slab for installing the pipes. After installation of pipes, lean concrete shall be filled up in the remaining portion of the pipe chase. The size of the pipe chase shall be suitable to the pipe to be installed.

r) Embedded conduit running parallel to a masonry surface shall, wherever possible, have a cover of at-least 50 mm. Conduit shall be firmly fixed in place by being wired to reinforcing steel or by other approved means to avoid being disturbed during placement of concrete. Where conduit terminates at or leaves the masonry, it shall be carefully and firmly positioned by means of a suitable template. Where conduits change from embedded construction to exposed construction, all conduits in the same layer of the exposed runs shall clear structural surfaces by the same amount, regardless of size, and the embedded portions shall be installed so that such clearance will be provided without bending the exposed portions.

s) Where embedded conduits leave masonry, whether for permanent termination or for temporary termination for subsequent continuation, they shall have a minimum threaded projection of 50 mm beyond the ultimate finished surface of masonry, unless otherwise indicated on the drawing. The CONTRACTOR shall be responsible for determining the position of such finished surfaces, recognising the fact that finished courses, curbs etc.

This document is an intellectual property of Nuclear Power Corporation of India

may be incorporated in the structural designs, and will be placed subsequent to the masonry work in progress or completed at the time conduits to be embedded are placed. This requirement for projection beyond ultimate finished surfaces of masonry shall not apply in special cases such as where a bend emerging from the concrete would be incomplete or where the Drawings or scope of the work clearly require that the exposed portion of the conduit is to be carried to a particular point.

t) Where embedded conduits turn upwards from a slab or sill, the termination dimensions shown on the Drawings, if any, shall be taken to represent the position of the straight extension of the conduits external to and immediately following the bend. At least one half of the arc length of the bend shall be embedded.

u) Where conduits are stubbed out of masonry for future extension outside the structure, they shall be specially protected against corrosion and shall be terminated with a coupling and end cap, the threads well coated with epoxy Zinc rich paint and the entire end consisting of cap, coupling and conduit shall be painted as per the instructions of the PURCHASER/ENGINEER.

v) Conduits extending out of floors, walls, ceilings etc. and which are exposed to possible damage shall be boxed in or otherwise protected.

w) Metallic pipes carrying electrical cables shall be bonded to ensure electrical continuity and shall be earthed at minimum two points. All pipes/conduits exposed to open atmosphere shall be sealed by Epoxy putty.

x) In installing asbestos pipe or other fibre conduit, no cracked pieces shall be used and sections cracked or broken during or after placement shall be replaced by the CONTRACTOR. As specified above, ends of all conduits shall be square and clean.

y) Where ducts are to be constructed by the CONTRACTOR in concrete envelope, pre-cast concrete chassis or spacers shall generally be provided to properly space conduits and ducts, to hold them rigidly in place evenly pitched, during concrete encasement. Spacers between layers of conduits shall be installed one over another in the same vertical plane, with all spacers in each plane, vertical plane tied together at the edges of the spacers. Conduits shall be adequately anchored to prevent floating when concrete is placed. Immediately after placement of concrete, each conduit encased shall be tested with a swab for a clear opening without any evidence of concrete entry, and any obstructions shall be removed. Blocked conduits, from which obstructions cannot be removed shall be replaced. The foregoing, while specifically referring to multiple runs, shall apply equally to single runs of underground conduits.

z) The CONTRACTOR shall be responsible for bonding of conduits/pipes in which cables have been installed, to main earthing grid. Entire system of conduit after installation shall be tested for mechanical and electrical continuity throughout and permanently connected to earth clamps efficiently fastened to the conduits. Gas or other pipes shall not be used as earth medium.

Specific requirements/Instructions for installation of conduits:

a) The conduits shall be free from burrs and internal roughness. All conduit accessories for coupling shall be threaded type.

b) In long distance straight runs of conduit, inspection type screwed junction box is to be provided at reasonable intervals.

c) Threads and conduit pipes in all cases shall be between 13mm to 27mm long sufficient enough to accommodate pipes to full threaded portion of the couplers or accessories.

This document is an intellectual property of Nuclear Power Corporation of India

d) To protect against rust, the outer surface of the conduit and Accessories shall be painted with anti-corrosive preservation.
e) Conduits shall be sized so as to keep a minimum 40% of area of the conduit free inside.
f) No. of wires per conduit shall strictly as per the relevant IS.

Specific requirements/Instructions for Wiring works:

a) All wires (P, N, E) in a conduit shall be drawn simultaneously. No subsequent drawing of wires is permissible.
b) Wires shall be spliced only at junction boxes terminated &connected with approved type terminal strip.
c) Separate neutral wires are to be provided for each circuit.
d) Care shall be taken in pulling the wires so that no damage occurs to the insulation of wires.
e) No joints shall be allowed inside the conduits and junction boxes.
f) The maximum number of wires admissible for conduit shall be in line with the relevant standards

6.5.7 Cable glands - Supply & Installation

a) Cable glands shall be of tinned/nickel plated brass type.. The cable glands for all power cables and control cables (outdoor terminations type) shall be weather protected, double compression type. Cable glands forming a part of relevant flameproof enclosure shall be of flameproof type, tested by CIMFR or any other recognized independent testing laboratory and approved by CCoE or any other statutory authority as applicable. Indigenous flameproof glands shall have valid BIS license as per the requirements of statutory authorities. The size of cable glands supplied shall be appropriate to the size of cable so that flame- proofness of glands is retained. The size of gland shall be supplied as per BoQ

b) Cable gland shall conform to relevant standard and shall be COMET/SMI/NPCIL Approved Make. Glands shall conform to IS 12943/equivalent standard.

c) The cable glands shall be provided with PVC shrouds.

d) The cable glands shall be weatherproof. Whenever specified they shall also be flameproof and certified for the specified electrical area classification as applicable.

e) Cable glands shall be supplied to suit the cable dimensions, taking care of tolerances. Various components like rubber ring, metallic ring, metallic cone and the outer / inner nuts, etc. shall be capable of adjusting to the indicated tolerances of cable dimensions.

f) The cable glands shall be qualified to suit the location where they are to be installed.

6.5.8 Heat Shrinkable Sleeves - Supply & Installation

a) Heat shrink sleeves/tubing shall be used for providing electrical insulation, mechanical protection, sealing, etc. When heated, the heat shrink tubing shall conform to the size and shape of the substrate beneath for quick and easy installation.

This document is an intellectual property of Nuclear Power Corporation of India

b) Heat Shrinkable Sleeves shall conform to relevant standards and shall be RAYCHEM/NPCIL Approved Make.

c) Heat shrinkable sleeves shall be flame retardant halogen free type and shall conform to IEC 60332-1 and IEC 60134.

d) The HS sleeves shall be qualified to suit the location where they are to be installed.

6.5.9 Cable Lugs - Supply & Installation

a) All cable/conductor lugs shall be heavy duty compression type as per IEC 61238.
b) Cable lugs/ferrules for power cables shall be tinned copper solderless crimping type suitable for copper conductor cables. Cable lugs and ferrules for control cables shall be tinned copper type. Wherever called for, the cable lugs for cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipment. Cable lugs and ferrule shall conform to relevant standard and shall be DOWELL/Raychem/NPCIL Approved Make.

c) Ferrules shall be of approved type and of size to suit core size and shall be employed to designate the various cores of control cable by the terminal numbers to which the cores are connected, for ease of identification. Ferrule shall be of printed type. At the end of ferruling, needful shall be provided to prevent unwarranted movement / slipping of ferrules during the termination works or subsequently.
d) For all cable termination of 70 sqmm and above, standard termination kit with lugs, heat shrinkable sleeves over the lug & conductor, etc. of standard makes like Raychem shall be supplied and installed.

6.5.10 Cable Adaptor box for LV Motor termination - Supply & Installation

The adaptor box used for termination of LV power cable to motor terminals wherever required shall be fabricated from 2mm thick sheet steel, hot dip galvanized, then epoxy painted (and stoved) with required GI support and hardware. Fabrication drawings shall be prepared by the Contractor and got approved by PURCHASER prior to actual fabrication. The box shall have IP55 enclosure for indoor use and IP 65 for outdoor usage.

6.5.11 Hardware for cable clamping - Supply & Installation

Clamps made from Aluminium strips of 25 mm width and 3 mm thickness (minimum) shall be provided for clamping the cables to the cable pans with requisite hot dip galvanised fasteners. Single core cables shall be clamped use qualified for short circuit forces) trefoil clamps. Price for supplying and installation of clamps and hardware is included in cable installation cost.

6.6 Earthing and Lightning Protection Systems - Supply & Installation

6.6.1 General

This document is an intellectual property of Nuclear Power Corporation of India

The requirements for supply of earthing conductors have been provided in the relevant specification document(s). The work shall be carried out in accordance with relevant project layout drawings, typical drawings and guideline enclosed with the specification, working drawings (to be provided to the Contractor during execution) and as stipulated in this document.

6.6.2 Earthing Installation Work

a) The installation work shall include storing, laying, fixing, jointing/termination, (exothermic) welding, drilling of holes, testing and commissioning associated with the safety earthing system in all areas. All (exothermic) welding/brazing equipment, necessary tools and testing equipment shall be provided by the CONTRACTOR.
b) The CONTRACTOR shall carry out the earthing of all equipment/panels/ structures/ cable trays as indicated in the PURCHASER'S working drawings.
c) The CONTRACTOR shall install GI/Aluminium/Copper conductors, etc., required for the earthing of the individual equipment earthing. All work such as cutting, bending, supporting, drilling, brazing/ (exothermic) welding, clamping, bolting and connecting onto steel structures, equipment frames, terminals, rails or other devices shall be in the CONTRACTOR's scope of work. All incidental hardware and consumables such as fixing cleats/clamps, anchor fasteners, lugs, bolts, nuts, washers, bitumastic compound, anti-corrosive paint, electrodes required for brazing / (exothermic) welding as required for the complete work shall be deemed to be included by the CONTRACTOR as part of the installation work.
d) The alignment of conductors are only shown approximately in the earthing drawings and these may be suitably shifted/finalised in consultation with the site ENGINEER/PURCHASER to avoid any interference. If earth connection to any device is not shown specifically in the relevant earthing drawings, it shall be field routed.
e) The work of embedment of the main earthing conductor in RCC below ground floors/walls along with provision of pads/earth risers is to be done by the civil Contractor when the floor/walls are cast.
f) The tap connections (earthing leads) from the verticals located on the walls to the equipment shall be embedded in floor by making the chases in the flooring by the CONTRACTOR if the equipment is located more than 500 mm (approx.) away from the pad/riser. The work involves chasing, concreting and resurfacing to the original status. The concrete cover shall not be less than 50 mm.
g) The scope of installation of earth connection leads in outdoor area to equipment such as steel structures and equipment like LA, etc. shall include laying the conductors, (exothermic) welding/cleating at specified intervals, (exothermic) welding/brazing to the pig tails from main earth grid bolting/ (exothermic) welding at equipment terminals and coating welded/brazed joints by bitumatic paint. Galvanised conductors shall be touched up with epoxy zinc rich paint where holes are drilled at site for bolting to equipment/structure.
h) Work details shall be as per the drawings and earthing system, with table giving sizes, number and material of earth leads for earthing various items. In general, the following practices shall be followed:
    1) Wherever main earthing conductor crosses cable trenches, they shall be buried below the trench floor.

This document is an intellectual property of Nuclear Power Corporation of India

2) Earth leads and risers between equipment earthing terminals and the earthing grid shall follow as direct and short a path as possible.
3) Neutral connection shall never be used for the equipment earthing.

Note: The requirement mentioned in the relevant document "technical requirement for grounding and lightning protection system" shall also be complied during grounding and lightning protection work.

6.6.3 Lightning protection system installation work

Generally, all the lightning protection system work has been included in the scope of the civil Contractor for the relevant buildings. Mainly the lightning protection conductor isolation boxes and the termination of conductors are included in the subject work. In specific cases specific work might have to be done under the subject work as brought out in the relevant part of the tender. The installation work shall include storing, laying fixing, jointing/ termination, testing, commissioning associated with lightning protection system for the various building as instructed by the Purchaser. All (exothermic) welding/ brazing equipment, necessary tools and testing equipment shall be furnished by the CONTRACTOR.

6.7 Lighting System - Supply & Installation Work

6.7.1 Scope

The requirements of lighting system supply, qualification, installation, testing and commissioning of complete lighting system and power receptacles are brought out in the relevant specification/data sheets included in this tender. It basically comprises various types of lighting fixtures, power receptacles, lighting distribution boards/panels, distribution cables/wires, lighting switches, junction boxes, termination, etc. The scope covers indoor lighting, area lighting (excluding street lighting), aviation warning lighting, evacuation lighting, etc.

6.7.2 INSTALLATION WORK

a) The installation work shall include storing, unpacking, fixing of all equipment associated with lighting system, routing and laying of cables, wiring, termination, testing, commissioning and all other work items necessary for completing the job.

b) The supply of all mounting accessories, earthing wires and incidental hardware and consumables like fixing saddles, spacer plates, connectors, jointing ferrules, all fixing brackets, screws and studs, shall be deemed to be included as part of installation work. Mounting accessories like saddles spacer plates, pull boxes, junction boxes and fixing hardware shall be of galvanised mild steel.

c) Fixing of lighting distribution panels and boards as per lighting layout drawings on the walls with anchor fasteners. The CONTRACTOR shall do touch-up painting on lighting panels/boards if the same is damaged during installation handling.

d) Cabling for lighting fixtures shall comply with the requirements specified in the cabling guidelines

This document is an intellectual property of Nuclear Power Corporation of India

6.8 Other works included in the scope.

The following works are also included in the scope of the contract.

a) Protection setting calculations of complete electrical systems of KKNPP 5&6 and submission of reports along with the recommended relay set points using proven power system studies software and all the software used/ loaded in the above systems/ equipment shall be submitted to the Purchaser, in original, along with software modification tools, if any, required to meet the design intent. For protection setting calculation of 6kV switchgear and their feeders, contractor also need to follow/take into account of the calculation guidelines to be provided by NPCIL during the execution (the guideline will be provided to only successful contractor to which order is placed).

b) Providing software tools, software (Basic and application) and also providing the detailed procedure for doing any corrections, changes during course of commissioning, operation & maintenance for all computer based systems including SCADA.

c) Installation drawings for all electrical equipment taking into account respective room/building layouts.

d) Relay Protection, Control monitoring system Schematic and wiring diagrams for all electrical equipment

e) SF_6 leak detection system in 400kV and 230kV GIS buildings (0 UAB & 0 UAD).

f) Canopies, complete with fixing arrangement and hardware, for all outdoor equipment.

g) Safety equipment such as shock hazard charts, first aid boxes, caution boards, apron, eye shields, discharge rods, fire extinguishers, insulating mats, sand buckets, photo-luminescent/ auto-glow stickers showing important signages such as exit, turn left/ right etc., 6kV grade hand gloves and other equipment for safety of all electrical equipment and personnel as per statutory regulations.

h) Relevant insulating mat of PVC pasting type as per latest IS, shall be installed on the front and back side of the switchgear area before charging of the floor. Wherever necessary, temporary insulating mats shall also be provided during the testing / pre-commissioning / commissioning works, so that, the permanent insulating mat does not get damaged before handing over of the systems to the concerned Groups.

i) Tools and tackles for erection, operation and maintenance of all electrical equipment and systems. This shall include following tools & tackles as a minimum but not limited to these:

- Analogue & digital multi meters
- Clip-on meters of different ranges
- Tong testers
- Allen keys
- Hammers
- Complete tool kit for the electrician comprising of screw drivers, testers, pliers, spanners, cable cutter/ stripper, adhesive tapes etc.
- Portable battery and mains operated MV and LV megger
- All necessary equipment operation tools and tackles as required.

The above list is only indicative. For detailed list of tools and tackles to be supplied along with the equipment, the technical specification of the respective equipment shall be referred.

j) All erection, start up and commissioning spares up to handing over to the Purchaser.

k) Mandatory spares.

This document is an intellectual property of Nuclear Power Corporation of India

l) Recommended spares for five years of normal operation for all electrical equipment along with itemised unit prices.

m) Contractor shall include painting and marking of all buses, individual incomers, all outgoing feeders etc. with details such as tag no., feeder rating, sending end source reference, etc. for all switchgear along with danger notice boards in three languages (English + Hindi + Tamil). In addition to the above, sufficient no. of electrical safety charts shall be displayed in the electrical buildings / switchgear rooms to spread awareness on electrical safety.

n) Civil works as brought out in the relevant specifications/other tender documents.

o) Scope of works includes survey of the embedded parts, cable openings provided in the floor, below the panels, EP levelling etc. for their suitability for equipment erection and cabling works. Non –conformity, if any, for the same shall be brought to the notice of the corporation. Any minor modifications / rectifications of EP (within the tolerance of civil drawings) required to bring the same to the desired level, as shown in the equipment drawings, enlargement of the openings as required, providing shim plate, shall be done as a part of equipment installation works. Only in case of any major re-works / rectification / modification, if any, of the EPs, core cutting, etc., then the subject works, on a case to case basis, can be analysed and treated as separate works for its operation as directed by Engineer–in –charge and as covered under respective items in the BOQ. Decision of the Engineer–in –charge shall be final and binding in this respect.

p) **Construction Power supply:**
Purchaser's obligation to supply construction power shall be as per the relevant section of the Tender document. To ensure uninterrupted construction activities and to keep pace with overall construction/ project schedule, any shortfall in power availability shall be met by Contractor by providing portable DG sets, distribution board etc. as required at their own labour and cost.

It may be noted that, construction power supply will be given to the Contractor at only one point at the nearest sub-station and all further cabling from this point shall be in the scope of Contractor. The Contractor shall allocate a semi–permanent route for the construction power supply in the designing stage itself so that, an ear marked space and route is available for semi-permanent installation/ routing of the cabling and panels deployed for the construction power supply network. Indiscriminate and temporary laying and criss-crossing of the power supply lines/ cabling lines etc. shall not be acceptable.

In addition, it shall be added that, Contractor shall route all these cabling lines and installation of temporary panels only after acceptance of the above routing/ location by the Purchaser and Contractor shall take written permission for the same, prior to carrying out this task.

q) Some of the facilities are common for both KKNPP3&4 and KKNPP5&6 and are located in the auxiliary area of KKNPP 3&4. The facilities comprise buildings/structures housing the facilities and equipment in the buildings, under the work of 'BoP-Common Services for KKNPP 3&4' being executed through a separate contract and includes the following:
- Civil structures for both KKNPP3&4 and KKNPP5&6
- Process Equipment for KKNPP3&4
- Electrical Equipment in general, for both KKNPP3&4 and KKNPP5&6, except for those which may be additionally required.

The scope under the subject package includes:

This document is an intellectual property of Nuclear Power Corporation of India

- Providing the required cable metal structure for cables, etc. in the buildings/areas constructed in auxiliary area of KKNPP3&4 over and above what is already constructed (information if felt required by NPCIL shall be provided to the successful bidder) and that which is required as per detailed engineering works.
- Augmentation/Providing additional equipment/items like switchgear, Dry type auxiliary transformers, MCC, distribution boards (ACDB/DCDB/LDB/LP, etc.), cables, lighting & receptacles, junction boxes, earthing, lightning protection, etc. as found required during detailed engineering. Key Single line diagram of 6kV & 415V system, envisaged and allocated (from the existing switchgear) for the equipment included under KKNPP 5&6 works can be provided for reference during execution, if required. This information is provided for the bidder of this tender to know the content of equipment/system already covered under KKNPP-3&4 works.
- Providing of power supply for process equipment for KKNPP 5&6.- also covered under the respective documents for process

  Auxiliary area common to KKNPP-3&4 and KKNPP-5&6 - layout drawing shall be provided to the successful bidder during detailed engineering. For routing of power & control cables from the trestle to local control station of GUD system and other systems, separate field routing on trestle column with light channels and through heavy duty GI pipes/heavy duty RCC Hume pipes buried in soil at a depth not less than 750mm shall be used. Cable routing philosophy would be based on cabling principles specified in this scope document and elsewhere in the tender.

7.0 PROCUREMENT:

Invitation of bids for bought out items based on specifications prepared, bid evaluation, preparation of purchase recommendation, placement of order, review of drawings and documents, quality surveillance during manufacture, witnessing non destructive testing and performance testing of equipment at manufacturer's works, packing, supply, oceanshipment and marine insurance and clearance through Indian port of entry in case of imported plant and equipment, inland transportation, inland transit insurance, delivery to site, unloading, taking delivery, site storage, receiving all the drawings and documents from vendor, preservation during transit & storage.

The list of suggested vendors for supplying the various items is provided in Section for Vendor List. Contractor is expected to evaluate and place the suborders accordingly. In case of any difficulty, the Contractor can also propose vendors other than those listed in the vendor list with proper justification. In such cases, the Contractor shall evaluate these vendors with respect to their technical and financial capabilities, order booking position, adhering to delivery schedule, etc. and submit the reports to NPCIL for review and approval. Selection of vendors and inspection agencies & the inspectors, shall be subjected to approval of NPCIL. It shall be Contractor's responsibility to ensure that the Vendor selected implements the quality assurance programme in line with NPCIL's quality assurance programme in respect of work he is performing. **In addition to the above, NPCIL reserves its rights to insist on the same make of equipment as in KKNPP 3&4 which the Contractor shall comply with no additional cost and time implication to NPCIL.**

The bidder at the time of submission of Part-I (Technical) bid may indicate additional subcontractors for any of the given items, for evaluation by the Purchaser and if found acceptable, inclusion of such subcontractor in approved subcontractors list, before opening of

This document is an intellectual property of Nuclear Power Corporation of India

Price Bid. In so far as no Subcontractors are listed against any such item, the Contractor shall prepare and submit to Purchaser a list of Subcontractors for such items for approval and inclusion in such list. List of sub-vendors as issued with the Contract shall be strictly adhered to for procurement of goods/services from designated subcontractor(s). However, under very special and extra-ordinary circumstances, Contractor may request Purchaser for change of subcontractor giving sufficient reasons and submit name and credentials along with Contractor's recommendation of subcontractor(s) proposed by him to the Purchaser for approval, in sufficient time so as not to impede the progress of work on the Facilities. Approval by the Purchaser for any of the Subcontractors shall not relieve the Contractor from any of its obligations, duties or responsibilities under the Contract.

Transportation of over dimensional consignments shall be planned by CONTRACTOR well in advance and any limitation shall be taken care of. All arrangements and procedures of transportation of over dimensional consignments from vendor /supplier works to site are in scope of CONTRACTOR. Responsibility of making arrangements to temporarily strengthen the roads, culverts, bridges, modification of transmission lines etc. for the safe passage of equipment also lies with the CONTRACTOR. All necessary clearances from governmental agencies shall be in the scope of Contractor.

8.0 RESOURCE MOBILIZATION

All the resources such as manpower, plant and machinery, tools & tackles, consumables, erection and commissioning spares, infrastructure like office, stores, approach roads, labour colonies, etc. Any other requirement not specifically mentioned but required for successful completion of the scope of works in all respect shall be arranged by the Contractor.

9.0 WARE HOUSE MANAGEMENT:

Contractor shall warehouse or otherwise provide appropriate storage at site (in accordance with manufacturer's recommendation and taking into account climatic and other relevant conditions at the warehousing site) for all Equipment, Plant & Machinery and Contractor's equipment.

All Equipment, Plant & Machinery, tools, tackles and spares, shall be stored at appropriate location approved in advance by the Engineer-incharge, and properly tagged and identified for segregated from other goods and Preserved as per manufacturers recommendations.

The Contractor shall arrange and be responsible for security of all the equipment, Plant & Machinery and Stores to be incorporated in or forming part of the facilities and tools, tackles, spares and other items, which are required to be delivered to the Purchaser under the contract, till acceptance of the facilities or acceptance of such items, as the case may be, by the Purchaser. Detailed scope shall be referred in the "Requirements of construction supervision and management" specification

10.0 COMMISSIONING AND TESTING:

Scope of commissioning & testing include preparation of detailed logical and sequential programme of commissioning activities, commissioning procedures. Commissioning of all the system, including commissioning and maintaining clean condition during commissioning

This document is an intellectual property of Nuclear Power Corporation of India

structure and equipment to verify the design intent, preparation of commissioning reports. To carry out any modification required in the system, structure and equipment based on commissioning feedback. Preparation of operation and maintenance manuals for all systems, equipment and structures. Preparation of history dockets for all systems equipment and piping system, Development and preparation of operating procedures & operating flow-sheets. Performance testing of systems included in the scope. Detailed scope shall be referred in "Pre-commissioning, commissioning, performance, and guarantee test / site acceptance" specifications.

CONTRACTOR shall impart training on PURCHASER's operating personnel to become familiar with operating characteristics and maintenance aspects of the plant

11.0 HEALTH AND SAFETY:

The Contractor shall at all times take all reasonable precautions to maintain the health and safety of the Contractor's Personnel. The Contractor shall ensure minimum first-aid arrangements available at all times at the Site and other arrangements in collaboration with local health authorities like medical staff, sick bay, ambulance, etc. The Contractor shall also make suitable arrangements for necessary welfare and hygiene requirements and for the prevention of epidemics. In case the Contractor fails to make arrangements as aforesaid, the Purchaser shall be entitled to do so and recover the cost thereof from the Contractor.

The Contractor shall at his own expense arrange for Compliance of "Contract Conditions for Industrial Safety" as appended to this GCC or as required by the Purchaser in respect of all labour directly or indirectly employed, for performance of the Facilities and shall provide all facilities in connection herewith. In case the Contractor fails to comply with these conditions, the Purchaser shall be entitled to take steps as necessary to ensure compliance and recover the cost thereof from the Contractor.

12.0 EXCLUSIONS:

a) Supply of oil filled power transformers such as generator transformers, unit auxiliary transformers, reserve auxiliary transformers, common station auxiliary transformer, shunt reactors, line reactors, rectifiers and inverters, Reactor building (UJA) hermetic cable penetrations, Unitised SCADA panels, protection panels & measurement panels for GT & UAT, GCB, 24kV IPBD and its supporting structures, RCP transducer panels, some 0.4kV switchgear & MCCs of main building (UBA, 1-4UKD, UMA, UKC), DG sets & their auxiliaries, chlorination plant package.
b) Street/road lighting.
c) Co-ordination with the Nuclear regulator.

13.0 FREE ISSUE MATERIAL & SERVICES:

Oil filled power transformers such as generator transformers, unit auxiliary transformers, reserve auxiliary transformers, common station auxiliary transformer, shunt reactors, rectifiers and inverters, Reactor building (UJA) hermetic cable penetrations, Unitised SCADA panels, protection panels & measurement panels for GT & UAT, GCB, 24kV IPBD, RCP transducer panels, some 0.4kV switchgear & MCCs of main building (UBA, 1-4UKD, UMA, UKC, etc.).

This document is an intellectual property of Nuclear Power Corporation of India

14.0 TERMINAL POINTS:

1. Seal off bushings of the main generator.
2. DG sets- 6kV terminal box of DG, DG MCC incomer, DG LCP incoming TB.
3. Chlorination plant-Terminal of 6kV switchgear incomer, terminal of AC/DC group-2 and group-1 power supply DB incomer, terminal building peripheral lighting DB incomer, control and FO cable for SCADA at terminal of 6kV switchgear of chlorination plant.
4. 400kV:
   String insulator on the Gantry structure for 400kV for external transmission lines. For 400kV tie lines between KKNPP56 and KKNPP34, scope includes works in KKNPP34 area also.

   230kV:
   String insulator on the Gantry structure for 230kV for external transmission lines.
5. Terminals of Purchaser's equipment.

15.0 DOCUMENTATION:

The Contractor shall submit a detailed write-up on how the Contractor proposes to plan this work. This write-up, among the other things, should spell out the proposed design sequence, extent of deliverables issues envisages, planning program and other pertinent details. The Contractor shall also submit various reports considered as and when necessary by NPCIL.

All drawings and documents pertaining to Design & Engineering, Manufacture, Procurement, Erection / Construction, commissioning & testing, trial operation, performance testing and handing over shall be issued and controlled in a timely manner. The Contractor shall follow NPCIL's drawing/document numbering procedure while numbering drawings and documents. The Contractor shall submit all drawings and documents for NPCIL's review. The Contractor shall ensure that the reviews have been performed by the NPCIL.
The Contractor shall meet the requirements indicated in the vendor data requirements documents and the Documents/Drawings Preparation and Submission document included in the tender.

In case discrepancies / corrections with respect to inputs and drafting of drawings are observed, the Contractor shall be responsible for the time and cost over run on this account. NPCIL procedures for preparation of drawings and documents shall be issued to the successful bidder. Contractor shall prepare a procedure based on the same and submit for NPCIL approval. Approved document shall be followed for project execution.
The Contractor shall be responsible for the correctness and accuracy of the drawings and documents prepared by the Contractor and towards this responsibility, the Contractor shall make amendments to the drawings and documents without any additional charge, if necessary. Approval of the drawings and documents by NPCIL shall not relieve the Contractor of his responsibility of correctness and accuracy of such drawings and documents.

All documents are to be submitted in English language. In case of foreign suppliers all the relevant information's required for the erection, commissioning and operation shall be clearly indicated in the drawings and documents. Reference to industrial /factory standards shall be avoided.

This document is an intellectual property of Nuclear Power Corporation of India

The Contractor shall furnish Final Documentation and "As Built" drawings as detailed in vendor document requirement (VDR) in tender.

16.0 CODES AND STANDARDS:

All equipment and systems covered under this specifications shall comply with the latest editions as on date of Notice Inviting Tender (NIT) (including amendments thereto) of currently applicable codes, standards, statutes, regulations and safety codes in the locality where the equipment will be installed but not limited to the codes and standards listed herein as well as in various sections of this specification. Nothing in this specification shall be construed to relieve the Contractor of this responsibility.

In the event of any conflict between codes and standards referred to elsewhere in the specifications and the requirements of this specification, the more stringent of the two shall govern.

Other National Standards are acceptable if they are established to be equal or superior to the standards indicated herein as well as in various sections of this specification subject to approval by the Purchaser. Contractor will be responsible for establishing the equality or superiority of other standards than those specified here. In all such cases, however, legal copies of English translation of such National Standards shall be furnished along with the tender. The tenders not complying with this requirement are liable for rejection.

The Tenderer shall submit his proposal both in MKS units and SI units. During detailed engineering, the Contractor shall use SI units with corresponding MKS units in parenthesis. The Contractor shall engrave MKS units on equipment rating plates & instruments.

Wherever word "latest" has been used it should be understood as applicable as on date of NIT.

Codes and Standards of following Institutes are applicable as specified in various sections of this specification:-

American National Standards Institute (ANSI)
American Society of Mechanical Engineers (ASME)
National Electrical Manufacturer's Association (NEMA)
Bureau of Indian Standards (BIS)
Manufacturers Standardization Society (MSS)
Piping Fabricators Institute (PFI)
American Welding Society (AWS)
British Standards Institute (BSI)
American Society for Testing and Materials (ASTM)
ANSI-NEMA
ANSI /ASME – Performance Test Codes
Heat Exchange Institute Standards (HEI) / Specifications
International Organisation for Standardisation
Expansion Joint Manufacturers Association (EJMA)
American Society for Non- Destructive Testing (ASNT)
ISI Steam Tables
Tubular Exchanger Manufacturers Association (TEMA)

This document is an intellectual property of Nuclear Power Corporation of India

Instrument Society of America (ISA)
Federal Occupational Safety and Health Administrative Standard (OSHA)
ANSI/ISA S75.02 Control Valve Capacity Test Procedure
American Gear Manufacturer's Association
Hydraulic Institute Standards
Atomic Energy Regulatory Board (AERB) Safety Guide for Works Contract (No. AERB/SG/IS-1).
American Water Works Association (AWWA)
IEC
IEEE
Indian Electricity Rules and Act
Indian Factory's Act
AERB Safety Codes, Safety Guides and Safety Manual as Applicable for Design And Construction.
Atomic Energy (Factories) Rules 1996
In the event of conflicts between different standard codes, Contractor shall refer the conflict to Purchaser for a written resolution.

17.0 AVAILABILITY REQUIREMENTS:

Refer the respective TS , DS & SLD for details.

18.0 SAFETY AND SEISMIC REQUIREMENTS:

The Contractor shall clearly understand the concept of safety and seismic classification requirements and shall strictly adhere to the requirements of specific classes. For understanding the design requirements Contractor shall refer to the referred codes for Safety classification and seismic categorisation for structures, systems and components. Safety and seismic classification is included in the respective Technical specification document.

EPSS equipment and items are to be qualified for SSE + OBE + ASW as per IEEE std 344.

Normal operation including reliable power supply system equipment and items are to be qualified for OBE as per IEEE std 344.

However, for seismic qualification of SSCs in BOP areas, clause no. 3.2.1 shall prevail.

The panel/equipment used in the shake table test can be supplied to the Purchaser, provided the Contractor/vendor justifies the same through the values of maximum strain measured by the strain gauges during testing with respect to the yield values in the Sn curve of the material, for review and approval by the Purchaser. In case such a measurement and justification/comparison with the endurance limits is not practical or possible, the equipment used for testing shall not be supplied to the Purchaser by the Contractor/Vendor. However, the requirements regarding the supply of seismic test prototype given in the TS shall supersede the above. Generalised response spectra and ASW requirements are provided in document no. R01.KK56.0.0.DS.RR.PR001 (part 01 and part 02) and guidance provided in NPCIL document no. R01.KK56.0.0.AP.PZ.PR001, applicable version of which will be provided by the Purchaser to the Contractor during execution. Floor response spectra are for various floors and buildings is provided elsewhere in tender as additional information. Further, Specific

This document is an intellectual property of Nuclear Power Corporation of India

floor response spectra can be provided by the Purchaser during execution of the work, if applicable.

The Contractor/Vendor can either qualify an item for the higher requirement and the same can be used in both EPSS + normal operation or equipment can be qualified for the specific requirement (say separately for OBE in NOS & SSE + ASW for EPSS/located in safety related buildings) and used for the specific category of system. In either case, the equipment by itself shall not be different from each other, shall be interchangeable and only anchoring/fastening can be different to suit the actual requirement

19.0 QUALITY ASSURANCE PROGRAM:

The quality assurance programme shall provide control over all activities affecting the quality and reliability of all the equipment, components and services included in this contract. The programme shall include but not be limited to the activities of Design & Engineering, Manufacture, Procurement, inspection & testing, packing & supply, Erection / Construction, commissioning & testing, trial operation, performance testing and handing over. Activities affecting quality shall be accomplished under suitably controlled conditions namely, use of appropriate equipment, suitable environmental conditions, adequate cleanliness and other prerequisites for the particular activity. The programme shall take into account the need for special controls, processes, test equipment, tools and skills to attain the required quality, and the need for verification of quality by inspection and test.

Contractor shall furnish the quality assurance programme for review by Purchaser which shall include but not be limited to the requirements of the tender specification. Contractor shall provide to Purchaser all documents and records relating to quality programme and audit status for activities affecting quality.

Indicative quality assurance plans of equipment are included in the Tender, for preparation of final quality assurance plan of various equipment by the Contractor and for further review & approval by the Purchaser. Tenderer shall furnish the QAPs covering all but not limited to the activities indicated in the QAPs along with the offer for all equipment and systems and activities. Upon placement of order Purchaser will review and approve these QAPs which will form the basis for execution of contract.

Contractor to refer the relevant Quality Management System Requirement document for quality management.

Quality policy shall be submitted as a part of the bid document which shall be binding. Owners quality manuals shall be issued to the Contractor based on which he shall prepare and submit the QA manual for the contract.

The validity of type test report in general will be as per latest CEA guidelines on the validity and extension of type tests except for cases specifically brought in respective TS/DS e.g. cables etc. TS/DS shall govern in such exceptions where specifically specified. However, the contractor and their sub-vendor/manufacturer shall provide necessary evidence in all the cases as per industry standard/practice that the product has not undergone any change after the type test.

This document is an intellectual property of Nuclear Power Corporation of India

The type tests, especially for all major equipment should have been conducted at any one of the reputed International Test Laboratories mentioned below or any internationally accredited test laboratory subject to verification of accreditation certificate issued by international accreditation board only.

a) KEMA, Holland
b) EDF, France
c) Hydro-Quebec, Canada
d) CESl, Italy
e) CPRI, Bangalore
f) IPH Germany

Type test reports shall be specifically for the equipment that is offered under the subject tender. Type test reports shall be considered valid only if the type tested equipment and the offered equipment are the same, including the process of manufacturing and the major components used.

In the technical specification for the respective equipment it has been mentioned that "The Purchaser reserves the right to demand repetition of some or all the type tests in the presence of his representative. Contractor shall quote unit rates for carrying out each type test and special test." However, to facilitate quoting by the bidders, the type and special tests for which unit rates are to be quoted have been brought out in Section E of the tender.

20.0 DESIGN / ENGINEERING CONTROL:

The Contractor shall have a well-established QA program for all activities related to design & engineering. The Contractor' QA manual for design related activities shall conform to Purchaser's QA policy. It is expected that the design & engineering jobs taken up adhere to well established and proven principles involved in such activities. Personnel entrusted with design & engineering activities shall have necessary experience, expertise and qualification commensurate with the nature of design activities and related jobs taken up. The organisation shall adhere to a graded system of development of such activities and shall have written down procedures for carrying out design related works. All notes/reports/sheets indicating calculations, analysis methodology and design approach shall maintain a graded approach of preparation, checking, review and approval. Calculations or reports describing analysis and design shall be approved by persons who have adequate expertise in the specialised field/discipline.

The Contractor shall establish measures to assure quality standards pertaining to various documents such as concept notes, design basis reports, design calculations, analysis reports, optimization studies, drawings, design manuals, etc. and, deviations from such standards shall be controlled by the Contractor. Measures shall be established for the identification and control of design interfaces in respect of revision of documents, review, approval, release and distribution.

The design control measures shall also provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculation methods, or by the performance of a suitable testing program. Where a test program is used to verify the adequacy of a specific design feature in lieu of other verifying

This document is an intellectual property of Nuclear Power Corporation of India

or checking processes, it shall include suitable qualification testing of a prototype unit under the most adverse design condition. Items which call for critical and complex analysis or lead to first-of-a-kind design shall invariably be peer reviewed by an Independent Group/Agency. The review reports of Independent Verifiers shall be maintained by the Contractor. All calculation tools including commercial software available off-theshelf used for analysis or used to carry out design calculations shall be utilised in a manner as advised by the Developers. All software calculation tools developed in-house shall be maintained up-to-date with latest revisions or updates and shall be validated. All such validation reports for the different versions shall be maintained. Personnel involved in the use of such software tools shall be adequately trained and shall have good working knowledge in the area of their application.

All personnel involved in the use of analysis & design software tools shall undergo well established training procedures and their level of expertise shall be gauged through periodic assessments. The Contractor shall maintain adequate manpower at all times to meet the demand of engineering & design works taken up at various times. The allocation of such manpower shall be maintained in a verifiable manner.

A system of audit in design shall be maintained regularly which should be oriented to identify and capture incorrect procedures or lacunae in quality. Authorisation shall exist for different levels of expertise and they shall be subjected to periodic review. Appropriate corrective actions shall be identified to be implemented to set right shortfalls identified through internal audits. The QA programme shall contain scope for external audits, including that by the Purchaser, for whom the engineering & design activities are undertaken. The scope of such external audits shall endeavour to meet the Purchaser's legitimate demands such an inspection of the office premises, verification of the tools utilised in the engineering & design activities, verification of competence of the personnel allocated for the jobs, adequacy of personnel deployed to meet schedule and quality expected for the jobs, adherence to protocols on maintenance of documentation etc. A well organised QA programme which is subjected to audit and is periodically reviewed and conforms to the overall quality objective of the Contractor will ensure meeting the required quality objectives.

Bidders shall submit the QA Policy document of the company and the detailed QA programme at the time of bid submission. The programme shall include relevant details such as organizational set up for taking up the required design & engineering works, list of qualified engineers with their experience, list of valid software, etc., proposed for the Work. The QA programme shall be vetted by the Purchaser before commencement of major activities related to the Work.

21.0 CONSTRUCTION CONTROL:

The QA during construction shall shall follow the following control.

Material Control Fabrication control	Refer relevant QM Document for the requirements for Construction

This document is an intellectual property of Nuclear Power Corporation of India

Inspection & Testing	Supervision and Management by CONTRACTOR.
Packaging & Transport	
Receiving & Storage	
Erection	
Site testing	
Documentation Control	
Quality Management System	
Welding	
Inspection & Testing	
Quality Surveillance	
Guarantees	

22.0 TRAINING OF PURCHASER'S PERSONNEL:

The Contractor shall train Purchaser's engineers, supervisors, technicians in the shops, where the equipment will be manufactured and/or in their Collaborator's works to enable those personnel become familiar with the equipment, or at his Works or at his Sub-Contractor's Works or at site. In addition to training at works, Contractor shall also provide training at site for at least one week period for pre-commissioning, commissioning, operation & maintenance etc. for the equipment/system.

The number of personnel to be trained and the period of training shall be adequate and mutually agreed upon between the Purchaser and the Contractor.

The training shall be so oriented as to make the Purchaser's personnel proficient in installing/operating the Equipment.

The Purchaser's personnel shall also be trained for routine maintenance work and lubrication, overhauling, adjustments, testing and replacement procedures to be adopted for the equipment offered.

The Contractor shall train the Purchaser's personnel in carrying out minor repairs, if need arises, during the operation of the equipment.

The charges for training the Purchaser's personnel and the cost of training material, if any, shall be included in the price for erection, testing and commissioning.

The Contractor shall provide all necessary instruction material for the training, which shall include manuals, booklets, pamphlets, drawings, sketches, models, pictures, photos, colour slides, film, etc. All the literatures shall be in English. The training and instruction materials shall become the property of the Purchaser.

The Contractor shall provide at no extra cost to the Purchaser all necessary facilities and reasonable assistance as deemed necessary for the training. The travelling and living expenses of such personnel shall be borne by the Purchaser.

This document is an intellectual property of Nuclear Power Corporation of India

The training shall be in the form of lectures, hands on experience, factory visit during design, manufacturing, erection, testing and commissioning. The medium of instructions for training shall be English. All the training shall be completed well in advance before start of commissioning activities at site. However, hands on training shall be along with the actual activity to be carried.

23.0 PAINTING:

Refer respective TS & DS document for painting of the equipment. For general item which are not specifically covered in the respective TS & DS, refer respective documents for White Washing, Colour Washing, Distempering, Painting and Polishing and document for surface preparation, selection and application of primers and paints on external surfaces of equipment, vessels, machinery, piping, ducts, steel structures, external & internal protection of storage tanks for all services and chimneys if any.

Internal/External Surface preparation and primer painting, and final painting/lining for the external/internal surfaces of all equipment are also included in the scope of EPC contractor.

24.0 COMMISSIONING, TRIAL OPERATION AND HANDING OVER:

Detailed requirements of commissioning & testing, trial operation, Performance testing and handing over of SSCs under this package shall be as per PURCHASER document, which will be provided to the successful bidder at appropriate time.

25.0 SPARES:

The Tenderer shall include in his scope of supply, the essential/mandatory spares as described in the respective TS & DS and other relevant documents. Tenderer shall work out the requirement of recommended spares and indicate along with the bid. The Purchaser reserves the right to finalise the exact quantities of the spare parts and effect price adjustment on the basis of the unit rates quoted by the Tenderer. The spares, ordered by the Purchaser, shall be delivered at site along with the main equipment/plant. The requirement of recommended spares shall be for a period of five (5) years for satisfactory operation of equipment / plant / system.

START-UP SPARES are those spares which may be required during start-up and commissioning of the equipment / plant / system. All spares used until the equipment/plant/ system is finally handed over by the Contractor to the Purchaser shall come under this category. All the start-up spares shall be under the supply scope of equipment and considered to be included in rates of the equipment supply by the Contractor.

ESSENTIAL SPARES are those spares which are considered necessary by the Purchaser for five (5) years of normal plant operation. The term “ESSENTIAL” and “MANDATORY” may be considered as same.

The Purchaser reserves the right to alter the items and/or quantities of spares while placing the order. Contractor shall give the break up and rates of all essential spares.

This document is an intellectual property of Nuclear Power Corporation of India

RECOMMENDED SPARES are those spares which the 'Tenderer' considers necessary for five (5) years of normal plant operation, and which are not included in Essential Spares/Mandatory spares specified by the Purchaser. The Tenderer shall indicate his recommended list of spares. Their unit prices shall also be indicated. The Purchaser reserves the right to buy any or all of the Recommended Spare Parts. The total price of Recommended Spares shall not be considered while evaluating the tender.

The Tenderer shall also indicate the service expectancy period for the spare parts under normal operating conditions before replacement will be necessary. All spare parts shall be despatched along with the main equipment concerned.

26.0 HOUSE KEEPING & WASTE DISPOSAL:

All wastes generated like surplus earth after use/surplus construction materials to be disposed off from time to time to the disposal locations as directed by the site Engineer in Charge.

Handling, Transportation& Disposal of the waste generated during construction, installation, commissioning, etc. shall be a part of the contractor’s scope of work. Contractor to collect such waste generated within battery limit and then transport and dispose to the locations as directed by the site Engineer in Charge. Also, housekeeping and dewatering of the area under the control of the Contractor shall be a part of the Contractor’s scope of work.

27.0 PERFORMANCE GUARANTEE:

Performance guarantee parameters indicated in GCC & SCC and technical specifications shall be adhered to.
At least one certificate of performance issued by an end-user, for all major equipment, certifying that the equipment being proposed for supply by the Bidder has been operating without any failure, is required to be submitted by the Bidder along with the bid document. Such certificates should also carry details of the issuing company, its postal address, the name and contact details of the person/s issuing the certificate/s. Purchaser retains the right to independently verify such information provided by the Bidder; directly with the enduser, etc. Bidder(s) shall have no objection for this process of verification by Purchaser.

28.0 PROJECT EXECUTION AND MANAGEMENT:

Refer respective document for detailed requirements of Project execution & procedures to be submitted by the Contractor to Purchaser approval with reference to the execution of this contract.

Effective project management for completion within the time frame of contract is in the Contractor’s scope. Planning, scheduling and monitoring is essential for timely completion of the Project and the project management system to be adopted shall be enumerated in the bid. Integrated project management system is to be implemented during execution of the contract. Bidder(s) shall submit documentary proof of the project management system implemented in their earlier projects including the management tools used along with the bid. The system of organization and control, feedback and corrective measures, communication and project execution scheme are to be submitted along with the bid.

This document is an intellectual property of Nuclear Power Corporation of India

29.0 REAL TIME INTEGRATED COMPUTERIZED PROGRESS MONITORING SYSTEM:

Real time integrated computerized progress monitoring system is also included in the scope of the Contractor. Contractor shall note the requirements as given below for implementing the Real Time Integrated Computerized Progress Monitoring System. For overall success of the project, a huge number of activities involved in the package at all phases of the execution need to be completed in time and cost. This can be achieved by proper planning, execution, monitoring and closing of activities, which can be accomplished by close coordination between the Purchaser, Contractor, Contractor's engineering consultant, Suppliers, Manufacturers and Sub-Contractors. Real time monitoring of activities and traceability is a key in ensuring timely execution of the package. The Contractor shall establish a server based computerized relational database management system. The system should link Contractor's head office, design office(s) with site office, and provide viewing access to Purchaser's agencies through internet.

The software for this purpose should be user friendly and it should serve the following:
It shall provide real-time information for better decision making.
It shall be capable of providing traceability of drawings/documents as well as materials / activities involved up to the level desired by the Purchaser covering total scope of work during all stages viz., planning, execution at HQ and at site and completion of the project.
It should be user-friendly to operators, engineers involved. Internet based screens for Purchaser's viewing shall be provided.

Customization of reports shall be as per Purchaser's report formats. It shall be able to provide reports/ details at all levels e.g. system, KKS code, drawings, line wise erection reports, Weld inspection reports, NDT reports, etc. which can help in generating Mechanical Completion reports, Construction Completion Certificate and Material Consumption and Reconciliation, etc.

The software should be based on relational database management system and all drawings/design notes/Design basis reports and documents like Contractor's enquiry specifications for tendering, purchase specification, Un-priced sub-orders, QS requests, letters, queries, clarifications, QAPs, Weld inspection reports, NDT reports, Procedures etc. that are required for the processing of the material shall be generated through this system and submitted along with transmittals to PURCHASER for processing through this system. All history documents, instruction/installation manual, SR, TC details and other documents etc. that are generated during the course of execution of the contract shall also be generated and/or attached. System should have provision to review and approve the documents wherever required with digital signature. However, for record purposes PURCHASER will provide necessary stamp and signature on printed formats that Contractor has to submit after incorporation of PURCHASER comments if any on the same. All above documents shall be linked with item tag no. and SOR Sr. no. and item code no. etc. and shall be retrievable. Contractor has to submit the necessary module of the software through which PURCHASER will be able to retrieve all the above mentioned necessary information about history document and instruction/ installation manual for complete life of the plant even after complete execution of the contract. No separate payment shall be made in this regards. Software meeting above requirements and all other requirements as specified in the tender specification is acceptable. The system should be accessible to the bidder's expeditors and QS engineers,

This document is an intellectual property of Nuclear Power Corporation of India

bidder's site office and Purchaser sites, Bidder's HQs, Purchaser's design group, and Purchaser's HQ, Purchaser QS units at various locations, etc.

Contractor is expected to develop the system immediately after award of work and demonstrate the functions and utilities of the same to PURCHASER's HQ as well as at Site. This activity is considered to be a part of mobilization.

30.0 REFERENCE DOCUMENTS:

The relevant documents to be referred by the bidder are listed in the index document (Annexure 1). Bidder(s) shall thoroughly study the documents, understand the requirements and scope of work before submitting the bid.

31.0 STATUTORY REQUIREMENTS:

The Contractor during detailed engineering, procurement, construction & commissioning, shall take into account and comply with various local statutory requirements, standards and codes, as applicable including but not be limited to the following:

1. Atomic Energy Regulatory board.
2. Factories Act
3. Indian Petroleum Rules
4. Tariff Advisory Committee (TAC) Guidelines (for Insurance purposes)
5. Indian Boiler Regulation Act (IBR)
6. Civil Aviation Rules
7. Indian Railway Authority
8. Indian Electricity Act
9. Indian Electricity Rules
10. Central Electrical Authority (CEA)
11. Director- General, Factory Advice Service and Labour Institute, Bombay
12. Central Mines Research Institute (CMRI), Dhanbad
13. Department of Atomic Energy
14. Requirement of Chief Controller of Explosives (CCE), Nagpur, India.
15. Standards prescribed by Oil Industry Safety Directorate (OISD), Ministry of Petroleum and Natural Gas, Govt. of India.
16. Ministry of surface transport.
17. National Institute of Oceanology
18. Department of Water Resources, Tamil Nadu
19. Stipulations stated in Environmental clearance granted by Ministry of Environment and Forest, Govt. of India.
20. Liquid Effluent Discharge as per Minimal National Standards for Liquid effluents and air emissions confirming to Pollution Control Board Standards.
21. Stipulations of Environmental authorities of the State of Tamilnadu. Other legislations relating to Environmental protection such as (but not limited to) :
    - Hazardous wastes (Management and Handling) Rules 1989.
    - Water (prevention and control of pollution) Act, 1974.
    - Water (Prevention and Control of Pollution) Act, 1977.
    - Air (Prevention and Control of Pollution) Act, 1977.

This document is an intellectual property of Nuclear Power Corporation of India

- Environment (Protection) Act, 1986.
- Forest (Conservation) Act, 1980.
- Municipal Byelaws of Urban Development Authority of State Government for Buildings in Township.

22. Pollution Control Board.
23. Atomic Energy (Factories) Rules - 1996

32.0 ABBREVIATIONS USED:

ASW	:	Air Shock Wave
BOP	:	Balance of Plant
CEA	:	Central Electricity Authority
ELCB	:	Earth Leakage Circuit Breaker
EOT	:	Electrical Overhead Travelling
EPSS	:	Emergency Power Supply System
GI	:	Galvanised Iron
HVAC	:	Heating, Ventilation and Air Conditioning
KKNPP	:	Kudankulam Nuclear Power Plant
LCC	:	Local Control Cabinet
LDB	:	Lighting Distribution Board
LV	:	Low Voltage
MCC	:	Motor Control Centre
MOV	:	Motor Operated Valve
MV	:	Medium Voltage
NOS	:	Normal Operating Supply
OBE	:	Operational Basis Earthquake
OFC	:	Optical Fibre Cable
OSBL	:	Out Side Battery Limit
PCC	:	Power Control Centre
PDB	:	Power Distribution Board
QA	:	Quality Assurance
RTCC	:	Remote Tap Changing Control
SCADA	:	Supervisory Control And Data Acquisition
SLD	:	Single Line Diagram
SSE	:	Safe Shutdown Earthquake
TAC	:	Tariff Advisory Committee
TTS	:	Tender Technical Specification

33.0 LIST OF ATTACHMENTS:

Annexure 1: List of Applicable Documents for Electrical Package for KKNPP- 5&6

Annexure-2: Safety and seismic requirement for BoP areas.

Annexure-3: I02.KK56.0.0.ET.OKP.WD004_SLD for 400kV System.

Annexure-4: I02.KK56.0.0.ET.OKP.WD005_SLD for 230kV System.

This document is an intellectual property of Nuclear Power Corporation of India

Annexure-5: I02.KK56.01UAK.0.ET.OK.WD001_ Layout of 400kV Outdoor Switchyard.

Annexure-6: I02.KK56.02UAK.0.ET.OK.WD001_Layout of 230kV Outdoor Switchyard.

Annexure-7: Sample Cable log.

Annexure-8: Consolidated Cable log in MS Access Format

Annexure-9: Electrical load Schedule.

Annexure-10: Typical terminal list format.

Annexure-11: Sample electrical equipment layout diagram.

Annexure-12: Sample cable tray routing layout diagram.

Annexure-13: Sample grounding layout.

Annexure-14: Sample lighting protection layout.

Annexure-15: Sample termination drawing.

Annexure-16: Sample cable tray layout drawing.

Annexure-17: Lighting layout.

This document is an intellectual property of Nuclear Power Corporation of India

ANNEXURE-1 TO SCOPE OF WORKS - ELECTRICAL PACKAGE FOR KKNPP 5&6 (I02.KK56.0.0.PR.TT.PR008)

LIST OF APPLICABLE DOCUMENTS FOR ELECTRICAL PACKAGE- KKNPP 5&6

Sl. No.	Name of the document	Document number
1.	Job specification of electrical system of KKNPP-5&6	I02.KK56.0.0.PR.TT.PR009
2.	Vendor list for electrical equipment of KKNPP-5&6	I02.KK56.0.0.AP.REP.PR003
3.	Vendor data requirement of KKNPP-5&6	I02.KK56.0.0.TH.REP.PR002
4.	Mandatory spares for electrical equipment	I02.KK56.0.0.ET.TB.PR002
5.	Technical specification for SCADA systems of KKNPP 5&6	I02.KK56.0.0.ET.TS.PR104
6.	Technical specification for fibre optic cables and accessories of units-5 & 6	I02.KK56.0.0.ET.TS.PR080
7.	Technical specification for 6 kV switchgear of KKNPP-5&6	I02.KK56.0.0.ET.TS.PR078
8.	Technical specification for numerical relays (other than DG protection relays) of KKNPP units-5 & 6	I02.KK56.0.0.ET.TS.PR090
9.	Technical specification for control monitoring & relay protection panels of 400kV & 230kV switchyard, KKNPP units-5 & 6	I02.KK56.0.0.ET.TS.PR092
10.	Technical specification for MV isolated phase bus duct	I02.KK56.0.0.ET.TS.PR079
11.	Data sheet for MV isolated phase bus duct	I02.KK56.0.0.ET.DS.PR074
12.	Datasheet for numerical relays (other than dg protection relays) of KKNPP units-5 & 6	I02.KK56.0.0.ET.DS.PR082
13.	Data sheet for 6 KV switchgear of KKNPP-5&6	I02.KK56.0.0.ET.DS.PR073
14.	Technical Specification For 400kV Outdoor Switchyard	I02.0.0.KK56.ET.TS.PR052
15.	Technical Specification For 230kV Outdoor Switchyard	I02.0.0.KK56.ET.TS.PR054
16.	Technical Specification for 400kV Gas Insulated Switchgear and Gas Insulated Bus Duct.	I02.0.0.KK56.ET.TS.PR051
17.	Technical Specification for 400kV Tie Line between KKNPP 5&6 and 3&4	I02.0.0.KK56.ET.TS.PR051
18.	Technical Specification for 230kV Gas Insulated Switchgear and Gas Insulated Bus Duct.	I02.0.0.KK56.ET.TS.PR053
19.	Technical Specification for MV Power Cables Cable Type-PvVng(A)-LS	I02.KK56.0.0.ET.TS.PR019
20.	Technical Specification for dry type Auxiliary & lighting Transformers for KKNPP 5&6	I02.KK56.0.0.ET.TS.PR099
21.	Technical Specification for LV Switchgear and MCC	I02.KK56.0.0.ET.TS.PR091
22.	Technical Specification for LV Bus Duct	I02.KK56. 0.0.ET.TS.PR096
23.	Technical Specification for LV Power Cables Cable Type-VVGng-FRLS & VVGEng-FRLS	I02.KK56. 0.0.ET.TS.PR004
24.	Technical Specification for LV Power Cables Cable Type-VVGng-LS & VVGEng-LS	I02.KK56. 0.0.ET.TS.PR003
25.	Technical requirement for cable systems and cabling guidelines	I02.KK56.0.0.ET.TT.PR002
26.	Technical Specification for Cable carrier systems	I02.KK56.0.0.ET.TS.PR101
27.	Technical Specification for Glass Reinforced Polyester (GRP) cable tray	I02.KK56. 0.0.ET.TS.PR109
28.	Technical Specification for Wire mesh cable tray	I02.KK56. 0.0.ET.TS.PR111

This document is an intellectual property of Nuclear Power Corporation of India

29.	Technical scpecification for Rectifiers, Inverters and spare cell chargers for KKNPP 5&6	I02.KK56. 0.0.ET.TS.PR084
30.	Technical Specification for DC distribution boards for KKNPP 5&6	I02.KK56. 0.0.ET.TS.PR082
31.	Technical specifications for battery and load bank for KKNPP 5&6	I02.KK56. 0.0.ET.TS.PR085
32.	Technical Specification of wall mounted power distribution boards for KKNPP 5&6	I02.KK56. 0.0.ET.TS.PR081
33.	Technical Specification for Control cables Cable Type-KVVGng-FRLS & KVVGEng-FRLS	I02.KK56. 0.0.ET.TS.PR113
34.	Technical Specification for Control cables Cable Type-KVVGng-LS & KVVGEng-LS	I02.KK56. 0.0.ET.TS.PR114
35.	Technical requirements for Grounding and Lightning Protection System for KKNPP 5,6	I02.KK56. 0.0.ET.TT.PR005
36.	Technical Specification for bare tinned copper conductor up to 400 mm2	I02.KK56. 0.0.ET.TS.PR002
37.	Technical Specification for Lighting system and receptacles for KKNPP-5&6	I02.KK56. 0.0.ET.TS.PR086
38.	Technical Specification for switching devices and Junction boxes (other than used for lighting) for KKNPP 5&6	I02.KK56. 0.0.ET.TS.PR083
39.	Technical Specification for GS flat/strip, GS rod, CBSC, GS test link boxes and GS junction boxes	I02.KK56. 0.0.ET.TS.PR001
40.	Technical Specification for Fire barrier and fire resistance coating of Balance of plant- common services	I02.KK56. 0.0.ET.TS.PR132
41.	Technical Specification for MV cables inside containment	I02.KK56. 0.0.ET.TS.PR100
42.	Technical specifications for LV power cables (PvPng-A-HF & PvPng-A-FRHF)	I02.KK56. 0.0.ET.TS.PR098
43.	Technical specifications for LV power cables (PPGEng-A-FRHF, PvPGEng-A-FRHF & PvPEng-A-HF)	I02.KK56. 0.0.ET.TS.PR097
44.	Datasheet for 400kV Outdoor Switchyard	I02.KK56. 0.0.ET.DS.PR046
45.	Datasheet for 230KV Outdoor Switchyard	I02.KK56. 0.0.ET.DS.PR048
46.	Datasheet For 400kV Gas Insulated Switchgear and Gas Insulated Bus Duct	I02.KK56. 0.0.ET.DS.PR045
47.	Datasheet For 230kV Gas Insulated Switchgear and Gas Insulated Bus Duct	I02.KK56. 0.0.ET.DS.PR047
48.	Data Sheet for MV Power Cables Cable Type-PvVng(A)-LS	I02.KK56. 0.0.ET.DS.PR016
49.	Data Sheet for Dry Type Auxiliary and Lighting Transformers	I02.KK56. 0.0.ET.DS.PR089
50.	Data Sheet for LV Switchgear and MCC	I02.KK56. 0.0.ET.DS.PR083
51.	Data Sheet for LV Bus Duct	I02.KK56. 0.0.ET.DS.PR086
52.	Data Sheet for LV Power Cables Cable Type-VVGng-FRLS & VVGEng-FRLS	I02.KK56. 0.0.ET.DS.PR003
53.	Data Sheet for LV Power Cables Cable Type-VVGng-LS & VVGEng-LS	I02.KK56. 0.0.ET.DS.PR002
54.	Data Sheet for Control cables Cable Type-KVVGng-FRLS & KVVGEng-FRLS	I02.KK56. 0.0.ET.DS.PR094
55.	Data Sheet for Control cables Cable Type-KVVGng-LS & KVVGEng-LS	I02.KK56. 0.0.ET.DS.PR095

This document is an intellectual property of Nuclear Power Corporation of India

56.	Datasheet for Rectifiers, Inverters and spare cell chargers for KKNPP 5&6	I02.KK56. 0.0.ET.DS.PR078
57.	Datasheet for DC distribution boards for KKNPP 5&6	I02.KK56. 0.0.ET.DS.PR076
58.	Datasheet for battery and load bank for KKNPP 5&6	I02.KK56. 0.0.ET.DS.PR079
59.	Datasheet of Wall mounted power distribution boards and panels for KKNPP 5&6	I02.KK56. 0.0.ET.DS.PR075
60.	Data sheet for bare tinned copper conductors up to 400 mm2	I02.KK56. 0.0.ET.DS.PR001
61.	Data Sheet for MV cables inside containment	I02.KK56. 0.0.ET.DS.PR090
62.	Data Sheet for LV power cables (PPGEng-A-FRHF & PvPGEng-A-FRHF)	I02.KK56. 0.0.ET.DS.PR087
63.	Data Sheet for LV power cables (PvPng-A-HF & PvPng-A-FRHF)	I02.KK56. 0.0.ET.DS.PR088
64.	TS/DS of LAN cables e.g. Cat-6/Cat-7 etc.	I02.KK56.0.0.ET.TS.PR041
65.	Technical specification for civil works of electrical balance of plant outdoor structures	I02.KK56.0.0.CC.TS.PR001
66.	Generic seismic test procedure for electrical equipment	I02.KK56.0.0.ET.PM.PR001
67.	Documents and drawings enclosed with the TS/DS of the systems/equipment listed above.	-
68.	Format of various documents to be prepared by the Contractor, in addition to the ones intended under sr. no 65.	
68.1	400kV Single Line Diagram (SLD)	Annexure-3 of this document
68.2	230kV Single Line Diagram (SLD)	Annexure-4 of this document
68.3	400kV GIS and GIBD layout	Refer TS of 400kV GIS and GIBD
68.4	230kV GIS and GIBD layout	Refer TS of 230kV GIS and GIBD
68.5	400kV Outdoor switchyard equipment layout	Annexure-5 of this document
68.6	230kVOutdoor switchyard equipment layout	Annexure-6 of this document
68.7	Format for preparation of Cable logs in both PDF and editable (A3-sheet MS word) building and voltage grade wise	Annexure-7 of this document
68.8	Format for preparation of consolidated cable log in MS Access format	Annexure-8 of this document
68.9	Electrical Load schedule format	Annexure-9 of this document
68.10	Terminal list format	Annexure-10 of this document
68.11	Equipment layout	Annexure-11of this document
68.12	Cable tray layout	Annexure-12 of this document
68.13	Grounding layout	Annexure-13 of this document
68.14	Lightning protection layout	Annexure-14 of this document
68.15	Termination / connection diagram	Annexure-15 of this document
68.16	Cable tray layout of auxiliary area/ buildings	Annexure-16 of this document
68.17	Lighting Layout	Annexure-17 of this document
68.18	Document for DEC management	Will be provided during execution as required

Note: In case any of the applicable document is missed or not mentioned above list, contractor shall obtain the same from NPCIL during execution.

This document is an intellectual property of Nuclear Power Corporation of India

Annexure-2
Seismic category and spectra requirements for Electrical BoP and main plant areas equipment

Sr. No.	Equipment Name	KKS Code	Name of the Buildings	Floor	Seismic category of the equipment as per AERB/NPP-PHWR/SG/D1	Remarks regarding RRS to be used for seismic qualification
1	400kV GIS &GIBD	ACA,ACB	UAB	0	Seismic category-2.	IEEE 693 High design level
2	400kV Outdoor Switchyard	01UAK	01UAK	0	Seismic category-2.	IEEE693 High design level spectra /Ground motion spectra
3	230kV GIS&GIBD	ADA,ADB	UAD	0	Seismic category-2.	IEEE 693 High design level
4	230Kv Outdoor Switchyard	01UAK	01UAK	0	Seismic category-2.	IEEE693 High design level spectra /Ground motion spectra
5	6kV switchgear	50BBA, 50BBB, 50BBC, 50BBD, 50BDE, 50BDF	50UBA	0.00MeL	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification
6	6kV switchgear	60BBA, 60BBB, 60BBC, 60BBD, 60BDE, 60BDF	60UBA	0.00MeL	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification
7	6kV switchgear	51BDA	51UKD	0.00MeL	Seismic category-1	Floorwise FRS of the building given in relevant annexure of additional clarification
8	6kV switchgear	52BDB	52UKD	0.00MeL	Seismic category-1	Floorwise FRS of the building given in relevant annexure of additional clarification
9	6kV switchgear	53BDC	53UKD	0.00MeL	Seismic category-1	Floorwise FRS of the building given in relevant annexure of additional clarification
10	6kV switchgear	54BDD	54UKD	0.00MeL	Seismic category-1	Floorwise FRS of the building given in relevant annexure of additional clarification
11	6kV switchgear	61BDA	61UKD	0.00MeL	Seismic category-1	Floorwise FRS of the building given in relevant annexure of additional clarification
12	6kV switchgear	62BDB	62UKD	0.00MeL	Seismic category-1	Floorwise FRS of the building given in relevant annexure of additional clarification
13	6kV switchgear	63BDC	63UKD	0.00MeL	Seismic category-1	Floorwise FRS of the building given in relevant annexure of additional clarification

This document is an intellectual property of Nuclear Power Corporation of India

14	6kV switchgear	64BDD	64UKD	0.00MeL	Seismic category-1	Floorwise FRS of the building given in relevant annexure of additional clarification
15	6kV switchgear	00BDG, 00BDH	05UKD	0.00MeL	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification
16	6kV switchgear	50BBE	50UMA	+16.00Mel	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification
17	6kV switchgear	60BBE	60UMA	+16.00Mel	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification
18	6kV switchgear	00BCG & 00BCH	0UTF	0.00MeL	Seismic category-3	NA
19	6kV switchgear	50 BCA, 50 BCB, 50 BCC, 50 BCD	01UBG	0.00MeL	Seismic category-2	FRS will be provided during execution stage. In case of unavailability of FRS, the RRS for Moderate design level of IEEE std 693 shall be used for seismic qualification.
20	6kV switchgear	60 BCA, 60 BCB, 60 BCC, 60 BCD	02UBG	0.00MeL	Seismic category-2	FRS will be provided during execution stage. In case of unavailability of FRS, the RRS for Moderate design level of IEEE std 693 shall be used for seismic qualification.
21	6kV switchgear	00BCE and 00BCF	03UBG	0.00MeL	Seismic category-2	FRS will be provided during execution stage. In case of unavailability of FRS, the RRS for Moderate design level of IEEE std 693 shall be used for seismic qualification.
22	ALT panel	Automatic load transfer system module/panel between 50BBA & 50BCA, 50BBB & 50BCB, 50BBC & 50BCC, 50BBD & 50BCD, 50BDE & 50BDF	50UBA	0.00MeL	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification
23	ALT panel	Automatic load transfer system module/panel between 60BBA & 60BCA, 60BBB & 60BCB, 60BBC & 60BCC, 60BBD & 60BCD, 60BDE & 60BDF	60UBA	0.00MeL	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification

This document is an intellectual property of Nuclear Power Corporation of India

24	ALT panel	Automatic load transfer system module/panel between 00BCE & 50BCA, 00BCF & 50BCD	03UBG	0.00MeL	Seismic category-2	FRS will be provided during execution stage. In case of unavailability of FRS, the RRS for Moderate design level of IEEE std 693 shall be used for seismic qualification.
25	ALT panel	Automatic load transfer system module/panel between 00BCG & 50BCB, 00BCH & 50BCC	0UTF	0.00MeL	Seismic category-3	NA
26	6kV busduct	00BCT01GD010-R,Y,B, 00BCT01GD020-R, Y,B, 50BCT01GD010-R,Y, B, 50BCT01GD020-R,Y, B, 50BCT02GD010-R,Y,B, 50BCT02 GD020-R,Y,B, 60BCT01GD010-R,Y, B, 60BCT01GD020-R,Y, B, 60BCT02GD010-R,Y, B, 60BCT02 GD020-R,Y, B,	04UBG	0.00MeL	Seismic category-2	FRS will be provided during execution stage. In case of unavailability of FRS, the RRS for Moderate design level of IEEE std 693 shall be used for seismic qualification.
27	6kV busduct	50BBT01GD010R,Y, B 50BBT01GD020R,Y, B 50BBT02GD010R,Y, B 50BBT02GD020R,Y, B	50UBF	0.00MeL	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification
28	6kV busduct	60BBT01GD010R,Y, B 60BBT01GD020R,Y, B 60BBT02GD010R,Y, B 60BBT02GD020R,Y, B	60UBF	0.00MeL	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification
29	Rectifier	ATL	00UAC	0.00MeL	Seismic category-2	FRS will be provided during execution stage. In case of unavailability of FRS, the RRS for Moderate design level of IEEE std 693 shall be used for seismic qualification.
30	Rectifier	BTL, BTM	UBA	7.8 MeL & 15.6 MeL	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification
31	Rectifier	BTP	UKD	0.00MeL	Seismic category-1	Floorwise FRS of the building given in relevant annexure of additional clarification
32	Battery	ATA	00UAC	0.00MeL	Seismic category-2	FRS will be provided during execution stage. In case of unavailability of FRS, the RRS for Moderate design level of IEEE std 693 shall be used for seismic qualification.

This document is an intellectual property of Nuclear Power Corporation of India

33	Battery	BTA, BTB	UBA	7.8 MeL & 15.6 MeL	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification
34	Battery	BTD	UKD	0.00MeL	Seismic category-1	Floorwise FRS of the building given in relevant annexure of additional clarification
35	DCDB	AUA, AUB, AUAXXGH00, AUBXXGH00	00UAC	0.00MeL	Seismic category-2	FRS will be provided during execution stage. In case of unavailability of FRS, the RRS for Moderate design level of IEEE std 693 shall be used for seismic qualification.
36	ACDB	XXARTXXGH	00UAC	0.00MeL	Seismic category-2	FRS will be provided during execution stage. In case of unavailability of FRS, the RRS for Moderate design level of IEEE std 693 shall be used for seismic qualification.
37	DCDB	BUA, BUB, BUC, BUD, BUL, BUM	UBA	7.8 MeL & 15.6 MeL	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification
38	DCDB	BVA, BVB, BVC, BVD,BVE,BVF,BVG,BVH,BVJ,BVK,BVL,BVM and their sub-DCDB	UKD	0.00MeL, 3.6MeL	Seismic category-1	Floorwise FRS of the building given in relevant annexure of additional clarification
39	ACDB	XXBRTXXGH	00UZM	0.00MeL	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification
40	Lighting fixtures	NA	All buildings	All floors	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification
41	Wall mounted PDBs	All the types of PDBs mentioned in I02.KK56.0.0.ET.TS.PR081	Various buildings	Various floors	Seismic category as mentioned in I02.KK56.0.0.ET.TS.PR081.	FRS will be provided during Execution stage.
42	LV BUSDUCT	00BHA00GD	UKU	15.5m El	Seismic category-3	NA
		00BKL00GD	UKU	15.5m El		
		00BKM00GD	UKU	15.5m El		
		00BKT12GD012	UQR	8.4m El		
		00BKT22GD022	UQR	8.4m El		
43	LV BUSDUCT	BD-1 TO 5	UAC	18.9 m El	Seismic category-2	FRS will be provided during execution stage. In case of unavailability of FRS, the RRS for Moderate design level of IEEE std 693 shall be used for seismic qualification.

This document is an intellectual property of Nuclear Power Corporation of India

44	Dry type Transformer	BMT13,BMT23,BMT33,BMT,BMT11,BMT12,BMT21,BMT22,BMT31,BMT32,BMT41,BMT42	UKD	0Mel	Seismic category-1	Floorwise FRS of the building given in relevant annexure of additional clarification
		BFT31,BFT41,BFT21,BFT11,BHT43,BHT51,BHT61,BFT13,BFT33,BFT23,BGT23,BHT72,BGT12,BGT11,BGT21,BHT71,BGT13,BGT22	UBA	0Mel	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification
		BFT44,BFT34,BFT24,BFT14,BFT42,BFT32,BFT22,BFT12	UBA	+7.8 Mel	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification
		BJT21,BJT31, BHT62,	UQA	7.65Mel	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification
		BJT22,BJT42	UPX	0.6 Mel	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification
		00BKT13,00BKT13	UKS	+6.9Mel	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification
		00AFT10,00AFT11,00AFT21,00BKT80,00BKT81	UAC		Seismic category-2	FRS will be provided during execution stage. In case of unavailability of FRS, the RRS for Moderate design level of IEEE std 693 shall be used for seismic qualification.
		00BKT14,00BKT24,00BKT12,00BKT22,,00BHT11, 00BKT84,00BKT85	MBOP AREA(UKU,UTF,UQR)		Seismic category-3	NA
45	LV switchgear/MCC	AFA, AFB, AFA34, AFB34, AFA44, AFB44, AFA32, AFB32, AFA43, AFA33, AFB33, AFB43, AFA31, AFB31, AFA41	UAC,UAB,UAD,UBG		Seismic category-2.	IEEE693 Moderate design level spectra /Ground motion spectra
46	LV switchgear/MCC	00BKJ00 - 00BKJ05 00BKK00 - 00BKK05 00BHC00 - 00BHC02	00UKS	+6.9Mel	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification

This document is an intellectual property of Nuclear Power Corporation of India

47	LV switchgear/MCC	00BKJ71GH001 00BKK71GH001 00BKJ72GH001 00BKK72GH001 00BKJ73GH001 00BKK73GH001 00BKJ74GH001 00BKK74GH001 00BKJ20GH001 00BKK20GH001 00BKJ50GH001 00BKJ50GH002 00BKJ50GH003 00BKK50GH001 00BKK50GH002 00BKK50GH003	00UKS	+6.9Mel	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification
48	LV switchgear/MCC	50BJF01, 50BJF02, 50BJF03, 50BJF04, 50BJF05 50BJK01, 50BJK02, 50BJK03, 50BJK04, 50BJK05 50BJF30GH001 50BJK30GH001	50 UPX	+6.0Mel	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification
49	LV switchgear/MCC	50BJB01, 50BJB02, 50BJB03, 50BJB04, 50BJB05, 50BJB06, 50BJB07 50BJC01, 50BJC02, 50BJC03, 50BJC04, 50BJC05, 50BJC06 50BHH01, 50BHH02 50BJB30GH001 50BJB30GH002 50BJB30GH003 50BJB30GH004 50BJB30GH005 50BJC30GH001 50BJC30GH002 50BJC30GH003 50BJC30GH004 50BJC20GH001	50 UQA	+7.65Mel	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification

This document is an intellectual property of Nuclear Power Corporation of India

50	LV switchgear/MCC	51BMA20GH001 51BMA30GH001 51BME20GH001 51BME30GH001 52BMB20GH001 52BMB30GH001 52BMF20GH001 52BMF30GH001	51 UQC	+7.65Mel	Seismic category-1	Floorwise FRS of the building given in relevant annexure of additional clarification
51	LV switchgear/MCC	53BMC20GH001 53BMC30GH001 53BMG20GH001 53BMG30GH001 54BMD20GH001 54BMD30GH001 54BMH20GH001 54BMH30GH001	52 UQC	7.65Mel	Seismic category-1	Floorwise FRS of the building given in relevant annexure of additional clarification
52	LV switchgear/MCC	50BGE63GH001 50BGE63GH002 50BGF63GH001 50BGE66GH001 60BGE66GH001 00AFA71GH001 00AFA71GH002 50BFB71GH003 00AFB71GH001 50BFD71GH002	UZM	0.00MeL	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification
53	LV switchgear/MCC	50BFF75GH001 50BFF76GH001 50BFG75GH001 50BFG76GH001 60BFG76GH001 60BFF75GH001 60BFG75GH001	UUA	+6.6Mel	Seismic category-2	Floorwise FRS of the building given in relevant annexure of additional clarification
54	LV switchgear/MCC	51BMA21GH001 61BMA21GH001 52BMB21GH001 62BMB21GH001 53BMC21GH001 63BMC21GH001 54BMD21GH001 64BMD21GH001	UUQ	+7.7Mel	Seismic category-1	Floorwise FRS of the building given in relevant annexure of additional clarification
55	LV switchgear/MCC	00BKG, 00BKH, 00BKG10GH001	UQR		Seismic category-3	NA

This document is an intellectual property of Nuclear Power Corporation of India

56	LV switchgear/MCC	00BKL, 00BKM, 00BHA 00BKL10GH001 00BKM11GH001 0BKL22 GH001 00BKL21GH001 00BKL23GH001 00BKM51GH001 00BKM50GH001 00BKM70CY001 0BKM21 GH001 0BKM22 GH001 0BKM23 GH001 0BKM73GH001 00BKL53GH001 00BKM53GH001 00BKL79GH002 00BKM79GH002 0BKM71GH001 0BKM72GH001 00UKU11GS001-02 00BKKXXGHXXX 01-04 (380V MCC IN UKU BUILDING)	UKU		Seismic category-3	NA
57	LV switchgear/MCC	00BKL76GH001 00BKL24GH001 00BKM60GH001 00BKL25GH001 00BKL79GH001 00BKM76GH001 00BKL77GH001 00BKL78GH001 00BKM74GH001 00BKL52GH001 00BKL52GH002 00BKL52GH003 00BKL52GH004 00BKL79GH001 00BKM79GH001	UYB		Seismic category-3	NA
58	LV switchgear/MCC	00BKG14GH001 00BKH14GH001	USV		Seismic category-3	NA
59	LV switchgear/MCC	00BKG**GH001/B	01UGH		Seismic category-3	NA
60	LV switchgear/MCC	00BKG**GH001/C	02UGH		Seismic category-3	NA
61	LV switchgear/MCC	00BKG**GH001	UTF		Seismic category-3	NA
62	PDB	02UYE10GH001	02UYE		Seismic category-3	NA
63	LV switchgear/MCC	50BGE41GH002	03UGF	FFL. RL. 9.3	Seismic category-1	FRS will be provided during Execution stage.

This document is an intellectual property of Nuclear Power Corporation of India

64	LV switchgear/MCC	00BKS, 00BKU 00BKS15GH001	UPK		Seismic category-3	NA
65	LV switchgear/MCC	00BKG**GH001/A	00UGV		Seismic category-3	NA
66	LV switchgear/MCC	01UYE01GH001	01 UYE		Seismic category-3	NA
67	CMRP	Various CMRP panels	0UAC	0.0	Seismic category-2	FRS will be provided during execution stage. In case of unavailability of FRS, the RRS for Moderate design level of IEEE std 693 shall be used for seismic qualification.
68	SCADA panels	Mosaic panels: 00AWE01-08 and AWE01S IO cabinets: 00CKL81, 00CKL82,00CKL83 Industrial grade Operator Automated workstations: 00CKE11,12,13 Medium level ethernet switch panels for LAN A and LAN B housing GPS receivers: CYG06 and CYG07 Gateway cabinets: CME05 and CME06 Server Panel housing main and redundant servers and corresponding rack monitors: 00CKL31 Network panels: CKK**	00UAC	0.00 mel	Seismic category-2	FRS will be provided during execution stage. TRS shall be enveloped spectrum of 0UAC, 0USV, 0UTF and 03UBG. In case of unavailability of the above mentioned spectra IEEE693 Moderate design level spectra is also acceptable.
69	SCADA panels	Industrial grade Operator Automated workstations: 00CKE01 and 00CKE02 Oscillogram server panel: 00CKL32	0USV	3.6 mel	Seismic category-2	
70	SCADA panels	IO cabinet: 00CKL84	0UTF	0.00 mel	Seismic category-2	
71	SCADA panels	IO cabinet: 00CKL85,00CKL86	03UBG	0.00 mel	Seismic category-2	

Note:-

1) The seismic category is mentioned "Seismic category of the equipment as per AERB/NPP-PHWR/SG/D1" is for understanding the meaning/definition of category only. However there may be the cases in which AERB/NPP-PHWR/SG/D demands for lower/some other seismic qualification of the building structure compare to this list. For all such cases the category provided in this list shall be overriding to category provided in AERB/NPP-PHWR/SG/D.
2) For some cases seismic cat-2 as per AERB/NPP-PHWR/SG/D1 or IEEE std 693 is mentioned, for such cases either of the two is acceptable.
3) Other than above mentioned list of equipments and seismic requirements, the requirements mentioned in relevant technical specifications/tender document shall be followed (higher of of the two in case of conflicting requirements).

This document is an intellectual property of Nuclear Power Corporation of India

Safety and seismic requirements for Mechanical BoP areas equipment

Sr. No.	Building KKS Code	Name of the Buildings, structures	Building / Structure description	System / Facilities housed	System KKS code	Location/ Area	Electrical Systems involved with the facility	
							Safety Class	Seismic requirement
1.	0 1UGE	Waste water neutralization building	building	Waste water neutralization system	GNR	Auxiliary area of KK3-6	NINS	III
2.	0 3UGF	Fire-fighting service water pump station	Building	Fire-fighting water Main pump & associated piping	SGA	Main plant of KK34	NINS	IIb
3.	0 3UGF	Fire-fighting service water pump station	Building	Fire-fighting water Jockey pump & associated piping	SGA	Main plant of KK34	EB	I
4.	0 1UGH	Storm water pump house	Building	Storm water pump	GUD	Main plant	NINS	III
5.	0 2UGH	Storm water pump house	Building	Storm water pump	GUD	Main plant	NINS	III
6.	0 3-7UGM	Pump stations in outdoor network GMA	intermediate outdoor pump station	Oil water system Pumps	GMA	Main plant	NINS	III
7.	0 1-16UGV	The pump stations in networks GQA	intermediate outdoor pump station	sewage system pumps	GQA	Main plant & auxiliary area of KK-56	NINS	III
8.	0 4-8UGT	The pump stations in networks GQD	intermediate outdoor pump station	sewage system Pumps	GQD	Main plant & auxiliary area of KK56	NINS	III
9.	0 UEL	Diesel and oil pump house	Building	Oil pumps	XJN, QSB	Auxiliary area	EB	IIb
10.	0 UGX	Desalination Plant	Outdoor plant	Sea water desalination	GCB	Auxiliary area	NINS	III
11.	0 2UGA	Desalinated water storage tank	Steel tank with Foundation	Desalinated Water storage	GCB	Auxiliary area	NINS	III
12.	0 3UGA	Desalinated water pump station	Pump station in covered area	Desalinated water pumps	GCB	Auxiliary area	NINS	III
13.	0 UGD	DM water plant, post treatment plant building/ DM Plant & Plant Water Treatment System.	Building	Ion exchanges, pumps, filters, etc.	GCF	Auxiliary area of KK 3-6	NINS	III
14.	0 1UGD	Chemical storage building	Building	Chemicals preparation and supply system	QC	Auxiliary area of KK 3-6	NINS	III
15.	0 5UGB	DM & potable water pump station	Pump station in covered area	DM water pumps	GCF	Auxiliary area of KK 3-6	NINS	III
16.	0 1UYE	Nuclear Island guard house	Equipment with buildings	Personnel identity systems, office		Main plant	NINS	III
17.	0 2UYE	Nuclear Island guard house	Equipment with buildings	Personnel identity systems, office		Main plant	NINS	III
18.	0 UKU	Controlled-access area central workshops	Equipment with buildings	Work shop machineries		Main plant	NINS	III
19.	0 UQR	Chiller building	Plant with buildings	Chillers, pumps, piping system	QGA, QKA, PCB, LDN	Main plant	NINS	III
20.	0 USV	Engineering utility and laboratory building	Lab with buildings	Lab instruments, office		Main plant	NINS	III
21.	0 UTF	Compressor building	Plant with buildings	Air compressors	SCA	Main plant	NINS	III
22.	0 UYB	Health physics building (controlled-access area)	Equipment with buildings	Health physics equipment		Main plant	NINS	III
23.	0UGV	Common access area sewage treatment plant	Equipment with buildings	Sewerage treatment system	GQA	Main plant	NINS	III
24.	0UGW	Controlled access area sewage treatment plant	Equipment with buildings	Sewerage treatment system	GQD	Main plant	NINS	III
25.	01UGT	Silt platform	RCC structure	Sewerage treatment system	GQD	Part of UGW	NINS	III
26.	02UGT	Gas-discharge stack	RCC structure	Sewerage treatment system	GQD	Part of UGW	NINS	III

This document is an intellectual property of Nuclear Power Corporation of India

Sr. No.	Building KKS Code	Name of the Buildings, structures	Building / Structure description	System / Facilities housed	System KKS code	Location/ Area	Electrical Systems involved with the facility	
							Safety Class	Seismic require ment
27.	03UGT	Pump station of purified waste water	Pump station	Sewerage treatment system	GQD	Part of UGW	NINS	III
28.	GKD	Potable/Domestic water piping network	Buried pipeline net work	Potable water	GKD	Main plant	NINS	III
29.	PCD	Service Water piping net work	Buried pipeline net work	Service water system	PCD	Main plant	NINS	III
30.	GQA	Domestic waste water of common access area piping net work	Buried pipeline net work	Sewage water from common area	GQA	Main plant & auxiliary area	NINS	III
31.	GQD	Control access area waste water piping net work	Buried pipeline net work	Sewage water from controlled area	GQD	Main plant & auxiliary area	NINS	III
32.	GMA	Oily water sewage piping net work	Buried pipeline net work	Oil containing Sewage water	GMA	Main plant & auxiliary area	NINS	III
33.	GUD	Storm water drainage piping net work	Buried pipeline net work	Storm water system	GUD	Main plant & auxiliary area	NINS	III
34.	GQA	Disposal pipeline from 0UGV treatment plant to UGU	Buried pipeline net work	treated water system	GQA	Main plant &auxiliary area	NINS	III
35.	GQD	Disposal pipeline from 0UGW treatment plant to UGU	Buried pipeline net work	treated water system	GQD	Main plant &auxiliary area	NINS	III

This document is an intellectual property of Nuclear Power Corporation of India

1.0 GENERAL

1.1 This specification shall be read in conjunction with all other documents which form a part of the Tender document, like Scope of Works - Electrical systems for KKNPP 5&6 (I02.KK56.0.0.PR.TT.PR008) & its annexures, technical specification documents for various items & indicative QAPs, respective data sheets, SLDs, schematic drawings, layouts, installation drawings & annexures etc. referred in the Tender document. The annexure-1 attached with this Job Specification shall be referred for understanding in detail the scope of erection, testing and pre-commissioning/ commissioning requirements of the equipment/ systems covered under the scope of this tender.

As has been brought out in the other sections of the tender, the Project is being executed on a technical co-operation basis with the Russian Federation. M/s Atomstroyexport are the main Contractor and M/s Atomenergoproekt are the General designer for the main plant areas for NPCIL and NPCIL is the designer for BoP areas.

Based on the division of responsibilities between NPCIL and Russian Federation side, the works under the subject tender can be categorised into the following three major categories (i.e. based on the works which are in NPCIL scope as per division of responsibilities between RF and NPCIL).

a) Design & supply in RF side scope and erection & commissionning in NPCIL scope: All such systems are a part of main plant systems. Examples of such systems are generator transformers, 24kV GCB, 24kV isolated phase bus ducts, 0.4kV switchgear & 0.4kV MCCs of main buildings, main plant electrical SCADA systems, protection panels of generators/unit auxiliary transformers/generator transformers, hermetic cable penetrations, associated cables, etc. in main plant areas/buildings. All such NPCIL scope works (with respect to RF side) are covered under the scope of this contract including the associated cabling works. Equipment installation drawings, equipment layout, cable tray layout, cable schedules, cable termination details, lighting layout, etc. are developed by the Russian Federation designer for the main plant areas, reviewed/accepted by the Purchaser and issued to the Contractor for execution of the subject work. The contractor need to assess/review/workout the constructability/adequacy/completeness of the issued documents and drawings for erection & commissioning works and bring out the difficulty/mismatches/inadequacy, if any, on timely manner to NPCIL along with their suggested corrections/updates so as to take timely corrective actions to avoid delays in the execution. The contractor also needs to bring out the inadequacy, if any, in the BoQ of erection and commissioning on timely manner to NPCIL for corrective action.

b) Basic design in RF scope and detailed design, supply, erection and commissioning in NPCIL scope: All such systems are part of main plant systems. Examples of such systems are Diesel Generator Sets (DG sets) along with their auxiliaries, unit auxiliary transformers (UATs), 6kV isolated phase bus ducts (IPBDs), 6kV switchgear, 6/0.4kV auxiliary transformers, some of the 0.4kV switchgear & 0.4kV MCCs, rectifiers, DC boards, battery banks, inverters, AC boards, all associated power/control/FO cables, all

This document is an intellectual property of Nuclear Power Corporation of India

associated cable carrier systems, all cable fire protection systems, lightning & grounding protection systems, lighting and receptacles systems of entire main plant areas etc. All such NPCIL scope works (with respect to RF side) are covered under the scope of this contract including the associated cabling works except the works of DG sets and their auxiliaries, supply of oil filled power transformers such as UATs, and rectifiers and inverters of Mainplant area. Supply of oil filled power transformers such as UATs are covered under a separate contract but erection and commissioning of these power transformers including all interface related works for them are covered under the scope of this contract. Supply, erection and commissioning of DG sets along with their auxiliaries are covered under a separate contract. However, all interface of DG sets with other systems are covered under the scope of this contract. Supply and commissioning of rectifiers and inverters are covered under a separate contract, but erection, cable termination and other interface related works for commissioning of these rectifiers and inverters are covered the scope of this contract. Documents/drawings developed by the package contractor and their sub-vendors & manufacturers as part of the scope of the supply of the equipment as per respective TS/DS (no separate item envisaged in the BoQ for such documents/drawings development as they are deemed part of the scope of either supply or erection, as the case may be, of equipment itself) will go as design input to RF side who in-turn will develop the final working documentation (WDs) taking into account equipment inputs/manufacturer's inputs. Hence the package contractor's documents/drawings and sub-vendor's/manufacturer's documents/drawings and equipment inputs developed in accordance with the requirement of respective TS & DS need to be provided in a timely manner to NPCIL for review, approval and further sharing with RF side by NPCIL (both editable autocad/word, etc. version and pdf version). All observations/comments on the manufacturer's documents and equipment input from NPCIL and RF side need to be addressed by the Contractor. Final WDs submitted by the Russian side will be issued to the Contractor for execution of the execution of works. However, some of the package contractor's documents/drawings and sub-vendor's/manufacturer's documents/drawings will still be useful for site execution e.g. individual equipment installation drawings etc. The contractor need to assess/review/workout the constructability/adequacy/completeness of the issued documents and drawings for erection & commissioning works and bring out the difficulty/mismatches/inadequacy, if any, on timely manner to NPCIL along with their suggested corrections/updates so as to take timely corrective actions to avoid delays in the execution. The contractor also needs to bring out the inadequacy, if any, in the BoQ of erection and commissioning on timely manner to NPCIL for corrective action.

Equipment installation drawings, equipment layout, cable tray layout, cable schedules, cable termination details, lighting layout, etc. would be developed by the Russian Federation designer taking into account the above said manufacturer's document inputs then reviewed/accepted by the Purchaser and issued to the Contractor for execution of the subject work.

c) Design, supply, erection and commissioning in NPCIL scope: All such systems are generally a part of balance of plant (BOP) systems. However, some of the systems may be part of main plant systems also e.g. lighting systems, receptacle systems etc.

This document is an intellectual property of Nuclear Power Corporation of India

Examples of such systems in BOP are 400kV gas insulated switchgear along with outdoor termination equipment, 230kV gas insulated switchgear along with outdoor termination equipment, 400kV gas insulated bus ducts (GIBDs), 230kV GIBDs, 400kV shunt reactors, reserve auxiliary transformers, common station auxiliary transformer, complete control, monitoring & relay protection systems (CMRP systems) for entire 400kV & 230kV equipment, 6kV isolated phase bus ducts (IPBDs), 6kV switchgear, 6/0.4kV auxiliary transformers, 0.415kV switchgear & 0.415kV MCCs, rectifiers, DC boards, battery banks, inverters, AC boards, switchyard SCADA systems covering entire electrical systems of BOP areas, all associated power/control/FO cables, all associated cable carrier systems, all cable fire protection systems, lightning & grounding protection systems, lighting and receptacles systems of entire BOP areas etc. All such NPCIL scope works (with respect to RF side) are covered under the scope of this contract including the associated cabling works except for the supply of oil filled power transformers such as RATs, CSATs, shunt reactors and the rectifiers and inverters in switchyard control building (UAC). Supply of oil filled power transformers such as RATs, CSATs, shunt reactors are covered under a separate contract (along with UATs) but erection and commissioning of these power transformers including all interface related works for them are covered under the scope of this contract. Similarly, supply and commissioning of rectifiers and inverters of switchyard control building are covered under a separate contract, but erection, cable termination and other related interface jobs for commissioning is covered under the scope of this contract. The documents and drawings developed by the package contractor's and their sub-vendor's/manufacturer's and the equipment documents itself will become final working documents (WDs). Neither NPCIL nor the Russian side will make any document/drawing for such works and instead the package contractor themselves will be responsible for development of all required documents and drawings for such works within the scope of this contract as per the methodology described below. All manufacturer's documents/drawings, package contractor's documents/drawings, sub-vendor's documents/drawings and equipment inputs developed in accordance with the requirement of respective TS and DS need to be submitted/provided in a timely manner with NPCIL for review and approval (both editable autocad/word, etc. version and pdf version). Any observations/comments of NPCIL on the manufacturer's documents/drawings, package contractor's documents/drawings, sub-vendor's documents/drawings and equipment input needs to be addressed by the Contractor and required revisions/updates in documents/drawings needs to be submitted. Format and contents of the documents/drawings shall be in the form acceptable to NPCIL as manufacturer's documents/drawings, package contractor's documents/drawings, sub-vendor's documents/drawings itself will become final working documents. Mostly works of BOP areas (both electrical and mechanical BOP areas) works fall into this category. There are interfaces of BoP areas with main plant areas and hence the Contractor will have to provide required inputs for equipment/items supplied by them for further development of interface related designs (beyond BoP battery limits) such as interface cable logs, interface cable carrier systems, etc. by the Purchaser or RF side designer.

For the buildings in BoP area (non RF design scope), the Purchaser will provide the relevant cable tray layout, electrical equipment layout, lightning protection & earthing

This document is an intellectual property of Nuclear Power Corporation of India

layout, lighting layout, external cable connection diagram/connection schedule, etc. PDF drawings of the relevant buildings/floors of KKNPP34 (sample drawing - one of each type is included in the tender) as input for development/preparation of the drawings/documents for KKNPP 5&6 taking into account actual requirements of KKNPP 5&6. The Purchaser will also provide the 'as designed' (ACAD) civil architectural drawings of the relevant buildings/floors of KKNPP56. Based on the above, TS/DS requirements, individual equipment GA/isometric/installation drawings by equipment manufacturer/sub-vendor and directions if any from the Purchaser, the Contractor under the relevant item of the BoQ (for preparation of drawings), shall prepare cable tray layout, electrical equipment layout, lightning protection & earthing layout, lighting layout ACAD drawings, external cable connection diagram/connection schedule of the relevant buildings/floors of KKNPP 5&6 for review and approval by the Purchaser. These drawings are to be used by the Contractor for execution of the work. Contractor to note that these works are not just drafting works but involves development of engineering documents/drawings based on the said design inputs provided by NPCIL and actual equipment to be supplied under the subject contract taking into account all mismatches between civil drawings and electrical drawings. Contractor to also note that this work is different from the individual equipment GA, installation and isometric drawings to be developed by the equipment manufacturer/sub-vendors as part of the scope of supply of the equipment as per respective TS/DS. 70% of the payment will be released under relevant item in the BoQ on first R0 approval of drawing/document and the balance 30% payment will be done only after submission and approval of final site as-built drawings/documents. Contractor will have to carry the required revisions or changes or issue DCNs or issue FCNs as required for execution of works before site as built stage. However, such revision made or change issued or DCNs issued or FCNs issued based on the requirement of the works between R0 version and the final site ‘as-built’ version will not be measured/billed separately and is included in the measurement of the original drawing and is to be done by the Contractor. Final WDs developed as per above methodology and approved by NPCIL shall be issued to the Contractor for execution of the works. The contractor need to assess/review/workout the constructability/adequacy/completeness of the issued documents and drawings for erection & commissioning works and bring out the difficulty/mismatches/inadequacy, if any, on timely manner with required revisions to NPCIL to avoid delays in the execution. The contractor also needs to bring out the inadequacy, if any, in the BoQ of erection and commissioning on timely manner to NPCIL for corrective action.

Cable schedules (cable logs) of KKNPP 3,4 of BoP building/ areas would be provided by the Purchaser as input for development/preparation of the cable log for KKNPP 5&6 taking into account actual cable route, actual coordinates, actual equipment location at from and To ends, cable lengths, number of cables, etc. Final cable schedules (cable logs) shall be developed by the Contractor for the BoP buildings/areas taking into account these and inputs (if any) provided by the Purchaser, subsequently reviewed/accepted by the Purchaser and issued to the Contractor for execution. Separate items have been envisaged in Section-E (supply part) of this Tender for preparation of all these cable schedule (cable logs) of BoP building/ areas. 70% of the payment will be released under relevant item in the BoQ on first R0 approval of

This document is an intellectual property of Nuclear Power Corporation of India

drawing/document and the balance 30% payment will be done only after submission and approval of final site as-built drawings/documents. Contractor will have to carry the required revisions or changes or issue DCNs or issue FCNs as required for execution of works before site 'as built' stage. However, such a revision made or change issued or DCNs issued or FCNs issued based on the requirement of the works between R0 version and final site as-built version will not be measured/billed separately and is included in the measurement of the original drawing and is to be done by the Contractor.

Scope of work includes survey (including field) of all the connected interfaces with other SSCs, providing of solutions in case of any incompatibility, preparation of requisite changes in documents in the form of drawings for FCNs/DCNs/Other equivalent documents, for formal release by NPCIL and subsequent execution of the works based on the same meeting all technical requirements. This work is deemed to be included as a part of revision of drawings under BoQ for preparation of drawings or cable log as applicable and no separate payment will be made on account of this. In case the field solution requires change in the connected interface instead of electrical systems, relevant input is to be provided to NPCIL by Contractor for needful with the concerned agency (s).

1.2 The above categories cover the entire electrical systems of KKNPP 5&6 and only i) DG sets & their auxiliaries ii) chlorination plant package are not covered under the scope of the subject tender and supply of oil filled power transformers UATs, CSAT, RATs & shunt reactors are not covered under the scope of the subject tender (but erection & commissioning covered). However, all interfaces of DG sets, chlorination plant package and oil filled power transformers with other systems of plant are covered under the scope of this tender. In addition, all interface related works between main plant systems and BoP systems are also covered under the subject tender.

1.3 The scope of work (under supply) includes gathering of inputs regarding different equipment listed in the tender BoQ, from the relevant engineering drawings & documents which are either being provided as a part of this tender or will be provided to the Contactor during execution stage. The Contactor shall incorporate those inputs in the design, manufacturing, supply, erection, commissioning of the equipment/components in the Contactor scope of supply as well as erection. The engineering documents and drawings consists of (but not limited to) electrical layout drawing, civil layout drawings, isometric drawings developed by designers, electrical single line diagrams, electrical scheme drawings, CMRP drawings, earthing and lightning protection drawings, lighting layouts and connection schemes, terminal block lists, cable logs, etc.

The Contactor shall prepare BoQ lists of all the equipment/components (even if the equipment/component is not already included in the scope of supply of the Contactor), of each type and rating with their technical description and location of erection, based on the Purchaser's inputs mentioned above, and submit this list to the Purchaser for review. Development of all these documents/lists, etc. are envisaged as a part of supply scope of the equipment included in the tender. Based on the list, Purchaser shall approve sub-

This document is an intellectual property of Nuclear Power Corporation of India

ordering of each type of equipment/component corresponding to the items present in the BoQ of the tender. The Contactor shall sub-order equipment/component in the BoQ of the tender only after written approval of the Purchaser.

In case of LV switchgear, MCCs, DCDBs, ACDBs, wall mounted PDBs and other types of power distribution boards in the scope of this tender, the Contactor (as a part of the supply scope) shall prepare a board-wise feeder & incomer list from the Purchaser's inputs mentioned above. The list shall also bring out the modifications/addition/deletion of type/rating of feeder modules/incomer modules/components from that drawings/details which are being given along with this tender. The Purchaser may ask the Contactor for incorporating some/all of those modifications/additions/deletions during the design, manufacturing and supply of the equipment/component. For addition/deletion/modification of the type/rating of feeder modules/incomer module/components, separate items have been envisaged in Section-E of this Tender. For addition of any feeder module/incomer module/component, the respective amount as per PO shall be paid to the successful bidder during execution. Similarly, in case of deletion, the respective amount will be deducted. That is, for any change, the net cost after addition and deletion of the respective amounts in the PO shall be applicable along with the amount for the subject panel/board.

The cost of the works mentioned in the above paragraphs shall be included along with the cost of supply of the individual equipment/component.

The Purchaser may also ask for modifications/addition of type/rating of feeder modules/incomer modules/components after the supply of the equipment at site. In that case, the Contactor shall incorporate the modifications/additions during the erection and commissioning stage. The Contactor shall supply the additional components required for the modification/addition of the type/rating of feeder modules/incomer modules/components at site. The replaced components, subsequent to in-situ modifications shall be handed over to the Purchaser's store at site. Towards the cost for supply of additional items and modification at site, separate items have been envisaged in Section-E of the Tender.

The Contractor shall continuously keep an account of the items removed & installed elsewhere, freshly supplied items & installed, items removed & have become surplus which need to be handed over to the Purchaser and account the same at the end of the contract. This work is deemed a part of the supply till delivery to site is done and subsequently a part of erection.

1.4 The intent of this Job Specification document is to define the electrical system and the specific requirements applicable to the scope covered under the subject work in addition to the equipment specification, design philosophy, drawings, etc. as enclosed with the Tender document, process requirements and the same shall be complied for engineering, supply, installation, testing and commissioning. The designed system shall also comply with the requirements of applicable Indian/ international standards and Indian statutory regulations as on NIT date. Wherever Purchaser’s specification is not available, specification documents shall be prepared by Contractor for Purchaser’s review and approval as a part

This document is an intellectual property of Nuclear Power Corporation of India

of the supply scope of the item. Critical job specific requirements are also covered in this document as a part of conflict avoidance.

1.5 Codes and standards as prevailing in the country of origin may be followed for equipment purchased abroad provided that the equivalent standards are as or more stringent than Indian/ international standards and meet the statutory regulations of the approving Indian statutory authorities.

1.6 It is the responsibility of the Contractor to highlight any contradiction amongst various documents at the (pre-bid) bid stage itself for resolution prior to contract finalisation. In case of conflict between Purchaser specifications and other specifications, the most stringent requirement will apply.

1.7 The following order of priority shall be followed. In case of a conflict between requirements specified in various documents, the more stringent one shall be followed. Purchaser's concurrence shall, however, be obtained before taking a decision in such matters:

- Statutory Regulations
  In particular, the latest version of the following statutory regulations in force as on NIT date shall be followed for design of electrical system:
  - Indian Electricity Act
  - Indian Electricity Rules/ CEA Regulations
  - The Factory Act
  - Requirements of other statutory bodies as applicable, e.g. CEA, LPCB.
  - Atomic Energy Regulatory Board guidelines
- Description in SOQs and rates
- SCC (special conditions of contract)
- Data sheets & drawings
- Job and Technical specifications
- GCC (General condition of contract).

In case of any further conflict in this regard, Purchaser's decision shall be final.

1.8 Contractor shall furnish the list of conflicts/deviations, if any, along with their pre-bid queries and also furnish the basis that is considered for submitting offer. Purchaser will resolve listed conflicts as a part of the pre bid clarification. Still if deviations/conflicts exist the same shall be brought out as a part of the bid. In such a case prior to award the Purchaser will bring out the final requirement prior to award of work. In case of ambiguity, Bidder shall inform Purchaser of their interpretation. In case Bidder fails to convey the same prior to award, the Purchaser's decision on interpretation shall be considered final if need arises during the execution. No additional cost or extra time on account of conflicts/ambiguities shall be admissible.

2.0 POWER SYSTEM DESCRIPTION

2.1 This section gives a brief description of Electrical Systems of Kudankulam Nuclear Power Project (KKNPP Unit – 5 & 6).

This document is an intellectual property of Nuclear Power Corporation of India

2.2 For detailed SLDs, schematic diagrams & annexures the respective TS & DS shall be referred.

2.3 The basic scope of electrical systems in this Tender is intended to extend the required type and group/ category of electrical power supply to meet the system/ process requirements so as to give the desired and guaranteed performance parameters.

2.4 Electrical power, generated at 24kV, three phase, 50Hz by the 2x1000MW turbo-generator units, is stepped up through the 24kV/ 420kV, single phase generator transformer and the same is evacuated through 400kV grid using gas insulated bus duct (GIBD) & 400kV Gas Insulated Switchgear (GIS). Normal auxiliary power supply is derived through 24/6.3kV UATs (two nos./per unit) and supplied to 6kV (4 nos.) buses of normal auxiliary power supply system. 6kV buses of normal auxiliary power supply system when required are connected (through ATS) from 230 kV grid through 6kV reserve power supply system. 6kV EPSS buses are connected to 6kV NOS buses of normal auxiliary power supply system through tie CBs at both ends. EPSS buses are backed by emergency diesel generators. 6kV reliable PSS buses are connected to 6kV NOS buses of normal auxiliary power supply system through tie CBs at both ends. As a reserve source of power supply, 230kV GIS of KKNPP 5,6 is connected by a 230kV tie line with KKNPP Unit 3 & 4 and with TNEB/ TANGEDCO 230kV grid.

Interconnection between 400kV GIS of KKNPP 5&6 and 400kV GIS of KKNPP 3&4: To form a common 400kV bus for KKNPP 3 to 6, 400kV GIS bus of KKPP 5,6 is connected by two numbers of overhead tie lines with 400kV GIS bus of KKNPP 3,4.

2.5 Refer the respective Technical specification documents and data sheets for the complete equipment and section E for total list of equipment/components/system covered in the scope of the subject Tender.

2.6 The various electrical equipment such as 400kV gas insulated switchgear along with outdoor termination equipment, 230kV gas insulated switchgear along with outdoor termination equipment, 400kV gas insulated bus ducts (GIBDs), 230kV GIBDs, 400kV Shunt reactors, Interconnection between 400kV GIS of KKNPP 5&6 and 400kV GIS of KKNPP 3&4, Power transformer, monitoring & relay protection systems for entire 400kV & 230kV equipment, two numbers of 400kV tie lines between KKNPP3,4 and KKNPP5,6 units along with its associated equipment , 6kV isolated phase bus ducts, MV switchgear, auxiliary transformers, LV switchgear and LV bus ducts, MCCs, wall mounted PDB, DCDBs, rectifiers, inverters, batteries, cable tray and cables & cabling works, lighting, earthing & lightning protection, fire protection system, etc., required for the above process system shall be developed in line with requirements stipulated, in detail, in the respective technical specifications and data sheets provided/ in this tender.

2.7 The above requirements shall be considered as minimum and any other technical requirement, even though specifically not mentioned and listed, but required for

This document is an intellectual property of Nuclear Power Corporation of India

achievement of guaranteed parameters, shall be engineered, supplied, installed, tested and commissioned without any extra cost or time implication to the Purchaser.

2.8 Classification of power supplies

Based on the requirements of reliability, nature of power supply and the permissible interruption period, power supply systems are divided into three groups:

Group-1: DC power supply to the plant auxiliary loads which require un-interruptible DC power and AC power supply to the plant auxiliary loads which require un-interruptible alternating current power or with very short interruption of not more than 20msec., under all modes (operation, shutdown, safety/ emergency conditions etc.) of plant, including the condition of loss of supply from all AC sources, are classified as Group-1 power supply.

Group-2: Alternating current power supply to the plant auxiliary loads which can tolerate a short interruption of time as defined by the conditions, without affecting safety of the reactor (ranging from 20 to 60sec.), under all modes (operation, shutdown, safety/ emergency conditions etc.) of plant, including the condition of loss of supply from all off-site sources, is classified as Group-2 power supply.

Group-3: Power supply to the plant auxiliary loads normally required under all modes (operation, shutdown, safety/ emergency conditions etc.) of plant, which can tolerate prolonged interruption in power supply, without affecting safety of the plant, and do not require obligatory availability of power supply even after the actuation of reactor trip system, is classified as Group-3 power supply.

2.9 Power Output System

The electrical system for the two units of Kudankulam Nuclear Power Plant (KKNPP), each of 1000 MWe, mainly consists of Power Output System and Auxiliary Power Supply System.
The Power Output System is designed for evacuation of power generated at NPP. The Auxiliary Power Supply System provides electric power to NPP auxiliaries to carry out their assigned functions, in all operating modes of the NPP.

The electrical power, generated by the turbo-generators of both the units at 24 kV, 3 phase, 50 Hz, is stepped up to 400kV by the respective generator transformers and is evacuated through 400 kV transmission lines. For reserve source of power to auxiliaries of KKNPP it is connected through 230kV lines to 230kV grid and to KKNPP3,4.

The KKNPP generator is rated at 1000MW, 24kV, 3-phase, 50Hz, power factor of 0.9.
The generator is connected to generator transformer through 24kV isolated phase bus duct with the provision of a 24kV, 28kA generator circuit breaker connected in the run of IPBD. The generator is generally, synchronized with the grid using the GCB, though a provision for synchronising through the GTCB exists. The provision of GCB allows scheduled start-up and shutdown of power unit from 400 kV grid.

This document is an intellectual property of Nuclear Power Corporation of India

The generator transformer capacity of 1250 MVA (3 single-phase units of 24/400 kV 417MVA each) is designed for evacuation of the full power output of the generator. One single-phase unit of generator transformer is envisaged as a common spare for both the units of NPP is located near the GTs of Unit-5 and installed without connecting into the system. The spare transformer is maintained as per recommendations of the manufacturer, so that it is ready to be put in service whenever required.

400 kV and 230 kV switchgear are of SF6 gas insulated type housed indoors considering the saline atmosphere at Kudankulam site. 400kV switchgear is designed as one and half circuit breaker scheme. 230kV switchgear is designed as two main bus scheme.

Oil filled shunt reactors (SR) have been provided to compensate the MVAR consumption by Main Generator during light load condition for stable operation of Generator or during light load conditions without generator in service, during the power transmission through long lines for 400kV system voltage.

230kV power supply is stepped down to 6kV utilization level through one no. Common Station Auxiliary transformer (CSAT) and two groups of 2 nos. Reserve Auxiliary transformers (RATs) (one group of 2 RATs for each unit), to feed the 6kV reserve power supply to both the units as well as to feed the common station loads.

RATs are used as standby to unit auxiliary transformers, in case of loss of power supply from unit auxiliary transformer. RATs shall also be connected to 6kV buses of common station auxiliary power supply system (00BCE, 00BCF) to use it as a standby to CSAT. RAT of Unit-5 shall be used as manual backup to RAT of Unit-6 and vice-versa.

CSAT provides power supply to common station loads by stepping down the 230kV voltage to 6kV utilization level, through 6kV switchgear.

2.10 **6kV & 380V/0.415/230/240 AC systems and 220V/110V DC system –** For details of the equipment refer to the respective TS & DS.

3 JOB SPECIFIC REQUIREMENTS

3.1 General

3.1.1 Various equipment to be supplied by the Contractor shall in general, be in accordance with the requirements defined in respective equipment technical specifications, respective equipment data sheets and typical schematics/ applicable drawings. Besides these, the following requirements as detailed out in respective clauses for the equipment shall also be considered.

3.1.2 Contractor shall ensure that all electrical equipment comply to site and system conditions, rating and other technical requirement as specified in the Tender/ Technical specifications

This document is an intellectual property of Nuclear Power Corporation of India

and as shown in the relevant single line diagrams/schematic drawings & other drawings, equipment layout diagrams.

3.1.3 Contractor shall use this specification along with scope document, data sheets and technical specification, for various equipment to be designed, supplied, installed and commissioned. However for equipment where Purchaser's technical specifications have not been attached, or some of the essential technical requirements are not specifically covered in any of these documents, even then, the Contractor shall use their own specification developed based on project specific requirement and good engineering practices prevalent in the industry so as to ensure the design intent and objectives of the systems and to ensure satisfactory operational and maintenance requirements of the equipment offered, subject to approval by Purchaser.

3.1.4 It is also possible that, data sheets for some of the equipment or their auxiliaries may not have been specifically mentioned and enclosed separately. Yet, data sheets for all such equipment/ their auxiliaries shall be submitted by the Contractor. Equipment data sheets for all such equipment/ auxiliaries/ accessories etc. shall be prepared by the Contractor based on relevant codes and specifications. Such data sheets shall contain all technical data and information which are essential for review and technical acceptability, detailed engineering, installation, testing, repair and maintenance, replacement, etc. Such data sheet shall be submitted for review and approval of Purchaser.

3.1.5 All equipment should be type tested, shall be subjected to routine and acceptance tests as per applicable specifications.

3.1.6 Contractor shall clearly specify in their purchase specifications, the requirement of conducting other special tests/ type tests, which are envisaged for various electrical equipment, and shall have no impact on cost and time. Contractor shall preferably restrict the make of switchgear to one particular make only, both 6kV as well as 0.380/0.415kV levels, Group 1 220V DC, to ensure better co-ordination and from maintenance point of view for the Purchaser.

3.2 Fault level selection

Contractor shall refer to the respective drawings/technical specification/data sheet documents for fault levels at various voltage levels.

3.3 Development of Manufacturer's document and Engineering documents:

Respective TS and DS covers only basic design requirements and basic engineering details. Scope includes development of detailed manufacturer document and drawings taking into account TS and DS requirements, including:

- detailed design calculations and analysis,
- preparation of single line diagrams,
- control & protection schematic drawings,
- protection calculations and relay settings documents,
- general arrangement layout & isometric drawings,

This document is an intellectual property of Nuclear Power Corporation of India

- intra panel cable schedule and terminal list of each board,
- providing of engineering inputs to Purchaser to facilitate carrying out of detailed engineering under Purchaser's scope of design,
- procurement,
- fabrication/ manufacturing of equipment,
- quality control and assurance during all the above processes,
- factory inspection & testing,
- safe loading, insurance,
- safe transportation to site,
- safe unloading of the items at site,
- safe storage and safe shifting of the same to erection point,
- supply of all materials/ equipment (except those listed under works - excluded) including all the necessary tools and tackles, installation, field quality plans/ erection procedures, site testing, supervision by the manufacturer's specialists for erection and commissioning of all the major equipment,
- carrying out of special tests by the manufacturer's specialists, pre-commissioning, commissioning and performance guarantee,
- obtaining necessary statutory/ CEA clearances, wherever necessary, safe preservation till hand over and handing over of all electrical works including all essential/ mandatory and recommended spares, complete in all respects as per data sheets, drawings, specifications, standards etc., specified in the Tender Document for KKNPP-5&6.

-Scope also includes the following due to change e.g. terminal number as a result of manufacturer's specific design in the BoP areas: updating of NPCIL/ external cable termination document.

For systems/equipment which are classified as per clause 1.1 (b), all the manufacturer's documents will go as design input to RF side who in turn will develop final working documents (WDs) taking into account equipment inputs/manufacture's inputs. Hence all manufacturer's documents/drawings, package contractor's documents/drawings, sub-vendor's documents/drawings and equipment inputs developed in accordance with the requirement of respective TS and DS need to be provided in a timely manner to NPCIL for review and approval and further sharing the same with RF side by NPCIL (both editable autocad/word, etc. version and pdf version). Any observations/comments on the manufacturer's documents/drawings, package contractor's documents/drawings, sub-vendor's documents/drawings and equipment input from NPCIL or RF side need to be addressed by the Contractor. Such category of works mostly are a part of main plant areas.

For systems/equipment which are classified as per clause 1.1 (c), all the manufacturer's documents/contractor's document/sub-vendor's document and equipment documents itself will become as final working documents (WDs). All manufacturer's documents/drawings, package contractor's documents/drawings, sub-vendor's documents/drawings and equipment inputs developed in accordance with the requirement of respective TS and DS need to be exchanged in a timely manner to NPCIL for review and approval (both editable autocad/word, etc. version and pdf version). Any observations/comments on the manufacturer's documents/drawings, package contractor's documents/drawings, sub-vendor's documents/drawings and equipment input from NPCIL side need to be addressed by the Contractor. Format and contents of the document shall be in the form acceptable to

This document is an intellectual property of Nuclear Power Corporation of India

NPCIL as manufacturer's documents itself will become final working documents. Such category of works are mostly in the part of BOP areas (both electrical and mechanical BOP areas). There are interfaces of BOP areas with main plant areas also and hence Contractor will have to provide required inputs for equipment/items supplied by them for further development of interface related designs such as interface cable logs, interface cable carrier systems, etc.

The documents/drawings annexed/attached as part of the respective TS/DS are based on the information of the previous project (s) with specific make/manufacturer and the same is provided for reference of the contractor for development of similar documents/drawings for the execution of works under this tender. Contractor need to prepare/develop specific document/drawing for KKNPP 5&6 project in similar manner taking into account of the equipment input of KKNPP 5&6 and development/updates in industry/regulations for such works, updated input if any from NPCIL etc. and carry our execution as per approved documents/drawings for KKNPP 5&6. In case of any change in the qualification requirements due to change in the installation arrangement, layout etc. of equipment of KKNPP 5&6, the required qualification for KKNPP 5&6 is deemed part of the scope of the contractor under this contract.

3.4 Equipment sizing and single line diagram

3.4.1 Equipment shall be capable of continuous operation at rated output under the following conditions:

a.	Voltage variation	:	± 10% (+10% to -15% in DC)
b.	Frequency variation	:	± 5%
c.	Combined voltage & frequency variation	:	± 10%

3.4.2 The kVA rating and percentage impedance of each transformer shall be chosen as per the specifications/drawings and be able to limit the rated current and short circuit current to values which are within the current rating and interrupting capacity of standard switchgear available.

3.5 Safety and Seismic Classification

Safety and Seismic category requirements shall be as per details provided in the respective Technical specification & data sheets and/or the scope document.

3.6 Cables and Cabling System

3.6.1 Overall cabling philosophy, cable laying and cable carrier system shall conform to Purchaser's document "Technical Specification for cable system & cabling guideline" – included in this tender.

3.6.2 The cables are sized based on the maximum continuous load current, the voltage drop, system voltage, system earthing and short circuit withstand criteria as applicable. The de-

This document is an intellectual property of Nuclear Power Corporation of India

rating due to ambient air temperature, earth temperature, grouping and proximity of cables with each other, thermal resistivity of soil, etc. are considered.

3.6.3 The salient features/ requirements of the cabling are covered in the relevant chapters/ sections of Technical Requirement document.

3.6.4 For the cable metal structure and cable trays (for field routing), layout is to be designed by the Contractor, Contractor shall design and develop the same based on the technical information/ inputs / general guidelines provided by the Purchaser to the Contractor, during execution of the work. The relevant erection item is deemed to include the cost towards this and no extra payment is envisaged for this. The salient features of the same are already covered in the relevant chapters/ sections of technical specification/ requirement documents.

3.6.5 It shall be the Contractor's responsibility to co-ordinate the activities under this tender with other Contractors/agencies executing works like ducting, civil, etc. where ever interfaces/interferences exist. .

3.6.6 No cable joint is acceptable except in cases where a single length cannot be manufactured/ transported and in case of any such constraint, the same shall be brought to the notice of Purchaser. No joints shall be permissible in hazardous areas.

3.6.7 Single core 6kV cables shall be laid in trefoil configuration with 1D gap. The clamping and banding of the 6kV cables in trefoil form shall be carried out as per the technical requirements for cable system & cabling guidelines.

3.6.8 Cabling in hazardous areas shall address all requirement meant for hazardous areas in addition to the requirements brought out in the relevant specification for cabling in other areas.

3.6.9 Cable laying/installation shall be strictly organised to provide maximum spare space in cable trays/ trenches and haphazard laying is strictly prohibited.

3.6.10 Details of fire barrier/ fire coating to the cables shall be as specified in the Technical Requirement/ Specification documents.

Specification documents for various types of cables are as provided in the index.

Termination of OFC Cables of any number of cores (ERECTION WORKS):

Scope of OFC cable termination also includes all the termination works such as provision of splicing boxes, splicing of OFC cables, preparation for fusing, fusing of cables, measurement of attenuation / loss after joining, continuity checking, The scope of works also include supply of suitable LIU - Light Interfacing Unit Boxes required for the works, pigtail couplers, qualification of the jointer, arrangement of suitable electrodes, fusing machines, connection &installation of patch cords (mentioned as separate items in BOQ) loss measurement instruments, and any other special tools and tackles required for the successful completion of the works, in all respects, as recommended by the Purchaser. The

This document is an intellectual property of Nuclear Power Corporation of India

cost of special tools, splicing kits, measuring kits, LIU units and other consumables required for termination of OFC as detailed above are deemed included in the relevant installation/termination item for OFC. Termination of fibre optic cable is core wise.
Patch cords shall be supplied as per the technical specification for fibre optic cable & accessories and installation of the same is covered in the tender.

3.6.11 For splicing and termination of fibre optic cable, the scope also includes arrangement & supply of splicing boxes and patch cords as required for intended termination works.

3.6.12 After the termination of fibre optic cable, attenuation/damping factor measurement is to be done for checking the effectiveness of termination. Attenuation value/damping factor shall be as per the technical specification for fibre optic cables and accessories.

3.7 Lighting System

3.7.1 Plant lighting system comprises:
a. Normal lighting (Fed from Group 3 power supply)
b. Emergency lighting (Fed from Group 1/ 2 power supply)
c. Evacuation lighting (Fed from Group 1 power supply).

3.7.2 During normal operation, both emergency and normal lighting shall be fed by normal power source. Both normal-fed + emergency-fed lighting together shall meet the lux level requirement. On failure of normal supply, emergency lighting load shall be transferred to emergency power supply source. Evacuation lighting shall be normally kept ‘ON’ and fed from Group-1 AC power supply or local battery back-ups.

3.7.3 Normal lighting system shall provide enough illumination so as to enable plant operators to move safely within the accessible areas of plant to perform routine operation including reading of field instruments, operation of all valves etc. and to carry out all the necessary maintenance and adjustment to equipment. Measurement of lighting levels shall be done on completion of the work, to ensure if they are in line with the design intent. In case they are not sufficient additional lighting shall also be provided to comply with the minimum lux levels. The scope of work includes providing of required instruments, detailing of additional lighting fixtures and installing them. Supply and installation of lighting fixtures for the additional requirement would also be operated under the respective items of the BoQ of the tender.

3.7.4 Areas requiring emergency lighting (fed from Group-2 power supply in case of unmanned areas and from Group-1 AC power supply in the case of manned areas).

3.7.5 Generally 5 - 10% of the total lighting fixtures are fed from emergency supply.

3.7.6 AC Evacuation lighting is fed from Group-1 240V

3.7.7 All technical details and requirement, wiring types, lighting fixtures, etc., are covered in technical specification of lighting system

This document is an intellectual property of Nuclear Power Corporation of India

3.8 Earthing and Lightning Protection Systems

3.8.1 All electrical equipment shall be suitably earthed. Earthing system shall, in general, cover the following:

a. Equipment earthing for personnel safety
b. System neutral earthing
c. Protection against static and lightning discharges
d. Shielding arrangement to take care of electrostatics, especially in areas like relay room, control room, etc.

3.8.2 The main earthing network is used for earthing of equipment to protect it against static electricity. Earthing network shall consist of main earth conductor (grid conductor) forming a closed ring network to provide a common earth for electrical devices and metallic structures.

3.8.3 Lightning protection is provided as per the requirements of IEC 62305 and is generally covered under the civil scope of work. However, specific works like test link boxes, its connections and some parts of the lightning protection may be covered in the scope of this tender under the respective BOQ item.

3.8.4 Self-conducting structures having metal thickness of more than 4.8 mm may not require a separate lightning protection arrangement with aerial rod and down conductors. They are, however, to be connected to the earthing system, at least at two points at the base.

3.8.5 For earth resistance values, size of earthing conductors, signal earthing, lightning protection of buildings and structures and other details, refer Technical requirement document for Grounding system for Electrical package and Lightning Protection documents.

4 INSPECTION AND TESTING AT MANUFACTURER'S WORKS

4.1 All major electrical equipment and material shall be subject to inspection by Purchaser or his authorized representative at manufacturers' works. Contractor/ Vendor/ Sub-Vendor shall furnish all necessary information concerning the supply to Purchaser.

4.2 During fabrication, all the equipment shall be subject to inspection by Purchaser or by an agency authorized by the Purchaser to assess the progress of work as well as to ascertain that only quality raw material is used.

4.3 Routine and acceptance tests as listed in relevant Indian standard and equipment specifications shall be conducted. Type tests shall be applicable as listed in QAPs & respective TS and in the relevant data sheet. These tests shall be carried out by the Contractor/ Vendor/ Sub-vendor and shall be witnessed by the Purchaser or an agency authorized by Purchaser as brought out in the specific QAPs to be developed by the Contractor/Vendor based on the indicative QAPs provided in the tender document.

This document is an intellectual property of Nuclear Power Corporation of India

4.4 For details of quality control and QAP requirements, and requirements of packing, safe loading, insurance during transit, safe transportation, unloading at site, site transportation/ handling, safe storage, safe preservation till handing over, insurance during erection and till handing, over etc., Contractor shall refer the relevant sections in the Tender document.

5 INSTALLATION, FIELD TESTING & COMMISSIONING

5.1 Contractor shall carry out installation, field testing and commissioning of all items of electrical equipment as per approved erection procedure/ manufacturer's instruction/ field quality plans, etc. which are all to be prepared and be submitted to Purchaser for review and acceptance. All the erection activities shall be carried out only after the acceptance of the above documents. Job hazard analysis for all the erection activities shall be carried out prior to commencement of any erection activity so that, the works shall be carried out with compliance of all safety measures. Please refer to annexure-1 of this document for details on erection, testing, pre commissioning and commissioning works.

5.2 Further, appropriate test and commissioning reports and as-built documentation as necessary for all electrical equipment shall be provided.

5.3 Field testing, calibration and commissioning of 400kV GIS along with outdoor equipment, 400kV shunt reactor, 230kV GIS along with outdoor equipment, 230 kV tie line, GIBD, GTs, GCBs, Power transformer, 24kV Isolated phase bus ducts, MV switchgear, 6kV Isolated phase bus duct, Auxiliary transformers, numerical relay and integrating equipment, Group 1 DC & AC systems, Hermetic penetrations, LV switchgears, MCCs, LDBs, PDBs, WDBs, Lighting panels, VDBs, Space heater panels, SCADA systems, metering and protection panels, local control panels, all associated power/control/FO cabling, etc. shall be done by Contractor and the above activity, with proper deputation of manufacturer's representative shall be done with advance planning, without affecting the project schedule as decided by Purchaser. For other equipment, Contractor shall ensure services of manufacturers' representatives for supervision of installation, testing and commissioning.

5.4 Contractor shall coordinate with manufacturers of other equipment (even those which are not supplied under this tender but involves installation, etc.) wherever required and shall freely and readily supply all technical information for this purpose as and when called for.

5.5 All electrical equipment shall be said to be installed and mechanically complete after circuit testing, primary and secondary injection testing and loop simulation is complete along with demonstration of successful commissioning and ensuring performance guarantee. Due care and consideration shall be given to the installation of all equipment, material and facilities.

5.6 Obtaining the necessary clearance for energizing the complete electrical facilities covered under this Tender and approval of installation/ drawings from central electrical inspector

This document is an intellectual property of Nuclear Power Corporation of India

and any other concerned approving authority e.g. CEA, TAC, etc. is included in the Contractor's scope work.

Statutory Approvals/Clearances - All the applicable safety codes applicable for nuclear power plant, national laws and local regulations/ AERB guidelines shall be followed by the successful bidder for the design, engineering, fabrication, erection, commissioning of the systems/ equipment and necessary approvals shall be obtained from the concerned statutory authorities by the Contractor.

It shall be ensured that all activities from detailed engineering up to handing over of the systems should accommodate statutory requirement during the execution of the contract and forms part of the scope. Documents as required for taking statutory approvals shall be generated and submitted to the statutory authorities by the Contractor through Purchaser/Owner. Follow up and obtaining clearances shall be the responsibility of the contractor. Statutory bodies from which approvals may have to be taken included but not limited to State Pollution Control Board, Factory Inspectorate, Labour Authorities, Electrical Inspectorate and Chief Controller of Explosive, etc. The contractor shall ascertain requirement of approvals as applicable in such plants and initiation of action as required shall be in contractor's scope.

Interaction with regulatory authorities, replies to queries raised by regulatory authorities, attending any technical discussion with regulatory authorities is the responsibility of the Contractor. Contractor shall provide all the input required for the same.

Statutory Requirements

The Contractor during detailed engineering, procurement, construction & commissioning shall take into account and comply with various local statutory requirements, standards and codes, as applicable including but not be limited to the following:

1. Atomic Energy Regulatory board.
2. Factories Act
3. Indian Petroleum Rules
4. Tariff Advisory Committee (TAC) Guidelines (for Insurance purposes)
5. Indian Boiler Regulation Act (IBR)
6. Civil Aviation Rules
7. Indian Railway Authority
8. Indian Electricity Act
9. Indian Electricity Rules
10. Central Electrical Authority (CEA)
11. Director- General, Factory Advice Service and Labour Institute, Bombay
12. Central Mines Research Institute (CMRI), Dhanbad
13. Department of Atomic Energy
14. Requirement of Chief Controller of Explosives (CCE), Nagpur, India.

This document is an intellectual property of Nuclear Power Corporation of India

15. Standards prescribed by Oil Industry Safety Directorate (OISD), Ministry of Petroleum and Natural Gas, Govt. of India.
16. Ministry of surface transport.
17. National Institute of Oceanology
18. Department of Water Resources, Tamilnadu
19. Stipulations stated in Environmental clearance granted by Ministry of Environment and Forest, Govt. of India.
20. Liquid Effluent Discharge as per Minimal National Standards for Liquid effluents and air emissions confirming to Pollution Control Board Standards.
21. Stipulations of Environmental authorities of the State of Tamilnadu. Other legislations relating to Environmental protection such as (but not limited to) :
    - Hazardous wastes (Management and Handling) Rules 1989.
    - Water (prevention and control of pollution) Act, 1974.
    - Water (Prevention and Control of Pollution) Act, 1977.
    - Air (Prevention and Control of Pollution) Act, 1977.
    - Environment (Protection) Act, 1986.
    - Forest (Conservation) Act, 1980.
    - Municipal Byelaws of Urban Development Authority of State Government for Buildings in Township.
22. Pollution Control Board.

5.7 The specific requirements for the installation and field inspection of electrical equipment shall be as per attached Annexure-1, which shall be followed in general for the installation & field inspection requirements of various equipment covered. However, for specific requirements of the installation & field inspection manufacturer's instructions/ recommendations, standard procedures and approved field quality plans shall be followed.

5.8 Tests/work to be controlled by erection and O&M commissioning groups at site of Purchaser shall generally be as per Annexure-1 to this document. However, detailed erection and commissioning procedures along with the checklist, QAPs, etc. for each system/equipment shall be prepared and submitted by the Contractor for review and approval of Purchaser. Generally, erection procedure along with associated documents shall be submitted to erection group at Site for their review & approval and commissioning procedures along with associated documents shall be submitted to site O&M group for their review & approval (with concurrence of Purchaser's HQ design group). Not all electrical items might have been covered in this annexure, but based on these principles, detailed procedures shall be developed by the Contractor for approval of the Purchaser and subsequent execution by the Contractor accordingly.

5.9 The above requirements covered are only in brief. The Bidder shall study the tender document and detailed technical specifications for assessment and understanding of the detailed job specifications of erection, testing and commissioning, as given separately in the Annexure-1 to this document, as referred above.

6 FIVE YEARS SPARES

This document is an intellectual property of Nuclear Power Corporation of India

Bidder shall furnish the list of recommended/ required spares for five years of normal operation and maintenance (spares required over and above the mandatory spares as per requirement indicated in respective TS & DS of all electrical equipment with itemized quantity and unit rate. However, Purchaser will decide ordering as per their requirement during the execution of the contract.

7 MANDATORY SPARES

List of mandatory spares- Electrical equipment for Electrical package of KKNPP 5&6 is covered under the scope of this tender shall be supplied as per the list indicated in doc. no. I02.KK56.0.0.ET.TB.PR002. The items supplied as per the above list shall not be drawn for use in lieu of any equipment/ component failure encountered during the erection, testing & commissioning and if it is done due to any site exigency, the subject spare item shall be arranged by the Contractor and be handed over to the Purchaser.

8 MAKES OF EQUIPMENT/ COMPONENTS

8.1 "Vendor List" section in the tender document (Document no. I02.KK56.0.0.AP.REP.PR003**)** provides acceptable makes of major electrical equipment and electrical components.

8.2 Contractor/ Vendor while ordering shall ensure the availability of spare parts and maintenance support services for the offered equipment at least for 15 years from the date of supply. Contractor/ Vendor shall give a notice of at least one year to the Purchaser before phasing out the products/spares to enable the Purchaser to place orders for spares and services.

8.3 Contractor/ Vendor may procure material from any of Purchaser approved vendors. However, current validity and range of approval as per Purchaser, workload, stability and solvency need to be verified by the Contractor/ Vendor before placement of order.

8.4 Please refer document no. I02.KK56.0.0.AP.REP.PR003 for vendor list. Only in case of specific problem(s), Contractor/ Vendor can offer equipment/components of makes other than specified in the tender during order execution. The Contractor/ Vendor shall however evaluate the alternate make of equipment/components and submit proposals, reports (along with satisfactory track record and test certificates of the equipment/ components of proposed make) for review and approval by the Purchaser, prior to placing order. In case the alternate makes are not found acceptable, equipment/components shall be strictly as per vendor list enclosed with the Tender.

8.5 In addition to the above, NPCIL reserves its rights to insist on the same make of equipment as in KKNPP 3&4 which the Contractor shall comply with no additional cost and time implication to NPCIL.

This document is an intellectual property of Nuclear Power Corporation of India

Please refer annexure-1 of Scope of Works – Electrical System for KKNPP 5&6 (I02.KK56.0.0.PR.TT.PR008) for the list of technical specification, data sheets and other documents attached with the tender.

9 ANNEXURES

Annexure-1: I01.KK56.0.0.PR.TS.P001- Project Document on Job Specification – Execution of Site Works of Main Plant Electrical Systems, KKNPP-5&6.

10 ABBREVIATIONS USED

ACDB	:	Alternating Current Distribution Board
CMRP	:	Control Metering Relay Protection
CSAT	:	Common Station Auxiliary Transformer
CVT	:	Capacitive Voltage Transformer
DCDB	:	Direct Current Distribution Board
DOL	:	Direct on Line
EHV	:	Extra High Voltage
GI	:	Galvanised Iron
GIS	:	Gas Insulated Switchgear
GIBD	:	Gas Insulated Bus Duct
HV	:	High Voltage
HVAC	:	Heating, Ventilation and Air Conditioning
KKNPP	:	Kudankulam Nuclear Power Plant
LCC	:	Local Control Cabinet
LDB	:	Lighting Distribution Board
MCC	:	Motor Control Centre
MOV	:	Motor Operated Valve
NO	:	Normally Open
OHLP	:	Over Head Line Protection
OLTC	:	On Load Tap Changer
PCC	:	Power Control Centre
PDB	:	Power Distribution Board
PGCIL	:	Power Grid Corporation of India Limited
PLCC	:	Power Line Carrier Communication
QAP	:	Quality Assurance Plan
RAT	:	Reserve Auxiliary Transformer
RF	:	Russian Federation
RTCC	:	Remote Tap Changing Control
RTU	:	Remote Telemetry Unit
SCADA	:	Supervisory Control and Data Acquisition

This document is an intellectual property of Nuclear Power Corporation of India

SLD	:	Single Line Diagram
TNEB	:	Tamil Nadu Electricity Board
TANGEDCO	:	Tamil Nadu Generation & Distribution Corporation
TTS	:	Tender Technical Specification

This document is an intellectual property of Nuclear Power Corporation of India

TABLE OF CONTENTS

1.0 INTRODUCTION 5

2.0 PROJECT AND SITE DATA 5

2.1 LOCATION OF THE SITE 5

2.2 METEOROLOGICAL DATA 5

2.3 SITE INSPECTION 5

2.4 SITE CONDITIONS 6

3.0 RESOURCE MOBILIZATION 6

4.0 WAREHOUSE MANAGEMENT 6

5.0 HEALTH AND SAFETY 7

6.0 CONSTRUCTION CONTROL 7

7.0 HOUSE KEEPING AND WASTE DISPOSAL 8

8.0 STATUTORY REQUIREMENTS 8

9.0 ABBREVIATIONS USED 9

10.0 JOB SPECIFICATIONS FOR ERECTION, TESTING, PRE-COMMISSIONING / COMMISSIONING OF ELECTRICAL EQUIPMENT 11

10.1 GENERAL 11

10.2 JOB SPECIFICATIONS FOR GENERAL SCOPE OF WORKS 11

10.3 JOB SPECIFICATIONS FOR 230 KV & 400 KV GAS INSULATED SWITCHGEAR (GIS) AND GAS INSULATED BUS DUCT (GIBD) 25

10.4 JOB SPECIFICATIONS FOR 400KV AND 230KV OUTDOOR SWITCHYARD WORKS (ELECTRICAL) 31

10.5 JOB SPECIFICATIONS FOR 24KVGENERATOR CIRCUIT BREAKER (GCB) 34

10.6 JOB SPECIFICATIONS FOR 24KV ISOLATED PHASE BUS DUCT (IPBD) 38

10.7 JOB SPECIFICATIONS FOR POWER TRANSFORMERS (GTs, UATs, RATs, CSAT & SHUNT REACTOR) – OIL FILLED 44

10.8 JOB SPECIFICATIONS FOR 6 KV MV / 0.38 KV / 0.415 KV LV SWITCHGEAR / MCCs / ACDBs / DCDBs, RECTIFIER / INVERTERS / CMRP PANELS / SCADA /METERING /TRANSDUCER PANELS/ POWER DISTRIBUTION BOARDS 58

10.9 JOB SPECIFICATIONS FOR 6KV ISOLATED PHASE BUS DUCT (IPBD) 67

10.10 JOB SPECIFICATIONS FOR NON SEGREGATED PHASE BUS DUCT (NSPBD) 72

10.11 JOB SPECIFICATIONS FOR DRY TYPE AUXILIARY TRANSFORMERS 78

10.12 JOB SPECIFICATIONS FOR BATTERIES 82

10.13 JOB SPECIFICATIONS FOR HERMETIC CABLE PENETRATIONS (HCPs) 85

10.14 JOB SPECIFICATIONS FOR CABLE CARRIER SYSTEM WORKS (CABLE METAL STRUCTURE (CMS)/ CABLE TRAY & SUPPORTS 93

10.15 JOB SPECIFICATIONS FOR CABLING / CABLE LAYING WORKS 99

10.16 JOB SPECIFICATIONS FOR CABLE TERMINATION WORKS 115

10.17 JOB SPECIFICATIONS FOR CABLE TERMINATION WORKS OF HERMETIC CABLE PENETRATIONS 128

10.18 JOB SPECIFICATIONS FOR LIGHTING SYSTEM WORKS 134

10.19 JOB SPECIFICATIONS FOR GROUNDING AND LIGHTNING PROTECTION SYSTEM WORKS 143

10.20 JOB SPECIFICATIONS FOR FIRE BARRIER PROTECTION SYSTEMS AND FIRE RESISTANCE PAINT COATING WORKS 152

10.21 JOB SPECIFICATIONS FOR 400 KV TIE LINE BETWEEN KKNPP - 3&4 AND KKNPP - 5&6 156

10.22 JOB SPECIFICATIONS FOR SANITATION / HOUSE KEEPING WORKS DURING ERECTION/TESTING AND COMMISSIONING ACTIVITIES 159

11.0 DETAILS OF ERECTION TESTS / PRE-COMMISSIONING & COMMISSIONING WORKS TO BE CONTROLLED BY ERECTION GROUP VIS A VIS COMMISSIONING GROUPS AT SITE 163

12.0 LIST OF BUILDINGS UNDER SCOPE OF WORK FOR ELECTRICAL PACKAGE FOR KKNPP 5&6 180

13.0 REFERENCES 198

1.0 INTRODUCTION

Nuclear Power Corporation of India Limited (hereinafter referred as NPCIL) is setting up 2 x 1000 MWe (KKNPP-5&6) Nuclear power plants at KKNPP Site, Kudankulam, Radhapuram Taluk, Tirunelveli District, Tamil Nadu located at a distance of 27 km from Kanyakumari. Nuclear Power Plant is being constructed on Technical collaboration with Russian Federation. The construction of the project started with first pour of concrete on 29-06-2021. This document details about indicative scope of works specific to Execution of Site Works of Main Plant Electrical Systems, KKNPP-5&6.

2.0 PROJECT AND SITE DATA

2.1 LOCATION OF THE SITE

KKNPP site is a coastal site on the shores of Gulf of Mannar located on the South-Eastern tip of India near Kanyakumari. It is located in Radhapuram taluk of Tirunelveli District of Tamil Nadu state. It is about 27 kms by road from Kanyakumari. The nearest Railway

Stations are the one at Kanyakumari, and the other at Vadakku-Valliyoor which is about 27kms away, both having broad gauge railway track. There is a Major District Road (MDR) from Kanyakumari to Tiruchendur passing through Kudankulam village at a distance of 2-3 kms from the site. The MDR joins National Highway No.7 at about 8 kms north of Kanyakumari. The site is accessible by road from Nagercoil (approx. 35 kms) and from Kanyakumari.

2.2 METEOROLOGICAL DATA

The site experiences a tropical climate with humidity ranging from 40% to 90% (as per Kanyakumari Met data) depending on the seasons and is subjected mainly to the winter monsoon during the months of October, November & December. The air masses are mainly of tropical nature with typical wind flow mainly from the west. Temperatures range from 19 deg. C to 39.6 deg. C. The yearly average rain fall is around 700 mm. Meteorological data such as maximum and minimum temperature in the year, relative humidity, rainfall, etc. will be available in the office of the Purchaser for study by tenderer, if required.

2.3 SITE INSPECTION

Interested tenderers should visit the site to familiarize themselves thoroughly with the site conditions before submitting their tenders. Non-familiarity with site conditions will not be considered a reason for extra contractual claims and shall not be an excuse for not carrying out the work in strict conformity with the drawings, time schedule and specifications. For

any clarification regarding specifications, conditions of contract, schedule of quantities, scope of work, etc., the tenderer(s) should contact the authorized official of the Purchaser.

2.4 SITE CONDITIONS

The overburden soil over highly weathered charnokite rock varying from 2 M to 5 M depth forms the rock structure. It mainly consists of coarse sands /silts and is variable. Just below the overburden lies highly weathered friable rock upto depths of 20 M. By examining these subsurface sections, the sub-surface strata may be generalized as below:

0.0 to 2.0 - Topsoil

2.0 to 5.0 m - Sandy/gravelly soil

5.0 to 20.0 m - Weathered rock of WIV/W III grade with joints at less than 1.0 m interval

Below 20.0 m - Moderately weathered/ fresh rock/WII/WI.

3.0 R ESOURCE MOBILIZATION

All the resources such as manpower, plant and machinery, tools & tackles, consumables, erection and commissioning spares, infrastructure like office, stores, approach roads, labour colonies, etc., any other requirement not specifically mentioned but required for successful completion of the scope of works in all respect shall be arranged by the contractor.

4.0 WAREHOUSE MANAGEMENT

Contractor shall have warehouse or otherwise provide appropriate storage at site (in accordance with manufacturer's recommendation and taking into account climatic and other relevant conditions at the warehousing site) for all Equipment, Plant & Machinery and Contractor's equipment.

All Equipment, Plant & Machinery, tools, tackles and spares, shall be stored at appropriate location approved in advance by the Engineer-in charge, and properly tagged and identified for segregated from other goods and Preserved as per manufacturers recommendations.

The Contractor shall arrange and be responsible for security of all the equipment, Plant & Machinery and Stores to be incorporated in or forming part of the facilities and tools, tackles, spares and other items, which are required to be delivered to the Purchaser under the contract, till acceptance of the facilities or acceptance of such items, as the case may be, by the Purchaser. Detailed scope shall be referred in the "Requirements of construction supervision and management" specification.

5.0 HEALTH AND SAFETY

The Contractor shall at all times take all reasonable precautions to maintain the health and safety of the Contractor's Personnel. The Contractor shall ensure minimum first-aid arrangements available at all times at the Site and other arrangements in collaboration with local health authorities like medical staff, sick bay, ambulance, etc. The Contractor shall also make suitable arrangements for necessary welfare and hygiene requirements and for the prevention of epidemics. In case the Contractor fails to make arrangements as aforesaid, the Purchaser shall be entitled to do so and recover the cost thereof from the Contractor.

The Contractor shall at his own expense arrange for Compliance of "Contract Conditions for Industrial Safety" as appended to this GCC or as required by the Purchaser in respect of all labour directly or indirectly employed, for performance of the Facilities and shall provide all facilities in connection herewith. In case the Contractor fails to comply with these conditions, the Purchaser shall be entitled to take steps as necessary to ensure compliance and recover the cost thereof from the Contractor.

6.0 CONSTRUCTION CONTROL

Following control measures shall be followed for the requirements of Construction Supervision and Management by the Contractor.

Material Control
Fabrication control
Inspection & Testing
Packaging & Transport
Receiving & Storage
Erection
Site testing
Documentation Control
Quality Management System
Welding

Inspection & Testing
Quality Surveillance
Guarantees

7.0 HOUSE KEEPING AND WASTE DISPOSAL

All wastes generated like surplus earth after use/surplus construction materials to be disposed off from time to time to the disposal locations as directed by the site Engineer in Charge.

Handling, Transportation& Disposal of the waste generated during construction, installation, commissioning, etc. shall be a part of the contractor's scope of work. Contractor to collect such waste generated within battery limit and then transport and dispose to the locations as directed by the site Engineer in Charge. Also, housekeeping and dewatering of the area under the control of the contractor shall be a part of the Contractor's scope of work.

8.0 STATUTORY REQUIREMENTS

The Contractor during detailed engineering, procurement, construction & commissioning shall take into account and comply with various local statutory requirements, standards and codes, as applicable including but not be limited to the following:

1. Atomic Energy Regulatory board.
2. Factories Act
3. Indian Petroleum Rules
4. Tariff Advisory Committee (TAC) Guidelines (for Insurance purposes)
5. Indian Boiler Regulation Act(IBR)
6. Civil Aviation Rules
7. Indian Railway Authority
8. Indian Electricity Act
9. Indian Electricity Rules
10. Central Electrical Authority(CEA)
11. Director- General, Factory Advice Service and Labour Institute, Bombay
12. Central Mines Research Institute (CMRI), Dhanbad

13. Department of Atomic Energy
14. Requirement of Chief Controller of Explosives (CCE), Nagpur, India.
15. Standards prescribed by Oil Industry Safety Directorate (OISD), Ministry of Petroleum and Natural Gas, Govt. of India.
16. Ministry of surface transport.
17. National Institute of Oceanology
18. Department of Water Resources, Tamil Nadu
19. Stipulations stated in Environmental clearance granted by Ministry of Environment and Forest, Govt. of India.
20. Liquid Effluent Discharge as per Minimal National Standards for Liquid effluents and air emissions confirming to Pollution Control Board Standards.
21. Stipulations of Environmental authorities of the State of Tamilnadu. Other legislations relating to Environmental protection such as (but not limited to):

- Hazardous wastes (Management and Handling) Rules1989.
- Water (prevention and control of pollution) Act,1974.
- Water (Prevention and Control of Pollution) Act,1977.
- Air (Prevention and Control of Pollution) Act,1977.
- Environment (Protection) Act,1986.
- Forest (Conservation) Act,1980.
- Municipal Byelaws of Urban Development Authority of State Government for Buildings in Township.

22. Pollution Control Board.
23. Atomic Energy (Factories) Rules -1996

9.0 ABBREVIATIONS USED

ASW : Air Shock Wave

BOP : Balance of Plant

CEA : Central Electricity Authority

ELCB : Earth Leakage Circuit Breaker

EOT	: Electrical Overhead Travelling
EPSS	: Emergency Power Supply System
GI	: Galvanised Iron
HVAC	: Heating, Ventilation and Air Conditioning
KKNPP	: Kudankulam Nuclear Power Plant
LCC	: Local Control Cabinet
LDB	: Lighting Distribution Board
LV	: Low Voltage
MCC	: Motor Control Centre
MOV	: Motor Operated Valve
MV	: Medium Voltage
NOS	: Normal Operating Supply
OBE	: Operational Basis Earthquake
OFC	: Optical Fiber Cable
OSBL	: Out Side Battery Limit
PCC	: Power Control Centre
PDB	: Power Distribution Board
QA	: Quality Assurance
RTCC	: Remote Tap Changing Control
SCADA	: Supervisory Control and Data Acquisition
SLD	: Single Line Diagram
SSE	: Safe Shutdown Earthquake
TAC	: Tariff Advisory Committee
TTS	: Tender Technical Specification

10.0 JOB SPECIFICATIONS FOR ERECTION, TESTING, PRE-COMMISSIONING / COMMISSIONING OF ELECTRICAL EQUIPMENT

Erection, Testing, Pre-Commissioning / Commissioning Requirements (General)

10.1 GENERAL

1. This document covers the general activities and requirements for the erection / installation of all electrical equipment in Kudankulam Nuclear Power Units – 5 & 6.This document provides only indicative minimum requirements for some of the items/equipment. Similar approach may be followed for all other items/equipment which are not covered in this document. In addition to the details covered here and in the respective technical specifications, the specific/ detailed requirements for the installation of equipment concerned shall be complied / followed as per manufacturer's instructions/ recommendations, standard procedures, applicable Indian / International standards and approved field quality plans etc. by Contractor through equipment wise erection procedure to be prepared and submitted for NPCIL review / concurrence and acceptance after the award of contract, but prior to taking up actual erection works at site.

2. In case of any conflict with the requirements specified in the respective technical specifications and requirements covered in this document, the matter shall be brought to the notice of Purchaser / Corporation and the decision of Purchaser / Corporation shall be final in this regard.

10.2 JOB SPECIFICATIONS - GENERAL SCOPE OF WORKS

The scope under this section covers the activities to be followed for the complete erection works of equipment and accessories specified in the tender document supplied by the Contractor as well as that electrical equipment which are issued as free issue materials to the Contractor. The scope includes right from the activities of safe unloading of equipment at site, safe storage of materials, entire material handling and transportation of equipment

from Contractor's storage to erection point, erection and its preservation till handing over of the equipment to Purchaser / Corporation.

The detailed scope of above works, in general, includes the following:

1. The Contractor shall first draw an organization chart delineating the responsibility of persons to be deployed for various site works up to the level of engineers / supervisors / technicians. Organization chart shall also have dedicated and separate crew / group for ensuring total quality, safety and house- keeping of the works being taken up at site.
2. Wherever required, qualification of the workmen to be deployed / procedure to be adopted for specialized works, as covered in detail in the equipment-wise procedure, shall be followed in line with standard qualification procedure followed at site.
3. Purchaser reserves the right to review the deployment schedule of contractor for carrying out the intended works and any improvement recommended by the EIC / Corporation in this regard shall be complied to ensure smooth progress the works without compromising the quality and safety as well as house-keeping of the area.
4. The scope of works involve the following works prior to taking up actual works at site such as study of drawings issued for construction, understanding the nature works to be executed, mobilization of required resources such as materials and manpower and preparation of erection procedure, field quality plan, check list etc..
5. Erection procedure shall be developed based on the drawings released for construction as well as guidelines given in the technical specifications, applicable standards / codes, manufacturer's manual, etc.
6. The actual erection works of any electrical equipment shall be taken up only after the preparation of erection procedure, which shall be duly reviewed, concurred and accepted by the concerned agencies / groups of the Corporation. Invariably for all the equipment to be erected, field QAP - Quality Assurance Plan (indicating the extent of inspection, witness and hold points required from the respective / concerned agencies, involved in the execution, supervision and control of the erection activities), shall be prepared, which shall be duly reviewed, concurred and accepted by the authorized agencies / groups of the

Corporation. Wherever applicable, check list shall also be prepared and appended with erection procedure and field quality assurance plans.

7. Safe transportation of the material inside the site, material receipt at site and unloading of the materials for safe storage set up by Contractor's place, in line with recommendations of manufacturer. In case of readiness of the buildings / structures, the equipment can be directly shifted near the building / structure with the due concurrence of EIC and the equipment be safely unloaded, as the case may be. Proper machineries such as Hydra cranes, fork lifters, pellets etc. shall be mobilized for unloading operations at site.
8. For items which are issued as free issue materials to the Contractor, Contractor shall make his own arrangements to collect the equipment and its accessories, from NPCIL stores (except only for 7 NOS. OF GENERATOR TRANSFORMERS, which will be made available at a location near to erection location on trailer- which is the terminal point), right from shifting of the materials from NPCIL stores to loading on the truck / trailer, transportation to erection point, unloading /shifting from trailer to location etc. and any plant and machineries such as cranes, long bed trailer, hydraulic jacks, wooden sleepers, tools and tackles etc.. shall all be arranged by the Contractor.
9. 7 nos. of Generator Transformers (GT) will however be delivered to the nearest possible point near actual erection site by the Corporation. However any plant and machineries such as cranes, long bed trailer, hydraulic jacks, wooden sleepers, tools and tackles etc. (wooden sleepers required, if any, during the unloading point shall be arranged by the Contractor).
10. Visual inspection of the packing followed by safe unpacking and inspection of the items received at site, checking of Bill of Materials at site, and generation of suitable reporting on the missing contents / items, if any, results of the visual examination, coordination with Insurance, if any, in case of observance of any damages to the package / items kept inside the package etc. For items supplied by the Contractor, the scope of works also includes re-packing of the material after inspection, in order to prevent ingress of any moisture / foreign materials etc. till they are issued for erection works.
11. The Contractor shall give timely information on the items received at site to the Purchaser / Corporation and all the items received at site shall be offered for inspection by the

Purchaser / Corporation or his authorized representative. For items supplied by the Contractor, a suitable Site Storage Inspection Report (SSIR) based on the above inspection citing the package receipt date, conditions of the package, conditions of the items inside the package (wherever applicable), bill of material verification / listing of damages / missing items, storage location codes etc.. shall be generated and be submitted to Purchaser / Corporation.

12. Temporary storage / preservation of the equipment at the contractor's storage yard till shifting of the equipment to actual site / erection point, including periodic inspection of the materials kept at storage yard / ware house. Periodic inspection report shall be generated for all such inspection carried out and the same be submitted to the Purchaser / Corporation.
13. All the requirements of safe storage, as specified in the relevant sections of the tender document, shall be complied for storing the equipment. Electrical panels housing critical electrical / electronic / static / micro – electronic / numerical – digital components such as switchgear cabinets / CMRP cabinets, Rectifiers / Inverters / DCDBs / ACDBs etc. shall be stored inside closed / semi closed ware house, as the case may be, and as specified elsewhere in the tender document. (The storage and ware house requirements shall be referred for the same)
14. Survey / inspection and verification of readiness of the building / structures / systems to assess the feasibility of commencement of erection works. Any report on the above inspection shall be generated in advance so that, pending jobs by other agencies / other groups (belonging to Contractor or otherwise) are listed and monitored / followed for speedy completion of the same. Equipment shifting shall be carried out only after certification of the readiness of the above area / structure / clean room condition, etc.
15. Drawl of equipment from stores, carrying out necessary checks to ascertain the healthiness, wherever possible and completeness of the equipment offered for erection, material handling/safe unloading and safe shifting of equipment to erection point, etc.
16. Unpacking of equipment and disposal / return of scrap / packing wood / empty cases / drums etc. to stores /scrap yard as directed by the Purchaser / Corporation.

17. For disposal of scraps of all kinds, getting generated during the execution of contract, please refer the requirements covered specifically elsewhere in the tender document.
18. Fabrication / assembly, installation of the supporting structures, alignment, EP verification & modification to suit / facilitate the erection works, installation of the same by welding, grouting, etc., as required as per the erection drawings, supply and installation of hard ware accessories wherever required, for completion of the erection works in all respects.
19. Unless specifically mentioned, all the required hardware accessories and consumables for erection, cleaning, welding/ brazing, NDT consumables such as nuts / bolts / washers / anchor fasteners / welding electrodes, cleaning agents, cotton cloth, etc. shall be arranged / supplied by the CONTRACTOR at no additional cost.
20. Painting of supporting structures with suitable paint including the supply of suitable paint as per the requirements covered in detail, in the relevant chapter / section on painting, elsewhere in the tender document.
21. Installation of equipment as specifically described below for each equipment, as per erection drawings / manufacturer's instructions / manual or recommendations of the manufacturer and as per approved erection procedure and as directed by the Engineer – in – charge.
22. The erection procedure for all the equipment shall be prepared in advance, prior to taking up any erection activities and be submitted for Purchaser's review and acceptance so that, all the activities are planned and executed in a well coordinated manner.
23. Prior to carrying out any erection activity at site, Job Hazard Analysis (JHA) shall be carried out listing all the job hazards associated with the particular job from material receipt at site to handing over of the equipment and action proposed to be taken to ensure all the safety measures / provisions to execute the jobs with total safety, in every stages of erection works, (i.e. from material receipt at site to handing over of equipment), throughout the period of execution of the contract.
24. Based on the above erection procedure and Job Hazard Analysis (JHA) carried out, as mentioned above, suitable PEP TALK / PRE - JOB BRIEFING shall be mandatorily given by the Job In – Charge / Safety Supervisor to all the workmen involved in that particular

job, prior to carrying out any of the erection activities planned in a day. The nature of the job / activities to be carried out by the workmen along with workmanship to be ensured and the safety pre-cautions to be taken shall be briefed during the PEP TALK / PRE-JOB BRIEFING. Records of the PEP TALK / PRE – JOB BRIEFING given shall be invariably recorded and be shared with EIC / Corporation, which can also be subject to periodic verification by the concerned agencies / groups of Corporation / EIC. Format of the PEP – TALK / PRE – JOB BRIEFING shall be finalized in consultations with the EIC / Corporation prior to commencement of any works.

25. Zinc rich Epoxy Touch-up painting and finishing including supply of suitable paint as per the requirements covered in detail, in the relevant chapter / section on painting, elsewhere in the tender document.

26. Safe storage / preservation of the equipment installed in the erection point / location, till handing over of the equipment to Purchaser / Corporation for further works. Periodic inspection / condition monitoring report shall be generated for equipment installed, and such reports shall be submitted to Purchaser / Corporation till handing over of the equipment. Any recommendation made by the Engineer – in charge in this regard, to maintain the preservation requirements of the equipment shall be met / implemented at no extra cost. This may include supply of required polythene sheets/tarpaulin sheets/zipped box type polyethylene covers etc.. as the case may be.

27. All the erection requirements as described in relevant sections / technical specifications / as per working drawings / tender specifications /manufacturer's instructions/documents, relevant standards / practices and as directed by the Engineer-in-charge shall be complied. All the tools, equipment, instruments, if any, duly calibrated. , etc. shall be arranged for the completion of the erection of the equipment, in all respects.

28. Inspection, site testing, pre-commissioning/commissioning as described in relevant sections / technical specifications / as per working drawings / tender specifications /manufacturer's instructions/documents, relevant standards / practices and as directed by the Engineer-in-charge. All the testing tools, equipment, measuring instruments etc. shall be arranged for the testing of the equipment, duly calibrated.

29. Wherever necessary, as decided by Corporation and as directed by the Engineer – In-Charge, the contractor shall arrange the supervision of the on-going erection / inspection / site - testing / pre –commissioning / commissioning works including calibration / software loading / up-gradation etc. by Manufacturer at no extra cost.
30. Documentation of erection, site testing and pre-commissioning/commissioning activities as well as documentation of all QA/Erection/ testing/pre-commissioning procedures/check lists, testing reports , etc. and submission of the same in hard & soft copy form.
31. Once the erection works are all completed, inspection of the erection works shall be carried out Contractor's QA personnel and in case of completeness of all the erection activities including verification of completeness of Bill of Materials of the equipment supplied and erected, then the 'Erection Completion' check list shall be offered for inspection initially by Execution Group and in case of clearance of the 'erection completion' check list (including field quality plan) by Execution Group, the same shall be offered for inspection by departmental QA Group.
32. The comments and observations given by the Engineer – in - charge and / or authorized representatives of Execution Group and NPCIL QA group shall be complied and the check list shall be re-submitted for inspection and verification of the Corporation. Contractor shall take all care to ensure that, there are minimal or almost negligible observations from the Corporation during the above exercise, when equipment erected are offered for inspection and verification by NPCIL groups and the same shall be ensured through better workmanship, quality management and effective quality assurance surveillance programme of the contractor throughout the period of the contract. Decisions of Engineer – in – charge is final in this regard and it is expected that, Contractor shall take extra efforts to clear the field quality plans and erection check lists in time.
33. Once the 'erection completion check list' is cleared by NPCIL Execution and QA with concurrence of field quality plan, the equipment shall be released for Site Testing / Pre-Commissioning / Commissioning Group of the Contractor and all these activities are to be carried out with necessary supervision by concerned Commissioning / O & M Group of the Corporation.

34. In case of observance of any defect and malfunctioning of the parts and / or whole of the equipment, supplied and erected by the Contractor, as found during the site testing and pre-commissioning / commissioning stage, the same will be brought to the notice of Corporation and if these failures are due to poor or inadequate quality of workmanship occurred during the supply and / or erection, then the equipment parts and / or whole of the equipment shall be replaced / substituted by a fresh and new piece / part.
35. All effort shall be done to complete the above testing and pre-commissioning / commissioning in a time bound manner by the Contractor so that equipment erected and handed over are commissioned in time and put into service without any delay. However, the exact time schedule and general deadline, if any, for reporting any such non-conformity will be discussed and mutually agreed between the concerned groups, but any decision of Engineer – in – charge in this regard is final and binding on the Contractor.
36. In case of observance of any such failure or non-conformity as found during the testing / pre-commissioning / commissioning stage by the concerned groups within the agreed time schedule, Contractor shall also analyze the problem and submit the root cause analysis of the component failure / non – conformance observed, as the case may be.
37. Depending on the nature and importance of the testing / pre-commissioning / commissioning activities being undertaken by the Contractor, witness of the same by Corporation personnel, if any, needed, shall be mutually discussed and decided between the concerned groups.
38. Full assistance and cooperation to NPCIL / authorized representatives as well as Russian representatives present at KKNPP site during any supervision of erection activities by them. Supervision of the above will be arranged solely at the discretion of the CORPORATION.
39. The contractor is required to complete all the above required works of equipment erection works in a fixed time frame as per the agreed schedule / network. Any delay in the completion of the agreed work by the contractor in the agreed schedule shall be considered as delay in the work.

40. The installation along with all other associated activities mentioned above shall meet the requirements of all currently applicable codes and standards including local statutory requirements.
41. Commissioning tests on all electrical equipment after completion of erection, including calibration and setting of all instruments, controls and protective devices covered under the contract scope.
42. Performance guarantee tests for all the items supplied under this package and commissioning operations on all equipment and accessories covered in this specification in the presence of Purchaser and handing over the same in fine operating condition.
43. Preparation and submission of handling / erection / testing / inspection / pre-commissioning / commissioning reports, wherever applicable.
44. After the completion of the above erection and attending the punch list, if any, by the concerned groups of Corporation, as-built marked up copy of the erection drawing shall be prepared and submitted by the Contractor to the Corporation, based on the changes / adjustments done, if any, in the panels / equipment erected by the Contractor.
45. In case of any necessity to send the items (part or whole) to factory, the scope of works also include, repacking of the equipment, wherever necessary, as directed by CORPORATION and re-transportation of the equipment / component back to its factory for repair / analysis or replacement of the same with fresh piece, if any, wherever manufacturing defects are observed during the inspection or later during the erection, testing and commissioning as mentioned above. While shifting of the items back to factory for any repair and /or re-supply of the same with fresh piece, as the case may be, insurance during transportation shall be arranged by the Contractor at no extra cost.
46. Material accounting of the items issued, used with respect to the measured quantities and return of the unused / surplus items, which are supplied by the equipment manufacturer as a main or spare part of the equipment, etc. to NPCIL stores in proper condition, etc.
47. Deposition of scrap resulted during the erection to pre-defined area / location on a daily basis. Details on the same are covered separately in the relevant sections of the tender document.

48. Maintenance of clean room conditions right from commencement of erection works to handing over of the equipment with a dedicated crew of house-keeping team, as per the detailed requirements covered elsewhere in the scope of tender document. Contractor shall give top most priority to maintain utmost clean room conditions and highest standards of housekeeping / up keeping both within and outside the buildings covered in the scope of this document.
49. In case of engagement of any sub-contractor for critical jobs, then the credentials of the sub-contractor's firm shall be submitted, before their engagement in the site for due review and concurrence / acceptance of the Purchaser / Corporation. In case of any rejection of the sub-contractors, the decision taken by the Engineer – in - charge is final and binding in this regard.
50. Any re-works resulted due to the manufacturing defect of the items supplied by the Contractor, shall be carried out without any additional cost, but in case of any major re-works necessitated due to interference with other systems (such as removal of welded panels / re-installation / total shifting & re-shifting / total mounting & dismantling etc.) then such works would be operated under separate item of the BOQ, on a case to case basis and analysis.
51. Contractor shall be ready to carry out any additional civil works required to be carried out to facilitate the timely completion of the erection works such as requirement of any new openings, enlargement of existing openings, disposal of debris resulted during the enlargement exercise, core cutting, finishing and post opening – smoothening jobs, etc. and all such jobs will be operated as a separate works as directed by Engineer – in – charge and as covered under respective items in the BOQ.
52. In sum, all the erection & commissioning works shall be done as per the relevant working drawings, manufacturers guidelines /tender specifications, standards / codes / approved erection & commissioning procedures and as directed by the Engineer – in – charge.

    The Contractor shall note that, the scope of erection is not limited to the requirements as described in this section and the CONTRACTOR shall not be relieved from his responsibility to ensure completion of the works in all respects, "without compromising the

QUALITY AND SAFETY" at no extra cost. The scope of erection herein only provides only the guidelines regarding the works and activities to be carried out.

The specification and the accompanying drawings are intended to describe and provide for a finished item of work. It is to be understood and agreed by CONTRACTOR, that the work described shall be complete in every detail, even though every item necessarily involved is not particularly mentioned. The CONTRACTOR shall be required to provide all the required labour, materials, tools and equipment necessary for the entire completion of the work in all respects described and shall not avail himself of any manifesting unintentional error, omission or inconsistency that may exist.

As mentioned above, Contractor shall check and report to the Engineer-in-charge about any damaged item and/ or missing component for getting the same replaced as per specifications. During installation, all accessories and loose items shall also be inspected by the Contractor before their assembly/ mounting.

For better understanding of the works to be executed during the erection works, the detailed scope of the works, equipment wise, are given separately.

53. Scope of technical & General Requirements of Pre-Commissioning / Commissioning works.

This section defines the technical requirements and scope of Contractor's work pertaining to the Pre- commissioning & Commissioning of Electrical Equipment:

a. Up-keeping cleaning of all the testing / commissioning area, adjoining area, equipment and removal of dust / debris around the commissioning / testing works are deemed to have been included in the scope of works.

b. The job is to be executed by Contractor, engaging sufficient of calibrated tools / tackles and testing instruments with qualified engineer / skilled personnel who have the following qualifications:

- Previous experience of pre-commissioning / commissioning electrical system equipment
- Familiarity with Indian Electricity Acts / Rules / Codes etc. required to be adopted for commissioning
- Adequate knowledge of the single line drawings / electrical schemes / CMRP diagrams (control, monitoring & relay protection) / logic schematics / interlocking schemes / internal wiring schemes of electrical equipment etc..
- Understanding of electrical performance parameters of the equipment being commissioned
- Awareness of the KKNPP safety requirements, permit systems, administrative procedures etc.

c. Readiness for arranging the trained/Highly Skilled manpower and required testing equipment on short notice for the commissioning works.

d. Ready availability of special testing equipment along with the tools & tackles including specialized testing instruments required for commissioning of supplied equipment.

e. Capability to handle the EHV/HV Electrical equipment with care and safety to the operating/testing personnel as well as the equipment being commissioned in compliance with the statutory provisions and stipulations.

f. All works shall be carried out as per approved commissioning procedure prepared in line with manufacturer's recommendations, with due review and acceptance of the Purchaser.

g. The Contractor is responsible for initiating/arranging required safety permit/ area permit / work permit etc. & necessary coordination for carrying out the works.

h. The Contractor shall arrange all the required proper testing instruments/tools and tackles/ consumables as per approved procedure.

i. The instruments used for testing and commissioning work shall be properly calibrated with required accuracy class as required by the commissioning documents/passport or as directed by the Purchaser's Engineer.

j. Before taking up any works, the equipment shall be cleaned with vacuum cleaner, isopropyl alcohol/ cleaning agents / rust remover if required, as a part of the works. Dust accumulated inside the panels shall be cleaned with soft cloth and all efforts to improve the IR value shall be taken up. The required cleaning agents CRC/Isopropyl alcohol, cotton

cloth, soft cloth, hot air blower, vacuum cleaner etc. as required shall be arranged by the Contractor.

k. Area cleaning and housekeeping in working area shall be maintained throughout.

l. Proper Tools kits / bags with required tools shall be issued to the staffs during the testing works.

m. Extension Box Used for testing shall have proper earth and three pin connections. No temporary arrangements are allowed. Torque Range duly calibrated and proper range shall be used depending on the requirement / application.

n. All Electrical equipment shall be properly cleaned as directed by the Engineer in Charge before charging and this may involve repetitive jobs, which shall be carried out at no additional cost.

o. The Contractor shall maintain separate housekeeping group to maintain area cleaning in the working area, as also covered specifically in the relevant sections of the document.

p. All staffs shall wear the required PPEs during the testing and commissioning works and follow the safety norms of KKNPP.

q. All the stationary including Xeroxing, CD / DVD / Pen Drives, Hard disk drives, if any, required for the submission of the documents/entire checklists of commissioning works shall be arranged by the Contractor as part of the works.

r. The deficiency / improvement / QA check list report, if any, given by other agencies such as O & M / QA etc. shall be complied and action taken shall be reported back in order to make the equipment ready for commissioning.

s. The commissioning works may have to be taken up in parallel, simultaneously in many systems, by arranging parallel groups / crews for an early completion of commissioning works. Accordingly, the team shall have team leader with sufficient nos. of highly skilled / qualified personnel, skilled personnel, semi-skilled / unskilled persons without affecting the pace of the works, as directed by the Engineer –in-charge.

54. Providing PPE's to personnel:

a. The Contractor shall provide safety helmets, safety shoes, safety belts, gloves, goggles, mask etc. and any other PPE's required during the works.

b. It is the supreme responsibility of Contractor to ensure the adequate number of PPE's for all the employed personnel from time to time and they are adequately trained to work with all safety PPEs.

c. Personnel shall also undergo height pass test for clearance to work at height which is in the scope of the Contractor.

55. Preparation and submission of erection reports/daily reports / monitoring sheets.

56. For free issue materials, the contractor will be provided with manufacturing documents, working documents, drawings and any other documents required for erection of equipment. The contractor must go through all the documents and prepare the erection procedure and submit the same for NPCIL approval before taking up erection works.

57. The Contractor will be provided with manufacturing documents, and any other documents required for commissioning of equipment. The Contractor must go through all the documents and prepare the commissioning documents and submit the same for Purchaser's approval or the Purchaser's approved commissioning documents will be issued to the contractor before taking up commissioning works.

58. The passport of each equipment shall be verified for correctness of installation, BOM checks etc. No work shall be taken up without approved procedure or documents.

59. Before start of any commissioning activities in any of the electrical equipment, the erection and pre commissioning checklist needs submitted by the Contractor. The report should be submitted to Purchaser's for the completeness in all respects by the Contractor

60. The testing should be carried out in line approved commissioning procedure

61. The Contractor shall plan and prepare daily schedule of erection/ Pre-Commissioning / Commissioning activity with manpower allotment one day in advance and it is to be submitted to the Purchaser for review and acceptance. The overall weekly and monthly schedule shall also be prepared before taking up the works and shall be submitted to the Purchaser for review / acceptance.

62. The contractor shall maintain field log book with the field activities carried out, entered in legible and chronological manner.

63. The contractor shall submit commissioning checklist after completion of each commissioning activity based on the various documents / commissioning procedures / drawings given prior to any testing / commissioning activities.
64. The test reports / commissioning reports as per the tests to be carried out shall be submitted. The Contractor shall prepare compiled test reports and submit to Purchaser's – KKNPP for the equipment commissioned.
65. The Contractor shall check for BOM and any missing parts from the equipment shall be informed well in advance to avoid the delay in arranging of spares for the equipment.
66. The termination / wiring mismatches, deficiencies, if any, found during the commissioning / schematic / logic checks with respect to the approved documents / drawings / manuals etc. shall be rectified with due consultation of concerned engineers at no additional cost, for successful commissioning / charging.
67. Attending / removal / rectification of any deficiencies as reported by Purchaser are all included in the scope of works. If Purchaser representative is not satisfied with commissioning tests carried out the required/all tests to be repeated for verifications of the same. Commissioning adjustments / relay setting adjustments to be carried out during the process commissioning are also included in the scope of works.

10.3 JOB SPECIFICATIONS FOR 230 kV & 400 kV GAS INSULATED SWITCHGEAR (GIS) AND GAS INSULATED BUS DUCT (GIBD)

Scope of erection works includes the following:

1. Material receipt at site, safe unloading at site and safe storage at site etc. as per the specific requirements covered elsewhere in the relevant chapters / sections of the document.
2. All the items received at site, shall be listed and documented properly and the packages shall be inspected both visually as well as for verification of bill of materials as per the packing list. Missing items shall be listed and necessary action shall be taken to arrange the same without any delay. Necessary actions to replace the damaged parts / components / equipment shall also be taken, in case of observance of any damages during the transportation / unloading etc.

3. Inspection of the material received at site, with due participation of all the concerned groups / agencies / representatives of Purchaser / Corporation.
4. Insurance during the storage, erection, testing and commissioning / till handing – taking over of the equipment to Purchaser / Corporation in line with guidelines.
5. Drawl of the various parts, assemblies from stores, safe material handling /safe transportation to the location/erection point, storage, preservation, verification of healthiness and completeness after unpacking etc. Required handling machineries / cranes shall be mobilized for the above.
6. The transport units house the partly assembled units. To prevent ingress of moisture and dust in the gas compartments, all the transport units which can be sealed are pressurized with dry Nitrogen. Scope includes maintenance of the shipment units if the storage exceeds prescribed limits including supply and replenishment of nitrogen gas in case of requirement.
7. Thorough / Deep cleaning of the area, i.e. cleaning of the floor, ceiling, walls, corners, trenches, ducting, equipment etc. to ensure total dust free atmosphere before taking up actual installation works. Cleaning and maintenance of dust free atmosphere is a continuous process and the same shall be carried out using high powered vacuum cleaners to remove all sorts of fine dust present inside the building. Cleaning shall be done right from the beginning of GIS / GIBD erection to commissioning.
8. Prior to commencement of the job, bench mark given / available in the site shall be inspected and transferring of level coordinates to the GIS / GIBD installation shall be done with utmost accuracy. With the help of drawings, all the coordinates given in the drawings shall be marked and cross – checking of the same to match the drawings / coordinates of other equipment such as Transformers, outdoor switchyard, GIBD etc. shall be carried out.
9. Erection of GIS/GIBD supports / supporting structures including grouting of the anchor bolts / halfen beams, if applicable, in the foundation pockets/welding on to embedded parts/fastening through concrete fasteners. Supply of all required consumables for civil grouting, finishing, etc. is also included in the scope. Any field modifications required in the supporting structures shall be carried out within the scope of this contract.

10. It is possible that, core cutting machine may have to be deployed for drilling the holes in the floor for installation of anchors and the same shall be mobilized by the Contractor before commencement of job at no extra cost.
11. The items required for the erection shall be brought sequentially as per erection sequence as discussed and decided along with manufacturer's representative. Assembly/alignment, erection of the various components like circuit breakers, bus bar, connectors, earthing switches, SF6/air bushings, lightning arrestors, CTs, VTs, bus ducts, local control panels, etc. and SF6 gas filling in various assembly units of GIS/GIBD.
12. Installation of the appropriate size/type of grounding conductors between the earthing points of the equipment and the nearest earthing pad/strip including all the welding/brazing, required as per the drawings. All required consumables for welding, inspection of the welds is also included in the scope of works.
13. Any GIS / GIBD installation involves / needs lot of consumables and all these items shall be arranged without fail throughout the erection / commissioning period. Temporary racks for storing the GIS components may have to be arranged to facilitate the erection in a systematic manner.
14. Any GIS / GIBD installation involves / needs a large no. of special tools and tackles and the same shall be arranged either directly (wherever possible) or from the manufacturer (preferably better) to facilitate smooth erection, testing and commissioning. In case, some of the Special tools which are used during the erection, needs to be taken back by the GIS / GIBD manufacturer, such a list shall be submitted to the Purchaser in advance for review / concurrence of the Purchaser. However, decision of Purchaser is final in this regard.
15. Touch up painting of the GIS/GIBD as directed by Purchaser including supply of approved touch up paint.
16. Cabling and wiring installation, glanding, termination, connection between all the components of the GIS/GIBD and up to the local control panels. The entire lot of cables and its accessories required for the above are in the scope of GIS / GIBD supplier. The necessary inputs regarding cabling works shall be given in advance to civil designers of the contract in order to design sufficient size of the cable trench inside the GIS building.

17. The cable trench inside the GIS buildings shall be covered by steel or FRP / GRP chequered plates and lifting and closing operations of these trench covers may have to be done repeatedly during the scope of this contract and the same shall be done within the scope of contract.
18. Termination/Connection of the GIS with GIBD/SF6-air bushings/SF6-oil Bushings at all points and incase of GIBD, connection of GIBD with SF6-Oil Bushings of Transformers/shunt reactors and with GIS.
19. Sealing of openings in the wall after erection of the GIBD/SF6-Air bushings with a permanent set up as recommended by the manufacturer. The scope may also include temporary closure of these openings during the erection to prevent dust or water entry during the erection and the same shall be done prior to taking up erection at no extra cost. In case of any special arrangement to close these openings, the same shall be brought to the notice of Purchaser.
20. Providing assistance and carrying out necessary modifications, as felt necessary, during commissioning and performance testing in the presence of manufacturer
21. Presence of manufacturer's representative is mandatory for GIS / GIBD erection and Purchaser reserves the right to request the Contractor to augment the no. of specialists to be mobilized at site during the erection, testing, pre-commissioning / commissioning works. Persons being deployed at site shall be qualified and experienced enough to resolve the various issues cropped up during the erection. To begin with, one or two specialists shall be arranged but as the erection goes further, the no. shall be augmented to meet the network schedule and during the peak works of erection / gas filling / testing etc. there shall be separate specialists for GIS and GIBD works of each unit.
22. Qualified and experienced Specialists shall be mobilized for the HV testing of GIS / GIBD installation at no extra cost and testing engineer / specialist shall control and supervise the entire testing operations from the start to end, in the safest possible manner, in order to complete the HV testing as per operating manual and approved erection & testing procedure / QA Plan, as the case may be.

23. Inspection, testing and commissioning of the equipment (GIS & GIBD) as per the approved procedure / manufacturer's instruction / QA Plan etc.
24. In addition to the daily floor cleaning / mopping, the contractor shall deploy a dedicated team for cleaning the GIS equipment prior to commissioning / charging. In addition to the epoxy paint flooring provided as per civil specification to the GIS floor, GIS assembly area / floor shall be pasted with PVC mat to ensure smooth handling of the GIS components being erected.
25. Any kind of re-works during the HV testing such as removal of GIS/ GIBD assemblies / sections / CBs / DS / ES or even flanges, conductors, bushings, etc. shall be carried out as a part of the GIS / GIBD works and no extra claim is permissible. This may even involve removal of outdoor switchyard equipment such as Bus post insulators, CVTs, Wave Traps etc. and the same shall be done within the scope of works of GIS / GIBD. The presence of manufacturer's specialist during the HV testing shall also be arranged for witnessing and prompt analyzing of the HV test results.
26. All the jobs required to accomplish the successful HV testing of GIS / GIBD installation shall be carried out within the scope of GIS / GIBD works such as arrangement of HV testing equipment to site, handling of testing equipment, setting up of test set up, HV testing, report generation, any trouble shooting during the HV testing, requirement of any special arrangement to be made during the HV testing to prevent flash over with adjoining structures / pipelines etc..
27. Any failure of insulators / GIS and GIBD components during the HV testing shall be replaced at no extra cost and root cause analysis (RCA) of the failure shall also be carried out to find the reasons behind any such failure and decision of Purchaser is final and binding in this regard.
28. Earthing conductor required for earthing of GIS / GIBD shall also be supplied as a part of GIS / GIBD works and installation of the same is covered within the scope of GIS / GIBD works.

29. Any modifications required in the GIS / GIBD assemblies / sections / conductors, etc. to integrate the GIS / GIBD installation with RATs / CSAT / GTs / Shunt Reactors / SF6 bushings shall all be carried out as a part of the GIS / GIBD works.
30. SF6 gas shall be supplied as per technical specifications and relevant standards and gas shall be arranged in sufficient quantity as specified in the tender document. The scope of GIS / GIBD works include all the associated works required for SF6 gas filling works such as, evacuation, vacuuming, gas filling, re-evacuation, re-filling, leak detection, etc. and all these jobs shall be done as a part of the entire works. The job may necessitate multiple operations of this kind due to site exigencies / HV testing etc. and the same shall be done without any extra cost.
31. During the SF6 gas filling job, in some cases as decided by the manufacturer, we may need Nitrogen gas of purity 99.99% to fill the GIS / GIBD sections prior to Sf6 gas filling to ensure the leak tightness for pre-determined period so that, clearance for SF6 gas filling can be given. All the necessary N2 gas shall be arranged by the Contractor for the above operations.
32. Painting / labeling of the GIS / GIBD installation with KKS codes as per the site procedure / colour codes etc.
33. The scope of GIS / GIBD works described above is complete in all respects, in order to hand over the fully erected and commissioned GIS / GIBD installation. However any other job, minor or major, which is not specifically mentioned, but required to complete the supply, erection, testing, pre-commissioning / commissioning of GIS / GIBD installation, the same shall be done and accomplished as a part of the GIS, GIBD works, complete in all respects.
34. Operation and maintenance of the EOT crane installed inside the building is also covered within the scope of contract, till completion of GIS / GIBD installation works.
35. For lowering of the GIBD inside the tunnel, the slab covers of the tunnels may have to be opened and closed repeatedly, as a part of GIS / GIBD installation works. Similar actions may have to be taken up in case of any need to replace or interchange the GIBD from / to the GIBD tunnels.

36. Special trolleys required to facilitate the erection and movement of GIBD inside the tunnel shall also be mobilized as a part of the GIS / GIBD works.
37. Provision of Temporary power supply and temporary lighting required during the erection, testing and commissioning is also included in the scope of these works.
38. The workmanship during the entire erection works shall be of very high order, both in terms of quality as well as safety and the same high standards shall be maintained throughout the period of contract without any compromise.

10.4 JOB SPECIFICATIONS FOR 400kV and 230kV OUTDOOR SWITCHYARD WORKS (ELECTRICAL)

The scope of erection works includes the following:

1. The scope includes preparation of Design Basis Report (DBR) for all the equipment for both 400kV and 230kV switchyards before start up of the works.
2. Based on the DBR, individual equipment design / selection, support structures design / selection, design of gantry structures, drawings of each individual systems, single line diagram, equipment layout, etc. shall be submitted for Purchaser approval and necessary clearance before start of works.
3. Erection procedure, safety procedure, QA procedure along with checklist and JHA should be submitted and necessary approval to be taken from Purchaser.
4. Separate procedures are to be prepared where ever necessary such as copper welding, welding procedure, outdoor copper conductor brazing/welding, crimping etc and necessary approved from Purchaser.
5. Detailed scheduling including documentation should be submitted to Purchaser. Based on the detail scheduling, daily progress report should be sent to Purchaser. If any delay in progress of the work, the daily progress report should have mentioned the reason for delay and agency for the delay should also be mentioned and all the necessary coordination with PGCIL/TANGEDCO should be done by the contractor till complete commissioning of outdoor switchyards.
6. All the tools & tackles, cranes for erection use shall be of standard make and should have calibrated in Purchaser approved Test labs.

7. All the PPEs, used by the work force for erection, testing commissioning should be qualified one.
8. Where ever necessary the work man should be qualified by Purchaser or Purchaser authorized group for specialized jobs.
9. Whenever temporary electrical power is taken for erection/testing it should be follow the Purchaser safety guide lines and any improvement required as per Purchaser safety guidelines it should be complied.
10. The procedures for handling of the outdoor switchyard equipment, such as unloading / loading operations, transportation, job hazard analysis, measurement of various parameters, Material receipt at site / Contractor's store, safe unloading at site and safe storage at site etc.. shall all be as per the specific recommendations from Manufacturer.
11. All the items received at site, shall be listed and documented properly and the packages shall be inspected both visually as well as for verification of bill of materials as per the packing list. Missing items shall be listed and necessary action shall be taken to arrange the same without any delay. Necessary actions to replace the damaged parts / components / equipment shall also be taken, in case of observance of any damages during the transportation / unloading etc.
12. If any components are found damaged during the inspection, the same shall be replaced with fresh piece, to be supplied at no extra cost.
13. Drawl of the various parts, assemblies from stores, safe material handling /safe transportation to the location/erection point, storage, preservation, verification of healthiness and completeness after unpacking etc. Required handling machineries / cranes shall be mobilized for the above.
14. Inspection of the material received at site, with due participation of all the concerned groups / agencies / representatives of Purchaser / Corporation.
15. Insurance during the storage, erection, testing and commissioning / till handing – taking over of the equipment to Purchaser / Corporation
16. The cleaning of all the equipment and housekeeping is in scope of contractor till commissioning and handed over to Purchaser is in the scope contractor.

17. All the testing equipment should have required accuracy class and been calibrated in Purchaser approved labs.
18. Only standard connectors/clamps/testing supply equipment should be used for testing.
19. Thorough Cleaning of the area to ensure dust free atmosphere before taking up installation works. Cleaning and maintenance of dust free atmosphere is a continuous process and the same shall be carried out to remove all sorts of fine dust present in the area.
20. Regular cleaning shall be ensured right from the beginning stages of erection to commissioning / handing over.
21. Prior to commencement of the job, bench mark given / available in the site shall be inspected and transferring of level coordinates to outdoor equipment installation shall be done with utmost accuracy. With the help of drawings, all the coordinates given in the drawings shall be marked and cross – checking of the same to match the drawings / coordinates of other equipment such as GIS / GIBD, IPBD etc. shall be carried out.
22. Excavation of the site for installation of concrete pillars shall be carried out as per the approved layout plan of the drawings in a safe manner. The extra soil resulted from the above activity must be taken out the erection site and be dumped away to the location decided by the Purchaser.
23. Anti-termite / anti – weed treatment shall be considered as per the relevant guidelines and standards followed for the same, as a part of the outdoor switchyard works.
24. Earthing of all the outdoor switchyard structures shall be carried out as per the approved drawings.
25. The aggregates spreading shall be carried out as per the technical specifications and as directed by Purchaser, throughout the area of outdoor switchyard.
26. Danger notices on the fencing of the outdoor switchyards shall be provided as per the standard guidelines and relevant specifications / drawings.
27. Fencing shall be grounded separately as specified in the drawings / technical specifications and shall have the provision of lockable gates at either ends of the yard.

28. Transportation, shifting, erection, testing and commissioning is to be done by the manufacturer's recommendation and if any deviations are found, then the decision of Purchaser's engineer – in – charge is final in this regard.
29. If crane is proposed to be used for the handling of the outdoor switchyard equipment, then, the required capacity of the crane duly tested and calibrated shall be deployed after assessment safety measures in place. Arrangement of any such crane is also in the scope of Contractor.
30. During the erection of outdoor switchyard equipment as well as during the High Voltage Testing of the Gas Insulated Switchgear, heavy vehicles, cranes etc.. may have to be moved inside the outdoor switchyard area and hence, in order to facilitate the smooth movement of handling vehicles, plant & machineries, internal road designed within the outdoor switchyard area shall be sufficient enough to meet the above purpose.
31. Any removal of erected structures during the HV testing of GIS shall be carried out at no additional cost and re-erection of the same shall also be carried out within the scope of these works.
32. Identification of R, Y & B Phases shall be marked / painted on the outdoor switchyard equipment
33. The scope also includes necessary coordination with grid authorities for smooth integration of gantry structure with terminal towers of 230kV & 400kV transmission line systems respectively.

10.5 JOB SPECIFICATIONS FOR 24kVGENERATOR CIRCUIT BREAKER (GCB)

Scope of erection works includes the following:

1. Generator Circuit Breaker (GCB) along with its auxiliaries such as Dis-connector Switch, Earthing Switch, Circuit Breaker Compartments, Surge Arrestors / Surge Capacitors, shorting links will be offered as 'free issue material' to the Contractor for erection works.
2. Verification of equipment front readiness at site. Since GCB needs clean area prior to taking up erection works, a survey of the area for its readiness to take up the actual erection works at site, shall be carried out an area readiness report shall be generated.

3. The survey of the embedded parts and pockets left out in the floor for mounting the GCB shall be carried and non – conformity of the same shall be brought to the notice of the Corporation.
4. Any minor chipping of the concrete, EP levelling etc. are all included as a part of the GCB erection works. However in case of any major rectification of the EPs, then the same shall be carried out as a separate works under the respective item of BOQ.
5. In case of assurance of readiness of the site fronts, necessary handling equipment for shifting of the GCB from NPCIL stores to erection point such as crane of required capacity, long bed trailers, appropriate ropes etc. shall also be mobilized prior to actual shifting of the GCB.
6. Drawl of the GCB from stores, safe material handling /safe transportation to the location/erection point, storage, preservation, verification of healthiness and completeness after unpacking etc.
7. On receipt of the item at erection point, all the items received at site, shall be listed and documented properly and the packages shall be inspected both visually as well as for verification of bill of materials as per the packing list. Missing items shall be listed and shall be reported to Corporation immediately for appropriate resolution.
8. All care shall be taken to avoid any kind of damages / scratches / dents to the consignment, during the transportation / loading / unloading operations.
9. To prevent ingress of moisture and dust in the compartments, all the transport units which can be sealed are pressurized with dry Nitrogen. Scope includes maintenance of the shipment units if the storage exceeds prescribed limits including supply and replenishment of nitrogen gas in case of requirement
10. Thorough cleaning of the area, i.e. cleaning of the floor, ceiling, walls, corners, trenches, ducting, equipment , etc. to ensure total dust free atmosphere before taking up actual installation works. Cleaning and maintenance of dust free atmosphere is a continuous process and the same shall be carried out using high powered vacuum cleaners to remove all sorts of fine dust present inside the building. Cleaning shall be done right from the beginning of GCB erection to completion of erection works.

11. Prior to actual commencement of the job, bench mark given / available in the site shall be inspected and transferring of level coordinates to the GCB installation shall be done with utmost accuracy in order to ensure its smooth integration with Generator side IPBD leads on one side and GT side IPBD leads on the other side. The survey of entire routing covering generator to generator transformer shall be carried out before taking up erection to ensure that, GCB coordinates are within the required tolerance on either side.
12. The orientation of GCB shall be checked with the help of drawings to install the right phase unit at right place in the required orientation.
13. In order to ensure the above, all the coordinates given in the drawings shall be marked and cross – checking of the same to match the drawings / coordinates of other equipment such as Transformers, Generator etc. shall be carried out.
14. Erection of GCB supports / supporting structures including grouting of the anchor bolts / welding to EP in the foundation pockets , etc. shall be carried out as per the drawings.
15. Supply of all required consumables for civil grouting, welding, finishing etc. are also included in the scope of works. Any minor field modifications required in the supporting structures shall be carried out within the scope of this contract.
16. The items required for the erection of GCB units shall be brought sequentially according to the erection sequence as per the erection drawings. Assembly/alignment, erection of the various components like circuit breakers, bus bar, connectors, dis-connector switches earthing switches, CTs, VTs, Surge Capacitors, local control panels, etc. shall all be mounted as per the required sequence and as per the erection drawings.
17. Installation of the appropriate size/type of grounding conductors between the earthing points of the equipment and the nearest earthing pad/strip including all the welding/brazing / termination required, if any, as per the drawings. All required consumables for welding / brazing / termination, etc. and inspection of the same are all included in the scope of works.
18. Mounting of the GCB enclosure through welding/bolting to base frame as specified by OEM. Assembly of the GCB, bus duct and the buses, alignment, jointing of the different

sections by Aluminium welding and bolt/nut/flange as per applicable standards and manufacturer's specifications.

19. During the erection, before welding of the GCB enclosure to IPBD, pole frame supports shall be removed and GCB shall be erected on the supports of the GCB.
20. Prior to welding of the GCB enclosure to IPBD enclosure or vice versa, the Qualification of welding procedure/welder for welding of bus duct & GCB enclosure shall be carried out with a mock up assembly to be arranged by the contractor. Only the welder qualified for welding the IPBD / GCB enclosure is allowed to take up the actual job. Contractor shall take necessary steps to ensure qualification of at least two – three welders to ensure that, progress of the job is not affected.
21. Argon gas welding shall be employed for all Aluminium to Aluminium welding for bus bar, bus duct enclosure, unless specified otherwise in the document / manufacturer's instructions.
22. 100% Dye Penetration Test (DPT) of each run of weld on all site welds.
23. Installation and connection of the flexibles at either ends, as applicable, for all the poles.
24. Installation of all the cables, termination and connection of the same between various components/accessories / local control panels of the GCB.
25. Connection of surge arrestor, Surge capacitor to bus duct has to be done with flexible copper conductors of sufficient size as specified in OEM specifications.
26. Installation of grounding conductors of the size as mentioned in the drawings from the GCB to the nearest grounding pad/riser/ main grounding strip including welding, brazing, at the joints as specified by OEM.
27. In case of GCB being supplied without SF6 gas, the scope of the GCB erection works also include the works of Sf6 gas filling, as per the specified SF6 gas filling procedure at no additional cost. SF6 gas will be arranged by the Corporation at NPCIL stores and Contractor shall make his own arrangements to shift the required quantum of SF6 to erection site for the above mentioned SF6 gas filling works.
28. The scope of gas filling works include all the associated works required for SF6 gas filling works such as, evacuation, vacuuming, gas filling, re-evacuation, re-filling, leak detection ,

etc. and all these jobs shall be done as a part of the entire works. The job may necessitate multiple operations of this kind due to site exigencies and the same shall be done without any extra cost.

29. After the completion of erection works, cleaning of the enclosure shall be done using vacuum cleaners and Contractor shall ensure exclusion of any Foreign Materials (i.e. FME Practice) inside the GCB chambers.
30. During the installation works at site, to prevent the atmospheric precipitation, sand or dust getting into the inner chambers of the GCB chambers, end sections shall be wrapped with suitable polythene sheets or through any other suitable methods.
31. Touch up painting (paint as specified by the manufacturer) of the exposed / scratched surfaces after completion of erection works prior to handing over for site testing and commissioning works.
32. The scope GCB Erection works described above is complete in all respects, in order to hand over the fully erected GCB unit to the concerned group for further testing and commissioning. However any other job, minor or major, which is not specifically mentioned, but required to complete the GCB installation, then the same shall be done and accomplished as a part of GCB works, complete in all respects.
33. The workmanship during the entire erection works shall be of very high order, both in terms of quality as well as safety and the same high standards shall be maintained throughout the period of contract without any compromise.

10.6 JOB SPECIFICATIONS FOR 24kV ISOLATED PHASE BUS DUCT (IPBD)

24kV Isolated Phase Bus Ducts (IPBD) along its auxiliary systems and accessories will be offered as 'Free issue materials' to the Contractor for taking up the erection works**.**

The scope of erection works includes the following:

A. General Guidelines:

1. The bus ducts as per issued drawings shall be supplied in parts and all the parts shall be assembled and the bus bar connections shall be made at site.

2. The insulators in bus ducts shall be inspected for any possible damage during transit and the defective ones shall be replaced. The insulators shall be cleaned during this inspection process.
3. Contact surface of bus bars, bus bar bolts and nuts shall be thoroughly cleaned. Petroleum jelly shall then be applied and bolted connection made.
4. The bus duct enclosure shall be checked for earth continuity and then earthed at one place. The bus duct shall be properly supported between switchgear and transformer.
5. The openings in the wall, where Isolated Phase Bus Duct enters the electrical building / switchgear room, shall be completely sealed to avoid rain water entry.
6. Expansion joints, flexible connections etc. shall all supplied by the manufacturer of the bus duct and they all shall be connected as per the manufacturer recommendations.
7. The bus duct leveling shall be checked with spirit level and pendulum weight or any other suitable instrument.
8. During the installation, usage of hoists, slings to bus duct sections and its assemblies shall be carried out by only experienced and trained work force. For hoisting and transportation of the bus duct elements, only hoisting slings, in good condition, shall be used.

B. The scope of works, in detail, are covered as given below:

1. Drawl of the various parts, assemblies from stores, safe material handling /safe transportation to the location/erection point, storage, preservation, verification of healthiness and completeness after unpacking etc. Required handling machineries / cranes shall be mobilized for the above.
2. Thorough Cleaning of the area shall be carried out to ensure dust free atmosphere before taking up installation works. Cleaning and maintenance of dust free atmosphere is a continuous process and the same shall be carried out to remove all sorts of fine dust present on the IPBD. Cleaning shall be done right from the beginning of erection to commissioning in order to ensure the desired IR value before charging.
3. Prior to commencement of the job, bench mark given / available in the site shall be inspected and transferring of level coordinates at either end equipment of IPBD shall be done with utmost accuracy to ascertain the alignment along with equipment on either sides.

With the help of drawings, all the coordinates given in the drawings shall be marked and cross – checking of the same to match the drawings / coordinates of other equipment such as Transformers, IPBD etc. shall be carried out. Coordinates of IPBD supporting structures erected prior to taking up of erection of IPBD shall be checked and verified with drawings.

4. Leveling, mounting and welding of base frames / supporting structures to embedded parts at relevant locations. Shim plates wherever required shall be supplied and installed to achieve the leveling requirements. The welding of the base frame with the EP shall be as per the design documents /drawings.
5. Since EPs and supporting structures are embedded and installed respectively by the Corporation, survey of the same shall be carried out and any minor modifications / rectifications of EPs / supporting structures required to bring the same to the desired level, as shown in the equipment drawings shall be done as a part of IPBD installation.
6. Painting of the welded areas, base frame, EP, including supply of primer and finish enamel paints, touch up painting including supply of the same
7. Mounting of the hot dip galvanized base frame supplied by IPBD manufacturer / Corporation to the base channel through bolting / welding or grouting of the support on the pockets provided in the foundation, etc. as specified in the drawings.
8. Contractor shall plan the general sequence of installations of the bus duct sections and assemblies with due regard for local environment and considerations such as commencement of installation from Generator end to Transformer end including the tappings to auxiliary transformers.
9. Mounting of the IPBD enclosure through bolting to base frame. Insulating pad to be provided for getting electrical isolation between IPBD enclosure and earthed supports. IR value of each assembly to be taken prior and after erection and minimum value to be ensured before proceeding to next assembly welding.
10. Prior to taking up installation works, the inner surfaces of the IPBDs shall be cleaned through blowing of compressed air and vacuuming. The supporting insulators must be inspected for any visible damages and a report on the same be recorded / generated.

11. The seal off bushings and gaskets of the IPBDs shall be visually checked for its clearances as per the manufacturer's drawings.
12. Assembly of the bus duct and the buses, alignment, jointing of the different sections by Aluminum welding and bolt/nut/flange as per applicable standards and manufacturer's specifications.
13. Mounting, alignment, jointing/bolting of panels/cubicles, etc. as per erection Assembly of the hot dip galvanized / metalized supports, installation of the same by grouting, fabrication, welding, painting of the welded areas, including supply of hardware wherever required.
14. Bus duct sections shall be provisionally arranged on support beams and metal works, fastened to embedded items in accordance with accepted installation procedure.
15. At the place of bus duct joint, if rings are specified, then different sections of the enclosure are to be joined through a ring which shall be welded on either sides to the enclosure with a weld size of 6 mm max or otherwise specified by OEM. The Rings are to be supplied along with the IPBD.
16. Assembly and installation of all auxiliary systems and its accessories like coolers, heaters, valves/dampers, associated piping VTs, CTs, expansion bellows, local panels etc. and touch up painting of the outer surfaces as specified in the drawings. While installing the actuators for dampers (if applicable) care shall be taken for not interchanging between regulating type dampers and on/off type dampers.
17. During the installation works at site, to prevent the atmospheric precipitation, sand or dust getting into the inner chambers of the IPBDs, end sections shall be wrapped with suitable polythene sheets or through any other suitable methods.
18. Earthing of IPBDs needs to be done at one end only as specified in the drawings, by giving two independent minimum 70 sq mm size conductor grounding.
19. While installing the telescopic units of IPBD, if applicable, at generator side, the Y phase outer enclosure shall be aligned in such a way that radiator ribs of Y phase shall not touch with other two phases.

20. The grounding points of Inbuilt IPBD VTs shall be connected by a suitable conductor to IPBD enclosure, wherever applicable.
21. Inspection, erection and erection testing, if any, of the equipment as recommended by the manufacturer. Repeated cleaning of the IPBD insulators may have to be done to ensure the minimum IR value of the IPBD (with respect to phase to enclosure and enclosure to earth) as recommended by the manufacturer. In case of any necessity to replace the insulators to improve the IR value, the same shall be carried out at no extra cost.
22. Connection/Termination of copper flexible wherever applicable, at the GT / UAT / GCB ends as well as fixing/mounting of all CTs, VTs, in IPBD run shall be carried out as per the drawings.
23. In case of closure of joining of sections to the power transformers, Contractor shall ensure the design values of the clearances between the end contact plug of the IPBD and the transformer terminal and fasten (provisionally) the compensators, connecting terminals with buses of the bus duct, as given in the erection / manufacturer drawings.
24. Installation of grounding conductors of the size mentioned in the drawing from the IPBD to the nearest grounding pad/strip/riser including welding, brazing, etc.
25. Grounding of IPBD structures to nearest grounding risers to be done at all the locations nearer to that structure
26. The covers of VTs and CTs to be opened without any obstructions and there shall be approachability to do the maintenance on the same equipment inside the IPBD.
27. The earth continuity shall be ensured by connecting the copper flexible strips between the nearest telescopic unit to stationary enclosure. In this regard, detachable casings of bus ducts shall be grounded by means of flexible copper wires / strips.
28. All the temperature sensor unit aluminum sleeves and gas analyzer pipe points shall be welded as per the locations given in the WD.
29. The connection/removal of flexible at GT, Generator, UAT side, GCB end, or PT groundings, Surge capacitor/surge arrestor removal and reconnection for any type of Testing are to be performed without any extra cost till its handing over.
30. Sealing gaskets, wherever it is applicable, shall be installed as per the erection drawings.

31. Prior to IPBD welding, the Qualification of welding procedure/ welder for welding of bus duct & enclosure shall be carried out with a mock up assembly to be arranged by the contractor. Only the qualified welder is allowed to take up the actual job and qualified procedure shall be followed for actual works. Contractor shall take necessary steps to ensure qualification of at least two – three welders to ensure that, progress of the job is not affected.
32. Argon gas welding shall be employed for all Aluminum to Aluminum welding for bus bar, bus duct enclosure, unless specified otherwise in the document / manufacturer's instructions. Welding electrodes, welding machines and any other consumables required for the above works shall be arranged by the Contractor as a part of the above works.
33. 100% Dye Penetration Test (DPT) of each run of weld on all site welds.
34. The quality of weld in the buses and the casings shall be controlled by visual inspection and measurements as specified in the erection drawings and applicable standards / guidelines.
35. Erection and erection tests, if any, at site as per WD / manufacturer's recommendations and as per relevant standards / manufacturer's instructions prior to releasing of IPBDs for Pre-commissioning / Commissioning by the concerned groups of Contractor.
36. The copper flexible after checking the correctness with respect to duct conducting portions at both side may have to be taken and kept stored safely for avoiding theft and damages. This can be installed during final stage before handing over.
37. Touch up painting of enclosure and welded portions (paint as specified by the manufacturer) of the exposed surfaces after erection / welding prior to handing over to the concerned groups / Corporation including supply of touch up paint.
38. The scope of installation works also include the erection of IPBD auxiliary systems such as forced and closed loop air cooling system for main IPBD portions and for the Generator terminal portions.
39. In the erection of IPBD auxiliary systems, scope also includes installation of ventilation unit consisting of fans and electrical motors along with changeover valves and air ducts as well as other ventilation unit consisting of fan, air coolers, air ducts and systems of valve

controlled by single turn electrical mechanisms, flow controlled electrical operating rotary valves, etc. as detailed in the manufacturer drawings.

10.7 JOB SPECIFICATIONS FOR POWER TRANSFORMERS (GTs, UATs, RATs, CSAT & SHUNT REACTOR) – OIL FILLED

7 nos. of 1 Phase, 24 / 400kV, 417 MVA Transformers will be offered as 'Free Issue Materials' to Contractor for taking up the erection works.

4 nos. of 3 Phase, 24 / 6.3 / 6.3 kV, 63 MVA Unit Auxiliary Transformers, 4 nos. of 3 Phase, 230 / 6.3 / 6.3 kV, 63 MVA Reserve Auxiliary Transformers, 1 nos. of 3 Phase, 230 / 6.3 / 6.3 kV, 63 MVA Common Station Auxiliary Transformers and 2 nos. of 3 Phase, 400 kV, 125 MVAR Shunt reactor will be offered as 'Free Issue Materials' to Contractor, for taking up the erection works.

The scope of erection works includes the following:

1. The contractors shall thoroughly go through the manufacturer's manual and the instruction given shall be complied for preparation of erection & testing procedure. The Transformers and its accessories are to be maintained safely as per manufacturer's manual till completion of erection & handing over to the PURCHASER.
2. The procedures for handling of the transformers such as unloading / loading operations, transportation, job hazard analysis, measurement of various parameters, Material receipt at site / Contractor's store, safe unloading at site and safe storage at site , etc. shall all be as per the specific recommendations from Manufacturer.
3. In case of readiness of the site / erection location, the transformer can be directly shifted to the erection location and be safely unloaded with prior permission of the Purchaser / Corporation.
4. In case of non- readiness of the transformer erection point, while loading / unloading and during the shifting of the transformers, route / road survey needs to be carried out to facilitate smooth transportation of the transformer to site / erection point. Special

importance shall be given to the orientation of the transformer while loading in the trailer so that, turning operations of the transformer is minimized near the erection location.

5. A separate procedure for transportation and handling of the above shall be carried out prior to above job.
6. Necessary inputs required for the road / area strengthening near the transformer yard / road movement shall be given in advance for carrying out the road strengthening works.
7. All the items received at site, shall be listed and documented properly and the packages shall be inspected both visually as well as for verification of bill of materials as per the packing list. Missing items shall be listed and necessary action shall be taken to arrange the same without any delay. Necessary actions to replace the damaged parts / components / equipment shall also be taken, in case of observance of any damages during the transportation / unloading, etc. including coordination required, if any, with insurance groups.
8. Inspection of the material received at site, with due participation of all the concerned groups / agencies / representatives of Purchaser / Corporation.
9. If Impact-o-graphs are provided, as per technical specifications of the transformers, for recording the any undue vibrations / smooth transportations of the transformer, as well as handling of the transformer till its placement at erection point, then the graph of the same needs to be extracted from the instrument and to be analyzed for an impact / movement during the above operations and corrective actions, if any, need to be carried out based on the analysis of results.
10. Soon after receipt of transformer at site, preservation conditions of the transformers shall be verified as per the procedure given in the manufacturer's manual. If not specifically not mentioned / called for in the manual, the contractor shall take a sample of oil residue from the tank bottom and get it tested for moisture content in ppm, BDV value and tan delta. Pressure and Dew point of nitrogen gas in case of nitrogen filled tank, shall be done. This measurement shall be carried out every month during the preservation till erection completion.

11. Transformers during transportation from factory to site will be supplied with or without oil in the tank, as specified in technical specifications and as mutually agreed / discussed and decided at that stage.
12. In case of transformer is supplied without oil inside the tank, the same will be supplied with nitrogen gas of vey high purity inside with nitrogen replenishment cylinder duly fitted to the tanks. In this case, scope of the Contractor also includes periodic monitoring of nitrogen pressure and any leak shall be detected for taking corrective measures not only to arrest the leak but to replenish the nitrogen gas.
13. This operation shall be carried out with supply and replenishment of the nitrogen cylinders for pressurizing the transformer till oil filling.
14. If the transformers are supplied with oil inside the tank, then oil properties such as BDV, PPM, Tan Delta value etc. shall all be measured after its receipt at site through oil sampling as well as during the storage period (at periodic intervals) at NPCIL stores and reports on the same shall be generated and submitted to the Corporation.
15. Drawl of the various parts, assemblies from stores, safe material handling /safe transportation to the location/erection point, storage, preservation, verification of healthiness and completeness after unpacking etc.
16. Required handling machineries / cranes / wooden sleepers, etc. shall all be mobilized for the above with a crew specialized in these jobs.
17. Thorough Cleaning of the area to ensure dust free atmosphere before taking up installation works. Cleaning and maintenance of dust free atmosphere is a continuous process and the same shall be carried out to remove all sorts of fine dust present in the area.
18. In case of any need of strengthening of the locations in and around the Transformer erection point, the same shall be carried out.
19. Regular cleaning shall be ensured right from the beginning stages of erection to commissioning / handing over.
20. Prior to commencement of the job, bench mark given / available in the site shall be inspected and transferring of level coordinates to the transformer installation shall be done with utmost accuracy. With the help of drawings, all the coordinates given in the drawings

shall be marked and cross – checking of the same to match the drawings / coordinates of other equipment such as GIS / GIBD, IPBD etc. shall be carried out.

21. Verification of the leveling of the transformer foundation site shall also be carried out and any correction required to be done to meet the drawing coordinates / levels shall be done within the scope of this works.
22. Drawl of Material from stores, its various parts, components & accessories from stores, material handling /transportation to the location/erection point, storage, verification of completeness of the equipment/components after unpacking etc.
23. On readiness of the site and raising of material requisition, the main tank of the GT will be delivered by Corporation from NPCIL Stores to nearest possible location at erection point at site. Contractor shall ensure proper orientation of the Transformer before loading of the transformer on the trailer to minimize the site rotation / orientation change works, if any, at site.
24. Contractor shall however make prior necessary arrangements such as wooden sleepers, calibrated and tested hydraulic jacks of required capacity, in sufficient quantity to receive / unload the transformers near the erection point, for facilitating further unloading / shifting and moving the Transformers to its actual location.
25. All the above activities are to be ensured as stipulated in the manufacturer' s recommendation such as permissible angle of inclination during the movement, permissible lowering distance , etc. and if any deviations are found, then the decision of engineer – in – charge is final in this regard.
26. Transportation, shifting, erection, testing and commissioning (UAT, RAT, CSAT & Shunt reactor) is to be done by the manufacturer' s recommendation and if any deviations are found, then the decision of engineer – in – charge is final in this regard.
27. If crane is proposed to be used for the transformer (UAT, RAT, CSAT & Shunt reactor) shifting / transportation, then, the required capacity of the crane duly tested and calibrated shall be deployed after assessment safety measures in place. Arrangement of any such crane is also in the scope of Contractor for placement of transformer / reactor on rails.

28. Fresh and proven wooden sleepers required for the above job shall be arranged in sufficient quantity so that, on any given time, the sleepers arranged are sufficient enough for handling all the phases of Generator transformers at a time.
29. Steel plates, if any, required during the unloading / transportation operations shall be made ready in advance in case of any difficulties arisen due to soft / sinking soil below the transformer unloading point.
30. Once the transformer is received at erection point, visual inspection of the transformer shall be carried out again and report shall be generated for the jobs carried out and visual examination of the transformer, for checking of healthiness and completeness of the equipment offered for erection
31. Lifting of the transformer tank through calibrated and tested hydraulic jacks of the required capacity, to be arranged by the contractor well in advance and in sufficient numbers so that, two – three hydraulic jacks are always available extra to take care of any failure of the jacks, for fixing of the rollers as shown in the drawings, if required.
32. The transformer shall thus be safely lowered without violating the permissible degree of inclination and be safely moved to the actual erection point.
33. Whether it is called for or not in the transformer manufacturer's manual, internal inspection of the transformer inside the transformer tank shall be carried out, in particular for removal of any transport fasteners, core bolt tightness measurement, etc. Necessary corrective actions are to be taken in case of any deviations found during the inspection subject to review and acceptance of the same by Engineer – in – charge in this regard.
34. Prior to unsealing of the transformer, Dry air plant shall be arranged by the contractor which is capable of giving the dry air output at 250 cum / hour with a dew point of – 70 deg. C. in order to supply and fill the transformer tank with dry air at a min. pressure of 0.2 kg./ sq. cm or as per the value specified by the manufacturer.
35. Records of unsealing operations, with duration of transformer in unsealed condition, carried out during the erection period shall be maintained right from erection to commissioning period in order to ensure that, period of unsealing limit of transformer, as stipulated by the transformer manufacturer, is never crossed during the site works.

36. Transformer unsealing without dry air supply inside the tank is not acceptable right from the beginning.
37. Assembly of the various parts of the transformer like conservator, radiators, coolers, cooler control panel, OFTC / OLTC panel, bushings, etc. and internal inspection of the transformer as per erection drawings etc.
38. Vacuum pulling to the specified extent and vacuum hold test to be done. All required vacuum plant, nitrogen cylinders to be arranged by the CONTRACTOR. Every care and safety of the tank shall be taken / ensured during vacuum pulling operation to prevent any kind damage to the transformer tank.
39. Filtration of transformer oil in service tank(s) to achieve the required parameters. Scope includes periodic testing of the oil for the specified parameters at a NPCIL approved laboratory/facility. Contractor shall arrange the required capacity of oil filtration machine, service tanks, oil testing etc. at no extra cost. The capacity and specifications of the oil filtration machine to be used for the above job shall be submitted to NPCIL's review and acceptance prior to engagement of the same for site works.

i. Hot oil circulation shall be carried out until the required parameters of oil and electrical parameters of the windings are achieved and this may necessitate, multiple rounds of hot oil circulation and the same shall be carried out within the scope of works at no extra cost.
ii. Repeated hot oil circulation / filtration may have to be carried out under following circumstances:
    a. If Oil parameters are not within parameters of transformer manufacturer manual before charging / commissioning
    b. If Insulation resistance value of the transformer windings between each phase and ground is less than the acceptable value, as found during the electrical testing of the transformer
iii. In such a scenario, winding shall be dried using filtration machine, till the parameters are acceptable.
iv. In case of any large scale deviation of the IR value, the transformer may have to be dried using liquid nitrogen and technological tank, as per the procedure given by manufacturer or Engineer – in – charge, as the case may be.

v. Filling of tested oil into the transformer, pressure testing, connection and removal as instructed by the engineer) of the connections/terminations with the bus duct on LV and HV side.

40. Alignment of the Generator transformers with Isolated Phase bus duct (IPBD) on one side and with Gas Insulated Bus Duct (GIBD) on the other side. Any movement / shifting of the transformer to integrate / interconnect the transformers with IPBD & GIBD are included in the scope of the contractor as a part of GT / IPBD works.
41. Alignment of the other transformer with the bus duct(s) and grouting of the anchor bolts, if any, are included in the scope of the contractor as a part of transformer / IPBD bus duct(s) works.
42. Erection of neutral grounding/NGR supports (wherever applicable), grouting of anchor bolts for the same in the pockets provided, installation of the post insulators, NGR enclosure, painting, wherever applicable etc.
43. The scope also includes installation, termination, connection and testing of the HV side cables between the transformer neutral bushing and the NGR insulators (wherever applicable), all control cables and power cables between the control cubicle and various components like CT, fans, etc. including erection of cable trays supports (including fabrication, welding, painting, etc.), cable trays, grounding required for the same.
44. The transformer LV side terminal box and IPBD enclosure shall be sealed properly with suitable sealing compound to prevent ingress of water / moisture, etc.
45. Installation of grounding conductors from the transformer grounding points (tank, neutral, NGR, etc.) to the nearest earthing pad/riser/strip already provided through the specified sizes / types of conductors including all welding, brazing, joining through nut/bolts, etc. Wherever required bimetallic washers shall be supplied and installed.
46. Wherever necessary, supervision of the erection will be arranged by the Purchaser of Transformers/Shunt Reactors for erection, testing, pre-commissioning and commissioning.
47. Cleanup of the area, soak pits/burnt oil pits for the transformer prior and after erection and prior to commissioning.

48. Supply and spreading of gravel of the specified type and size in the area around the transformer as shown in the drawings to be provided before the actual work, as well as spreading of anti growth chemical compounds. Gravels size shall be as per relevant IS and the gravels shall be brought up to foundation level, from the soak pit bottom.
49. Touch up painting of the painted areas of transformer as well as complete painting (with same paint as the original paint) prior to plant startup including supply of paint.
50. Star and Neutral formation wherever applicable. The detailed technical requirements in case of Neutral formation of Generator Transformers are covered separately.
51. Inspection, erection, erection tests, if any, at site as per the manufacture's manual, prior to releasing transformer for pre-commissioning / commissioning by the Concerned groups of Contractor and subsequent charging of Transformers with necessary supervision/witnessing by concerned commissioning / O & M Group of Corporation.
52. Installation, erection tests, if any, of OLTC/OFTC including tap changer panel and marshalling panels, local control cubicles etc.

53. Generator Transformer Neutral Formations

53.1 The scope includes neutral formation through interconnection of neutral Bus bar (copper flat) supplied as a free issue material to the contractor, as a part of accessories of single phase Generator Transformers.

53.2 The work involves connecting the neutral bushing of Generating Transformers to neutral bus bar formed and connection of the neutral bus to the common station earthling in Unit 3 & 4 through multi-stranded copper conductor of approx. size : 400 sq. mm.

53.3 The jobs involves following works:

a) The supplied materials / accessories such as copper bus bar of 2 to 3 meter lengths, copper conductor for connecting the GTs neutral bushing terminal to bus bar and copper conductor for connecting the neutral bus bar connection to outdoor earthing conductor grid, support PI insulators for copper bus bar, etc supplied for the above job of "Neutral Formation" are to be visually inspected first at NPCIL stores and verification of the same for its compliance with the working documents requirements.

b) If any deficiencies in the supplied material or any shortage of accessories with respect to working documents, the same shall be brought to the notice of Engineer In Charge / Corporation.

c) Procedure for formation of neutral, copper welding procedure, safety procedure, JHA , etc. are all to be prepared and got approved from NPCIL before starting up the work.

d) Contractor shall note that, the job involves copper welding and only the person having prior knowledge and experience in this regard shall be mobilized for carrying out the welding works. The person who short listed for the above job shall be healthy, medically and physically fit, in view of the technically strenuous nature of the job.

e) As mentioned above, for copper welding, welder as well as welding procedure qualification shall be carried out first through mock up assembly and only the qualified welder is allowed for carrying out the copper welding works at site.

f) All possible safety precautions are to be taken as per approved procedure to avoid health and environmental damage during the copper welding.

g) All the supplied accessories are to be shifted to erection site in a safe manner after the completion of erection of GT and its interconnection with IPBD / GIBD and maintaining the same in safe custody. However the supporting post insulators (PI) for mounting the neutral bus bar on the sides of the 24kV IPBD supporting structures, can be drawn earlier for taking up the erection.

h) Since the erection of PI insulators along with supporting base frame have to be taken up at height, corresponding to the level of 24kV IPBD mounted on the eastern side of normal operation power supply building, the same shall be taken up through experienced person with height work permit. The required safety precautions are to be taken while working in height as per approved safety and JHA procedures.

i) Welding of the individual lengths of copper bus bars for neutral bus bar formation can be carried out at ground level and after the completion of welding and weld testing / verification etc., the same can be carefully and safely lifted for placing the same over post insulators already erected.

j) Contractor may please note that, in case of Unit -1 & 2, the neutral bus bar was installed at 15 mtr height, over supporting structures of 24 kV IPBD. However, this information is given only for reference and information of the contractor.

k) The Cu conductor for connecting neutral bus and the neutral bushing of Generator Transformers shall be carried out through heavy duty and special crimping machine, with copper lugs supplied by the Transformer Manufacturer. A mock up sample of the same shall also be carried out to ensure / demonstrate the fusing of lug with copper conductor with the crimping tool arranged by the Contractor. Heavy duty crimping tool shall be arranged by the contractor for the above works.

l) The Contractor shall ensure that, the connections made in the above mentioned manner at the both ends shall not load the neutral bushing and PI / Neutral bus bar and if extra supports are required for the same, the same (additional supporting arrangements) shall be arranged by the contractor as a part of the above works, to avoid transfer of load on either ends.

m) The neutral bus bar shall also be connected to outdoor grounding grid / common earth at two locations through multi-stranded copper conductor (supplied as free issue materials with transformer). While termination at bus bar end is to be carried out through crimping, at outdoor grounding grid, exothermic welding / brazing as per the approved procedure shall be adopted.

n) The conductors connected between the neutral bus bar and the outdoor grounding grid shall be supported where ever necessary. For example, if the conductors are running close to the fire barrier wall or structures, then the same shall be insulated with appropriate sleeves and clamped to the wall.

54. Following transformer erection & testing equipment / handing tools / tackles and machineries shall be arranged by the Contractor for transformer erection:

a. Required quantity of fresh and new sleepers for transformer loading / unloading

b. Required no. of duly tested and calibrated hydraulic jacks

c. New Dry air plant with a capacity of 250 cum / hr (min) with a dew point of – 70 deg. C

d. New Hot Oil circulation Filtration plant with a capacity of 6000 li / hr capable of doing parallel vacuuming / oil filtration jobs. The specifications of the machine shall be submitted to Engineer- in – charge prior to placement of the order and any recommendation in this regard shall be accepted. This machine shall be made ready well in advance, before the requirement

e. Oil heaters of capacity as per the specifications to be submitted and approved by the engineer – in- charge.

f. 10 nos. of Syringes for drawing the transformer oil samples from the tank

g. 10 nos. of oil sampling bottles

h. Transformer Oil Break Down strength testing kit and tan delta measurement kits

i. Required chemicals for oil testing / analysis required by NPCIL Oil testing lab.

j. High Duty Crimping Tool for crimping 400 sq. mm flexible conductor during neutral formation

Note: Services of the Transformer oil testing laboratory of Corporation, presently available in Chemical Laboratory of Unit – 1 & 2 can be extended for the following services, if required:

1. Solid insulation sample testing
2. Dissolved Gas Analysis (DGA)
3. Moisture Content measurement
4. Measurement of acid number, sediments, appearance, flash point, etc.

However, the manpower services required for the sampling and delivery of the required samples to laboratory and collection of reports, necessary coordination, etc. are all in the scope of Contractor.

However final testing of Transformer Oil and Dissolved gas analysis (DGA) shall be carried out in the NPCIL approved laboratories such as CPRI – Bengaluru / PGCIL – Hyderabad etc.

For the benefit of the Bidders / Contractors, the specific requirements of some of the

above works are covered in detail:

A. Lifting requirements, in case of handling of transformer / reactor through crane:

Transformers on receipt at site shall be unloaded by means of crane or lifting devices of adequate capacity. All lifting lugs shall be used to avoid unbalanced lifting and undue stresses on lugs. Lifting lugs, if any, provided for partial lifting (e.g. for active part, conservator) etc. shall not be used for lifting complete transformer. Parts other than those identified for lifting of the transformer shall not be used for lifting. While slinging, care shall be taken to avoid slings touching other parts. Loading points for lifting lugs and methodology of lifting shall be as per the sequence / procedure instructed by Reactor Manufacturer.

B. Transportation requirement through trailer:

Before lifting transformer, it shall be ensured that all cover bolts are tightened fully. In case when it is necessary to use jacks for lifting, projections provided for the purposes of jacking shall be used. Lifting jacks shall not be used under the valves or radiator tubes. For transporting transformers from stores to site, the transformers shall be loaded on a suitable capacity truck or trailer. The transformers shall be properly supported by steel ropes and stoppers on the trailer to avoid tilting of the transformers in transit due to jerks and vibrations. At no instance the transformer shall be kept on bare ground. Where it is not possible to unload the transformer directly on a foundation, it shall be unloaded on a properly built wooden sleeper platform. A transformer shall never be left without putting stoppers to the wheels.

C. Inspection at Site:

Transformers shall be examined for any sign of damage in transit. Particular attention shall be given to the following in this regard:

i. Dents on tank wall or cooling tubes, radiators
ii. Damage to protruding parts like valves, sight glass etc.
iii. Loosening of bolts due to vibration in transit
iv. Cracked or broken bushings
v. Oil leakage particularly along welds

vi. If any other adverse observation / deviation is noted, the same shall be then brought to the notice of Engineer- in- charge.

D. Inspection at Erection Location

i. Contractor shall examine the transformer base, oil pit, fire walls and foundations laid by the civil contractor. It shall be ensured that oil spills cannot propagate along cable trenches. Any discrepancy noted will be brought to the notice of Engineer- in- charge.

ii. Transformers shall be placed on channels or rails over concrete foundations.

iii. The transformers shall be levelled, aligned and checked for free movement on the channels or rails.

iv. Stoppers shall be provided to the transformers immediately to prevent any movement.

v. All the accessories like radiators, cooling fans, valves, conservator tanks, explosion vent pipe, bushings and other devices which are supplied in different packages shall be checked for any transit damage and cleaned thoroughly before fixing on the transformer.

vi. All loosely supplied parts shall be assembled as per manufacturer's instruction manuals/ drawings and documents.

vii. All the connections for CTs bushings and other wiring shall be checked for tightness and correctness before replacing the lid or tightening all the bolts.

viii. Gravels shall be filled in the transformer bay, soak pit as per requirement.

E. Topping of transformer with oil

a. Before topping up with oil, transformer shall be fitted with all accessories such as valves, gauges, thermometers etc.

b. Oil samples shall be taken from each drum and tested for determination of dielectric strength.

c. Any sign of leakage of the barrel or of its having been opened shall be recorded and reported.

d. It is necessary to filter the oil before the transformers are filled.

e. It shall be ensured in oil filling operation that no air pockets are left in the tank and that no dust or moisture enters the oil.

f. All air vents shall be opened.

g. Oil shall be filled through a streamline oil filter using metal hose.

h. To prevent aeration of the oil, the transformer tank shall be filled through the bottom drain valve.

i. In a transformer with conservator tank, the rate of oil flow shall be reduced when the level is almost up to the bottom of the main cover to prevent internal pressure from rupturing the pressure relief-pipe diaphragm.

j. Sufficient time shall be allowed for the oil to permeate the transformers and also for the locked -up air bubbles to escape.

k. Any air accumulation in the buchholz relay shall be released.

F. Transformer Oil

i. Sample of oil from the transformer shall be taken from the bottom of the tank.

ii. Testing of Oil: For dielectric test, the oil shall be tested as described in IS: 335. The oil shall also be tested for acidity in accordance with the methods prescribed.

iii. Drying out of the transformers, if required, shall be carried out and record maintained in accordance with IS: 10028. Normally a streamline filter shall be used for drying-up. IR value versus time of both windings along with OTI/ WTI and filtration machine temperature curve for IR value vs time shall also be plotted and recorded during the drying-up process.

G. Precautions to be observed during drying of Transformer:

i. The maximum sustained temperature to which transformer oil may be subjected shall be limited to 80°C.

ii. The transformer shall be carefully monitored throughout the drying out process and all observations shall be carefully recorded.

Drying out shall be continued so that the insulation resistance as prescribed in the standard code of practice is attained and the value remains constant for more than 12 hours. However, a minimum number of cycles shall be done for each transformer as found necessary by the Engineer-in-charge. Generally a Megger reading of 2 mega ohms/ kV at 60°C temperature with a 5kV Megger may be a rough indication for stopping the

dehydration.

55 Neutral Grounding Resistor (NGR) – Applicable to UAT/RAT/CSAT

The scope of works includes the following:

a. The NGR on its receipt to site shall be inspected for any damage to the resistor grid and other components and incoming inspection report be generated.

b. The resistor mounting shall be levelled and installed. All covers, its components etc. shall be checked for tightness to ensure that the enclosure of the resistor is dust, vermin and weatherproof.

c. Earthing conductors shall be taken from the outer end terminal of the resistor, for connection to earth electrodes / to the main grid. Checks such as IR, operation of space heater, earth resistance shall all be carried out before the commissioning.

d. NGR after installation shall be grounded as per the erection drawings.

e. The NGR box shall be painted with suitable KKS code marking.

f. All the consumables / hard ware accessories required for installation of the NGR are also included in the scope of this works.

10.8 JOB SPECIFICATIONS FOR 6 kV MV / 0.38 kV / 0.415 kV LV SWITCHGEAR / MCCs / ACDBs / DCDBs, RECTIFIER / INVERTERS / CMRP PANELS / SCADA /METERING /TRANSDUCER PANELS/ POWER DISTRIBUTION BOARDS

6kV Switchgears/0.38kV, 0.415kV Switchgears/MCCs/DCDBs/ACDBs / Rectifiers/ Inverters / CMRP Panels /common SCADA panels Power Supply Distribution Boards (PDBs , etc. under the Contractor's scope of supply for taking up the erection works (as per supply item SOQ of tender).

0.38kV, 0.415kV Switchgears/MCCs/ CMRP Panels/ unitized SCADA panels/metering panels/transducer panels/Power Supply Distribution Boards (PDBs), etc. will be offered as 'Free Issue Materials' to Contractor for taking up the erection works (as per erection items SOQ of tender).

The scope of erection includes the following:

A. General Guidelines:

1. Fabrication / assembly, installation of the supporting structures, alignment, EP verification & modification to suit / facilitate the erection works, installation of the same by welding, grouting, etc., as required as per the erection drawings, supply and installation of hard ware accessories wherever required, for completion of the erection works in all respects.
2. Unless specifically mentioned, all the required hard ware accessories and consumables for erection cleaning, welding/ brazing, NDT consumables such as nuts / bolts / washers / anchor fasteners / welding electrodes, cleaning agents, cotton cloth , etc. shall also be arranged by the CONTRACTOR
3. Installation of equipment as specifically described below for each equipment, as per erection drawings / manufacturer's instructions / manual or recommendations of the manufacturer and as per approved erection procedure and as directed by the Engineer – in – charge. The erection procedure for all the equipment shall be prepared in advance and be submitted for Purchaser's review and acceptance so that, all the activities are planned and executed in a well - coordinated manner.
4. Prior to carrying out any erection activity at site, Job Hazard Analysis (JHA) shall be carried out listing all the job hazards associated with the particular job from material receipt at site to handing over of the equipment and action proposed to be taken to ensure all the safety measures / provisions to execute the jobs with total safety, in every stages of erection works, (i.e. from material receipt at site to handing over of equipment), throughout the period of execution of the contract.
5. Safe storage / preservation of the equipment installed in the erection point / location, till commissioning and handing over of the equipment to Purchaser / Corporation. Periodic inspection / condition monitoring report shall be generated for equipment installed, and such reports shall be submitted to Purchaser / Corporation. Any recommendation made by the Engineer – in charge in this regard, to maintain the preservation requirements of the equipment shall be met / implemented at no extra cost. This may include supply of required polythene sheets / tarpaulin sheets / zipped box type polyethylene covers, etc. as the case may be, with concurrence of the EIC.

6. Maintenance of clean room conditions during from commencement of erection works to handing over of the equipment with a dedicated crew of house-keeping team, as per the detailed requirements covered elsewhere in the scope of tender document. Contractor shall give top most priority to maintain utmost clean room conditions and highest standards of housekeeping / up keeping both within and outside the buildings covered in the scope of this document.
7. The scope of erection is not limited to as described in this section and the CONTRACTOR shall not be relieved from his responsibility to ensure completion of the works in all respects at no extra cost. The scope of erection herein only provides the guidelines regarding the works to be carried out.

B. Installation Guidelines:

1. All the items received at site, shall be listed and documented properly and the packages shall be inspected both visually as well as for verification of bill of materials as per the packing list. Missing items shall be listed and necessary action shall be taken to arrange the same without any delay. Necessary actions to replace the damaged parts / components / equipment shall also be taken, in case of observance of any damages during the transportation / unloading etc.
2. If any insulators are found damaged during the inspection, the same shall be replaced with fresh piece, to be supplied at no extra cost.
3. Drawl of the various parts, assemblies from stores, safe material handling /safe transportation to the location/erection point, storage, preservation, verification of healthiness and completeness after unpacking etc. Required handling machineries / cranes shall be mobilized for the above.
4. Inspection of the material received at site, with due participation of all the concerned groups / agencies / representatives of Purchaser / Corporation.
5. Insurance during the storage, erection, testing and commissioning / till handing – taking over of the equipment to Purchaser / Corporation

6. The term "PANEL" here includes all HV/ MV/ LV switchgear panels, motor control centers, UPS panels, floor mounted ACDB / DCDBs, Battery charger / Rectifier panels, CMRP / SCADA panels etc.
7. Drawl of Material from stores, its various parts, components & accessories from stores, material handling /transportation to the location/erection point, storage, verification of completeness of the equipment/components after unpacking etc.
8. The switchgear panels shall be properly supported on the truck or trailer by means of ropes to avoid any chance of tilting. The switchgears shall be lifted after ensuring that panel supports, nuts and bolts are all intact and tightened. While lifting the panels in packed conditions, utmost care shall be taken to avoid any damage to insulators, bushings, metering and protective equipment.
9. The Panel shall be handled with care, avoiding any impact to the equipment. Dragging of the panels directly on floor shall be avoided and appropriate pellet trolley shall be used for shifting of the panels inside the buildings to erection point. Use of a crane and trailer shall be made for handling of equipment. Roller bars may be used for shifting of panels in case of difficulty to use pellets in certain locations owing to site constraints.
10. On receipt of the equipment at site, the loose components such meters, manufacturer supplied special cables, lugs, control display unit, if any, monitors, computers / VDUs if any, etc.. shall be separated out and be kept safely in Contractor's custody to prevent any damage / theft / mishandling during erection. List of all such removed components needs to be kept and maintained for easy reference and retrieval. These components need to be installed just prior to advanced stages of erection completion and handing over of the subject panel.
11. The panels shall be preferably kept inside the packing cases till foundations are ready. Proper rain/ sun/ dust protection shall be ensured till switchgears are installed.
12. After unloading of the panels near the erection point, the same shall be shifted inside the building using pellet trolleys / trucks. Shifting of the panels using rollers shall be avoided as far as possible.

13. For the panels to be located at higher locations, usage of hoists if any, through the equipment shaft is allowed, however, if the same is not available, then the Contractor shall make his own arrangement to shift the panels to higher locations using chain pulley blocks or any other suitable and safe arrangement.
14. Thorough Cleaning of the area to ensure dust free atmosphere before taking up installation works. Cleaning and maintenance of dust free atmosphere is a continuous process and the same shall be carried out using high powered vacuum cleaners to remove all sorts of fine dust present inside the building. Cleaning shall be done right from the beginning of erection to commissioning.
15. Prior to commencement of the job, bench mark given / available in the site shall be inspected and transferring of level coordinates to the switchgear installation shall be done with utmost accuracy. With the help of drawings, all the coordinates given in the drawings shall be marked and cross – checking of the same to match the drawings / coordinates of other equipment such as Transformers, IPBD etc. shall be carried out.
16. The cable openings provided in the floor, below the panels, shall be inspected for its suitability of the quantum of cables to be routed inside the panels and in case of any necessity to enlarge the openings, the same shall be ensured prior to placement of panels. However, in case of any requirements of altogether new openings / enlargement of opening through core cutting of the concrete, etc., all such works, on a case to case basis, can be analyzed and treated as separate work for its operation.
17. Leveling, mounting and welding of base frames to embedded parts at relevant locations. Shim plates wherever required shall be supplied and installed to achieve the leveling requirements. The welding of the base frame with the EP shall be ‘stitch welding’ with 40mm to 100 mm length of weld of 6mm fillet and 200mm interval, unless specified otherwise as per the design document / erection drawings. Random DP test may be carried out.
18. Wherever EP is installed / embedded by the other agencies / Corporation, any minor modifications / rectifications of EP (within the tolerance of civil drawings) required to bring the same to the desired level, as shown in the equipment drawings, shall be done as a

part of switchgear panel installation. Only in case of any major re-works / rectification / modification, if any, of the EPs, then the subject works, on a case to case basis, can be analysed and treated as separate works for its operation.

19. In general, the width of Embedded Parts (EP) are 100 mm to 200 mm with varying lengths provided by other agencies or the drawings issued to the electrical contractor, which may have to be fixed in concrete by chipping the finished floor around 50 to 100 mm and by anchoring of support plates in floor / wall/ soffit for installation of cable support structures. The tolerance level in horizontality of the long EP may vary from 10 – 25 mm for which shim plates of required thickness and size in 1-2 layers may have to be welded by the contractor without any additional cost to NPCIL.
20. In case, in some of the area, EP for panel installation have not been provided or missed as per the drawings and in all such cases, suitable steel plates / ISMC channels as recommended by the General Designer / FE groups, may have to be arranged and installed prior to actual erection works and in case any such major work / additional work, the subject works, on a case to case basis, can be analyzed and treated as separate work for its operation.
21. Painting of the welded areas, base frame, EP with epoxy based cold galvanizing paint/ zinc rich epoxy paint including supply of primer and finish anti corrosive paints, etc.
22. The switchgear panels shall be installed on prepared foundations or floor cutouts. Steel base channels shall be welded to inserts provided in floor slab. Cross members shall be provided at the junctions of each shipping section and other places as required. It shall be ensured that the base plate level of MV switchgear shall match with the finished floor level.
23. The foundation pockets and the grouted bolts shall be cured for a minimum period of 48 hours. Proper level of base frames shall be maintained throughout and shall be checked with water level/ spirit level. Steel shims shall be provided below base frame wherever required.
24. The panels shall be taken out from the packed cases and shifted one by one to their proper place. All the panels shall be assembled, aligned and leveled. Alignment of panels shall be

checked in both longitudinal and lateral directions. It shall be ensured that panel to panel coupling bolts, bus bar links etc. fit properly without any strain on any part. No new holes for jointing of the panels other than those recommended by the vendor shall be drilled. No gaps shall be left between the panels. Gap, if any, found between panels shall be suitably sealed using sealing compound or T-profile. The lifting, racking in and out operation of the breaker and all other motions shall be free from any obstruction.

25. The panels shall be checked for correct vertical position using plumb line and spirit levels. The panels shall be tack welded at suitable intervals at base channel.
26. Anti – corrosive painting of the welded areas, base frame, EP, including supply of primer and epoxy paints, zinc rich epoxy touch up painting including supply of the same
27. After erection of switchgear panels, all uncovered portions of floor cutouts shall be covered with 6 mm thick removable metal / FRP / GRP chequered plates finished with floor level, to be supplied and installed as per respective item work of the BOQ.
28. Jointing of bus bars, terminations with copper flexible including any field modifications required to match the bus bar alignment etc. shall be carried out within the scope of this works in such a manner that, no extra holes are to be made in the bus bar
29. Additional stiffener shall be provided at the bottom if required. Suitable lifting arrangements shall be provided for chequered plates. If metal chequered plates are used, then the same shall be painted with a coat of red oxide zinc chromate primer after proper surface preparation as per specifications.
30. After completion of installation of switchgears, all the cubicles, switchgear components such as switches, starters, CT and PT chambers, bus bar chamber shall be cleaned and checked for tightness of all the components.
31. Vacuum circuit breakers (if any) shall be checked for integrity of bottle seals. All loosely supplied items shall be fitted up. Bus bar sections or links shall be inserted and, where specified, of MV equipment shall be insulated. Interconnection wiring between shipping sections shall be made by Contractor.
32. All the external cable connections shall be completed as per the scope of cable termination works prior to handing over of the panels.

33. Contact resistance of all bus bar joints and contactors shall be checked. Insulator shall be checked for any damage. All the starters, switches, contacts shall be cleaned with Carbon Tetrachloride where required.
34. All panels shall all be installed complete in all respects with protective relays, auxiliary relays, CTs, VTs, indicating instruments, transducers, necessary inter panel wiring, etc. as per typical single line diagrams/schematic diagrams, working drawings and manufacturer's drawings & documents
35. All the moving parts shall be checked for easy and free movement. Hinges of panel doors shall be lubricated to give free and noise-free movement. All openings shall be kept completely closed to avoid ingress of any foreign particles inside the panel.
36. All the functional checks of the CB related to erection works such as smooth movement (rack in / rack out), mechanical interlock checking, closing / tripping mechanism, moving parts such as shutter mechanism, cable orientation through CBCT / CTs, blue matching , etc. shall be carried out within the scope of erection to be carried out prior to releasing of the panels to concerned commissioning groups of Contractor and all these activities are to be carried out under the supervision of concerned commissioning / O & M groups of Corporation.
37. Whenever there are chances of moisture ingress inside the panel or the panel is having a low IR value due to damaged insulators/bushings/any other insulated parts, or on account of any other reason, then the entire panel shall be dried-up according to the instruction of the EIC for the improvement of IR value to a safe level prior to handing over of the panels for further pre-commissioning / commissioning tests. Care shall be taken to protect the surrounding insulation from direct local heating during the drying up process.
38. It is possible that, the flexible between the bus bars, cable connections, terminations, inter panel couplings, etc., may all have to be removed or de-coupled and to be assembled back to attend any desired works to complete the panel works in all respects and all such works shall be carried out at no extra cost.

39. After completion of all the bus bar couplings and torquing, Insulation Resistance (IR) and High Voltage (HV) testing shall be carried out as per the manufacturer's manual / recommendations.
40. All the metering instruments, protective relays/Numerical protection relays and other relays and contactors shall be tested as per manufacturer's recommendations and according to the instructions of the Purchaser Engineer. Protection relays shall be inserted and connected and settings adjusted as required by the Purchaser.
41. All moving parts, of closing/ tripping mechanism, racking in and racking out mechanism, spouts and shutter closing mechanism shall be checked for proper operation. All the auxiliary contacts of breaker shall be checked-up, cleaned and contact pressure measured.
42. All the control wiring, PTs, bushings, bus bars, other live parts of switchgear, incoming and outgoing cables shall be meggered.
43. Indoor Earthing conductor connection of the panel to the nearest indoor grounding grid shall be carried out as per corresponding item of BOQ. This activity shall be completed prior to handing over of the panels. EP of the panel shall also be grounded.
44. Identification/marking of cubicles with suitable paints as per KKS code, generation of erection reports in the desired format
45. Prior to handing over of the panels, insulation mat as per latest IS codes shall be pasted both in the front and back side of the switchgear panel and supply and installation of the same is covered separately in the contract.
46. All hardware and consumables required for successful completion of erection of the panels are covered in the scope of Contractor.
47. Electrical simulation tests shall be carried out for all the protective, alarm and annunciation relays and external interfaces to ascertain proper functioning.
48. In case of PLCC, tele-metering panels, RTUs and / or any other panels / electrical equipment requiring coordination with grid authorities such as PGCIL / TANGEDCO, CEA etc.., the scope of works include all the coordination with these agencies involved with 230 & 400kV transmission line systems, including arranging their site visits for inspection, line clearance, coordination for relay settings, assistance for the grid

authorities, if any, for carrying out their erection, testing and commissioning works etc.., complete in all respects required for successful completion of testing, pre-commissioning / commissioning of 230 & 400kV Systems.

49. Common SCADA system under scope of this contract has interface with main plant top level plant control systems (TLPS) under RF scope of design and supply. The interface gateway design, supply, erection and commissioning is under the scope of contractor. Contractor need to comply with all interface requirements of gateway cabinet with TLPS systems. If required, Contractor will have to enter into a contractual agreement with the respective RF agency to comply with the interface requirements, at no additional cost and time to the Purchaser.

10.9 JOB SPECIFICATIONS FOR 6kV ISOLATED PHASE BUS DUCT (IPBD)

Supply of all 6kV Isolated Phase Bus Ducts (IPBD) required for connection of respective LVs of UATs, RATs and CSAT to 6kV switchgear is under contractor's scope as per SOQ of tender.

The scope of erection works includes the following:

A. General Guidelines:

1. The bus ducts as per issued drawings shall be supplied in parts and all the parts shall be assembled and the bus bar connections shall be made at site.
2. The insulators in bus ducts shall be inspected for any possible damage during transit and the defective ones shall be replaced. The insulators shall be cleaned.
3. Contact surface of bus bars, bus bar bolts and nuts shall be thoroughly cleaned. Petroleum jelly shall then be applied and bolted connection made.
4. The bus duct enclosure shall be checked for earth continuity and then earthed at one place. The bus duct shall be properly supported between switchgear and transformer.
5. The openings in the wall, where Isolated phase bus duct enters the electrical building / switchgear room, shall be completely sealed to avoid rain water entry.

6. Expansion joints, flexible connections etc. shall all supplied by the manufacturer of the bus duct and they all shall be properly connected.
7. The bus duct leveling shall be checked with spirit level and pendulum weight or any other suitable instrument.
8. During the installation, usage of hoists, slings to bus duct sections and its assemblies shall be carried out by only experienced and trained work force. For hoisting and transportation of the bus duct elements, only hoisting slings, in good condition, shall be used.

B. The scope of works, in detail, are covered as given below:

1. Material receipt at site, safe unloading at site and safe storage at site, etc. as per the specific requirements covered elsewhere in the relevant chapters / sections of the document.
2. All the items received at site, shall be listed and documented properly and the packages shall be inspected both visually as well as for verification of bill of materials as per the packing list. Missing items shall be listed and necessary action shall be taken to arrange the same without any delay. Necessary actions to replace the damaged parts / components / equipment shall also be taken, in case of observance of any damages during the transportation / unloading, etc.
3. Inspection of the material received at site, with due participation of all the concerned groups / agencies / representatives of Purchaser / Corporation.
4. Insurance during the storage, erection, testing and commissioning / till handing – taking over of the equipment to Purchaser.
5. Drawl of the various parts, assemblies from stores, safe material handling /safe transportation to the location/erection point, storage, preservation, verification of healthiness and completeness after unpacking etc. Required handling machineries / cranes shall be mobilized for the above.
6. Thorough Cleaning of the area shall be carried out to ensure dust free atmosphere before taking up installation works. Cleaning and maintenance of dust free atmosphere is a continuous process and the same shall be carried out to remove all sorts of fine dust present

on the IPBD. Cleaning shall be done right from the beginning of erection to commissioning in order to ensure the desired IR value before charging.

7. Prior to commencement of the job, bench mark given / available in the site shall be inspected and transferring of level coordinates at either end equipment of IPBD shall be done with utmost accuracy to ascertain the alignment along with equipment on either sides. With the help of drawings, all the coordinates given in the drawings shall be marked and cross – checking of the same to match the drawings / coordinates of other equipment such as Transformers, 6kV Switchgear etc. shall be carried out. Coordinates of IPBD supporting structures erected prior to taking up of erection of IPBD shall be checked and verified with drawings.
8. Leveling, mounting and welding of base frames / supporting structures to embedded parts at relevant locations. Shim plates wherever required shall be supplied and installed to achieve the leveling requirements. The welding of the base frame with the EP shall be as per the design documents /drawings.
9. Since EPs and supporting structures are embedded and installed respectively by the Corporation, survey of the same shall be carried out and any minor modifications / rectifications of EPs / supporting structures (within the tolerance of civil drawings) required to bring the same to the desired level, as shown in the equipment drawings shall be done as a part of IPBD installation.
10. Painting of the welded areas, base frame, EP, including supply of primer and finish enamel paints, touch up painting including supply of the same
11. Mounting of the hot dip galvanized base frame supplied by IPBD manufacturer / Corporation to the base channel through bolting / welding or grouting of the support on the pockets provided in the foundation, etc. as specified in the drawings.
12. Contractor shall plan the general sequence of installations of the bus duct sections and assemblies with due regard for local environment and considerations such as commencement of installation from tapings of power transformers.
13. Mounting of the IPBD enclosure through bolting to base frame. Insulating pad to be provided for getting electrical isolation between IPBD enclosure and earthed supports. IR

value of each assembly to be taken prior and after erection and minimum value to be ensured before proceeding to next assembly welding.

14. Prior to taking up installation works, the inner surfaces of the IPBDs shall be cleaned through blowing of compressed air and vacuuming. The supporting insulators must be inspected for any visible damages and a report on the same be recorded / generated.
15. The seal off bushings and gaskets of the IPBDs shall be visually checked for its clearances as per the manufacturer's drawings.
16. Assembly of the bus duct and the buses, alignment, jointing of the different sections by Aluminum welding and bolt/nut/flange as per applicable standards and manufacturer's specifications.
17. Mounting, alignment, jointing/bolting of panels/cubicles , etc. as per erection Assembly of the hot dip galvanized / metalized supports, installation of the same by grouting, fabrication, welding, painting of the welded areas, including supply of hardware wherever required.
18. Bus duct sections shall be provisionally arranged on support beams and metal works, fastened to embedded items in accordance with accepted installation procedure.
19. At the place of bus duct joint, if rings are specified, then different sections of the enclosure are to be joined through a ring which shall be welded on either sides to the enclosure with a weld size of 6 mm max or otherwise specified by OEM. The Rings are to be supplied along with the IPBD.
20. During the installation works at site, to prevent the atmospheric precipitation, sand or dust getting into the inner chambers of the IPBDs, end sections shall be wrapped with suitable polythene sheets or through any other suitable methods.
21. Earthing of IPBDs needs to be done at one end only as specified in the drawings, by giving two independent minimum 70 sq mm size of Copper conductor grounding.
22. While installing the telescopic units of IPBD, if applicable, on HV side, orientation shall be properly aligned without reducing the clearance between the nearby enclosure of other phases.

23. The grounding points of Inbuilt IPBD VTs shall be connected by a suitable conductor to IPBD enclosure, wherever applicable.
24. Inspection, erection tests, if any, of the equipment as recommended by the manufacturer. Repeated cleaning of the IPBD insulators may have to be done to ensure the minimum IR value of the IPBD (with respect to phase to enclosure and enclosure to earth) as recommended by the manufacturer. In case of any necessity to replace the insulators to improve the IR value, the same shall be carried out at no extra cost.
25. Connection/Termination of copper flexible wherever applicable, at the UATs, RATs, CSAT/6kV Switchgear ends shall be carried out as per the drawings.
26. In case of closure of joining of sections to the power transformers, Contractor shall ensure the design values of the clearances between the end contact plug of the IPBD and the transformer terminal and fasten (provisionally) the compensators, connecting terminals with buses of the bus duct, as given the erection / manufacturer drawings.
27. Installation of grounding conductors of the size mentioned in the drawing from the IPBD to the nearest grounding pad/strip/riser including welding, brazing, etc.
28. Grounding of IPBD structures to nearest grounding risers to be done at all the locations nearer to that structure
29. The earth continuity shall be ensured by connecting the copper flexible strips between the nearest telescopic unit to stationary enclosure. In this regard, detachable casings of bus ducts shall be grounded by means of flexible copper wires / strips.
30. Sealing of openings in the wall after erection of the bus duct as shown in the erection drawings.
31. Sealing gaskets, wherever it is applicable, shall be installed as per the erection drawings.

32. Prior to IPBD welding, the Qualification of welding procedure/ welder for welding of bus duct & enclosure shall be carried out with a mock up assembly to be arranged by the contractor. Only the qualified welder is allowed to take up the actual job and qualified procedure shall be followed for actual works. Contractor shall take necessary steps to

ensure qualification of at least two – three welders to ensure that, progress of the job is not affected.

33. Argon gas welding shall be employed for all Aluminum to Aluminum welding for bus bar, bus duct enclosure, unless specified otherwise in the document / manufacturer's instructions. Welding electrodes, welding machines and any other consumables required for the above works shall be arranged by the Contractor as a part of the above works.
34. 100% Dye Penetration Test (DPT) of each run of weld on all site welds.
35. The quality of weld in the buses and the casings shall be controlled by visual inspection and measurements as specified in the erection drawings and applicable standards / guidelines.
36. For evaluation of weld joints, following shall be checked:

- No cracks on the welded portions
- No burning – through and defects of welding (un-welded craters) on parent material

37. Erection and erection tests, if any, at site as per WD / manufacturer's recommendations and as per relevant standards / manufacturer's instructions such as IR tests, contact resistance test (milivolt – mv drop test) and HV test shall be carried out prior to releasing of the IPBDs to concerned commissioning groups of Contractor and all these activities are to be witnessed by the concerned commissioning / O & M groups of Corporation.
38. The copper flexible after checking the correctness with respect to duct conducting portions at both side may have to be taken and kept stored safely for avoiding theft and damages. This can be installed during final stage before handing over.
39. Touch up painting of enclosure (paint as specified by the manufacturer) of the exposed and welded surfaces after erection and just prior to handing over including supply of touch up paint.

10.10 JOB SPECIFICATIONS FOR NON SEGREGATED PHASE BUS DUCT (NSPBD)

Supply of Non Segregated Phase Bus Ducts is under contractor's scope as per SOQ of tender.

The scope of erection works includes the following:

A. General Guidelines:

1. The bus ducts as per issued drawings shall be supplied in parts and all the parts shall be assembled and the bus bar connections shall be made at site.
2. The insulators in bus ducts shall be inspected for any possible damage during transit and the defective ones shall be replaced. The insulators shall be cleaned during the inspection process.
3. Contact surface of bus bars, bus bar bolts and nuts shall be thoroughly cleaned. Petroleum jelly shall then be applied and bolted connection made.
4. The bus duct enclosure shall be checked for earth continuity and then earthed at one place. The bus duct shall be properly supported between switchgear and transformer.
5. The openings in the wall, where isolated phase bus duct enters the electrical building / switchgear room, shall be completely sealed to avoid rain water entry.
6. Expansion joints, flexible connections etc. shall all supplied by the manufacturer of the bus duct and they all shall be properly connected as per the manufacturer recommendations.
7. The bus duct leveling shall be checked with spirit level and pendulum weight or any other suitable instrument.
8. During the installation, usage of hoists, slings to bus duct sections and its assemblies shall be carried out by only experienced and trained work force. For hoisting and transportation of the bus duct elements, only hoisting slings, in good condition, shall be used.

B. The scope of works, in detail, is covered as given below:

1. Material receipt at site, safe unloading at site and safe storage at site, etc. as per the specific requirements covered elsewhere in the relevant chapters / sections of the document.
2. All the items received at site, shall be listed and documented properly and the packages shall be inspected both visually as well as for verification of bill of materials as per the packing list. Missing items shall be listed and necessary action shall be taken to arrange the same without any delay. Necessary actions to replace the damaged parts / components /

equipment shall also be taken, in case of observance of any damages during the transportation / unloading, etc.

3. Inspection of the material received at site, with due participation of all the concerned groups / agencies / representatives of Purchaser / Corporation.
4. Insurance during the storage, erection, testing and commissioning / till handing – taking over of the equipment to Purchaser.
5. Verify the route from unloading spot to erection spot for free access.
6. Ensure correct rating NSPBD is being received from the store as per drawing and it is being taken to its correct destination to the site.
7. Shifting of the NSPBD shall be done as per manufacturer's instruction with truck/trailer and crane. Required handling machineries / cranes shall be mobilized for the above.
8. Thorough Cleaning of the area shall be carried out to ensure dust free atmosphere before taking up installation works. Cleaning and maintenance of dust free atmosphere is a continuous process and the same shall be carried out to remove all sorts of fine dust present on the NSPBD. Cleaning shall be done right from the beginning of erection to commissioning in order to ensure the desired IR value before charging.
9. Prior to commencement of the job, bench mark given / available in the site shall be inspected and transferring of level coordinates at either end equipment of NSPBD shall be done with utmost accuracy to ascertain the alignment along with equipment on either sides. With the help of drawings, all the coordinates given in the drawings shall be marked and cross – checking of the same to match the drawings / coordinates of other equipment such as Transformers, etc. Shall be carried out. Coordinates of NSPBD supporting structures erected prior to taking up of erection of NSPBD shall be checked and verified with drawings.
10. Leveling, mounting and welding of base frames / supporting structures to embedded parts at relevant locations. Shim plates wherever required shall be supplied and installed to achieve the leveling requirements. The welding of the base frame with the EP shall be as per the design documents /drawings.

11. Since EPs and supporting structures are embedded and installed respectively by the Corporation, survey of the same shall be carried out and any minor modifications /rectifications of EPs / supporting structures (within the tolerance of civil drawings) required to bring the same to the desired level, as shown in the equipment drawings shall be done as a part of IPBD installation.
12. Painting of the welded areas, base frame, EP, including supply of primer and finish enamel paints, touch up painting including supply of the same
13. Mounting of the hot dip galvanized base frame supplied by NSPBD manufacturer / Corporation to the base channel through bolting / welding or grouting of the support on the pockets provided in the foundation, etc. as specified in the drawings.
14. Contractor shall plan the general sequence of installations of the bus duct sections and assemblies with due regard for local environment and considerations such as commencement of installation from tapings of power transformers.
15. Mounting of the NSPBD enclosure through bolting to base frame. Insulating pad to be provided for getting electrical isolation between NSPBD enclosure and earthed supports. IR value of each assembly to be taken prior and after erection and minimum value to be ensured before proceeding to next assembly welding.
16. Prior to taking up installation works, the inner surfaces of the NSPBDs shall be cleaned through blowing of compressed air and vacuuming. The supporting insulators must be inspected for any visible damages and a report on the same be recorded / generated.
17. The seal off bushings and gaskets of the NSPBDs shall be visually checked for its clearances as per the manufacturer's drawings.
18. Assembly of the bus duct and the buses, alignment, jointing of the different sections by Aluminum welding and bolt/nut/flange as per applicable standards and manufacturer's specifications.
19. Mounting, alignment, jointing/bolting of panels/cubicles , etc. as per erection Assembly of the hot dip galvanized / metalized supports, installation of the same by grouting, fabrication, welding, painting of the welded areas, including supply of hardware wherever required.

20. Bus duct sections shall be provisionally arranged on support beams and metal works, fastened to embedded items in accordance with accepted installation procedure.
21. At the place of bus duct joint, if rings are specified, then different sections of the enclosure are to be joined through a ring which shall be welded on either sides to the enclosure with weld size of 6 mm max or otherwise specified by OEM. The Rings are to be supplied along with the NSPBD.
22. During the installation works at site, to prevent the atmospheric precipitation, sand or dust getting into the inner chambers of the NSPBDs, end sections shall be wrapped with suitable polythene sheets or through any other suitable methods.
23. Earthing of NSPBDs needs to be done at one end only as specified in the drawings, by giving two independent Copper conductor grounding as specified.
24. While installing the telescopic units of NSPBD, if applicable, orientation shall be properly aligned without reducing the clearance between the nearby enclosure of other phases.
25. The grounding points of Inbuilt NSPBD VTs shall be connected by a suitable conductor to NSPBD enclosure, wherever applicable.
26. Inspection, erection tests, if any, of the equipment as recommended by the manufacturer. Repeated cleaning of the NSPBD insulators may have to be done to ensure the minimum IR value of the IPBD (with respect to phase to enclosure and enclosure to earth) as recommended by the manufacturer. In case of any necessity to replace the insulators to improve the IR value, the same shall be carried out at no extra cost.
27. Connection/Termination of copper flexible wherever applicable, at the Auxiliary transformers or LV Switchgear ends shall be carried out as per the drawings.
28. In case of closure of joining of sections to the auxiliary transformers, Contractor shall ensure the design values of the clearances between the end contact plug of the NSPBD and the transformer terminal and fasten (provisionally) the compensators, connecting terminals with buses of the bus duct, as given the erection / manufacturer drawings.
29. Installation of grounding conductors of the size mentioned in the drawing from the NSPBD to the nearest grounding pad/strip/riser including welding, brazing, etc.

30. Grounding of NSPBD structures to nearest grounding risers to be done at all the locations nearer to that structure
31. The earth continuity shall be ensured by connecting the copper flexible strips between the nearest telescopic unit to stationary enclosure. In this regard, detachable casings of bus ducts shall be grounded by means of flexible copper wires / strips. Sealing of openings in the wall after erection of the bus duct as shown in the erection drawings.
32. Sealing gaskets, wherever it is applicable, shall be installed as per the erection drawings.
33. Prior to NSPBD welding, the Qualification of welding procedure/ welder for welding of bus duct & enclosure shall be carried out with a mock up assembly to be arranged by the contractor. Only the qualified welder is allowed to take up the actual job and qualified procedure shall be followed for actual works. Contractor shall take necessary steps to ensure qualification of at least two – three welders to ensure that, progress of the job is not affected.
34. Argon gas welding shall be employed for all Aluminum to Aluminum welding for bus bar, bus duct enclosure, unless specified otherwise in the document / manufacturer's instructions. Welding electrodes, welding machines and any other consumables required for the above works shall be arranged by the Contractor as a part of the above works.
35. 100% Dye Penetration Test (DPT) of each run of weld on all site welds.
36. The quality of weld in the buses and the casings shall be controlled by visual inspection and measurements as specified in the erection drawings and applicable standards / guidelines.
37. For evaluation of weld joints, following shall be checked:

- No cracks on the welded portions
- No burning – through and defects of welding (un-welded craters) on parent material

38. Erection and erection tests, if any, at site as per WD / manufacturer's recommendations and as per relevant standards / manufacturer's instructions such as IR tests, contact resistance test (millivolt – mv drop test) and HV test shall be carried out prior to releasing

of the NSPBDs to concerned commissioning groups of Contractor and all these activities are to be witnessed by the concerned commissioning / O & M groups of Corporation.

39. The copper flexible after checking the correctness with respect to duct conducting portions at both side may have to be taken and kept stored safely for avoiding theft and damages. This can be installed during final stage before handing over.
40. Touch up painting of enclosure (paint as specified by the manufacturer) of the exposed and welded surfaces after erection and just prior to handing over including supply of touch up paint.

10.11 JOB SPECIFICATIONS FOR DRY TYPE AUXILIARY TRANSFORMERS

The scope of erection works includes the following:

1. Material receipt at site, safe unloading at site and safe storage at site, etc. as per the specific requirements covered elsewhere in the relevant chapters / sections of the document.
2. All the items received at site, shall be listed and documented properly and the packages shall be inspected both visually as well as for verification of bill of materials as per the packing list. Missing items shall be listed and necessary action shall be taken to arrange the same without any delay. Necessary actions to replace the damaged parts / components / equipment shall also be taken, in case of observance of any damages during the transportation / unloading, etc.
3. Inspection of the material received at site, with due participation of all the concerned groups / agencies / representatives of Purchaser / Corporation.
4. Insurance during the storage, erection, testing and till handing – taking over of the equipment by Purchaser / Corporation.
5. Drawl of the various parts, assemblies from stores, safe material handling /safe transportation to the location/erection point, storage, preservation, verification of healthiness and completeness after unpacking etc. Required handling machineries / cranes shall be mobilized for the above.

6. The Transformer box shall be properly supported on the truck or trailer by means of ropes to avoid any chance of tilting. The transformer shall be lifted after ensuring that its supports, nuts and bolts are all intact and tightened. While lifting the transformer in packed conditions, utmost care shall be taken to avoid any damage to insulators, bushings, winding and its enclosure equipment.
7. The Transformer shall be handled with care, avoiding any impact to the equipment. Dragging of the transformer directly on floor shall be avoided and appropriate roller bars shall be used for shifting of the panels inside the buildings to erection point. Use of a crane and trailer shall also be made for handling of equipment, wherever possible.
8. On receipt of the equipment at site, the loose components such meters, manufacturer supplied special cables, lugs, etc.. shall be separated out and be kept safely in Contractor's custody to prevent any damage / theft / mishandling during erection. List of all such removed components needs to be kept and maintained for easy reference and retrieval. These components need to be installed just prior to pre-commissioning of the subject panel.
9. The transformer shall be preferably kept inside the packing cases till foundations are ready. Proper rain/ sun/ dust protection shall be ensured till transformers are taken inside the building and installed.
10. After unloading of the transformer near the erection point, the same shall be shifted inside the building using appropriate method / roller bars, as recommended by the manufacturer.
11. For the transformer to be located at higher locations, usage of hoists if any, through the equipment shaft is allowed, however, if the same is not available, then the Contractor shall make his own arrangement to shift the panels to higher locations using chain pulley blocks or any other suitable and safe arrangement.
12. Thorough Cleaning of the area to ensure dust free atmosphere before taking up installation works. Cleaning and maintenance of dust free atmosphere is a continuous process and the same shall be carried out using high powered vacuum cleaners to remove all sorts of fine dust present inside the building. Cleaning shall be done right from the beginning of erection to commissioning.

13. Prior to commencement of the job, bench mark given / available in the site shall be inspected and transferring of level coordinates to the transformer installation shall be done with utmost accuracy. With the help of drawings, all the coordinates given in the drawings shall be marked and cross – checking of the same to match the drawings / coordinates of other equipment such as switchgear/switchgear panel opening/floor opening for cable , etc. shall be carried out.
14. The cable openings provided below the transformer shall be assessed for its suitability / margin availability for routing cables inside the transformer and in case of any necessity to enlarge the openings, which requires the same shall be carried out prior to placement of transformer within the scope of transformer works.
15. Levelling, mounting and welding of base frames to embedded parts at relevant locations. Shim plates wherever required shall be supplied and installed to achieve the leveling requirements. The welding of the base frame with the EP shall be 'stitch welding' with 40mm to 100 mm length of weld of 6mm fillet and 200mm interval, unless specified otherwise as per the design document. Random DP test may be carried out.
16. Wherever EP is installed / embedded by the other agencies / Corporation, any minor modifications / rectifications of EP (within the tolerance of civil drawings) required to bring the same to the desired level, as shown in the equipment drawings, shall be done as a part of Transformer installation. Only in case of any major re-works / rectification / modification, if any, of the EPs, then the subject works, on a case to case basis, can be analyzed and treated as separate works for its operation.
17. In case, in some of the area, EP for transformer installation have not been provided or missed as per the drawings, in all such cases, suitable steel plates / ISMC channels as recommended by the General Designer / FE groups, may have to be arranged and installed prior to actual erection works and in case any such major works / additional work, the subject works, on a case to case basis, can be analyzed and treated as separate work for its operation.
18. Painting of the welded areas, base frame, EP, including supply of primer and finish enamel paints, touch up painting including supply of the same

19. Mounting, alignment, jointing/bolting, etc. as per erection drawings along with levelling, alignment of auxiliary transformers with 0.38 kV or 0.415 kV switchgears shall be carried out.
20. Jointing / Interconnection of bus bars from transformer terminals to switchgears and termination with flexible copper connectors, including any field modifications required to match the bus bar alignment etc. shall be carried out within the scope of this works.
21. The bus bar between the Auxiliary Transformer and LV switchgear may have to be suitably insulated with neoprene rubber sheets / gaskets, etc. across the transformer frame and LV switchgear panel.
22. Installing neutral CT, WTI etc, marshalling box, indicating instruments, and all its auxiliaries, local Marshalling Panel etc. along with wiring with panels associated with the transformer, as per the drawings.
23. Grounding of Transformer neutral connection as per the erection drawings
24. Grounding of transformer core to the appropriate locations.
25. Sealing of cable entry points, and unused openings with fire barrier material.
26. Transformer door earthing shall be done at final stage of erection prior to handing over
27. Flexibles to transformers are to be taken out and kept in safe custody of contractor for avoiding damage and theft and same shall be normalized back during handing over time.
28. Testing and calibration of indicating instruments such as WTI
29. During erection site testing of the transformer, extensive reheating arrangements may have to be arranged to obtain the desired IR and PI value and all such works shall be carried out / arranged at no additional cost.
30. Identification/marking of transformer with suitable paints as per KKS code
31. Generation and submission of erection completion and field check list clearance reports
32. Prior to handing over of the transformer, insulation mat as per latest IS codes shall be pasted both in the front and back side of the transformer panel, as covered separately in the BOQ.
33. All hardware and consumables required for successful erection and erection tests, if any, to be conducted at site are covered in the scope of Contractor.

10.12 JOB SPECIFICATIONS FOR BATTERIES

The scope of erection works for Batteries includes the following:

1. Material receipt at site, safe unloading at site and safe storage at site, etc. as per the specific requirements covered elsewhere in the relevant chapters / sections of the document.
2. All the items received at site, shall be listed and documented properly and the packages shall be inspected both visually as well as for verification of bill of materials as per the packing list. Missing items shall be listed and necessary action shall be taken to arrange the same without any delay. Necessary actions to replace the damaged parts / components / equipment shall also be taken, in case of observance of any damages during the transportation / unloading, etc.
3. Inspection of the material received at site, with due participation of all the concerned groups / agencies / representatives of Purchaser / Corporation.
4. Safe custody of special tools /spares/ loose parts such as lugs, termination nut & bolts, battery links, special cables etc supplied along with the batteries. The same shall be listed and a copy of the items kept in safe custody, shall be shared with Engineer – in-charge.
5. Insurance during the storage, erection, testing and till handing – taking over of the equipment by Purchaser / Corporation
6. Required handling machineries / cranes shall be mobilized for drawl of the various parts, assemblies, acid cans from stores, safe material handling /safe transportation to the location/erection point, storage, preservation, verification of healthiness and completeness after unpacking etc.
7. Thorough Cleaning of the area to ensure dust free atmosphere before taking up installation works. Cleaning and maintenance of dust free atmosphere is a continuous process and the same shall be carried out using high powered vacuum cleaners to remove all sorts of fine dust present inside the building. Cleaning shall be done right from the beginning of erection to commissioning.
8. Levelling, mounting and welding of base frames / battery racks to embedded parts at relevant locations. Shim plates wherever required shall be supplied and installed to achieve the leveling requirements. The welding of the base frame with the EP shall be ‘stitch

welding' with 40mm to 100 mm length of weld of 6mm fillet and 200mm interval, unless specified otherwise as per the design document Random DP test may be carried out.

9. Wherever EP is installed / embedded by the other agencies / Corporation, any minor modifications / rectifications of EP (within the tolerance of civil drawings) required to bring the same, to the desired level, as shown in the equipment drawings, shall be done as a part of Battery / Stand / Rack installation. Only in case of any major re-works / rectification / modification, if any, of the EPs, then the subject works, on a case to case basis, can be analyzed and treated as separate works for its operation.
10. In case, in some of the area, EP for Battery Racks have not been provided or missed as per the drawings and in all such cases, suitable steel plates / ISMC channels as recommended by the General Designer / FE groups, may have to be arranged and installed prior to actual erection works and in case any such major work / additional work, the subject works, on a case to case basis, can be analyzed and treated as separate work for its operation.
11. If battery stands are supplied with factory welded / assembled form, then shifting of the same to erection point shall be carried out in an utmost safe manner to ensure that, stands are not getting damaged and the insulation coating on the battery stands / racks are not getting damaged during the handling operations.
12. After shifting of the battery racks to erection point, a joint visual inspection of the battery racks shall be carried out to assess the condition of the battery racks, prior to taking up installation and a report on the same shall be generated and recorded.
13. For the battery banks /racks to be located at higher locations, usage of hoists if any, through the equipment shaft is allowed, however, if the same is not available, then the Contractor shall make his own arrangement to shift the materials to higher locations using chain pulley blocks or any other suitable and safe arrangement within the scope of the contract.
14. However, inspite of the above, in case of any damage to the battery racks due to any inadvertent reasons, then proper assessment of the battery racks shall be carried out and in case and any major damage to the insulation coating, then the entire rack shall be replaced. For minor damages / scratches of insulated / PVC coated battery racks / stands occurred

during the storage, shifting or installation, shall be made good by suitable material / PVC coating (of the same grade as used originally), through heating / blowing the same grade PVC granules / as per manufacturer's recommendations and these works are also within the scope of the above works. Supply of required materials and arranging tools for repair works including special equipment / tools for testing the healthiness of insulation is in the scope of the contractor.

15. However, in case of any damage to the battery rack insulation due to any other agency, as found during the detailed analysis, then the subject works can be analyzed and treated as separate works, on a case to case basis.
16. Anti-corrosive Painting of the welded areas, base frame, EP, including supply of primer and finish enamel paints, touch up painting including supply of the same
17. Assembling the battery racks/sections covering, mounting, alignment, jointing/bolting of battery stands / racks, etc. as per erection drawings
18. Welding of the racks to the embedded parts as per the erection drawings, as recommended in the drawing and random DP test may be carried out.
19. After the readiness of battery stands / racks, clearance of ENC / Corporation and concerned agencies shall be obtained prior to shifting of battery cells to rooms / locations.
20. Battery cells shall be shifted carefully to the battery room / erection point safely and be kept over battery stands / racks one by one. If insulating spacers are provided as per the drawings / manufacturer's instruction, the same shall be installed along with above activity as per the assembly drawings.
21. Inter-connection of battery cell terminals with the connectors / links
22. Loop cables between individual rows of the battery banks shall be connected and torqued as per the recommendations of battery cell manufacturer. Jointing of battery cells, lug terminations including any field modifications required to match the battery bank alignment etc. shall be carried out within the scope of this works.
23. Cell terminal cleaning as well as supply and application of petroleum jelly as per the manufacturer's guidelines/instructions/standard practices

24. Main cable connections from the battery charger shall also be carried out as per the erection drawings / battery cell arrangement.
25. Identification/marking of battery banks with suitable paints as per KKS code
26. All hardware and consumables required for successful erection and erection testing, if any, of the battery banks are covered in the scope of Contractor
27. All the equipment / tools required for above mentioned works shall all be arranged by the Contractor.

10.13 JOB SPECIFICATIONS FOR HERMETIC CABLE PENETRATIONS (HCPs)

The Hermetic Cable Penetrations (HCPs) will be offered as 'Free issue Materials' to the Contractor.

The scope of erection works includes the following:

1. All Hermetic Cable Penetrations are offered as 'Free Issue Material' to the Contractor in a sealed package and the same shall be drawn for erection works, once the erection fronts are ready on either side of Reactor Building primary containment wall.
2. Hermetic Cable Penetrations are supplied with KKS codes and identification marking and the Contractor shall first study the erection drawings and identify / verify the readiness of the fronts for taking up the erection of Hermetic Cable Penetration works.
3. Wherever and whenever site fronts are getting ready, only the corresponding HCPs of that particular area, which is ready, shall be drawn from NPCIL Stores for erection works at site.
4. Drawl of the Hermetic Cable Penetration (HCP) from stores, safe material handling /safe transportation to the location.
5. The packing / HCP box shall be opened in a covered / semi – covered area in order to ensure that, dust or rain water or any kind atmospheric precipitation does not take place inside the HCP assemblies drawn for the erection works. After opening of the packing / crate, visual inspection of the materials issued, verification of healthiness and completeness of the packing list , etc. shall be checked and in case of any non-conformity, the same shall be brought to the notice of Engineer – in – charge.

6. Before shifting the unpacked HCP assembly to the actual erection point, thorough Cleaning of the area shall be carried out to ensure dust free atmosphere in the actual area of works. Once the same is ensured, the HCP assembly to be erected shall be shifted safely to the actual location of erection.
7. Contractor shall make his own arrangement to shift these assemblies to higher locations using suitable means, if hoists are not available at the location.
8. Based on the documents / manufacturer's manual collected from the NPCIL, Contractor shall draw out a detailed erection procedure along with field quality plan and check list.
9. **Following prerequisites shall be ensured by Contractor prior to actual erection works:**

i. Accepted cable penetration units as per Working Documents with all related accessories.
ii. Availability of approved drawings for erection of cable penetrations.
iii. Clearance for penetration erection from NPCIL.
iv. Through survey of route for shifting of materials.
v. Verification of exact dimensions of built in pipes in Reactor Building Primary Containment wall, suitable for erection of penetration as per layout drawing.
vi. Built in pipes free from foreign materials; In case of presence of any foreign material such as concrete debris, pipe burrs, sharp edges etc., then the same shall be removed before taking up erection works.
vii. Availability of calibrated welding machine.
viii. Availability of qualified WPS and welders.
ix. Availability of adequate lighting.
x. No traces of moisture, dust.
xi. Proper facilities for protection from drop of foreign materials.

10. **Following equipment, tools and tackles shall be mobilized by the Contractor for erection works:**

i. Measuring tape
ii. Venire Calipers
iii. Lifting equipment viz. chain pulley block, PP belt.

iv. Grinding machine, buffing machine.

v. Thermo-chalk for monitoring temperature rise.

vi. Access ladder, metallic platform.

vii. Sprit level, water level tube.

viii. Welding machine.

ix. Argon gas of grade-2 purity.

x. Tungsten electrode (with lanthanum added).

11. Following handling & pre-erection inspection of cable penetration shall be carried out by the Contractor:

a. After removing the case cover, it shall be checked whether the metalized plastic bag of the penetration is in order and any non-conformity shall be brought to the notice of EIC

b. Open the covering of the penetration along the sealed seams.

c. Identity the penetration in accordance with the designation in the penetration identification sheet and marking applied on to the penetration body

d. Check completeness of the penetration and installation set against the packing list.

12. Following Pre-Erection Inspection activities shall be carried out by the Contractor

a. Check for positive gauge pressure in penetration and compare with that of service log.

b. If actual pressure differs to that of service log, permissible leak rate of penetration is to be calculated as per the guidelines specified in the manufacturer's manual

c. If actual pressure is less than the calculated permissible value, the same shall be brought to the notice of EIC / Corporation

d. Once the above mentioned conditions are satisfied, the HCP unit shall be released for actual installation works.

13. Following Installation activities shall be carried out by the Contractor :

a. Screw out the plug of valve-gauge unit and de-pressurize the penetration down to 0 bar without removing the toroidal seal and replace the plug onto the valve-gauge unit.

b. Using hexagon-wrench(s=4), remove the valve-gauge unit and secure in bag provided

along with penetration.

c. Cover the valve – gauge unit seat with adhesive tape.

d. Remove the protective coating of peeling varnish applied to penetration counter flange, protective cover for securing pin holes, leak rate – monitoring hole.

e. Insert the penetration into the respective built in pipe gently so that the seat for valve-gauge unit is on outer side of containment and right side of penetration.

f. Locate penetration in the containment built in pipe so that it projects in equal lengths on both sides of the containment wall.

g. During installation, a minimum gap of 35mm should be maintained between existing welds and weld at counter flange to penetration body on both sides of containment wall.

h. Insert lead tapes each of 200mm length along the periphery of penetration body in the annular gap between penetration body and built in pipe from inside of containment wall.

i. A Minimum there layer of lead has to be inserted in the annular gap from inside containment wall so as to achieve biological protection (minimum depth of 150mm) as well as for alignment purpose. Absolutely zero gaps should be achieved in the annular gap by adjusting the lead tapes.

j. Use 100mm cut pieces of lead tape in outer side containment wall for alignment purpose.

k. Fit the counter flange inside and outside of penetration in accordance with installation drawing. Gap between counter flange and their and liner plate and EP shall not be more than 2mm.

14. Welding of Penetration generally involve following activities:

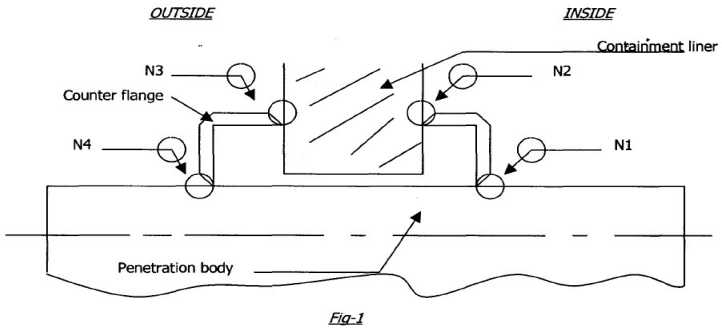


Fig-1

a. Prior to welding operation, ensure that penetration is protected with asbestos cloth to prevent from possible damage by welding spatter.

b. Areas of welds to be thoroughly cleaned for about 50mm wide by abrasive wheel (Buffing machine).

c. Welding wire surface should be cleaned for removing any traces of rust, dirt other containments.

d. Welding shall be carried out according to WPS No. WPS/KKNPP/E1/05 (counter flange to penetration body) and WPS No. WPS/KKNPP/E1/06 (Counter flange to containment liner).

e. Tack the counter flange to penetration body and counter to liner plate inside containment on four diametric corners. Each tack length shall be of 10-15mm.

f. Sequence of root weld is to be followed as per the guideline given in the manual

g. While root welding, necessary sequence is to be adopted to avoid heating of penetration body. Weld each subsequent section when previous section has cooled down below 100 deg C

h. Raise of temperature can be monitored by drawing lines on penetration body near to weld area with thermo chalk (which melts above 100oC).

i. After visual inspection of root weld, in case of any welding defects, it shall be rectified as mentioned in clause 9.6.

j. After root weld inspection, final weld of joints shall be done sequence as mentioned above

k. Dimension of fillet size: 16±2mm to be maintained as per approved WPS.

15. Weld inspection (Leak tightness test), generally, involve following activities:

a. Diagram of weld leak tightness test on penetration unit shall be carried out as per the procedure given in the manufacturer's manual – however for the reference and information of the Contractor, the following basic activities described, which shall be carried out after completion of welding activities.

Diagram of Weld Leak Tightness Test on Penetration Units (E.8-316-00).

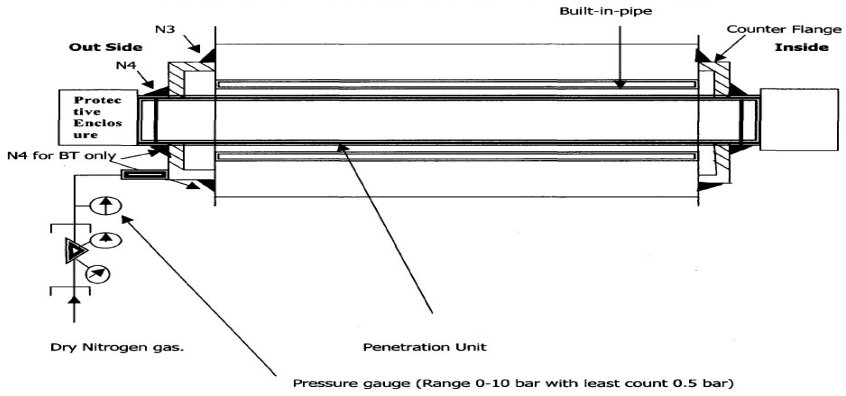


Fig-3

b. Fill dry gas through union nipple provided on outer side counter flange up to 6 bar

c. Apply LOCTITE 7100 from a distance of 20cm on the weld joints inside and outside containment.

d. Immediately after application, observe for any bubbles of foaming substance (LOCTITE7100) to identity major leaks

e. For identifying minor leaks, inspection time should be minimum 20 minutes from of application.

f. In case of any defects, follow weld repair procedure as mentioned below

16. Weld repair Procedure:

a. Before repair, remove the defects mechanically; ensure a smooth outline with no sharp protrusions burrs or recessed. The shape and amount of removal should ensure adequate fusion.

b. Check visually once the area of the defective after removal of material to ensure that all defective metal is removed.

c. Once defected area is welded up, abrade the weld flush on the surface of weld made previously.

d. After repair, leak test has to be done as mentioned above.

17. Following Finishing activities shall be carried out by the Contractor:

a. Remove the traces of LOTITE form penetration body pipe, counter flanges and from the built in item and liner.

b. Apply DOW CORNING high vacuum grease to the toroidal seal, counter flange union and fit the plug provided along with penetration.

c. Prepare for painting the metal surfaces of the penetration unit and built in pipe wherever there is no rust preventive coating as per NPCIL specification

d. Remove the adhesives tape from the holes for the grounding pins at the penetration body.

e. Remove the adhesive tapes from the valve-gauge units seat and from the seat at the penetration body flange.

f. Wipe the surface with gasoline 6-70 or ethyl alcohol.

g. Apply conducting grease to the threaded portions of the grounding pins with nuts, washers and of the holes for them and screw them in the holes.

i. After applying high vacuum grease, fit the vacuum gauge by means of screw to the penetration body securing the toroidal seal in place.

j. Fit a reducer with a connecting hose to the cylinder with dry nitrogen. Fit a leak rate monitoring device consisting of valve, calibrated pressure gauge and ½ connecting fitting (union and nut) to the connecting hose.

k. Open the valve of the leak rate monitoring device and below out the hose and the leak rate monitoring device and see that no moisture is present inside.

l. Close the reducer valve and the valve of device and screw ut the set up and plug the leak rate monitoring device to the valve and the gauge unit using ½ connecting fittings and open the cylinder reduce valve and with close the device valve, increase the test pressure in connecting hose p to 5 bar.

m. Increase the nitrogen pressure of penetration up to 2.5 bars + 0.1 bar in accordance with the reading of gauge pressure of penetration and then close the valve of monitoring device and close the nitrogen supply reduce valve and depressurize the hose of the leak rate monitoring device to disconnect the hose form valve gauge unit.

n. Using LOCTITE compound test the connection of the valve gauge unit to penetration body, hose to valve gauge unit, pressure gauge to valve gauge unit body.

o. In case of any leakage observed, tighten the fastening screws and respect the test.

p. Again record the gas pressure, ambient temperature, date and time of gagging in not less than 1 he after charging penetration with nitrogen.

q. Record the gas pressure, ambient temperature, date and time of gagging in not less than 72 hr after charging penetration with nitrogen.

r. In case if gauge readings differ from previous measurement, calculate the cumulative leak of penetration and the same shall be informed to NPCIL.

18. Following inspection activities shall be carried out by the Contractor on completion of the erection activities:

a. Erection of cable penetration as per installation drawing and layout drawing of containment built in pipes.

b. No gap in between penetration body and built in pipe after placing lead tapes.

c. No rejections in weld tests.

d. No drop of nitrogen pressure in penetration after final filling.

19. After completion of the above activities, check list and report on erection, inspection & testing of cable penetration as per the approved QAP shall be generated.

20. Following pre-cautions shall be ensured by the Contractor during the erection works :

a. While working at height scaffolding shall be prepared and required personal protection equipment like safety belts shall be used.

b. Sequence of penetration welding shall be strictly adhered to avoid more heating of penetrations.

c. Exposed portion of penetration shall be covered properly to avoid mechanical damages.

d. PPE shall be used during welding, grinding operations.

21. Welding/Welder Qualification: Following activities shall be carried out by the Contractor prior to taking up Erection activities.

a. Qualification of GTAW (Gas Tungsten Arc Welding) procedure through mock up welding

b. Mock up piece for the above will be arranged by the Corporation, but Contractor shall identify and offer experience welder for qualification of the above

c. The above process involves both qualification of welder as well as the WPS for the above mentioned works.

d. In view of the voluminous and relatively time taking nature of the job, Contractor shall arrange the qualifications of at least two – three welders for the above job, in order to maintain the continuity of the works at site under any exigencies.

10.14 JOB SPECIFICATIONS FOR CABLE CARRIER SYSTEM WORKS (CABLE METAL STRUCTURE (CMS)/ CABLE TRAY & SUPPORTS

Scope of works include the following:

1. Material receipt at site, safe unloading at site and safe storage at site, etc. as per the specific requirements covered elsewhere in the relevant chapters / sections of the document.
2. All the items received at site, shall be listed and documented properly and the packages shall be inspected both visually as well as for verification of bill of materials as per the packing list. Missing items shall be listed and necessary action shall be taken to arrange the same without any delay. Necessary actions to replace the damaged parts / components / equipment shall also be taken, in case of observance of any damages during the transportation / unloading, etc.
3. Inspection of the material received at site, with due participation of all the concerned groups / agencies / representatives of Purchaser / Corporation.
4. Insurance during the storage, erection, testing and commissioning / till handing – taking over of the equipment to Purchaser / Corporation.
5. Drawl of the various parts, assemblies from stores, safe material handling /safe transportation to the location/erection point, storage, preservation, verification of healthiness and completeness after unpacking etc. Required handling machineries / cranes shall be mobilized for the above.
6. Thorough Cleaning of the area to ensure dust free atmosphere before taking up installation works.

7. Drawl of Material from stores, its various parts, components & accessories from stores, material handling /transportation to the location/erection point, storage, verification of completeness of the equipment/components after unpacking etc.
8. For the CMS to be located at higher elevations / locations, scaffolding required, if any, shall be put up within the specified scope of works and the works shall be carried out in safest possible way. The scaffolding put up for the same shall be as per approved site procedure for scaffolding works, and the same shall be offered for inspection by the concerned agency of department prior to its actual use.
9. Usage of hoists if any, through the equipment shaft is allowed for equipment shifting, however, if the same is not available, then the Contractor shall make his own arrangement to shift the panels to higher locations using suitable means.
10. If cable tray supports are to be welded to the EPs already embedded, then cleaning and preparation of the embedded part (EP) shall be carried out first. The job includes verification of leveling of embedded parts at relevant locations and any rectification of the same, shall be carried out within the scope of this contract. Wherever EP is installed / embedded by the other agencies / Corporation, any minor modifications / rectifications of EP (within the tolerance of civil drawings) required to bring the same to the desired level, as shown in the equipment drawings, shall be done as a part of cable tray / CMS installation. Only in case of any major re-works / rectification / modification, if any, of the EPs, then the subject works, on a case to case basis, can be analyzed and treated as separate works for its operation.
11. Shim plates wherever required shall be supplied and installed to achieve the leveling requirements. The welding of the cable tray supports with the EP shall be as per the design document / erection drawings including lap or groove welding. Random DP test may be carried out.
12. CMS and cable tray installation works are generally carried out by welding the CMS racks / tray supporting stands to the EPs provided in the walls, floors and / or in the ceilings of the buildings. In some cases, CMS may have to be welded to the metallic supporting structures to be erected and / or erected by other agencies. The supply and installation of

all welding electrodes and consumables (including arrangements of sufficient nos. of welding machines) required for the job shall be arranged by the Contractor as a part of CMS installation works.

13. Similarly, in some of the area / tunnels / buildings, it is possible that, EP for CMS installation have not been provided and drawings issued for construction call for installation of the Cable tray supports / structural members, etc. through anchor fasteners, then the anchor fasteners of specified type (as indicated in the Working documentation including seismic qualified anchors) shall be arranged by the Contractor within the scope of works. The supply and installation of anchor fasteners of such cable tray supports shall be carried out at no additional cost, and the works shall be carried out, complete in all respects, similar to welding of cable trays supports carried out elsewhere.
14. Similarly, in case of any area / tunnel / building, where the electrical drawings issued for construction call for installation of the CMS supports by welding to the EPs provided by other agency, but EPs have not been provided as per civil drawings or EPs are missed due to whatever reasons , etc., in all such cases, the matter will be referred to Design Engineering Group and in all such cases also, the supply and installation of the anchor fasteners including seismic qualified anchors, as recommended by the design group, shall be carried out within the scope of CMS works covered in BOQ.
15. In case of painted trays, the paint shall be removed using suitable means before welding of the supporting structures to the EP.
16. Painting of the welded areas, base frame, EP with epoxy based cold galvanizing paint/ zinc rich epoxy paint including supply of primer and finish anti corrosive paints, etc.
17. Mounting, alignment, jointing / bolting of cable tray supports / cable trays / ducts, etc. as per erection drawings.
18. Fit up and welding of the base plate on to the EP with electrodes approved by NPCIL, as per the drawings. Inspection of the welds as mentioned in relevant sections of tender document.

19. Fastening of the slotted hot dip galvanized/epoxy coated vertical supports with the base plate, fastening of pre-fabricated hot dip galvanized/epoxy coated horizontal supports to the vertical supports through threaded fasteners.
20. Jointing of CMS supports / trays /ducts / accessories including any field modifications required to match the alignment / route etc. shall be carried out within the scope of this works for installation on the cable trays / ducts etc.
21. Zinc rich Epoxy Touch up painting after installation of the supports including supply of specified paint.
22. In case of any damage to the galvanizing coat or paint to the CMS / trays / ducts,etc. , the same shall be corrected / rectified using NPCIL approved procedure in order to ensure the life of the product being installed. The cut portion of the CMS supports / trays / ducts shall also be painted with epoxy based cold galvanizing paint.
23. All fabrication required for bends, tees, off sets , etc. required as per the drawings or as per the site conditions/field modifications to suit the site conditions , etc. shall be carried out, within the scope of respective installation works of CMS trays/ducts , etc. as also specified in the tender document and schedule of works.
24. The sharp edges occurred during the manufacturing or during the site fabrication shall be smoothened prior to submission of check list of cable metal structure works. In addition, Protective edge caps shall be supplied and installed wherever tray edges are cut and sharp edges are formed / found, to prevent damages to cables being laid.
25. Tightness of all the bolts shall be checked as per the erection drawings.
26. Earthing of cable tray supports and cable tray shall be ensured, as envisaged in the design and erection drawings in a way that, grounding continuity of entire cable trays / ducts / supports is ensured throughout the plant. Grounding for the EP of cable tray supports shall also be ensured. The grounding flat to be run on the wall/floor, nearest to the cable trays and all the cable trays / supports shall be connected to the nearest grounding flat or as per the grounding system installation works.
27. Any re-works in CMS necessitated due to interference with other systems shall be resolved in association with other agencies / concerned groups of corporation and the re-works such

as dismantling of erected cable trays, if any, shall be carried out as per respective item of BOQ / SOQR of the Contract.

28. Any minor modification of the openings provided in the routing of CMS works shall be carried out at no additional cost, within the scope of CMS / Cable Trays works. However in case of requirement of any new openings or enlargement of existing openings, core cutting if any, to take up CMS / Cable Tray works, then the same shall all be carried out as per the relevant item of the BOQ / SOQR of the Contract, and as directed by the Engineer in charge, to facilitate smooth progress of cable tray works from one level / place to other, as the case may be.

29. Painting of the cable tray by identification marking/numbers as indicated in the drawings with two coats of paint of the approved make as directed by the CORPORATION

30. Based on erection fronts getting released progressively at site, Contractor shall asses and analyze the quantum of materials required for the erection works at site and the same shall be arranged progressively to take up the works as well as to meet the project schedule. Contractor shall review the drawings and site conditions / requirements both, for assessing the quantum of materials required to be arranged for erection works at site.

31. In general, the width of Embedded Parts (EP)are 100 mm to 200 mm with varying lengths provided by other agencies or the drawings issued to the electrical contractor, which may have to be fixed in concrete by chipping the finished floor around 50 to 100 mm and by anchoring of support plates in floor / wall/ soffit for installation of cable support structures. The tolerance level in horizontality of the long EP may vary from 10 – 25 mm for which shim plates of required thickness and size in 1-2 layers may have to be welded by the contractor without any additional cost to NPCIL.

32. DISPOSAL OF CABLE METAL STRUCTURE / CABEL TRAY SCRAP:

32.1 Neatness and Cleanliness are the essence of any House Keeping works at site and all such works shall be carried out by the Contractor with utmost sincerity, seriousness and total commitment to the cause of maintaining TOTAL CLEANLINESS / SAFE SURROUNDINGS AROUND.

32.2 The contractor shall submit an action plan / a dedicated procedure for house -keeping of

the CMS works area before carrying out the actual works for review and acceptance of the EIC / Corporation. Along with daily plan of CMS works, disposal plan of the scrap generated during the works shall also be mentioned.

32.3 The cable metal structure (CMS) scrap / wastage generated during the works shall be removed / taken out of the building / area of works, on a day to day basis without fail, firstly to a pre-determined area / location, as discussed and finalized during the execution of works. Accumulation of metal scrap inside the buildings is strictly prohibited.

32.4 In order to prevent indiscriminate scattering of CMS wastage /scrap materials, a dedicated metal bin for disposal of CMS scrap shall be kept outside the building and maintained in the concentrated area of works so that, all the metal scrap generated can be accumulated at pre-determined place/s and be taken out by the Contractor for final disposal beyond the area of works/Unit – 3 & 4 operating area, once the metal bin is filled. Sufficient no. of bins shall be available so that, once the filled metal bin is taken out for disposal, empty metal bin is kept for the above said disposal.

32.5 The name of the agency / contractor / contact no. of area I/C responsible for the above works / house-keeping of the area along with purpose of the metal bin (i.e. FOR DISPOSAL OF CMS SCRAP) shall be prominently displayed in all the metal bins kept for the purpose. Metal bin can be fabricated at site or be arranged / ordered outside but the size and type of the metal bin shall be subject to review and acceptance of the EIC / Corporation.

32.6 Disposal of CMS scrap works also include removal of fine metal dust generated during the works and closed dust bins shall be provided and be maintained to facilitate smooth disposal of fine metal dust and help in maintaining the area neat and clean.

32.7 Final disposal of the above metal scrap accumulated during the course of works shall be carried out at regular intervals in order to dispose off the scrap material outside / beyond the erection works site area to Purchaser's Store.

32.8 Adequate tools and tackles shall be arranged for safe disposal of the CMS scrap / waste generated with deployment of dedicated resources such as hydra crane, tempo / truck / trailer , etc. as the case may be.

32.9 No laxity of any kind and manner in this regard is permissible and dedicated resources such as requirement of crane, handing equipment, vehicle, truck / trailer , etc. for the above works shall be arranged in priority, so that, disposal works get the due priority it actually deserve and Contractor shall submit the progress report of the scrap disposal activities too.

32.10 Entire area of CMS works shall thus be cleaned and maintained dust and scrap free after completion of works and any decision communicated by the EIC / Corporation in this regard any time during the currency of the contract to maintain the area of works NEAT & CLEAN throughout, shall be complied in true letter and spirit to maintain CLEANLINESS AROUND.

32.11 A dedicated person / supervisor for this job shall be specifically allocated entrusted with responsibility of keeping and maintaining the area NEAT & CLEAN THROUGHOUT THE PERIOD OF CMS WORKS & NO LAXITY IN THIS REGARD BY THE CONTRACTOR IS TOLERATED.

32.12 All the above works shall be carried out with TOTAL COMPLIANCE OF SAFETY MEASURES / PROVISIONS as per the prescribed safety guides and the works being carried out shall be supervised / audited by Safety supervisor as well.

32.13 Contractors are advised to refer the relevant clauses given in GCC & SCC for disposal of wastages / permissible wastages, etc.

10.15 JOB SPECIFICATIONS FOR CABLING / CABLE LAYING WORKS

The Scope of erection works includes the following:

(The entire scope of cabling works are further categorized under several heads and the works to be carried out under each head are described as below)

A. Cable Storage yard requirements:

The cable storage yard shall be set up by the Contractor with following requirements to facilitate faster and easier retrievability of the cables stored:

1. Cable storage area shall be leveled and prepared firm with no water logging during rains.
2. Separate storage area for power and control cables.

3. Within the power and control cables area, clearly demarcated / ear-marked area for HV and LV cables and LS and FRLS, HF and FRHF cables shall be maintained for easy retrieval.
4. Electrical and I & C control cables are also to be kept separately to facilitate easy identification / retrievability.
5. Allocation of separate and dedicated area within the above category for storage of partially used cable drums shall also be made.
6. The above area shall be clearly marked and all the cable drums shall be kept in an orderly manner.
7. Sufficient gaps / space must be left within the drums so that, retrievability of any cable drum on any given time is easily possible using hydra crane.
8. Suitable temporary fire protection measure plan / provision shall be kept ready in the nearby area to meet any eventuality.
9. Suitable security protection / fencing to the area shall be made to prevent unauthorized access to the area.
10. All the cable drums shall be kept with wooden log supports so that, they do not slide during the storage.
11. Periodic monitoring of the cable drum condition and storage conditions shall be reported.
12. Separate area, if any, shall be reserved for keeping partially used drums.
13. Empty drums shall be disposed without any delay, other than any limited amount of cable drums which are to be kept / reserved for winding left over cables.
14. Big sized drums shall be kept over the wooden logs in order to prevent the damage to the cable drums due to its self-weight during the storage period.
15. Special cables, if any, such as LAN / Cat cables, etc. needs to be stored indoor, if asked for, as per manufacturer's document.
16. Any other storage requirements, as specified by the cable manufacturer.
17. All cable ends shall be sealed with suitable cable shrouds & availability of the same shall be monitored regularly.
18. Any other specific recommendations given by the Engineer – in – charge including maintenance of orderly and neat conditions in cable storage yard.

19. Contractor is also encouraged to have their own novel system of cable drum identification for easy retrievability and location of the cable drums stored at site such as usage of RFID card / bar coding / allotment of unique no. / coding, etc. on the cable drum through proper records of storage / history sheet of the cable drum, etc., which all shall be shared regularly with Purchaser as well.
20. In case of deterioration of the cable drum, before its usage, the contractor shall carry out the re-winding of the cables in a fresh wooden drum, which is to be arranged at no additional cost.
21. Cable scrap accumulated at the site shall not be brought to the cable drum storage area.

B. Cable receipt & inspection at site

1. Material receipt at site, safe unloading at site and safe storage at site, etc. as per the specific requirements covered above and elsewhere in the relevant chapters / sections of the document.
2. All the items received at site, shall be listed, recorded and documented properly, both in hard and soft copy form and the master list of cable be updated accordingly.
3. All cable drums shall be inspected both visually as well as for verification of packing list vis-à-vis cables received at site.
4. Missing documents and items, discrepancies if any such as wrong supply, marking, missing cable drums, shortage of drum length wrt to packing list etc., shall all be properly recorded, listed and necessary actions shall be taken to resolve the non-conformity without any delay.
5. Inspection of the material received at site, with due participation of all the concerned groups / agencies / representatives of Purchaser / Corporation.
6. Insurance during the storage, erection, testing and commissioning / till handing – taking over by Purchaser / Corporation
7. Proper storage of cable drums as per the requirements of the storage yard given under sl. no. A above. In case of any abnormality of the cable drum stored such as weakening / powdering of cable drum wood material, then the cables in the drum shall be coiled in a

new drum of good quality without any extra cost and old drum be disposed off immediately.

8. It is the responsibility of the Contractor to show and demonstrate the actual length of the cable drum supplied, in a manner acceptable to the EIC / Corporation, without uncoiling the cable drum. If cable length meter with reasonable degree of accuracy is available and proven, then the same can also be used as an additional tool to prove and demonstrate the cable length.
9. Contractor is encouraged to suggest any other novel method to address the above issue to the satisfaction of the EIC / Corporation.
10. Contractor is also encouraged to adopt novel, state – of – the – art techniques, if any, such as use of RFID cards / bar coding, etc. on the cable drums supplied not only to locate the cable drums easily but also to have an updated and ready – to – use history sheet of the cable drums.

C. Issue of Cables for erection and Scope of Cabling works:

1. Drawl of the cable drums from stores, safe material handling /safe transportation to the location/erection point, orderly storage at site, etc. Required handling machineries / cranes shall be mobilized for the above works. In case of issue of any cables from Purchaser as 'free issue materials', then the same shall be drawn from NPCIL Store.
2. The cable drums shifted near the building shall be kept in a neat and orderly manner and any recommendations given by the Engineer – in charge in this regard shall be complied for shifting the cable drums from one location to another from any site considerations that may crop up during the course of erection / cable laying.

   All cable ends in the drums kept at site and those drawn for erection, shall be invariably closed with suitable shrouds without fail to be arranged by the Contractor. Any misplaced / lost shrouds during the site preservation shall also be arranged by the Contractor.
3. Uncoiling of the cables from the cable drums using proper jacks, rolling it on rollers, wherever necessary; adequate no. of proper rollers shall be arranged prior to taking up the above works. Uncoiling or pulling / dragging of cables over rough soil / surface is strictly not allowed. Contractor shall arrange sufficient nos. of protective sheets (eg. Tarpaulins) or

any other appropriate cushioning surface, while uncoiling the cables in order to prevent any damage to the cable sheath.

During the uncoiling of the cable in the above said manner, visual inspection of the cable outer sheath shall be carried out to examine any appearance / presence of any deformity, abnormal bulging, insulation damage, puncture , etc., and any such deviation shall be brought to the notice of EIC / Corporation and detailed examination of the same will be carried out further and if the cable is found to be unsuitable on account of the above reasons, then the cable is liable to be rejected and Contractor shall replace the cable at no additional cost. The root cause analysis of the above failure / non-conformity shall also be prepared and submitted to EIC / Corporation.

4. Before laying of the cables, route survey shall be carried out and constraint / interference, if any, in the route shall be brought to the notice of Engineer in charge in advance for any appropriate resolution.
5. Cabling plan for the day / week / month shall be given and the area / routes where cabling is proposed to be taken up, shall be discussed in advance and clearance / concurrence to be obtained from the Corporation / Engineer – in charge. Constraints report can also be generated in order to have proper follow up.
6. IR value and continuity of the cables being / to be laid shall be checked before laying and be recorded in a proper register (hard & soft copy) with date, cable type, size along with details of equipment used for measurement of cabling works and the same shall be produced for any verification by the Corporation. Acceptability of the above values measured shall be checked and verified prior to cabling works and in case of any non-conformance of the above, the same shall be brought to the notice of EIC. In case of Screened control cables, continuity of the screen shall also be measured in a similar way and be recorded in a register (hard copy) and soft copy form.
7. Prior to laying of the cables, cutting schedule shall be prepared by the Contractor in order to use the cable drum lengths in an optimum manner and to minimize the quantum of unused cut lengths of cables. Only after carrying out the above exercise, the cables from the drum shall be cut for issuing the same for further laying works.

8. Contractor shall use computer based cable cutting software program such as 'drum fit analysis', etc. to minimize the wastage and optimize the use of cables to be laid at site. The results of the programs shall be shared with EIC / Corporation.
9. EIC / Corporation shall be kept informed regularly with the above update on the cable stock position at stores vis-à-vis cables cut and used along with balance stock of cut lengths, etc. with the Corporation
10. Laying of the cables shall be carried out as per the cable schedules, resolutions agreed upon on the cable route surveying carried out, etc. The cables shall be drawn / uncoiled from the cable drum using rollers and pulling / drawing / dragging of the same over rough surface is strictly not allowed.
11. The length of the cables laid, in general, shall be sufficient enough between the panel and load ends such that, sufficient extra length is available at both ends of the cable for taking up the cable termination works without generating any stress on the cable / cable termination as well as to take care of any exigency / re-termination works that might have to be taken up in future, in particular for LT cables. The above aspect shall be reviewed and discussed with EIC on the site conditions / practicality, etc. prior to taking up HT / LT / Control cabling works on a case to case basis.
12. Cabling guidelines given in the technical specifications or issued during the execution of the contract, shall be followed / complied in letter and spirit. Contractor is advised to study the same and share the details and requirements to be complied with their cabling engineers / supervisors so that, proper dissemination of information and stipulations are carried out prior to carrying out the cabling works. In case of any doubts and difficulty to comply with these cabling guidelines, the contractor is advised to get it clarified with EIC / concerned agency / group of Corporation.
13. In view of the above, Contractor shall develop a fool proof mechanism and system to ensure orderly cabling works at site in compliance with the cabling guidelines issued by the Corporation. Any violation / deviation of the cabling guidelines with respect to cable logs / schedule issued for construction shall be brought to the notice of Engineer – in charge and the same shall be resolved appropriately.

14. Some of the cabling criteria such as route philosophy, distance between the cables to be laid, bending radius requirement, cable clamping / banding arrangement, etc. are all covered in this document / tender document and these requirements shall be kept in the mind during the cable laying and in case of any deviation with the above philosophy, the same shall be brought to the notice of Engineer – in charge for necessary resolution on the same in consultation with concerned groups.
15. Unilateral decisions by the Contractor in cabling works, without the consent of EIC / Corporation is not allowed.
16. Any removal and re-laying of the cables laid in violation of the cable logs and the above mentioned cabling guidelines, shall be carried out within the scope of cabling works, without any extra cost, as recommended by the Engineer – in – charge.
17. The scope of cabling includes supply and installation of NPCIL approved cable ties as stipulated in the technical specifications, cable tags made from anodized Aluminium sheet, with identification numbers punched, as mentioned in technical specifications of cabling works. The same shall be attached to the cables by G.I. binding wire / Scrap copper wire.
18. All 6kV single core cables shall be laid in trefoil formation and G.I. / AL. clamps made of 2/3 x 25/20 mm flat shall be used for fastening of the single core HT/LT cables. (2 x 20 mm is allowed in case of practical difficulty in obtaining the desired trefoil formation). The trefoil clamp to be used for the above purpose shall be tested for withstanding dynamic stresses that could be resulted due short circuit current with a value as specified in the cabling guidelines and test certificate for the same shall be produced. The above clamps shall be installed at every 5 metre length, clamped firmly to the cable trays, unless specified otherwise in the cabling guidelines. Proven trefoil clamps, of any reputed make, are also acceptable on submission of test certificates for the same with due concurrence of EIC / Corporation.
19. In case of cables of smaller cross section, particularly for control cables, Contractor shall make conscious efforts to explore the possibility of laying the cables in “bunched groups” in a given tray, in order to optimize / utilize the space more effectively without overcrowding the trays. Eg. In control cable tray, all the cables can be arranged together at

site first and then, the same can be bunched together in 100 mm groups (approx.) to have better utilization of the space.

20. HV cables shall be held together with 'cable banding ties' made of stainless steel and nylon ties, to hold the cables together in trefoil position every 0.5 m. Nylon and stainless steel ties can be used alternately.

21. LT/C & I cables shall be clamped with the trays at standard intervals, but at not more than 5 m intervals, and to be bonded together every 0.5 / 1 m band unless specified otherwise in the relevant clause(s) of technical specification / tender document / Cabling guidelines issued to the Contractor. Nylon / plastic ties as specified in the cabling guideline document shall be used, as specified and as recommended by Engineer – in – charge. For LT cables of higher cross section (> 16 sq. mm), GI or AL. clamping with cable trays along with cable ties at every 0.5 m may be required to hold the cables firmly with the cable trays. For LT cables of lower cross section (<1 6 sq. mm) and for control cables, the cables shall be bonded together at every 0.5 m. The gap thus decided between the cables laid shall be sufficient enough to hold the cables together firmly.

    In case of any cables to be terminated by other agencies, in particular for Instrumentation cables, the scope of cable laying includes lifting / dressing of the laid cables right up to the Panel / JB / TB level with suitable permanent marking with paint, over and above the cable tags to be provided as per standard cabling guidelines and technical specifications. In any case, the cables shall not be thrown indiscriminately on floor in such cases which would make it difficult later to trace / identify the required cable by other agencies.

22. After laying of the cables, if found necessary, additional supports / reinforcement of the cable trays with cables, may have to be carried out to prevent sagging of the cable trays as well as to provide additional support to the cable trays.

23. Requirement of any new openings and enlargement of existing openings, if any, etc.. to facilitate hassle - free cabling as well as to ensure segregation of the cables as per cabling philosophy, shall all be carried out as per relevant item of BOQ / Schedule, and as directed by the Engineer in charge to facilitate smooth passage of cables from one level / place to

other and to ensure proper segregation between various groups of the cables, as the case may be.

24. Temporary dressing and tagging of the cables laid shall be carried out immediately after laying of the cables in the cable trays. In case of LT power of smaller cross sections (< 16 sq. mm) and in case of control cables, dressing of the cables shall be carried out before laying of second layer of cables.
25. In addition to the GI / Anodized Al. plate tagging, cables shall also be painted (with suitably visible & contrasting colour w.r.t. cable insulation colour) with cable tag designation, at either ends of the cables, in order to overcome of the problem of misplacement of cable tags during the period of erection / contract.
26. Tagging (punching of cable tag with clearly legible identification marks) intervals shall be as per the distance / intervals specified in the technical specifications / cabling guidelines and approved erection procedures.
27. Cable tags shall be provided on the cables below the panels as well as inside the panels, unless specified otherwise elsewhere in the document. Cable tags shall also be provided on either side of the wall & floor openings / normal & fire door crossings, etc. unless specified otherwise elsewhere in the document.
28. Dressing of the cables shall be carried out immediately after laying of the cables as per cable logs / schedules, etc. and check list for the cabling done shall be submitted in two stages, stage – I covering the above activities and stage – 2 covering the final dressing and clamping of cables with the trays using 25/20 x 3/2 mm Al / G I clamp and completion of tagging of the cables in the entire route.
29. Persons involved with cable dressing shall be specifically and strictly instructed not to throw or leave the wiring cut / bit pieces from the wires used for cable dressing at the cabling trays / site / location , etc. and all the wiring bit pieces of these kinds shall be collected / removed from the scene on a daily basis without fail, at the end of work, thereby maintaining total cleanliness in a continuous manner. No site shall be left alone with such wiring bit pieces scattered around. Contractor is encouraged to device their own novel methodologies such as giving a small pouch with hook to tie it around the belt to all

the personnel involved with cable dressing, so that, the wiring cut pieces falling down after the cable dressing are collected then and there and put inside the pouches given to them and at the end of the day, these pouches can be emptied in the cabling wastage / scarp bins kept outside the building for its disposal.

30. After laying of the cables and above mentioned dressing of the cables, IR and continuity of the cables, as well as cable screen (for screened cables) shall be checked and recorded in hard and soft copy register prior to releasing the same for cable termination. In case the cables are to be terminated by other contractor / agencies, then, IR & Continuity of the cables shall be verified in the presence of representative of other agencies for handing over of the cables for cable termination.
31. After completion of the above final dressing and clamping, the workmanship of the above shall be offered for verification (through check list format) and acceptance by the concerned agencies for obtaining necessary clearance, if any, for carrying out HV tests (for HV Cables).
32. High Voltage Testing of the HV cables shall be carried out before releasing it for cable termination works and HV test, as per relevant standards, shall be carried out. In case of failure of HV testing due to failure of cable insulation along the cable length, then the said cable shall be replaced at no additional cost and reasons for the failure of the HV test shall also be diagnosed and root cause analysis report be generated.
33. All HV and LT Power cable ends shall be sealed back with cable shrouds to prevent ingress of moisture before carrying out cable termination works. Similarly, all control cable ends shall be sealed with insulation tapes to prevent ingress of any moisture before releasing the same for cable termination works.
34. Wherever screened and armoured cables are to be laid, continuity of screen shall be measured prior and after laying of the cables. In case of any non-conformity of the same, the same shall be brought to the notice of the EIC / Corporation and if discontinuity of the screen is found throughout the length of the cable, then the cables may have to be replaced by the Contractor and root cause analysis of reasons for failure of screen continuity shall also be submitted.

35. All necessary pre-commissioning checks/tests such as continuity tests, HV Tests, meggering etc. shall be carried out on the cable before termination at either ends and be documented.
36. After clearance of the check list, boxing up of the cable ducts with top / side covers etc., as the case may be, shall be carried out.
37. The removed covers of the cable duct and boxes shall be kept / preserved at a safe location in order to avoid any misplacement of the same. In case of tying of the same to cable duct on the top, tying shall be done with proper and strong GI wire to prevent accidental falling of the same during the period of cabling works, or till the cable duct covers are placed back on the duct / box, as the case may be.
38. Submission of daily progress / charts on the cabling laid vis – a - vis cables planned, weekly/ monthly / annual / total cumulative cabling done , etc. along with submission of manpower deployed
39. Preparation of weekly issue cum consumption statements and submission of all the relevant inventory stock / consumption details, etc. in soft copy form

40. Following requirements related to cabling works at site shall also be ensured:

40.1 Prior to cabling works, following specific PRE-REQUISITES shall be ensured:

a. Availability of approved cable schedule and drawings.
b. Proper identification numbers of the cable trays, identification marks for safety related cable trays, non-safety related cable trays and earth continuity of trays as per drawing.
c. Availability of cable trays free from any sharp edges, obstruction and foreign materials.
d. Availability of cables as per cable schedule duly inspected and accepted.
e. Availability of cable identification tags and clamps for fixing cable.

The contractor shall mobilize following basic equipment & accessories, but not limited to, for cabling works:

f. Cable drum jack of various sizes
g. Hydra for lifting cable drum
h. Measuring tape
i. Calibrated 500/1000V Megger

j. Continuity Tester

k. Cable rollers

In addition to the above, possibility of mechanized cable rolling machines, trolley mounted cable rollers etc. shall be explored to streamline the execution of works, systematically and safely.

40.2 Following specific steps shall be ensured after drawing the cables for cabling works:

a. As per cable schedule, cable drum with proper size, type and length of cable shall be shifted from stores to location as per approved material handling procedure.

b. Ensure the healthiness of the cable by checking IR value and conductor resistance using 500V megger for LT power, control, instrumentation cable and 1000V motor operated megger for HT cable prior to laying. The observed value shall be recorded and submitted to NPCIL for review.

c. Cable drums shall be placed on jacks with hydra. Cable shall be unrolled from drum/by rolling the drum on jacks to avoid kinking.

d. Remove the cable by rotating the drum in such direction (as shown on cable drum) so that cable shall come out from the top of drum and physical / visual verification shall be done simultaneously throughout the length of the cable.

e. The identified cable shall be laid in the cable trays as per the cable route given in the respective cable schedule. In case of C&I cables, the channel cable shall not be laid in the non-channel cable trays.

f. Any kinking of cable shall be removed from the cut length.

g. Proper care shall be taken to avoid mixing and crossing of HT, LT & Control cables and different divisions of cables. Minimum separation distance between the cables shall be maintained as specified in the specification and design notes / installation notes.

40.3 Following specific points are to be ensured for actual cable laying works:

a. **6 kV**, 3 core HT cables shall be laid in single layer only without exception. These cables in general will be laid with spacing equal to the diameter of the cable.

b. **1100V** grade power cable of OD above 16 sq. mm shall be laid touching in single layer in trays.

c. **1100V** grade power cables of OD 16 sq. mm and below can be laid in double layer and touching each other.

d. Control and instrumentation cables shall be laid touching up to a maximum of two layers or up to 70% volume wise, if not specifically mentioned otherwise, in each tray whichever is higher.

e. The sequence of cable laying shall be planned in a way to avoid criss-crossing of cables or jumping over the other cables, which taking out from main run.

f. In case the single core cable passing through the pipe sleeves, all the three cores pertaining to three phases (1 set) shall be laid in one sleeve only. Wherever pipe sleeves are provided, the possibility of routing 6kV cables in trefoil formation shall be checked / verified prior to actual cabling works and in case of any difficulty / non-conformity the same shall be brought to the notice of Customer.

g. Extra cable length, if any, shall be kept minimum and on panel/load/equipment side for termination.

h. In case of Control cable extra length shall be Height + Width + Depth of the panel while in case of Power cable extra length shall be decided on the basis of distance of Bus bar from gland plate.

i. The laid cables shall be provided with anodized aluminum tags with cable number as per cable schedule at regular intervals binded by G.I wire as mentioned in specification / working document.

j. In case, if cables are to be laid in the pipes/conduits care shall be taken to avoid any sharp edges at the pipe ends. These pipes / conduits shall be provided identification number and colour band as per installation notes & drawings. Pipe / conduits shall be suitably supported parallel on structure / wall or supported with ISMC channel as per drawing.

k. Directly buried cable shall be laid as per approved drawing and cable route markers shall be provided at intervals of every 15 meters on each cable length. A 100mm layer of sand above and below the cable and 20mm thick concrete tiles for HV cables and Burnt bricks

for LV shall be placed over the entire length of buried cable. Bricks shall be placed widthwise as per specification.

l. In each outdoor cable run greater than 60 meters, 4 to 5 meters extra cable length is kept at a suitable point with loop mark to enable a straight through joint to be made, should the cable develop fault at later date unless otherwise noted in the drawings.

m. Also 2 to 3 meters slack extra cable length is to be provided at either side of each straight through cable joint points to enable easy pulling and re joining in case of failure of joints.

n. Where under-ground cables cross roads and water, oil, gas or sewage pipes, the cable shall be laid in hume pipes. For road crossings, the pipe for the cable shall be buried at not less than 600mm from ground level unless otherwise noted in the drawings. Hume pipes shall be preferred to steel pipes from the point of view of corrosion.

o. For sealing arrangement at entry points, suitable pipe sleeves, shall be provided in building walls/slabs for passage of cables into a building from cable pans in cable trenches located outside the building or as mentioned in working document.

p. Cable trenches shall be raised by 300mm at entry points to avoid flooding.

q. The hume pipes are used when few cables have to cross the road and usually a cover of 1000mm is provided between the road surface and the top of hume pipe.

r. Trefoil clamps shall be used to clamp single core cables as per working document and as specified elsewhere in this technical specifications.

s. Cable supports shall be provided at equipment/panel and JB end as per drawings and cables shall be firmly clamped to these supports.

t. Final dressing of the cables shall be done neatly with PVC wires and GI / Al. clamping shall be done and tray cover shall be installed after final dressing & clamping.

u. Cables shall be checked for insulation resistance value as per working document by 500V megger for LV cables and 1000V megger for HV cables after completion of cable laying prior to termination of cable.

v. Field routing from cable tray to equipment shall be done as per separate procedure and requirement to be developed and be approved by the Customer.

w. Field register containing details of drum no., cable consumption details shall be maintained.

x. Empty cable drums are to be disposed as per the requirements covered separately

y. All care shall be taken to avoid storage of wooden / inflammable items at site

z. A separate, dedicated crew shall be allotted for this job with a special emphasis on housekeeping of the site during the cabling works, as covered specifically below.

41. DISPOSAL OF EMPTY CABLE DRUMS & CABLE SCRAP:

41.1 Neatness and Cleanliness are the essence of any House Keeping works at site and all such works shall be carried out by the Contractor with utmost sincerity, seriousness and total commitment to the cause of maintaining TOTAL CLEANLINESS/SAFE SURROUNDINGS ALL AROUND.

41.2 The contractor shall submit an action plan / a dedicated procedure for house -keeping of the Cabling works area before carrying out the actual works for review and acceptance of the EIC / Corporation. Along with daily plan of Cabling works, disposal plan of the scrap generated during the works shall also be mentioned.

41.3 **Empty cable drums generated during the works shall be removed / taken out of the building / area of works, on a day to day basis without fail**, firstly to a pre-determined area / location, as discussed and finalized during the execution of works. Accumulation of empty cable drums inside / outside the buildings is strictly prohibited. Indiscriminate scattering / lying of empty cable drums in the area of works is strictly not allowed.

41.4 Partially used cable drums can be stored near the building at mutually agreed locations only if the balance cut lengths of the cables are planned to be taken for laying immediately. Storage of any such partially used cable drums near the building is otherwise not allowed /permitted and all such drums shall be taken back to the cable yard area. The above job may involve repeated shifting/re-shifting of the cable drums from the cable storage yard to the area of cabling works & vice versa and all such works shall be carried out without any additional cost, to maintain the area neat and clean, throughout the period of the contract.

41.5 A dedicated trailer and hydra are to be maintained on daily basis during the cabling works

for disposal of these empty drums, at the end of every day.

42. Disposal of cabling scrap / wastage:

42.1 In order to prevent indiscriminate scattering of Cable wastages /Cable scrap / Cut-pieces / insulation scrap materials, etc., a dedicated metal bin for shall be kept outside the buildings and maintained in the concentrated area of works so that, all the cable scrap generated can be accumulated at pre-determined place/s and be taken out by the Contractor for final disposal beyond the area of works/Unit – 5&6 operating area, once the metal bin is filled. Sufficient no. of bins shall be available so that, once the filled bin is taken out for disposal, empty bin is kept for the above said disposal.

42.2 The name of the agency / contractor, company logo, package no. and contact no. of person responsible for the disposal of the above / House-keeping of the area, etc. along with identification of the metal bin (EG. FOR DISPOSAL OF CABLE SCRAP) shall be prominently displayed in all the metal bins kept for the purpose.

42.3 Metal bin can be fabricated at site or be arranged / ordered outside but the size of the metal bin shall be commensurate with quantum of cable wastage being generated in the vicinity of bin location, and shall be subject to review and acceptance of the EIC / Corporation.

42.4 Disposal of cabling scrap works also include removal of fine wire wastages generated during cable termination works such as small cut pieces, loose wires, conductor ends, etc. generated during the works and closed dust bins shall be provided for disposal of such fine wastages and be maintained in all the area of works to facilitate smooth disposal of such cable wastages and help in maintaining the area neat and clean.

42.5 Final disposal of the above cable scrap accumulated during the course of works shall also be carried out at regular intervals in order to dispose off the scrap material outside / beyond the erection area to the scrap yard.

42.6 Adequate tools and tackles shall be arranged for safe disposal of the cabling scrap / waste generated during the works with deployment of dedicated resources such as hydra crane, tempo / truck / trailer , etc. as the case may be.

42.7 No laxity of any kind and manner in this regard is permissible and dedicated resources such as requirement of crane, handing equipment, vehicle / tempo / truck / trailer, etc. for

the above works shall be arranged in priority, so that, disposal works get the due priority it actually deserve and Contractor shall submit the progress report of the scrap disposal activities too.

42.8 Entire area of Cabling works shall thus be cleaned and maintained dust and wastage free after completion of the cabling works and any decision communicated by the EIC / Corporation in this regard any time during the currency of the contract to maintain the area of works NEAT & CLEAN throughout, shall be complied in true letter and spirit to maintain CLEANLINESS AROUND.

42.9 Dedicated persons / supervisors for this job shall be specifically allocated entrusted with responsibility of keeping and maintaining the area NEAT & CLEAN THROUGHOUT THE PERIOD OF CABLING WORKS & NO LAXITY IN THIS REGARD BY THE CONTRACTOR IS TOLERATED.

42.10 All the above works shall be carried out with TOTAL COMPLIANCE OF SAFETY MEASURES / PROVISIONS as per the safety guides and the works being carried out shall be supervised / audited by Safety supervisor as well.

42.11 Contractor shall also refer the relevant clauses given in GCC regarding the permissible wastages of cables.

Note: The requirement mentioned in the General Cabling guidelines shall also be complied during cabling/ cable laying work which will be issued to the successful bidder.

10.16 JOB SPECIFICATIONS FOR CABLE TERMINATION WORKS

The scope of erection works includes the following:

1. Material receipt at site, safe unloading at site and safe storage at site, etc. as per the specific requirements covered elsewhere in the relevant chapters / sections of the document.
2. All the items received at site, shall be listed and documented properly and all items such as cable glands, termination kits, lugs, ferrules, etc. shall be inspected both visually as well as for verification of packing list.
3. Missing items shall be listed and necessary actions shall be taken to arrange the same without any delay. Necessary actions to replace the missing / damaged cable termination

kits / terminations etc. shall also be taken, in case of observance of any damages during the transportation / unloading, etc.

4. Inspection of the material received at site, with due participation of all the concerned groups / agencies / representatives of Purchaser / Corporation.
5. Insurance during the storage, erection, testing and commissioning / till handing – taking over of the equipment by Purchaser / Corporation
6. Contractor shall develop cable termination procedure and field quality plan for the review, concurrence and acceptance of the EIC / Corporation, detailing the various steps involved in the cable termination works to be complied during the actual works.

7. Qualification of the Cable Termination Personnel:

7.1 Contractor shall arrange experienced and qualified personnel for the cable termination works in order to carry out the intended works without compromising the quality and safety.

7.2 The persons being deployed for the works shall be properly screened and trained and qualified, wherever necessary, prior to their engagement in the cable termination works.

7.3 After the above mentioned training, trade test in the relevant field / area of works, where technicians will be deployed, shall be carried out through an authorized committee of the Contractor, for carrying out the assessment of the technician, their knowledge, skill and their qualification for carrying out the specified job at site.

7.4 Those who do not qualify in the above exercise shall not be engaged as “electrician” for the actual cable termination works at site.

7.5 Persons qualified through the above process having academic qualification and the past experience can be deployed as “Electrician” for termination works of cabling and lighting system on the commissioned / isolated system.

Persons qualified through the above exercise, having good experience but without academic qualification shall not be employed as “Electrician” for actual cable termination works on commissioned / isolated systems, but they can be employed for cable glanding and other supporting electrical works such as dressing, cleating, clamping, etc..

Persons qualified through the above process having academic qualification but without

past experience can be initially engaged for cable termination supporting jobs mentioned above

In line with schedule of works planned, Contractor shall thus ensure that sufficient no. of Electricians with "B" license or/and qualified through the above authorisation process and adequate experience in cable termination works are deployed at site, so that progress of cable termination works at site is not affected and most significantly, the quality and safety of the workmanship executed are of the highest order. Any change in the authorisation process as stipulated at site from time to time, shall also be complied with.

7.6 In case of 6kV HV Cabling & LT cables of higher C/S, qualification of the cable terminators / jointers shall be carried out prior to actual works, with mock up cable termination, duly reviewed and concurred by concerned groups of Corporation. Only those who are qualified through the above exercise shall be allowed to take up actual cable termination works at site.

8. In case of cable glanding works, first the cable size and panel gland plate hole size , etc. shall be measured to decide the correct the size of the cable gland to be used.

9. All cable termination works shall be taken up only after clearance of stage – 1 check list of the cabling carried out at site.

10. Removal of the gland plates of the panels and other loads, as applicable, for making of the desired size of the holes on the gland plate through a lathe or a knock out tool, finishing / smoothening of edges of the hole made, and restoring the paint surface to its original state in case of any damages / scratches to the gland plate. Machining of parts of the cable glands wherever required to suit the exact size of the cable.

11. In case of requirement of any support to the cables prior to glanding / termination etc, the same shall be done in order to prevent transfer of cable load / weight on the panel / glanding.

12. Installation of cable glands (single or double compression glands as specified in the document / technical specifications / drawings / manufacturer's instruction), required type of cable lug, termination kits, ferrules, shrouds, cable tags / ties , etc.

13. Any minor modification of the motor terminal boxes to suit cable termination and / or reducers may have to be used to gland / terminate the cables.
14. Installation of the cable glands on the power cables, supply & installation of PVC shrouds, fixing of the gland plates back on to the panel or any other load.
15. Installation of the HT termination kits for the HT cables through the specially qualified electrician, clamping of the HT cable appropriately, re-fixing, restoring of the paint of the gland plates, installation of the terminal lugs and connection on to the terminals.
16. Installation of crimping type Copper terminal lugs for the cables, supply and application of the corrosion inhibitive compound, connection on to the terminals.
17. Crimping tools of required type and sizes shall be arranged in sufficient numbers to ensure that non-availability of tools would never impede the progress of the works.
18. The small live portion exposed between the bottom of the lug and the cable insulation shall be covered with suitable insulation tape as specified in the technical specifications.
19. Complete dressing of the cable inside the panels/loads with appropriate type of nylon cable ties including supply of the same. For cables of higher C/S, additional supports, both inside as well as outside the panel, are required to prevent the loading of the cables at the terminal block / bolts etc., as the case may be.
20. Unused cores of the cables shall be bundled together, end sealed, properly dressed & ferruled with cable no. and suitable marking.
21. Unused openings in the panel shall be properly sealed to prevent entry of any foreign particle / material, which can cause failure of the integrity of the equipment.
22. For all the cables, cable tags shall be provided on either sides of the panel, i.e. below the panels and inside the panels and at the wall crossings/door crossings, if specified otherwise.
23. In some of the cases, particularly for long length LT cables of higher C/ S, cables may have to be terminated in a Junction box instead of directly terminating the same inside the load / panel end termination board, particularly where cables cannot be terminated directly.
24. In case, any cables are to be terminated on the load end through reducing termination kits or through flexible termination kits, as recommended by the General Designer in the

drawings / documents / operating manual instructions or as recommended by the EIC, then in all such cases, the cable termination / jointing of the cables laid shall be carried out with cable reducing kit at one end as per the recommended instructions of the jointing kit manufacturer and other end shall be terminated at the load end.

25. The gap between the cable gland and the opening provided in the Motor TB / JB, shall be sealed through recommended / NPCIL approved sealing compound at no additional cost. This job may have to be repeated couple of times during the testing and commissioning of the motor, where cables have to removed and re-connected again.
26. To facilitate the smooth cable termination works, some of the components / accessories such as separation plate, bolts, nuts, gland plates, inner plates, fuse , etc. may have to removed during the actual termination works, but all removed parts will have to be kept carefully in closed packet so that, they are not misplaced and promptly replaced back after completion of the works.

    Similarly, in case of motor TB termination works, TB cover shall be kept in the safe custody during the cable termination works in order to ensure that, the same is not misplaced. In case of any such misplacement, responsibility of replacement of the motor TB cover lies with the Contractor at no additional cost.
27. Colour coding insulation tapes shall be provided for power cables for phase identification and in case of control cables, identification ferrules shall be provided
28. For Power cable termination, flat and spring washers are required for cable termination and appropriate calibrated torquing tool shall be arranged for torquing / tightening of the lugs.
29. Bi-metallic washers shall be used wherever different metal are to be connected together.
30. Removal and changing of the phase connections wherever called to facilitate running of the motor in the appropriate direction shall be carried out at no additional cost.
31. Dressing of the cables inside the panel with appropriate FRLS cable ties including supply of the same as well as cable ferruling as per cable schedule/drawings
32. Connection on to the terminals in the panels, loads as per the relevant terminal list, termination / connection detail drawings

33. Sufficient length of the cable shall be left inside the panel to facilitate the connection of the cable at the appropriate terminal blocks and dressing of the cable inside the panel, by the other groups, if any, in the applicable panels.

34. For carrying out the cable termination works in the panels where fire barriers have already been installed below the cable entry openings / gland plates, all care must be taken to cut only the portion of the cables which are to be routed through fire barrier and the balance portion of the fire barrier shall not be disturbed. The gap resulted between the fire barrier openings, which are cut for routing the cables and the cables laid shall be made good with loose fire barrier material and sealing of the openings shall be done at the end of the cabling works.

35. Check list for clearance of HV cable termination works shall be prepared in two stages, with first stage covering the activities individual cable or cable group termination including dressing of the cables, if any, inside the panels and for obtaining the clearance for carrying out HV test.

    The second stage of the check list shall be submitted after completion of the all the cable termination works including the sealing of glands, sealing of openings, provision of fire barrier to seal the openings below the panels etc. shall also be completed.

36. Following additional points shall be ensured for cable termination works:

36.1 The accessories shall be supplied in kit form. Each component of the kit shall carry the manufacturer's mark of origin.

36.2 The kit shall include all stress grading, insulating and sealing materials apart from conductor fittings and consumable items. An installation instruction sheet shall also be included in each kit.

36.3 The contents of the accessories kit including all consumable shall be suitable for storage without deterioration at a temperature of 45º C, with shelf life extending to more than 5 years.

36.4 Cable accessories shall be of Heat shrinkable type. The terminating kits shall be suitable for termination of the cables to indoor switchgear or to a weatherproof cable box of an

outdoor mounted transformer/ motor. For outdoor terminations, weather shields/ sealing ends and any other accessories required shall also form part of the kit.

36.5 The straight through jointing kits shall be suitable for installation on overhead trays, concrete lined trenches, tunnels and ducts and for underground burial with uncontrolled backfill and possibility of flooding by water and chemicals. These shall have protection against any mechanical damage and suitably designed to be protected against rodent and termite attack. The inner sheath similar to that provided for cables shall be provided as part of straight through joint.

36.6 The cable glands shall be of tinned/nickel plated brass, as a minimum and shall be provided with PVC shrouds.

36.7 The cable glands shall be weatherproof. Whenever specified they shall also be flameproof and certified for the specified electrical area classification specified in the data sheets.

36.8 Cable glands shall be supplied to suit the cable dimensions, taking care of tolerances. Various components like rubber ring, metallic ring, metallic cone and the outer / inner nuts etc. shall be capable of adjusting to the indicated tolerances of cable dimensions.

36.9 Reducers / adapters shall be nickel plated brass / stainless steel, as a minimum. These shall also be weatherproof and / or flame proof wherever specified and certified for the electrical area classification specified in the data sheets.

36.10 Cable lugs shall be solder-less crimping type. Cable lugs for copper conductor cables shall be of copper. If copper lug is terminated on an aluminium bus bar, bimetallic washer shall be used.

36.11 Plugs shall be provided wherever specified. They shall be of nickel-plated brass.

36.12 Plugs shall be certified flameproof when used with flameproof junction boxes.

37.0 Disposal of Cable Termination Scraps:

37.1 Two plastic or metal dust bin shall be maintained at each and every room, where cable termination activities are in progress. One drum shall be identified for only PVC scrap and another for PVC with copper. (Both should not be mixed). All these dust bins shall be properly identified with Contractor name / logo / package name along with contact no. of the persons responsible for disposing of the same.

37.2 Metal bins kept / provided outside buildings / area of cabling / cable termination works shall be used for disposal of bigger cut pieces of the cable lengths / cable termination scrap generated during the works.

37.3 Persons involved with cable termination works shall be specifically instructed not to throw or leave the wiring cut / bit pieces from the cable wires used for cable termination inside the panel / site / location, etc. and all the wiring bit pieces of these kinds shall be collected / removed from the scene on a daily basis, at the end work, thereby maintaining total cleanliness in a continuous manner.

No site shall be left alone with such wiring bit pieces scattered around and Contractor is encouraged to device their own novel methodologies such as giving a small pouch with hook to tie it around the belt to all the personnel involved with cable termination works, so that, the wiring cut pieces falling down after the cable termination works are collected on a daily basis and put inside the pouches given to them and at the end of the day, these pouches can be emptied in the cable termination wastage / scarp bins kept inside / outside the building for its disposal.

37.4 Disposal of cable termination scrap works also include removal of fine metal dust generated during the works inside the panel and closed dust bins shall be provided and be maintained to facilitate smooth disposal of fine metal dust, if any, and help in maintaining the area neat and clean.

37.5 The dedicated vehicle / tempo / truck / trailer allocated for disposal of cable scrap / wastages shall be used for the above job with necessary manpower and the same shall be carried out on a daily basis to a pre-determined location, as decided prior to carrying out the works.

37.6 Final disposal of the above scrap accumulated during the course of works shall also be carried out at regular intervals in order to dispose off the scrap material outside / beyond the erection area to scrap yard. Metal bins arranged for the above jobs shall also be finally disposed off / taken out of the site area.

37.7 Adequate tools and tackles shall be arranged for safe disposal of the cable termination scrap / waste generated with deployment of dedicated resources both in terms of manpower

as well as machineries.

37.8 No laxity of any kind and manner in this regard is permissible and dedicated resources such as requirement of dust bins, crane, handing equipment, vehicle, truck / trailer , etc. for the above works shall be arranged in priority, so that, disposal works get the due priority it actually deserve and Contractor shall submit the progress report of the scrap disposal activities too.

37.9 Entire area of cable termination works shall thus be cleaned and maintained dust and scrap free after completion of works and any decision communicated by the EIC / Corporation in this regard any time during the currency of the contract to maintain the area of works NEAT & CLEAN throughout, shall be complied in true letter and spirit to maintain CLEANLINESS AROUND.

37.10 A dedicated person / supervisor for this job shall be specifically allocated entrusted with responsibility of keeping and maintaining the area NEAT & CLEAN THROUGHOUT THE PERIOD OF CABLE TERMINATION WORKS & NO LAXITY IN THIS REGARD BY THE CONTRACTOR IS TOLERATED.

37.11 All the above works shall be carried out with TOTAL COMPLIANCE OF SAFETY MEASURES / PROVISIONS and the works being carried out shall be supervised / audited by Safety supervisor as well.

38.0 TERMINATION OF OPTIC FIBRE CABLES (OFC)

38.1 This procedure covers the guidelines for termination of 62.5 / 125µ multi-mode optical fiber cables by Splicing, measuring end to end loss of each optical fiber cable terminated and Qualification of Splicing Operator. Any other type of FO cable will also have similar procedure.

38.2 The purpose of this document is to provide the guidelines for termination of fiber optic cables in relevant area, where OFC Cables are to be spliced and terminated.

38.3 This guideline is applicable for termination of fiber optical cables at breaker cubicles, MCCs, protection panel, Local control cubicles, inverter panel, control panels, communication, SCADA panels etc. in relevant buildings / area of this package.

38.4 Pre- Requisites

- Availability of necessary approved drawing indicating connection details.
- Availability of breaker cubical, MCCs, panels, optical fiber cables, appropriate glands in ready condition.
- LIU to place the splicing along with required numbers of ST / LC/SC adapters as per Working drawings / Site requirement.
- Pig tail/ Patch cord with ST / LC/ SC type connector as per WD / Site requirement.
- Work clearance from ENC / PURCHASER
- Availability of tools & tackles for termination

38.5 Special Tools and Tackles to be arranged:

The following special tools and tackles shall also be arranged for carrying out the job:

- Fusion splicing machine with calibration validity.
- OTDR Equipment with calibration validity
- Optical power meter with calibration validity
- Coating (micro) stripper, fiber cleaver tools, tube cutter, knife.
- Knockout punch, Hole saw cutter, screw drivers, continuity testers, hot air blower, and combination / nose pliers, spanner set.
- Cleaning agent, alcohol (99%), gel remover, lint free cloth.
- Grounding clamp printable sleeves, fusion splice protection sleeve, and cable ties.

38.6 Guidelines for the job:

1. For the information and benefit of the contractor, the terminologies used in this document are elaborated as given below:

a. OTDR: An Optical Time Domain Reflectometer (OTDR) is used in fiber optics to measure the time and intensity of the light reflected in an optical fiber and is used as a troubleshooting device to find faults, and bends in fiber optic cables, with an eye towards identifying light loss.

b. LIU: Light – guide Interconnection Unit (LIU) is essentially a fiber distribution box wherein the fiber backbone cables and the equipment cables are terminated. The splice tray

functions as a splice cover for pigtail splicing. Together they function as an excellent interface unit for fiber cables coming from field and those originating from the equipment.

2. Glanding :

a. On receiving work clearance site survey shall be done with External Optic connection diagram thoroughly and the suitable size / type of the cable gland to be used shall be identified with the size of the cable (Identify the cable with cable tag number as per WD).

b. Leave necessary length of the cable required for dressing of fiber cores / termination inside the LIU and also enough extra length outside LIU.

c. After glanding the tightness of the gland shall be checked and same shall be released for next stage.

3. Termination:

Fusion Splicing Procedure: Splicing shall be performed in "AUTO" mode.

a. Strip fiber cable jacket: Strip about two meter of fiber cable jacket to expose the loose tubes or tight buffered fibers. Use cable rip cord to cut through the fiber jacket. Then carefully peel back the jacket. Clean off cable gel with gel remover. Separate the fiber / loose tubes and buffers by carefully cutting away any yarn or sheath. Leave enough of the strength member to properly secure the cable in the splice enclose.

b. Strip loose tubes: For a loose tube fiber cable, strip away about 0.75 meter of fiber tube using a buffer tube stripper and expose the individual fibers.

c. Clean cable gel: Carefully clean all fiber in the loose tube of any filling gel with cable gel remover.

d. Secure cable tubes: Secure the end of the loose tube to the splice tray and lay out cleaned and separated fibers carefully. Strip and clean the other cable tube's fiber that is to be spliced, and secure to the splice tray.

e. Switch on the fusion splicer FSM 50S / FSM 60S and set it into AUTO mode: In auto mode core alignment, cleave angle measurement and arc calibration are done automatically. Also an estimation of splice loss shall be displayed after completion of splicing.

f. Fusion splice protection sleeve: Insert a fusion splice protection sleeve onto the fiber being spliced.

g. Strip first splicing fiber: Hold the fiber and remove the fiber coating (250µm for multi mode) with a micro stripping tool. There shall be no damage on the fiber.

h. Clean the bare fiber: Carefully clean the stripped bare fiber with lint-free wipes soaked in isopropyl alcohol. After cleaning, do not place the fiber anywhere so as to prevent the fiber from micro dusting.

i. Fiber cleaving: With a high precision fiber cleaver, cleave the fiber to 20 to 25 mm and place it in the fusion splicer.

j. Prepare second fiber being spliced: Provide correct printed sleeve. Strip, clean and cleave the other fiber to be spliced as per steps

k. Fusion Splicing: Place the second fiber in the fusion splicer and start splicing and observe for any reporting of improper cleaving, insufficient cleaning and alignment. In case of any error, the same shall be rectified before proceeding. Otherwise the fibers shall be fused and the estimated loss shall be observed.

l. If the estimated loss is more than 0.01dB, splicing is poor and shall be observed.

m. Heat shrink the fusion splice protection sleeve: Slide the fusion splice protection sleeve on the joint(bare fiber shall not be visible) and put it into the heat shrink oven of the fusion splicer and press the heat button. Wait for the fiber to cool down before removing from the heat shrink oven.

n. Place splice into splice tray: Carefully place the finished splice into the splice tray and loop excess fiber around its guides. Ensure that the fiber's minimum bending radius is not less that 40mm. Also connect the end connector (SC / ST) to the respective adapter (SC/ST) provided on the LIU.

o. Earthing: Armour of the cable shall be connected to the LIU chassis by clamping and the LIU shall be earthed using wire of cross section greater than or equal to 2.5 sq.mm.

p. Close the LIU: After all fibers have been spliced carefully close the LIU.

q. Mount the LIU: Mount the LIU into its position provided in the panel. If the space inside panel is insufficient, LIU can be mounted outside on additional support structure with the approval to ENC. Appendix-I show a typical arrangement of LIU on supports outside the panel.

r. Dress the excess cable with bending radius not less than 20 times outer diameter of the cable.

s. Interconnect LIU and Equipment terminal point using Patch cords as per WD (External Optic connection diagram / cable schedule) requirement. Identification shall be provided on the patch cord at both ends.

t. Patch cords routed outside the panels for interconnection, shall be laid through pipes / hoses or closed trays separately from other cables. Minimum bending radius shall not be less than 50mm. Use of spacers in between the patch cords and tray for clamping is not permitted. Clamping interval shall not exceed 0.4m. Clamping shall not exert any pressure on the cords. While laying vertically, putting up shall be avoided; instead it can be dropped from the top. Flexible hose has to be used in areas of bending and near panel entry points.

u. Coil & secure the extra length of the patch cord with diameter more than 100mm. Twisting and kinking shall be avoided.

v. Optical Loss Test:

- An optical loss test shall be performed using source and power meter on every optical cable terminated from one end to the other at 1310nm or at 1300nm. Total cable loss shall not exceed the value calculated by the following formula : Total Loss (dB) = (3dB x length of the cable in kilometer + 0.2 x no of connectors + 0.1 x no of fusion splice joints)
- Optical loss test using OTDR can also be conducted in place of above guideline.
- Perform an OTDR test of the spliced cable covering one end to the other end. Repeat the OTDR test from the other end also. Observe the OTDR trace; it shall be uniform except for peaking at starting point and at far end. Average of the loss measured in both directions shall not exceed the allowed total loss. i.e. Total loss (dB) = (3dB x length of the cable in kilometer + 0.2 x no of connectors + 0.1 x no of fusion splice joints)

w. Qualification of Splicing Machine Operator

- Splicing operator shall make three test splice joints of 62.5 / 125µ multi mode fiber type. If the splicing loss of all the three splices estimated by the fusion splicer is within 0.01dB, then only the technician shall be allowed to perform splicing.
- Performance of qualified technician shall be tested after every 500 splicing or every three months as per guidelines mentioned above, provided the same set of tools are used. In case

of change of the fusion splicer or the leaver, qualification shall be done again as mentioned above.

x. Acceptance Criteria shall be as given below:

- Splicing loss estimated by the fusion splicer for each splice shall not exceed 0.01dB.
- Total loss shall not exceed the limited stated in document
- Bare fiber shall not be visible beyond fusion splice protection sleeve.
- Fibers shall be guide in the splice tray and splice joints shall be secured in the splice tray provision
- Bending radius shall be better or equal to the manufacture's spec.
- Armour of the optical fiber cable and the LIU shall be earthed.
- Correct cable identification and core identification with printed sleeves as per drawings
- Splicing shall be performed by qualified technician using qualified tools.

y. After the completion of the job, checklist covering the details such as condition of tools, connectors, personal qualification, check for proper dressing / bunching / identification of cables / fibers, check for the correct striping / cutting / no twisting / cutting of the strands, etc.

Note: 1) The requirements mentioned in the Cabling guidelines shall be complied during cable termination work.

2) The above is provided for General guidance only. Contractor need to prepare procedure of termination of OFC cable taking guidance provided above and other best industry practices as on date. Fiber optic cable splicing procedure made by Contractor shall be reviewed and approved by the contractor before commencement of fiber optic cable splicing.

10.17 JOB SPECIFICATIONS FOR CABLE TERMINATION WORKS OF HERMETIC CABLE PENETRATIONS

The Termination Kits of Hermetic Cable Penetrations (HCPs) will be offered as 'Free issue Materials' to the Contractor.

The scope of erection works includes the following:

1. Termination Kits of Hermetic Cable Penetrations will be offered as 'Free Issue Materials' to the Contractor in a sealed package and the same shall be drawn for cable termination works of HCP on fulfillment of the following conditions :

- Completion of Erection of Hermetic Cable Penetration and clearance of its check list
- Completion of Cable laying works and clearance of its stage – I check list
- Availability of site fronts for taking up the cable termination works
- Completion of welding in the nearby area

2. Hermetic Cable Penetration Termination kits are supplied with KKS codes and identification marking and the Contractor shall first study the termination schedule / album / catalogue drawings and then identify / verify the readiness of the fronts for taking up the termination of Hermetic Cable Penetration works.
3. Wherever and whenever site fronts are getting ready, only the corresponding termination kits of HCPs of that particular area, which is ready, shall be drawn from Stores for cable termination works at site.
4. The packing / HCP Cable Termination Box shall be opened in a covered / semi – covered area in order to ensure that, dust or rain water or any kind atmospheric precipitation does not take place inside the termination kit drawn for the erection works. After opening of the packing / crate, visual inspection of the materials issued, verification of healthiness and completeness of the packing list, etc. shall be checked and in case of any non-conformity, the same shall be brought to the notice of Engineer – in – charge.
5. Before shifting the termination kits to the actual erection point, Cleaning of the area shall be carried out to ensure dust free atmosphere in the actual area of works. Once the same is ensured, the termination kits shall be shifted safely to the actual location of termination.
6. Contractor shall make his own arrangement to shift these assemblies to higher locations using suitable means.
7. Based on the documents / manufacturer's manual collected from the NPCIL, Contractor shall draw out a detailed termination procedure along with field quality plan and check list, which shall be reviewed, concurred and approved by the concerned agencies of Corporation.

8. All the cables entering the Reactor building containment (UJA) shall have to be terminated at either ends of the hermetic cable penetration.
9. The scope of works includes cutting, providing end terminations, installation of terminal lugs, installation of in-line ferrules, jointing, soldering, etc. as per manufacturer's instructions, etc.
10. Installation of heat shrinkable tubes on the cables and heat shrinking of the same as shown in the drawings.
11. Connection of the cables on to the hermetic cable penetration, at both the ends of the penetration.

Detailed Scope of HCP Termination Works:

12. As per the design and the new termination drawings issued, Power, Control & Instrumentation cables are to be terminated on either side of the IC wall penetration and therefore, the bidder shall study the drawings in detail before carrying out the works.
13. In addition to the above, it is also clarified that, in each cable, there are multiple cores and twisted pair of cables, including special type of coaxial cables, all of which have to be cored out before termination.
14. The no. of cables cores to be terminated on either side of the penetration may need / consume more time and manpower, and hence, Contractor shall deploy sufficient no. of experienced cable terminators in order to complete the job in time.
15. For HT, LT & Control Cables, there are different types of penetrations and each penetration is having different type of modules; HT Penetration will have single module, and for LT Cables, each module may consists of four to five nos. of cables and for I & C cables, there might be around 8 to 10 cables and hence type of efforts / time required for power and control cable may be different and Contractor shall mobilize the manpower accordingly depending on the type and quantum of works to be executed.
16. It is clarified that, the number of accessories to be used for penetration termination kit is more than that for general / normal straight-through joint kit accessories. Hence skilled manpower / engineers shall be deployed to study the drawings and identify / select actual type of termination kit necessary for the corresponding hermetic cable penetration.

17. In addition, different types of cables are given for termination on either side of the penetration owing to the different technical requirements of cable types inside and outside the RB and the same shall be studied closely before taking up the termination works.
18. Wherever mismatches of cable size with termination kits are observed, needing designer's intervention, the matter shall be referred to the corporation to resolve the problems.
19. Checking of the continuity & IR Value of the feed through is mandatory (at both ends of a module) and the contractor shall deploy qualified – highly skilled technicians for the job.
20. Prior to actual termination of the cables on the penetrations, environmental sleeves have to be inserted through the cable end and special sealing compound is to be applied and the cable end is to be sealed. This is a highly complex and time consuming job, requiring very high level of skill and expertise for carrying out the job.
21. Contractor shall note that, no. of termination kits supplied by Corporation matches with actual requirement at site and once the cable is terminated, no re-work is possible. Hence the jobs will have to be taken up with zero tolerance for any error or mistakes, and Contractor shall take utmost care and caution right from planning to execution of the works.
22. The works shall be carried out with deployment of dedicated engineer for supervision of the job / quality engineer for ensuring the quality of the job and deployment of safety engineer for ensuring the safety of the works being taken up in congested / confined area. Since the re-work will spoil the termination kit, utmost care is being taken to avoid the re-work.
23. Since all these termination activities are to be carried out on either sides of Reactor IC wall, which are all at various elevations and locations, staging arrangements may be required at some places, to carry out these works which demand a high level of precision, quality and safety.
24. The termination activity has to be taken up along with cabling inside UJA and the job has to be taken up immediately after the cable has reached the load end destination. Unless the load end systems / end point equipment is available, termination cannot be taken up and this sequencing might necessitate multiple deployment of termination crew for the same

penetration and continuation of termination activity in any single penetration, at one go may not be possible. The contractor shall mobilize and deploy the manpower accordingly to take up the works.

25. The persons to be deployed for termination jobs shall have to undergo qualification test by concerned agencies / groups of the corporation and only those who have been cleared for the jobs shall be allowed to work.
26. Whenever termination of penetrations are planned, checks of continuity of the cables is required to be carried first so that, re-work is avoided. The contractor shall carry out the above job and record the readings obtained for generating a report on the same. This report shall form a part of the overall history sheet of the HCP termination works. For screened cables, continuity of the cable screen / drain wire shall also be recorded.
27. Necessary manpower for above coordination with other agency for taking work permit, opening of terminated cores at the panel end etc.,(which are either commissioned or in the process of commissioning), to check the continuity & re-connection of the cores etc. shall be deployed as well.
28. It is possible that, at times, there will be a limited space / mobility available for the job, in particular on the Reactor building side of the UJA, and the works related to termination of such hermetic cable penetration terminations have to be planned in this type of terrain without affecting the quality and safety aspects of the works.
29. In addition to the above, there might be interferences with pipelines, HVAC ducts, civil structural platforms, beams etc… and all such interferences shall be promptly brought to the notice of Corporation for resolving the same with concerned agency.
30. In case of Reactor building, all the items needs to be shifted inside the UJA building has to be taken through the main / emergency airlock, located at 31.5 m el. and considering the location of penetration, items may have to be taken manually, needing more efforts for material handling of the works.
31. The termination details of the Hermetic cable penetrations are given in the form of albums, which were to be studied in depth for making a separate penetration specific drawing and based on this document, termination kits have to be identified for works at site. The

selection of termination kit has to be done through qualified engineer, who preferably well versed with such drawings released for the construction.

32. Working at higher elevations may also necessitate extreme care and safety measures which have to be taken up without compromising the safety and quality of the job.

33. All the termination activities shall be carried out as per the instructions of manufacturer's manual and approved erection procedure.

34. In case of control cables, following jobs will have to be carried out prior to termination works, for which all the required special tools and tackles shall be arranged:

a. Removal of Kapton insulation: Cables to be terminated on certain special type of control & instrumentation cables are provided with Kapton type insulation over the conductors inside the feed through. This Kapton insulation is a very fine layer of insulation coated on the conductor, which has to be removed with special tools, without damaging the conductor. Contractor shall mobilize the corresponding tool for the above works.

b. Core sleeves provided for some of the control & instrumentation cables were of different size, requiring special efforts to insert the sleeves, and the job has to be done without affecting the progress, quality and safety aspects of the work.

c. In case of coaxial cable penetration, the cable core may not go smoothly inside the co-axial connector (with hole size mismatch) and in all such cases, the contractor may have to do slight boring of the connector accessories to match the exact size of the cable core at no extra cost.

35. After the completion of the termination activities, HCP shall be tested as per the approved erection procedure / manufacturer's manual / field quality plans.

36. General requirements:

a. The scope of works also includes Up-keeping cleaning of all the area, adjoining area etc. where termination works are being taken up.

b. The job is to be executed by Contractor, engaging sufficient numbers of skilled personnel along with the necessary tools tackles and devices.

c. The Contractor shall ensure that during the termination works, the areas shall be cleaned

on daily basis for maintenance of clean and neat surroundings.

10.18 JOB SPECIFICATIONS FOR LIGHTING SYSTEM WORKS

The scope of erection works includes the following:

1. Material collection from stores and receipt at site, safe unloading at site and safe storage at site, etc. as per the specific requirements covered elsewhere in the relevant chapters / sections of the document.
2. All the items received at site, shall be listed and documented properly and the packages shall be inspected both visually as well as for verification of bill of materials as per the packing list. Missing items shall be listed and necessary action shall be taken to arrange the same without any delay. Necessary actions to replace the damaged parts / components / equipment shall also be taken, in case of observance of any damages during the transportation / unloading, etc.
3. Inspection of the material received at site, with due participation of all the concerned groups / agencies / representatives of Purchaser / Corporation.
4. Insurance during the storage, erection, testing and commissioning / till handing – taking over of the equipment to Purchaser / Corporation
5. Drawl of the various parts, assemblies from stores, safe material handling /safe transportation to the location/erection point, storage, preservation, verification of healthiness and completeness after unpacking etc. Required handling machineries / cranes / vehicles / tempo / truck / trailer etc. shall be mobilized for the above, as required for the works.
6. Thorough Cleaning of the area to ensure dust free atmosphere before taking up installation works. Cleaning and maintenance of dust free atmosphere is a continuous process and the same shall be carried out using high powered vacuum cleaners to remove all sorts of fine dust present inside the building. Cleaning shall be done right from the beginning of erection to commissioning.

7. Scope includes study and review of the lighting system drawings for the various main plant buildings, for its feasibility of installation at the specified locations and any difficulties / constraints in this regard shall be brought to the notice of EIC / Corporation to resolve the issue amicably. The purpose of this exercise is mainly to identify the existing as well as likely interference that might come later on account of other systems such as ventilation ducting, fire water pipelines, process pipelines, cable trays, cable tray supports, equipment, etc.

   In case of any deviation of lighting fixture location with respect to the location shown in the drawing, the same shall be recorded and information on the same shall be shared with EIC / Corporation.

8. Scope of installation of Lighting system works includes installation of lighting fixtures including lamps, control gear-box, accessories as per the mounting arrangement given in the drawings. Unless specified otherwise, **all lighting fixtures, including its junction boxes shall be installed using anchor fasteners of approved make to be supplied and installed within the scope of lighting system / Junction box installation works,** as applicable. Installation of the lighting fixtures shall be carried out as per the erection / mounting drawings.

9. Wherever lighting fixtures are to be installed / mounted on the steel beam structures (eg. High bay fitting) then, welding of the lighting fixture supporting structure with the EP shall be followed for mounting of the lighting fixture as specified in the lighting fixture mounting drawings. Welding of luminary body to the EP / beam etc. is not acceptable.

10. The anchor fasteners required for the above as well as welding consumables shall be NPCIL approved and as per the specifications covered in the relevant technical specifications of tender document. The same shall be supplied and installed as a part of the above works at no additional cost.

11. Fabrication, painting and erection including welding of all the structural supports, hangers, suspended conduits, and accessories, i.e. supply and installation of structural steel materials required for the above works, are covered separately under relevant items of BOQ.

12. The supply and installation of G.I. / FRP / GRP JBs (Junction boxes) required to be mounted along with lighting fixture installation are included separately in the schedule of works and not included in the scope of lighting fixture installation.
13. In case of requirement of any additional JB for the sake of looping of cables, then the scope of supply and installation of such Junction boxes required for the looping of the lighting cable circuits, is included separately in the Schedule of works. Contractor may note that, Metallic JBs shall be used in the area such as process systems, steel structures, high enthalpy area, hazardous area etc. whereas, in case of panel room, control room, tunnels, etc.. GRP / FRP JBs are to be used, unless specifically mentioned otherwise, as detailed in the relevant technical specifications of the tender document.
14. All metallic JBs shall be earthed using flexible copper wires which shall be connected further to the nearest indoor grounding grid, as specified in the erection drawings.
15. Installation of both the type of JBs shall be carried out as per erection drawings.
16. Junction boxes are to be used for those types of fixtures which are to be suspended from ceiling and these boxes shall be installed using anchor fasteners of NPCIL approved make, unless specified otherwise in the erection / mounting drawings. In all such cases, Supply of required type of JBs is covered under relevant item of BOQ, but supply and installation of the anchor fasteners required for the installation of JBs is included within the scope of installation of JBs.
17. All required hardware and accessories etc. for installation shall also be included in the scope of this work.
18. Scope also includes supply and installation of the cable glands (Nickle coated Brass / SS glands for metallic JBs and Polyamide glands for FRP / GRP JBs) for Junction Boxes as well as cable glands required on the lighting fixture as supplied by the lighting fixture manufacturer.
19. In case of non-suitability of cable gland supplied with lighting fixture, then required size of cable glands / reducer / adapters shall be arranged by the Contractor in lieu of cable glands supplied by the lighting manufacturer at no additional cost.

20. Wherever single strand cable is used, terminal lugs may not be required. However in case of multi-strand cable / wiring, then pin or ring type of terminal lugs shall be used suitable to the connector / terminal board of lighting fixtures. Supply and installation of the above Copper terminal lugs for terminating the power supply cable, wherever applicable, is also included in the scope of this item.
21. In case of unsuitability of terminal board supplied inside the lighting fixture to terminate the required cable size, then the TB shall be replaced by the Contractor at no additional cost. Removal of old TB and re-installation of new TB is also included in the scope of the works.
22. Scope of works also includes connection of the power supply cable, grounding of the lighting fixtures / metallic JBs, including interconnection between the control gear box and the fixture, etc..
23. Painting of the identification numbers on the lighting fixture, control gear box with the approved paint, including supply of suitable paint for the above. Colour coding for the normal / emergency / evacuation lighting systems shall also be followed as per the erection drawings / guidelines.
24. Earthing of the lighting system circuitry / lighting fixture equipment etc. shall be carried out and only after verification of the same through earth continuity checks, IR checks of the lighting circuits, the systems shall be cleared for commissioning. Report on the above in the form of Check list shall be generated for each circuit and submitted for verification by the EIC / Corporation. Invariably, the metallic body of the lighting fixture / JB, etc. must have at least one earthing connection and continuity of the same with indoor grounding grid shall be ensured. Connection of the indoor grounding grid with outdoor grounding grid shall also ensured prior to charging / commissioning of the lighting system.
25. Testing, pre-commissioning checks, IR value measurement, continuity checks, including lux level measurement and commissioning of the lighting systems are all included in the scope of this works. In case of any improvement required to obtain the desired lux level as specified in the design document, then the same shall also be carried out with additional circuits of lighting system and lighting fixtures

26. All fitting shall be marked with KKS code and name of the circuitry with suitable paint, such that, the same is clearly visible and readable from the floor level.

27. No lighting circuit / system shall be charged without check list clearance by concerned agencies and the same shall be done only after verification of the Insulation resistance check and continuity of earthing.

28. The entire maintenance of the lighting circuits shall be maintained by the Contractor from installation to completion of all the jobs inside the building and handling over of the building to Corporation.

29. Power Supply distribution to Lighting System/Fixtures

29.1 The power supply for the lighting fixtures shall be fed from the lighting distribution board (LDB) through lighting cables, which are to be installed as per the erection drawings / guidelines as specified in the tender document. Power distribution from the LDB to the JB shall be through cables from the outgoing circuits of the LDB. Subsequent distribution from the JB to lighting fixture, within a circuit shall be facilitated by loop in loop out arrangement in the terminal blocks of Junction boxes, unless specified otherwise in the technical specifications and tender document.

29.2 No loop in loop out of power cable is permitted in any lighting fixtures unless specified otherwise in the technical specifications and tender document.

29.3 Contractor is also encouraged to devise any novel and state – of – art methods for installation of lighting distribution cables and submit the same for the review and acceptance of the same by EIC / General Designer of Corporation, in order to execute the works neatly and aesthetically, without compromising the quality and safety.

30. Scope of work for installation of lighting distribution cable:

The scope of works includes the following:

a. If no. of cables to be installed are less, i.e. up to two cables, the same shall be cleated directly on the wall / column / ceiling , etc. using saddles and spacers, whose type and sample shall be approved before carrying out the job.

b. Installation of the cables on the wall, ceiling, columns, etc. with nickel coated / yellow passivated G.I. Saddles or epoxy powder coated saddles, as the case may be and as specified in the relevant technical specifications shall be carried out.

c. If the no. of cables are more than two belonging to the same system of lighting (i.e. normal / emergency / evacuation), then the same shall be installed inside a suitable enclosed cable box / cable channel / enclosed light channel with cover, etc. meant for fixing the lighting cable installation, as specified in the relevant technical specifications / tender document.

d. Termination of the cable at the LDB ends shall be carried out as per the termination / connection drawings of the lighting systems

e. Supply and installation of single / double compression cable glands, as specified in the tender document, at the ends in the junction boxes, MCB/ Push button lighting control boxes, etc..

f. Termination and connection of the cables at the JB ends onto the cage clamp type terminal blocks.

g. Supply and installation of cable identification tags made from anodized Aluminium sheet/flat.

h. Any additional openings in wall/floor for crossing of the cables, wherever not provided, restoring the surface/structure back to its original state.

31. The scope of the above works includes the supply of following accessories required for the installation works, complete in all respects:

i. All saddles and spacers, lead rawl plugs, all hardware for fastening of the cables are included in the scope of works covered under this item.

ii. Single compression type cable glands for termination at the JB, terminal lugs wherever applicable.

iii. Cable identification tags.

iv. Any other item though not specifically mentioned but required to complete the work is all respects.

v. Junction boxes with terminal blocks

32. GI rigid Conduit installation (wherever applicable):

The Scope of works includes the following:

a. Scope of works include supply and installation GI Conduits of NPCIL approved make along with of all accessories like saddles spacers, bends, couplers, pull boxes, check nuts, clamping etc. as per the installation notes/drawings to be made available prior to actual erection works. Conduit routes may have to be modified to suit site conditions and avoid interferences.

b. GI conduits shall be used exit type of lighting fixtures or wherever mechanical protection is necessary for the lighting cables, as specified in the erection drawings.

c. In general, rigid GI conduits are to be used for the above applications, but for the looping from the JB to exit type lighting fixtures, flexible GI conduits are to be used and supply of both the above conduits are included within the scope of works.

d. Installation of all types of junction boxes, with 5/8 way cage clamp type of terminal blocks of NPCIL approved make, for branching of wires.

e. Supply and installation of anti-corrosion cold galvanizing paint on the portion where galvanization has been removed.

f. Supply and installation of identification tags made from anodized Aluminium sheet with the numbers punched on it.

g. Supply and installation of 14 SWG Copper wire along each conduit fastened to same by means of Copper earth clips of thickness not less than 26SWG at intervals not exceeding 1000mm. Earthing of the conduit shall be ensured through fool proof systems and if copper wire system described above is not effective, then suitable systems shall be developed to ensure earthing of the conduit installed.

h. Requirement of any new wall / floor openings in for crossing of the conduits / cables , etc., where ever not provided, restoring the surface/structure back to its original state is also included in the scope of works

33. Installation of Lighting control MCB/push buttons boxes:

The scope includes the following:

a. Handling, transportation to the location, storage, etc. of all sizes of lighting control MCBs and their enclosures, push button boxes for control of lighting in buildings / tunnels and their accessories.

b. Installation of the single/double/triple pole MCB control switch shall be carried out with anchor fasteners of appropriate size as indicated in the layout drawings. Supply and installation of the NPCIL approved anchor fasteners are covered in the scope of above works.

c. Supply and installation of all required hardware / its accessories / consumables, etc.

d. Marking of the MCB control board with suitable KKS codes in a legible manner with suitable colour coding.

e. Different colours of MCB enclosures for Normal (Blue), Emergency (Red) and Exit (Green) type of lighting system shall be used.

f. Earthing of the MCB Control Board using flexible copper earthing / through lighting cable from the nearest Indoor grounding grid shall be ensured

g. Simulation checks of ELCB used in the LDB shall be carried out prior to charging / commissioning of the lighting systems.

34. Power / Welding Receptacles

Scope of works includes the following:

a. Handling, transportation to the location, storage, etc. of all types of power receptacles and their accessories

b. The welding / power receptacles shall be erected on steel/ concrete structures or wall mounted, as specified in the drawings. In isolated places, a separate support shall be fabricated and installed.

c. Fabrication of structural steel support (including cutting, drilling welding, cleaning and epoxy painting as directed), if required for the installation of the power / welding receptacles, on the wall, columns, as shown in the drawing to be provided prior to the actual erection, along with the accessories, etc.

d. All receptacles shall be installed through anchor fasteners, as indicated in the mounting drawings, and supply and installation of the same is included in the scope of erection supplied under this item.

e. 63A receptacles shall be installed as per NPCIL approved drawings using anchor fasteners of NPCIL approved make to be supplied at no additional cost. Wherever the receptacles are to be installed by welding to the support to the already embedded EPs, then the support frame / steel frame of the receptacle shall be welded to the EP / steel structure.

f. All the fabrication, cutting, welding, painting of the structural steel support , etc. required for the above works shall be executed as a part of 'Structural steel supply and installation scope', under relevant item of the BOQ.

g. Installation of Single /Double compression cable glands, including drilling of holes, making good the surface and termination of the power supply cables including loop in loop out, if any.

h. Supply and installation of Copper terminal lugs of the approved make, connection on to the terminals in the receptacles, etc.

i. Painting of the identification number on the receptacles with the approved paint, including supply of paint for the above.

j. Testing and commissioning including all pre-commissioning checks.

k. Handing over the plugs supplied with the receptacles to the designated user agency.

l. The plug tops for all these receptacles shall be preserved till handing over and any missing / lost parts of the receptacles shall be replaced with fresh piece and shall be handed over to Corporation in good condition.

m. The maintenance of all this equipment are in the scope of Contractor till handing over of the systems to Corporation.

35. Installation of Aviation Obstruction Lighting (AOL)

The scope of erection works includes the following:

a. Handling, transportation to the location, storage, etc. of the AOL fixtures and its accessories.

b. Fabrication including welding and installation of hot dip galvanized structure for mounting of the AOL including supply and installation of NPCIL approved make of concrete fasteners where ever required.

c. Supply and Installation of the AOL fixtures.

d. Supply and installation of IP 65 control panel with TPN MCBs for incoming and 4 way DP outgoing feeders, with neutral link, and all other associated items. Scope includes supply and installation of concrete fasteners for fixing of the control panels.

e. Supply and installation of the armoured FRLS power supply cable of 2.5 sq. mm Copper conductor from the Control panel to the lighting fixtures including supply and installation of cable clamps, saddles, Aluminium cable identification tags, accessories, hardware, etc.

f. Supply and installation of double compression brass, nickel coated cable glands of Comet/SMI/approved equivalent make for the cables at I) Control panel – incoming + outgoings, (ii) Lighting fixtures/control gear. Scope includes supply and installation of Copper terminal lugs for all the cable terminations as described above.

g. Supply and installation of all welding consumables required for all the welding involved in the works for cabling & fixing the AOL on the top of metallic vent stack

h. Grounding of the control panel and the lighting fixtures with appropriate size/type of conductor after getting it approved by the Engineer in Charge, including supply of the same.

i. Taking all clearances from the safety group for qualifying of personnel for this category of work.

Testing, measuring of the light intensities and commissioning of the system.

10.19 JOB SPECIFICATIONS FOR GROUNDING AND LIGHTNING PROTECTION SYSTEM WORKS

The scope of Installation works includes the following:

The Grounding and Lightning Protection System involve the following works at site:

a. Installation works of Outdoor Grounding Grid System (Buried Conductor in the plant area)

b. Installation works of Indoor Grounding Grid of 40 x 4 and 25 x 4 mm GI Flat / Strip

c. Installation works of 12 mm G.I. Rod for Grounding & Lightning Protection Systems

d. Installation of Test Link Boxes for interconnecting Outdoor Grounding Conductor and Lightning Protection System Conductor installed on the exterior surface of wall

e. Installation works of Equipment Grounding

General Scope of works (Applicable to all Systems)

1. The scope of works involve the following works prior to taking up actual works at site such as study of drawings issued for construction, understanding the nature works to be executed, mobilization of required resources such as materials and manpower and preparation of erection procedure, field quality plan, check list , etc.
2. Erection procedure shall be developed based on the drawings released for construction as well as guidelines given in the technical specifications, applicable standards / codes , etc. Erection procedure / Field Quality Assurance Plan and check list, prepared in this manner for the erection works shall be reviewed, concurred and approved by the concerned agencies of Corporation. Only after the approval of erection procedure and QAP, the actual erection works shall be taken up.
3. Material receipt at site, safe unloading at site and safe storage at site, etc. as per the specific requirements covered elsewhere in the relevant chapters / sections of the document.
4. All the items received at site, shall be listed and documented properly and the packages shall be inspected both visually as well as for verification of bill of materials as per the packing list. Missing items shall be listed and necessary action shall be taken to arrange the same without any delay. Necessary actions to replace the damaged parts / components / equipment shall also be taken, in case of observance of any damages during the transportation / unloading, etc.
5. In-coming Inspection of the material received at site, with due participation of all the concerned groups / agencies / representatives of Purchaser / Corporation.
6. Insurance during the storage, erection, site testing, till handing – taking over of the equipment by Purchaser / Corporation
7. Exothermic welding can be used for all the joints except test link boxes where Brazing can be used.

8. While carrying out welding operations of the conductor, suitable protection, through appropriate measures, shall be provided to the area around the conductor to ensure that, the wall / floor / ceiling , etc. are not blackened on account of welding arc.
9. The welder / brazer shall be qualified by NPCIL QA along with qualification of procedure (through mock up joint) to be adopted for welding / brazing / exothermic welding, as applicable, before taking up the actual job at site. All the machineries used for the above job shall be from reputed make duly calibrated.

10. Installation works of Outdoor Grounding Grid Network System (Only buried conductor directly in the ground)

a. Contractor shall study the drawings, technical specifications, nature of works involved and shall carry out the survey of the area, where works are to be taken up.
b. It is possible that, Outdoor Grounding Grid System works shall have to be taken up in several stages, part by part, depending on the area / front clearance for taking up the works.
c. Before taking up the works, Contractor shall also study the drawings of other process pipelines which are either already buried / installed or to be buried / installed by other agencies to plan his works accordingly.
d. The above coordination and planning of the works is necessary to avoid any kind of damage to the conductor during the excavation of the area for installation of the pipelines of other systems and vice versa.
e. In addition to the above, Contractor shall also take note of any power, water, communication lines laid underground, if any, laid by the Corporation and/or by any other agencies in the main plant area, either on permanent or temporary basis.
f. In view of the above, excavation clearance of all the concerned agencies shall be taken prior taking up outdoor grounding grid installation works.
g. Once the clearance and work permit is issued through above mentioned process, excavation of the trench for laying of the buried grounding conductor shall be taken up.
h. The depth of outdoor grounding conductor grid network shall be as per erection drawings from the graded level issued for the same, but not less than 0.7 m from the grade level.

After the excavation, a soft soil layer of 0.2 m layer shall be ensured for placing the grounding conductor at a depth of not less than 0.5 m.

i. The scope includes excavation of the soil of all types for the purpose and regardless of the type of soil, excavation of the trench for installing the outdoor grounding grid must be excavated to the level not less than the minimum depth specified in the drawings.

j. The works shall be planned to ensure minimum no. of conductor joints and wastages and Contractor shall share the above details to EIC / authorized representative prior to carrying out the above works.

k. The conductor shall be laid as per the erection drawings without any bend / kink, all along the length of the conductor.

l. The grid / mesh dimensions shall be as per erection drawings which is likely to be in the range of 25 x 25 m, unless specified otherwise in the drawings.

m. Whenever conductors are to be laid with mechanical protection, the same shall be ensured by providing metal conduit / Pipes of suitable size in the area of road crossing, particularly in the area physical damage to the conductors are anticipated. The metal pipes / GI Conduits shall be supplied and installed as per relevant item of the schedule of supply for the above works.

n. Wherever cutting/chipping/chiseling of concrete/PCC floor and restoring of the same are required to install the grounding conductor, the same shall be analyzed on a case to case basis and treated as separate works.

o. Whenever the main earthing conductor crosses cable/pipe trenches, tunnels, roads it may have to be laid in Hume pipes provided for the same by 500mm below the trench bed, tunnels and roads. Hume pipes for the above works shall be supplied and installed as per relevant item of the schedule of supply.

p. All Copper grounding conductor connections buried in earth shall be joined either by brazing or by exothermic welding as per the procedures approved by the Corporation through qualified welder / brazer, as applicable. The supply and installation of all the materials and consumables required for the above job of brazing / exothermic welding are included as a part of this works, at no additional cost.

q. The parts to be brazed shall be cleaned to make them free of oxides, grease, oil, dirt or any foreign materials either by wire brush or by use of acetone/benzene.

r. The surfaces to be brazed / welded shall be held in position and tied with copper binding wire.

s. The surfaces to be joined shall be bright but not too smooth/highly polished to prevent the jointing material from flowing away.

t. A gap of approximately 0.4mm to 0.5mm shall be kept between the surfaces to be joined and shall be verified by feeler gauge and flux shall then be applied on the parts to be joined. Supply and installation of the flux required for the above is within the scope of above works.

u. Brazing shall be done all around and along the length of joints. Fused residual flux powder on the joints shall then be cleaned by wire brush and then washed with water to prevent any possible corrosion.

v. 100 % brazed joint shall be visually inspected for checking the soundness by external appearance, such as continuity of the brazing, filler metal, size, and wetting of fillet along the joint. One brazed joint shall be cross-sectioned out of every 200 joints made by each brazer for ensuring quality and flow of brazed material.

w. Wherever necessary (eg. Rocky area), grounding resistance enhancement compound shall be sprayed around the grounding conductor installed in the trench, as directed by the Corporation. However, the scope of supply and installation of the same will be operated as separate works in the BOQ / SOQR.

x. Measurements of resistance shall be done for 100 % joints for conductor-to-conductor joint.

y. Brazed / welded joints are to be coated with Anti corrosive paint approved by NPCIL.

z. Once the above jobs are completed, the conductor laid along with joints and measurements carried out shall be offered for inspection of the concerned agencies of the Corporation and only after the clearance by the Corporation, the trench shall be closed and extra soil generated during the excavation shall be compacted to restore the level. While closing the trench it shall be ensured that, trench is filled with only loose soil and any rocky or hard stones which can cause damage to the conductor shall not be used.

aa. Outdoor Grounding Conductor grid markers shall be installed at every 15 to 20 m, immediately after completion of the outdoor grounding grid installation works in order to notify the area of grounding grid to all other agencies. The works related to installation of grounding grid markers, shall however be operated as a separate works in the BOQ / SOQR.

bb. After completion of the above, grounding grid layout master drawing shall be updated with suitable marking of the completed area and the same shall be updated regularly on completion of the works at site and drawings on the same shall be shared with Corporation.

cc. Contractor shall note that, outdoor Grounding grid network shall also be connected at minimum 4 places to the building periphery conductor grid which are laid along the external periphery of each building at the same depth, as shown in the erection drawings.

dd. Risers from these periphery conductors shall be brought above the ground level for connecting the same to the test link boxes installed on the external walls of the main plant buildings at the locations shown in the erection drawings.

ee. The riser brought above in this manner shall also be clamped along the wall / building platform through suitable spacers and saddles up to the test link box.

ff. Anti-corrosive compound/paint suitable for outdoor installation shall be supplied and applied over the brazed / welded joint carried out in the test link box, as mentioned above at no additional cost.

11. Installation works of Indoor Grounding Grid of 50x10 mm, 50x6 mm 40 x 4 and 25 x 4 mm GI Flat / Strip

a. Contractor shall study the drawings, technical specifications, nature of works involved and shall carry out the survey of the area, where works are to be taken up.

b. It is possible that, Indoor Grounding Grid System works shall have to be taken up in several stages, part by part, depending on the area / front clearance for taking up the works.

c. Before taking up the works, Contractor shall also study the drawings of other systems inside any given room / area, to identify the location of indoor grounding grid and find out any interference with other systems and chalk out the erection plan accordingly. In case of any

fouling/interference of the other systems / equipment with the erection drawings, the same shall be brought to the notice of Corporation for necessary resolution.

d. The above coordination and planning of the works is necessary to avoid any kind of damage to the conductor during the installation of other systems and vice versa.

e. Once the clearance and work permit is issued through above mentioned process, installation of Indoor grounding conductor shall be taken up.

f. The main Indoor Grounding Grid consists of installation of 40 x 4 mm GI Flat to be installed on the wall surfaces of the room, as per the drawings. The branch connections from the same shall be carried out through 25 x 4 mm GI Strip.

g. The works shall be planned to ensure minimum no. of conductor joints and wastages.

h. The conductor shall be laid as per the erection drawings without any bend / kink, all along the length of the conductor.

i. Unless specified otherwise in the drawings, the interior earthing mains of 40 x 4 G.I strip are to be laid at a height of 400 mm from finished grade level in rooms as per fastening arrangement shown in drawing.

j. Earthing conductor along the run on outer surface of columns, beams and walls shall be supported by clamp or spacer saddle at an interval of 750 mm through NPCIL approved anchor fasteners of size 8 / 10 mm, unless specified otherwise in the drawings. Supply and installation of anchor fasteners is also included as a part of indoor grounding grid works.

k. The above 40 x 4 mm GI conductor shall be connected / welded further to the 10 mm GI Rod risers projecting out of the walls / floors, which are installed during the concreting of the same as an embedded conductor.

l. 25 x 4 mm GI Flats are specified for branch off connections from the above 40 x 4 mm GI Flats to the nearby equipment.

m. Where ever 25 x 4 mm GI strips for grounding have to cross the floors, then the conductors shall be embedded in the floor. The floor shall be chipped to embed / engrave the conductor and the floor shall be restored to the original condition with a plastering / concrete cover the same. All the works related to the above are included in the scope of this works.

n. Alternatively, if the location of the indoor grounding grid is already known, then the location of the same can be shown in the civil drawings and a pocket for installation of the same can be left during the construction of finishing floor concreting.

o. 25 x 4 mm Grounding conductors shall be welded to the 40 x 4 mm Indoor Grounding grid at one end and the same shall be taken right up the equipment level, so that, further earthing connection can be carried out through flexible earthing conductor connection (covered separately in the BOQ). The scope of works in this regard however includes any bending required to route the flat up the equipment, as well as drilling of holes at the required place for termination of flexible earthing conductor between the 25 x 4 mm flat and the equipment.

p. 25 x 4 mm GI flat shall be anchored to the floor / wall / ceiling / beam, etc. through NPCIL approved anchor fasteners of 6 / 8 / 10 mm size, supply and installation of which is included within the scope of this works.

q. In case of requirement of any spacers and saddles, clamps, etc. the same shall be arranged by the contractor within the scope of this works and all such clamping shall be done using anchor fasteners of 6 / 8 / 10 mm size, unless specified otherwise in the drawing, including supply of the same. A sample of type of saddle / spacer to be used shall be shown to the Engineer in charge for acceptance and only after acceptance of the same by Corporation, the works shall be taken up.

r. All indoor grounding conductor connections shall be joined by welding as per the procedures approved by the Corporation through qualified welder.

s. The parts to be welded shall be cleaned to make them free of oxides, grease, oil, dirt or any foreign materials either by wire brush or by use of acetone/benzene.

t. G.I flat welded portion shall be applied with epoxy primer and enamel paint as per approved drawings.

u. Welded joint shall be visually inspected for checking the soundness by external appearance, such as continuity of the welding, filler metal, size, and welding of fillet along the joint.

v. All the consumables required for the welding and supply of anti-corrosive paint are included in the scope of contractor.

12. Installation works of 12 mm G.I. Rod for Grounding & Lightning Protection Systems

a. Lightning protection for all the buildings are covered in a different tender, although any specific requirements/particular area mentioned in the scope or technical requirements of the grounding specifications of the subject tender, Contractor shall study the drawings, technical specifications, nature of works involved and shall carry out the survey of the area, where works are to be taken up.

b. For all the welded surfaces, anti-corrosive compound/paint shall be supplied and installed on the welded joint portion within the scope of this works.

13. Lightning protection conductor - test link box installation:

Test link box installation of all the buildings are covered in a different tender, although any specific requirements/particular area mentioned in the scope or technical requirements of the grounding specifications of the subject tender, Contractor shall study the drawings, technical specifications, nature of works involved and shall carry out the survey of the area, where works are to be taken up.

a. Handling, transportation to the location, storage, etc. of the test link box and its accessories.

b. Installation of the test link box with NPCIL approved concrete/anchor fasteners, as shown in the drawings

c. Connection of the lightning protection conductors with the test links in the box.

d. Filling of the entry/exit holes for the lightning protection conductor with soft rubberized sealing compound like polysulphide (vertical grade) compound including supply of the same.

e. The installation and termination of test link boxes for terminating the externally cleated lightning protection system conductor on the walls is also included in the scope of works.

f. Test link boxes shall be installed using NPCIL approved anchor fasteners to be supplied and installed by the Contractor.

g. Grounding conductor from the bottom of the test link box shall be brazed using brazing electrode of NPCIL approved make to the outdoor grounding copper conductor grid.

h. The Lighting protection conductor coming from the top of the test link boxes shall be welded to the GI flat.

i. In case of inter - connection of any dissimilar metals, bi-metallic washers shall be used for the connection.

j. Supply and application of anti-corrosive paint for applying on the brazed /welded joints surface

k. Marking of the test link boxes with suitable KKS code / location marking, etc.

l. All saddles, spacers, clamps, lead rawl plugs along with any other hardware accessories required for the job shall be arranged by the Contractor as a part of the installation works.

14. Installation works of Equipment / Structure Grounding:

The scope of installation works includes the following:

a. All loads, electrical equipment (stationery & rotary) EPs, metallic structures etc. shall be grounded as per the erection drawings through specified grounding flat / strip of appropriate size and / or through a combination of flexible copper conductor / wire / cable at the end portion between the grounding flat laid and the object to be grounded.

b. The size and type of flexible copper conductor / wire / cable shall be as specified in the drawings issued for this purpose.

c. The scope of works includes connection of flexible conductor at the grounding flat through nut and bolt arrangement and the other end shall be connected to the identified location of earthing terminal on the equipment to be earthed.

d. The scope of works also includes supply and installation of suitable solder-less, crimping lugs of tinned copper of required size for termination of flexible copper wire / cable at either ends and all the accessories/consumables required for complete erection of flexible copper conductor to earth bus bar/earthing lead and equipment.

e. Foundation bolts shall not be used for earthing of the equipment.

10.20 JOB SPECIFICATIONS FOR FIRE BARRIER PROTECTION SYSTEMS AND FIRE RESISTANCE PAINT COATING WORKS

Scope of erection works includes the following:

1. Material receipt at site, safe unloading at site and safe storage at site, etc. as per the specific requirements covered elsewhere in the relevant chapters / sections of the document.
2. All the items received at site, shall be listed and documented properly and the packages shall be inspected both visually as well as for verification of bill of materials as per the packing list. Missing items shall be listed and necessary action shall be taken to arrange the same without any delay. Necessary actions to replace the damaged parts / components / equipment shall also be taken, in case of observance of any damages during the transportation / unloading, etc.
3. Inspection of the material received at site, with due participation of all the concerned groups / agencies / representatives of Purchaser / Corporation.
4. Insurance during the storage, erection, testing and commissioning / till handing – taking over of the equipment to Purchaser / Corporation
5. Drawl of the various parts, assemblies from stores, safe material handling /safe transportation to the location/erection point, storage, preservation, verification of healthiness and completeness after unpacking etc. Required handling machineries / cranes / vehicles / tempo / truck / trailer etc. shall be mobilized for the above, as required for the works.
6. Thorough Cleaning of the area to ensure dust free atmosphere before taking up installation works. Cleaning and maintenance of dust free atmosphere is a continuous process and the same shall be carried out using high powered vacuum cleaners to remove all sorts of fine dust present inside the building. Cleaning shall be done right from the beginning of erection to completion.
7. Scope includes study and review of the area where fire barrier materials are to be installed, as recommended by the EIC / Corporation. Contractor shall study the locations for its feasibility of installation at the specified locations, taking into account of the cable density and any difficulties / constraints in this regard shall be brought to the notice of EIC / Corporation to resolve the issue amicably. The purpose of this exercise is mainly to identify the existing as well as likely interference that might come later on account of cabling carried out / to be carried out in the area.

8. In case of any deviation / difficulty to install the fire barriers as per the guidelines / approved erection procedure, in the location shown in the drawing, the same (constraint) shall be recorded and information on the same be shared with EIC / Corporation for necessary resolution by the EPC Designer.
9. Prior to cable assembly, the necessary arrangements ensuring fire safety shall be implemented, wherever specified.
10. During assembly of cables in cable structures and in working areas the following requirements shall be fulfilled:

a. All passages of cables through walls and floors in rooms where cabling works are being carried out irrespective of their design (ready-made smooth openings, pipe penetrations, metal ducts), shall be sealed with fire-resistant materials according to erection agency's installation and service manuals on fire sealing approved by Corporation.

b. All fire seals / fire barriers damaged in the process of assembly of cables shall be restored daily upon completion of work throughout a cable run.

c. Fire-proof cable penetrations for passing cables through civil structures in the controlled access area and free access area shall meet the requirements for fire resistance, seismic stability, pressure drop and service conditions.

d. Fire-proof cable penetrations are made in accordance with the supplier's technological manuals.

e. Where cables pass through civil structures, the following fire resistance rating of penetrations shall be ensured, unless specified otherwise elsewhere in the document.

f. penetrations through fire partitions inside cable subways/ building throughout the site ensure 0,75 hour / 1.5 hours as per the requirement;

g. penetrations through partitions, entering to all buildings and structures of the plant from cable subways throughout the site and from the trestle ensure 3 hours.

h. Openings for passing cables through civil structures are indicated in civil drawings.

i. All materials required for Fire Belt such as paint, PUTTY Fire Sealant, and mineral wool , etc. shall all be visually inspected, for any damage and expiry date

j. The cable seals shall be visually checked and inspected for any damages.

k. All coating area shall be checked for cleanliness, to remove the dirt, moisture, oils, greases, and any other agents present.

l. Skilled workman qualified to apply paint and fire barrier materials only will be employed for the works.

m. Record of qualification in being maintained in a separate register by the company.

n. All safety precautions such as use of oxygen / breathing mask, protective gloves, safety PPEs such as Tester, Voltage Detector, Screw Driver, etc. shall also be arranged prior to carrying out the works.

o. Manufacturer's Procedure for applying Fire Barrier Materials / Paint, etc. in cable trays/duct as detailed in manufacturer shall be followed.

p. The area of works shall have clean Surface prior to application of agent / adhesive required to be applied first

q. Mineral wool shall then be cut in the required dimension.

r. The gaps between cables shall be filled using mineral wool mixed with adhesives / paint / putty and cover the wool with putty / paint

s. After 24 hours coat the belt using paint so as to fill the shrinkage cavities.

t. Belt geometry linear measurements as per drg/ Work Procedure shall be measured and recorded

u. Appearance wise, there shall be no cracking or peeling or gaps in the belt.

11. Fire-proof belts in metal ducts shall have fire resistance rating of 0.75 hour and shall be installed on vertical sections in 20 m intervals, and in horizontal sections in 30 m intervals as well as at the ends of cable routes and in the places of branching of cable streams.

12. Fire-proof belts of approved make shall be used in the design in accordance with the relevant technical specification and tender document requirements.

13. When cables are assembled the ducts shall be closed with covers. Welding of covers to a duct is not allowed.

14. The design provides a covering of cables by fireproof composition in cases:

- At volume of combustible materials in the tray more than 7 litres on running metre for cables of category of fire resistance "A" as per GOST or IEC 60331-21 - 90 minutes;

- At volume of combustible materials in the tray more than 3,5 litres on running meter for cables of category of fire resistance "B" as per GOST or IEC 60332-3-23 - 30 minutes;
- Power cables of safety system 6 kV voltage (in view of absence of fire-resistant cables);
- At joint cables routing of system of safety and normal operation;

15. Also it is necessary to cover the cables and cable structures with fireproof composition at rapprochement of cable routes of different safety trains, or system of safety and normal operation at a distance between routes less than 2 metres.
16. All the required adhesives, glues, supporting rods, required tools for installation of fire barrier shall be arranged by the Contractor.
17. While installation of cables, the fire barrier shall be cut without wasting the materials in the required shape and all the gaps between the fire barrier and cables shall be sealed with fire resistance sealant compound approved by Corporation.
18. The waste generated during the fire barrier installation shall be promptly disposed off on a daily basis.
19. Painting of the cables on either side of the fire barrier, for the specified length of cables, is also included in the scope of works.
20. Any re-works necessitated in fire barrier installation such as re-installation / re-sizing / re-sealing of fire barriers, etc. shall also be carried to complete the job in all respects.
21. The contractor shall follow the instructions of fire barrier / fire resistant paint supplier, and all the works related to the above, in line with supplier's manual / documents are included in the scope of contractor.

10.21 JOB SPECIFICATIONS FOR 400 KV TIE LINE BETWEEN KKNPP - 3&4 AND KKNPP - 5&6

1. GENERAL:

1.1 The power evacuation and standby power for KKNPP-5&6 is achieved through 400kV and 230kV Gas Insulated Switchgear (GIS) respectively. It is envisaged to connect the 400kV GIS of KKNPP-5&6 to the existing 400kV GIS of KKNPP-3&4 through a double circuit tie line.

1.2 The overhead line shall be a 400kV double circuit line with OPGW. The requirements as brought out in the technical specification and datasheets for 400kV Outdoor Switchyard (I02.KK56.0.0.ET.TS.PR052) shall be followed.

1.3 Routing of the 400kV overhead tie line shall take into account all the relevant stipulations, existing structures, etc. 230kV overhead transmission lines emanating from KKNPP 5&6 are intended to be crossed.

2. METHODOLOGY:

2.1 Brief details about the scheme of inter connecting tie-line between KKNPP Units 5&6 with the existing 400kV GIS of KKNPP Unit 3&4 is brought out in this tender.

2.2 This specification does not include complete details for the envisaged scope of work and is intended only to provide information to the bidders to bring out the inclusion of such work in the tenderer's scope. The bidder may visit site to ascertain the scope, route etc and develop a scheme and specifications required for the same complying to the IS / IEC standard protections and regulations.

3. SCOPE OF WORK/ SERVICES

3.1 The scope covers site visit(s), site survey for route selection, installation of towers, etc. meeting all statuary codes and standards requirements.

3.2 The scope covers detailed site survey for routing the tie line as mentioned above, design (Detailed Sizing calculations as per relevant IECs/IS), testing, supply of material, erection of towers (lattice), gantry and other supporting equipment/structures needed to complete the work under this tender, commissioning and charging of the tie line.

3.3 Design (including civil design), engineering, material selection, manufacturing, inspection, shop testing, packing, forwarding, delivery/supply to site, of all components for 400kV D/C tower required for tie overhead line connecting 400kV GIS of KKNPP 5&6 to 400kV GIS of KKNPP 3&4 (KKNPP 3&4 bays vacated after shifting of 400kV Tuticorin-II GIS (Quad) D/C line from 400kV switchyard of KKNPP 3&4 to 400kV switchyard of KKNPP 5&6), requirements for which are described in I02.KK56.0.0. ET.TS.PR051. The supply includes all tower accessories, hardware and associated accessories such as stubs, cleat, GI Bolts, nuts, washers, etc.

3.4 Quantum of work briefly comprises carrying out complete site survey and preparation of drawings for PURCHASER's review and acceptance, detailed design, supply, erection, commissioning, testing of overhead lines, optical fiber composite overhead ground wire (OPGW) line, underground fiber optic cable, transmission towers (lattice), transmission columns (lattice), earthing arrangement and other supporting equipment/structures, etc. needed to complete the work. All works required to fulfill the intended task for completion of the work is included in the scope of tender even if especially not brought out in the tender. All the equipment offered shall be as per relevant Indian standards/equivalent International standard agreed with the PURCHASER.

3.5 The scope of work also includes the following major works:

a. Routing of the overhead tie line taking into account all the relevant stipulations, existing structures, etc. Routing of the 400kV overhead tie line shall take into account all the relevant stipulations, existing structures, etc. 230kV overhead transmission lines emanating from KKNPP 5&6 are intended to be crossed.

b. Detailing and implementation of control and protection scheme, data connectivity through Fiber optic cable, and energy measurement (as required), etc. as per relevant specification.

c. String insulator/Polymer Insulator, Connectors and Clamps (400kV Tie line from gantry of KKNPP 56 to gantry of KKNPP 34) The requirements as brought out in the technical specification and datasheets for 400kV Outdoor Switchyard(I02.KK56.0.0.ET.TS.PR052) shall be followed

d. Connection to main earthing grid at outdoor switchyard and risers for equipment earthing.

e. Obtaining all required statutory clearances.

4. GENERAL REQUIREMENTS & GUIDELINES

Not limiting to what is specified herein, the Execution requirements as brought out in other parts of the tender also shall be applicable.

a. Fabrication/manufacture, procurement and transportation, erection and commissioning as well as testing (both at the factory and at site) of the tie-line between 400 kV GISs of the KKNPP -3&4 and KKNPP-5&6 shall be carried out by the Contractor as per relevant

applicable codes, standards, specification and best engineering practices. Unless otherwise specified, the latest published versions as on the day of submission of bids shall be used.

b. It is the onus on the Contractor to bring out any abnormality/discrepancy in the scheme proposed by NPCIL or any suitable alternative (no major change envisaged) within the scheme proposed by NPCIL for Tie-Line arrangement.

c. Notwithstanding any other provision, the Contractor, as a part of his obligation, shall perform all work and render all services, which may be required to complete the defined scope of work, whether or not mentioned specifically in this document or brought under the list of deliverables. He shall provide all facilities at his premises as required for discussions, checking of the equipment, review of the progress, etc. to NPCIL Engineers.

d. Marked-up drawings/ commented documents shall be retained by the Contractor till these are finally approved and accepted by NPCIL.

e. The documents / drawings furnished by NPCIL to the Contractor shall be returned to NPCIL at the earliest and in any case before the conclusion of the contract.

f. The Contractor quoting for this work shall clearly understand the quantum of job involved in the tender and work in close interaction and co-ordination required between his work and NPCIL and provide/take timely inputs to / from NPCIL for successful completion of the project as a whole.

5. REFERENCE DRAWINGS / DOCUMENTS

- Layout of 400kV outdoor switchyard (I02.KK56.01UAK.0.ET.OK. WD001)
- Technical Specification for 400kV Outdoor Switchyard (Doc. No.: I02.KK56. 0.0.ET.TS.PR052) and 400kV GIS & GIBD (I02.KK56. 0.0.ET.TS.PR051)
- Data Sheet for 400kV Outdoor Switchyard (Doc. No.: I02.KK56. 0.0.ET.DS.PR046)
- Technical Specification for Control Metering Relay Protection Panels for EHVSystem (Doc. No.: I02.KK56.0.0.ET.TS.PR092)
- Technical Requirements for Grounding & Lightning Protection Systems (Doc. No.: I02.KK56. 0.0.ET.TT.PR004)

10.22 JOB SPECIFICATIONS FOR SANITATION / HOUSE KEEPING WORKS

DURING ERECTION/TESTING AND COMMISSIONING ACTIVITIES

The scope of works includes the following:

(To be read in conjunction with requirements stipulated in Section – III – Special Conditions of the Contract and elsewhere in the document):

1. The CONTRACTOR shall be responsible for keeping the entire area allotted to him clean and free from rubbish, debris, etc., during the period of contract. The CONTRACTOR shall employ enough number of special personnel and dedicated group to thoroughly clean his work, regularly and as and when required, particularly after building erection works are completed and made ready for equipment erection.
2. The house keeping / Up keeping activities at site shall be carried out, but not limited, with strict compliance of following norms / requirements mentioned in this chapter.
3. A dedicated group shall be identified for the above jobs with sufficient strength (a set of 4 to 5 persons per building as mutually discussed and decided based on the magnitude / quantum of works in progress) and their works shall be supervised by a dedicated supervisor whose job is only to survey around the area, both inside and outside the buildings to maintain the area neat, tidy, clean and aesthetically in order, right since the beginning of the contract.
4. The above crew and supervisor shall be identified right from the beginning and shall be augmented during the course of execution depending on the works / quantum & magnitude of works and shall suitably augment during the commencement of equipment erection.
5. Contractor shall have an organization chart for the above job and shall submit to the Corporation, the methodology he proposes to execute the job on daily basis without fail.
6. The persons identified for the above group shall not be drawn for any other work so that they develop not only specialization but a sense of belongingness to the area they are supposed to monitor to maintain clean and neat surroundings.
7. The contractor shall give utmost importance to housekeeping / up keeping of the area and no compromise / laxity in this regard is acceptable.
8. All such rubbish and scrap material shall be stacked or disposed-off in a place to be identified by the CORPORATION.

9. Depending on the waste/scrap material, etc., suitable dust bins/metal bins/waste baskets of appropriate size (to be supplied by Contractor) shall be kept in every building/area, with due identification of Contract name for disposal of the waste & the same shall be cleared on a daily basis.
10. Suitable tools, tackles, machineries etc. for maintaining a clean room and dust free conditions shall be mobilized by the Contractor, as directed by the engineer in charge and no compromise in this regard is entertained. Wherever required, vacuum cleaners, mopping tools, etc. shall also be deployed to maintain the area clean and neat.
11. A dedicated vehicle such as tempo / tractor / truck / trailer along with hydra crane etc. shall be given to the house keeping crew so as to facilitate the disposal of waste on a daily basis.
12. All these waste bins shall be cleared on a daily basis without fail and submit a daily report on the House keeping / Up keeping activities carried out. Corporation reserves the right to take appropriate action, as deemed fit, in case of non – compliance with the above action by the Corporation.
13. Materials and stores shall be so arranged as to permit easy cleaning of the area. In areas where equipment might drip oil and cause damage to the floor surface, a suitable protective cover of a flame resistant, oil proof sheet shall be provided to protect the floor from such damage.
14. Similarly, the labour colony, the offices and residential areas of CONTRACTOR's employees and workmen shall be kept clean and neat to the entire satisfaction of the CORPORATION. Proper sanitary arrangement shall be provided by the CONTRACTOR, in the work areas, offices and residential areas of the CONTRACTOR.
15. The contractor shall set up all the essential and minimum facilities required for carrying out a decent standard living by laborers staying the colony.
16. The colony shall have proper access roads, sanitation, drinking water, electricity and all other essential facilities required for decent standard of living.
17. **Lunch Shed:**

17.1 The contractor shall set up a semi-permanent lunch shed with suitable arrangement for taking lunch for contract laborers, at least at one or two or even more locations depending

on the manpower / labour strength mobilized.

17.2 The Contractor shall inculcate the discipline to the laborers right from the beginning to take lunch only in the lunch shed and not inside any of the buildings.

17.3 The lunch shed constructed shall have decent facilities such as proper light, stand for keeping lunch boxes, semi – permanent seating / tabling arrangements, water supply for washing hands and proper disposal systems for waste management,etc. .

17.4 The Lunch shed shall be constructed within 3 months of commencement of works at site with due approval of purchaser / corporation for the place of shed, size of shed, facilities envisaged, etc.

18. **Toilet Blocks:**

18.1 Toilet blocks with proper crew for manning / cleaning and maintaining the toiler blocks shall be set up, for the sake of laborers deployed at the work site.

18.2 The area shall be maintained clean and neat with the provision of water supply, taps, plants, etc. so that, every worker in the plant is encouraged to use this facility and to maintain the construction site neat and clean.

18.3 In addition, the Contractor shall also exercise suitable control to ensure that, unwarranted paintings / caricature images / texts, etc. are not drawn on the doors / panels / walls, etc. Till the building is handed over, Contractor alone is responsible for maintaining the above said neatness and cleanliness. Whatever caricature images / written text on the walls / doors / panels drawn shall be removed and the place shall be made good with re-painting at no extra cost by the Contractor.

18.4 **Contractor is encouraged to adopt innovative methods to maintain the highest standards of house-keeping and up keeping in his area of works in line with above requirements as well as the stipulations covered in the Section - III: Special Conditions of the Contract and elsewhere in the tender document.**

11.0 DETAILS OF ERECTION TESTS / PRE-COMMISSIONING & COMMISSIONING WORKS TO BECONTROLLED BY ERECTION GROUP VIS A VIS COMMISSIONING GROUPS AT SITE

Tests/checks/work to be done by Erection group vis a vis commissioning group at Site ofKKNPP-5&6

S. No.	Checks/Tests to be done by Erection group	Checks/Tests to be done by Commissioning group
A:	**Tests/Checks to be done for switchgear (EHV switchgear/ HV switchgear/MV switchgear/ Isolated phase bus duct/LV switchgear/ MCCs/ PDBs/ DCDBs/ ACDBs/ LDBs/LPs/SCADA Panels)**	
1.0	Preliminary checks on switchgear/cubicle/panel a. Check nameplate details of every associated equipment according to specification and verification of bill of materials. b. Check for physical damage. c. Check tightness of all bolts, clamps and connecting terminals. d. Check cleanliness. e. Check cleanliness of insulators & bushings. f. Check earthing. g. Check heaters provided h. Alignment and levelling i. Verification of welding as per the approved drawings and the quality of welding. j. Verification of proper power and control cable glanding and	Commissioning checks on switchgear/cubicle/panel a. Each wire shall be traced by continuity test and it should be made sure that the wiring is as per relevant drawings. All interconnections between panels/equipment shall be similarly checked. b. All components e.g. switches, MCBs, contactors, timers, relays, CTs, PTs, SPPT cubicles, DS, ES, CBs, meters, sensors, resistors, capacitors, inductors, diodes, photo-sensors, insulators, bushings, transducers etc. shall be tested for their healthiness as per their respective procedures/manufacturers recommendations. c. Power, control and I&C cable connection checks as per relevant drawing. d. Checking availability of inter-panel

S. No.	Checks/Tests to be done by Erection group	Checks/Tests to be done by Commissioning group
	termination and provision of proper supports for power and control cables. k. Verification of switchgear assembly/IPBD as per the specifications and approved drawings. l. Verification of Breaker free movement in test / service / isolated positions m. IR of individual modular sections of IPBD during and after welding n. Bus bar tightening and torquing o. Dye Penetration (DP) Testing of Weld joints p. Torquing of applicable bolts / hardware used for IPBD erection works	and intra- panel shorting links at TBs and arranging shorting links as per relevant drawings. e. Measurement of Insulation Resistance of control wiring. f. Measurement of Insulation Resistance of Main Power circuit. HV test on high voltage on circuits at 80% power frequency withstand test voltage. HV test on Bus duct. g. Measurement of millivolt drop across bus bar joints/bus duct joints. h. Checks on relays as per technical specification of relay i. Checks on meters and transducers j. Checks on CTs k. Checks on VTs, SPPT cubicles Settings of relay, other alarms, tripping devices and interlocks as per scheme. l. Checks/Tests on other equipment of MV/HV switchgear such as Isolators/earthing switches Bus bar compartments/buses & Lines/Bushings, etc. m. Functional checking of all control circuit e.g. closing, tripping, control, interlock, supervision and alarm circuits including proper functioning of the component equipment. n. Checks of SF6 purity, dew point etc. and healthiness of density switches for

S. No.	Checks/Tests to be done by Erection group	Checks/Tests to be done by Commissioning group
		MV/HV switchgears o. Partial discharge measurement on MV/HV switchgear p. Differential stability checks in case of Interconnections switchgears are having differential protection. q. Bus bar differential stability test for MV/HV switchgear **r.** Checks on fiber optic cables/connections including attenuation measurements s. Functional checks of each component and simulation checks including calibration. Input/output verification checks at local and remote. t. Commissioning of system/equipment and final integration with system including charging, post charging observation test & subsequent condition monitoring. u. Bus bar differential stability test for MV/HV switchgear v. Checks on fiber optic cables/connections including attenuation measurements

S. No.	Checks/Tests to be done by Erection group	Checks/Tests to be done by Commissioning group
		w. Functional checks of each component and simulation checks including calibration. Input/output verification checks at local and remote. x. Commissioning of system/equipment and final integration with system including charging, post charging observation test & subsequent condition monitoring.
1.1	Preliminary checks on Circuit breakers/ Contactor/MCCB/MCB as applicable a. Check nameplate details according to specification. b. Check for physical damage. c. Check tightness of all bolts, clamps and connecting terminals. d. Check earth connections. e. Check cleanliness of insulators and bushings. f. Check all moving parts are properly lubricated. g. Specific checks recommended by the contractor.	Commissioning checks on Circuit breakers/ Contactor/MCCB/MCB as applicable a. Check alignment of breaker trucks for free movement inside the cubicle, check correct operation of shutters. Check for inter- changeability of CB trucks and PT trucks. b. Slow-closing/opening operation, if provided. c. Check control wiring for correctness of connections, continuity and IR values. d. Manual operation of breakers. e. Check on operating mechanism for MV/HV switchgear

S. No.	Checks/Tests to be done by Erection group	Checks/Tests to be done by Commissioning group
		f. Proper closing/opening operation manually and electrically. g. Breaker closing and tripping time and speed measurement. h. Trip free and anti-pumping operation. i. IR values, resistance and minimum pick up voltage of coils. j. Measurement of mill volt drop across breaker terminals and across cubicle terminals (Including fixed and moving contact assemblies of the cubicle) k. Check all electrical and mechanical interlocks provided as per 220V DC and 24V DC schematics. l. Checks on spring charging motor, correct operation of limit switches and time of charging. m. All functional checks as per 220V DC and 24V DC schematics. n. Simultaneous closing of 3 poles, duty cycle test & Vacuum pressure test. Any other tests recommended by the

S. No.	Checks/Tests to be done by Erection group	Checks/Tests to be done by Commissioning group
		manufacturer. o. HV Test at 80%voltage. p. IR value check for power circuit. q. Check for ALT scheme/Auto Transfer scheme on MV switchgears and LV switchgears
1.2	Preliminary checks on CTs a. Check nameplate details according to specification. b. Check for physical damage. c. Check tightness of all bolts, clamps and connecting terminals. Check earth connections	Commissioning checks on CTs a. Megger between windings and b. HV test. c. Polarity test. d. Spare CT cores, if any, to be shorted and earthed. e. Ratio test. f. Magnetisation characteristics. Measurement of Secondary winding resistance.

S. No.	Checks/Tests to be done by Erection group	Checks/Tests to be done by Commissioning group
1.3	Preliminary checks on VTs a. Check nameplate details according to specification. b. Check for physical damage. c. Check cleanliness d. Check tightness of all bolts, clamps and connecting terminals. e. Check earth connections.	Commissioning checks on VTs a. Insulation resistance test. b. Polarity test. c. Ratio test on all cores. d. Line connections as per approved drawings. e. HV test at reduced voltage.
1.4	Preliminary checks on Meters/Transducers/Relays a. Check nameplate details according to specification. b. Check for physical damage.	Commissioning checks on Meters/Transducers/Relays c. Check for calibration on Meters/Transducers d. Functional checks and secondary injection tests on relays for each functions/ranges e. Megger of all insulated portions. f. Check CT and VT connections with particular reference to their polarities for power type meters. g. Check for setting of relays
B.	**Checks/Tests on Battery**	

S. No.	Checks/Tests to be done by Erection group	Checks/Tests to be done by Commissioning group
	Preliminary checks on Battery Check nameplate details of every associated equipment according to specification. Check for physical damage. Check for tightness of all bolts, clamps and connecting terminals. Check cleanliness of cells, stands, and battery installation. Check for correct electrolyte level. Check for electrolyte specific gravity. Check for electrolyte leakage. Check for chemical analysis of acid and water for mixing with electrolyte and topping up. Check for any cell container crack. Verification of dimensions. Verification of stands and cell mounting etc. Verification of battery installation and terminations as per drawings.	**Commissioning Tests (Lead Acid Battery)** Visual inspection. Verification of markings. Tests for capacity (for duty cycle and C_{10} discharge) and capability to recharge. During any of the following discharge tests, cell voltage shall not fall below specified end of discharge voltage. If any cell reaches its end of discharge voltage before specified discharge time, it shall be repaired/ replaced. NOTE: The battery shall initially on first charging be charged as per manufacturer's recommendation and subjected to few charge- discharge cycles till 100% rated capacity assigned by manufacturer is obtained. Initial C_{10} discharge tests. Test C_{10} discharge up to specified end of discharge voltage as per standards and recharge the battery as per manufacturer's recommendations. Discharge duty cycle Test for 02 hours and at rates guaranteed in the data sheets

S. No.	Checks/Tests to be done by Erection group	Checks/Tests to be done by Commissioning group
	Verification of inter-cell, inter-stand, inter- row connection and measurement of their resistance. Alignment, levelling and welding the racks with base frame DPT testing of weld joints Checking of battery links tightening and torquing.	for a new cell. Charge as per manufacturer's procedure Discharge at duty cycle high rate till the specified end of discharge voltage. Charge as per manufacturer's procedure. Discharge at high rate for specified duration. Charge for 8 hrs. as specified. Discharge at high rate for specified duration. Completely recharge the battery and keep on float after adjusting electrolyte level in all cells to maximum position. Test for voltages both on bank and on pilot cells (1 out of each 6 cells) during discharge. Polarity and absence of short circuit. Insulation resistance test. Duty cycle discharge test on battery bank after float charge for three (3) months. Commissioning of system/equipment and final integration with system including charging, post charging observation test

S. No.	Checks/Tests to be done by Erection group	Checks/Tests to be done by Commissioning group
		& subsequent condition monitoring.
C	**Checks/Tests on Rectifiers/Inverters**	
	Preliminary checks on Rectifier/Inverter cubicles a. Check nameplate details of every associated equipment according to specification and verification of bill of materials. b. Check for physical damage. c. Check tightness of all bolts, clamps and connecting terminals. d. Check cleanliness. e. Check cleanliness of insulators & bushings. f. Check earthing. g. Check heaters provided h. Alignment and levelling i. Verification of welding as per the approved drawings and the quality of welding.	Commissioning checks on Rectifiers/Inverters **Checks/Tests on Rectifiers** Visual inspection for quality of workmanship, finish, dimensional checks and degree of protection. Verification of compliance with approved drawings including checking of bill of material and wiring. Power, control and I&C cable connections checks as per relevant drawing. Testing of components of inverters e.g. MVDT of joints, testing of transformer, capacitors, current shunt, meters, healthiness of thyristors, testing fan motors, resistors etc. Parameterization of rectifiers as per settings Load test of rectifiers Output voltage regulation for 0-100% and 100-0% load variation and input

S. No.	Checks/Tests to be done by Erection group	Checks/Tests to be done by Commissioning group
	j. Verification of proper power and control cable glanding and termination and provision ofproper supports for power and control cables k. Verification of rectifier/inverter assembly as per the specifications and approved drawings.	voltage/frequency variations. Battery current limiting feature and V-I characteristics of the charger. Tests to prove functional requirements. Variation of voltages and current limit set values for all modes of charging and checking of accuracy for above settings. Mechanical operation tests on switches, auxiliary electrical and mechanical devices. Checking of equipment overall current limit operation. Electrical control interlock and sequential operation tests. High voltage power frequency withstand tests and insulation resistance tests on main circuit, control circuit and auxiliary circuits. Functional tests on auxiliary devices. Alternating current measurements on the input side in all phases at rated load

S. No.	Checks/Tests to be done by Erection group	Checks/Tests to be done by Commissioning group
		and no load including power factor, wave shape and harmonics injected to the system. Measurement of losses and efficiency at full load, 50% and 25% of load. Ripple content of DC output at maximum and minimum DC bus voltage and charging conditions under specified input voltage range. All alarms and trips to be checked for satisfactory operation at various loads from zero to full load including specified over load. **Checks/tests on Inverters** Power, control and I&C cable connections checks as per relevant drawing. Bill of material checks Visual Inspection (as per IEC 60146 -2 section 7.3.1) Insulating test (as per IEC 60146-2 section 7.3.3)

S. No.	Checks/Tests to be done by Erection group	Checks/Tests to be done by Commissioning group
		Checking of auxiliary devices (as per IEC 60146-2 section7.3.2) Checking of protective devices (as per IEC 60146-2 section7.3.4) Light load test (as per IEC 60146-2 section 7.3.5.1) Functional test (as per IEC 60146-2 section 7.3.5.2) Rated output test (as per IEC 60146-2 section 7.3.6) Power loss determination (as per IEC 60146-2 section 7.3.9) Measurement for THD/THF for voltage (as per IEC 60146-2 section 7.3.10) Power factor measurement (as per IEC 60146-2 section7.3.11) Measurement of output voltage (as per IEC 60146-2 section7.3.12) Confirmation of output voltage adjustable range (as per IEC 60146-2 section 7.3.13) Confirmation of output frequency

S. No.	Checks/Tests to be done by Erection group	Checks/Tests to be done by Commissioning group
		adjustable range (as per IEC 60146 section 7.3.15) Checking automatic control (as per IEC 60146-2 section 7.3.17) Transfer test (as per IEC 62040-3 section 6.6.9) Inverter manual bypass transfer test Bypass transformer test Stabilizer test. Commissioning of system/equipment and final integration with system including charging, post charging observation test & subsequent condition monitoring.
D	**Checks/Tests on Transformers (Oil filled Transformers and dry type Transformer)**	
	Preliminary checks on Transformer Compare nameplate details with the specifications. Check for any physical damage, in particular, of support insulators. Physical inspection of transformer for any damage in transit/Internal inspection of oil filled transformer. Check and record reading of impact	Commissioning checks on Transformers Hot oil circulation and checking of Oil characteristics Checks and Tests on other equipment of oil filled transformer including OLTC, cooling FAN Motors, Pumps & Local control panel, Buchholz relays, oil breather & Conservator tank, WTI

S. No.	Checks/Tests to be done by Erection group	Checks/Tests to be done by Commissioning group
	recorder at receipt and verify the allowable limits as per manufacturer's recommendations. Tests on Oil filled transformer for ascertaining the damage. Carry out basic healthiness checks on equipment during storage for oil filled transformers. Check tightness of all bolts, clamps and connecting terminals. Check cleanliness of support insulators, core coil assembly, marshalling panels, enclosure etc. Check for clearances. Check earthing of transformer supporting structure/ enclosure and neutral terminals. Check that the transformer is correctly installed with reference to its phasing and properly aligned with respect to switchgear and interconnecting external bus duct (In case of auxiliary transformer and Oil filled Transformers). Check for proper termination support of cables, and provision of cable glands	&OTI, PRD, Gauges, NGR etc. Power, control and I&C cable connections checks as per relevant drawing. Checks/Tests on Bushing insulator and Lightning arrestors of oil filled transformers Check for earthing on Transformer including grounding of core and Neutral grounding. Insulation resistance test of windings and polarisation index on winding. Vector group test. Phase sequence test. Winding resistance test at all taps. Insulation resistance of control wiring. Core loss test at service tap. Short circuit test (% impedance test) Voltage/turns ratio at all the taps. Magnetic current balance at full voltage. Capacitance and tan delta measurement. Sweep Frequency Response Analysis (SFRA).

S. No.	Checks/Tests to be done by Erection group	Checks/Tests to be done by Commissioning group
	for the same. Check for proper alignment and connection of LV side bus bars with switchgear/ LV bus bars/LV bus ducts, where applicable. Check welding/bolting to embedded parts/floor of the building. Check and record the gas pressure in the transformer tank as well as in the gas cylinder. Dew point measurement and oil preservation tests. Vacuum check and drying of oil filled Transformer Transformer oil circulation/filling of transformer oil and measurement of oil parameters Checks on other equipment of oil filled transformer including OLTC, FAN Motors, Pumps, Buchholz relays, oil breather & Conservator tank, WTI & OTI, PRD, Gauges etc.	Checks and tests on relays Stability checks of restricted earth fault Stability checks of differential protection Demagnetization of core after completing the tests on transformer DGA tests Commissioning of system/equipment and final integration with system including charging, post charging observation test & subsequent condition monitoring. **Tests on current transformers** Continuity test. Polarity test. IR tests. Magnetisation characteristics. Ratio test. Secondary winding resistance measurement.

S. No.	Checks/Tests to be done by Erection group	Checks/Tests to be done by Commissioning group
	Check for earthing on Transformer including grounding of core and Neutral grounding	Measurement of mV drop across HV and LV power connections and joints.
E.	**Checks and tests on cables:**	
	a. Checks for physical damage b. Checks for screen continuity c. Checks for core continuity d. IR e. HV f. Loss/attenuation/continuity checks on FO cables and patch cords	
F.	**Checks and tests on cable carrier system:**	
	a. Checks for physical damage b. Checks for earthing continuity c. Welding checks	

12.0 LIST OF BUILDINGS UNDER SCOPE OF WORK FOR ELECTRICAL PACKAGE FOR KKNPP 5&6

Sl. No.	KKS Code	Description of Unit, building, structure
1.	00UAB	400 kV GIS Building
2.	00UAC	Switchyard Central Control Building
3.	00UAD	220 kV GIS Building
4.	00UAG	Interconnecting autotransformers structures
5.	00UAH	Structure for supports and equipment
6.	00UAL	Transmission line structures
7.	00UCM	Radiation monitoring equipment structures
8.	00UEL	Diesel and oil pump station
9.	00UFC	New fuel storage building
10.	00UGD	DM water plant building & post treatment plant facility
11.	00UGE	Waste water neutralization structures
12.	00UGG	Raw water treatment building
13.	00UGR	Sludge damp
14.	00UGV	Common-access area domestic waste water purification structures
15.	00UJY	Gallery of the controlled access area
16.	00UKS	Solid radioactive waste reprocessing and storage building
17.	00UKU	Controlled-access area central workshops
18.	00UKY	Gallery of the common access area
19.	00UPA	Intake pipe
20.	00UPK	Chlorination plant
21.	00UQR	Chiller building
22.	00USV	Engineering utility and laboratory building
23.	00USW	Electric cable tunnels

Sl. No.	KKS Code	Description of Unit, building, structure
24.	00UTF	Compressor building
25.	00UTP	Nitrogen plant
26.	00UTQ	Hydrogen & oxygen plant
27.	00UYB	Health physics building (controlled-access area)
28.	00UZA	Motor roads (in Nuclear Island)
29.	00UZC	Construction site area
30.	00UZJ	Construction of main plant boundary (MPB), watch tower @ KK 3to6 site
31.	00UZM	Shielded control building
32.	00UZN	Storm water cutoff trench
33.	00UZP	Shore-line protection bund
34.	00UZQ	Breakwater dike
35.	00UZR	Jetty
36.	00UZS	Flow Training dike
37.	01UAK	400 kV power line carrier communications structures
38.	01UBG	Reserve power supply building
39.	01UBZ	Cable channels of normal operation systems
40.	01UEK	Oil storage facilities
41.	01UEZ	Varnish pipeline duct
42.	01UGA	Desalinated water tank structure
43.	01UGD	Chemical storage building
44.	01UGF	Fire-fighting water tank
45.	01UGH	Storm water pump house
46.	01UGM	Oil containing water treatment structures
47.	01UGT	Silt platform
48.	01UGU	Storm water reservoir
49.	01UGV	The pump stations in networks GQA consisting of 15 pcs.
50.	01UGW	Pump station with receiving tank

Sl. No.	KKS Code	Description of Unit, building, structure
51.	01UPY	Bridge
52.	01UPZ	Cable channel of normal operation systems (Not Used)
53.	01USE	Hydrogen receivers structure
54.	01USF	Structure for nitrogen receivers
55.	01USK	Gas cylinders storage building
56.	01USY	Process trestle between Units 4 and 5
57.	01USZ	Cable channel of normal operation systems
58.	01UTZ	Cable tunnel of normal operation
59.	01UUA	Plenum ventilation center of bus duct tunnels (05UAZ, 06UAZ)
60.	01UUB	Exhaust vent center of NO cable tunnels (01UBZ, 02UBZ)
61.	01UYE	Nuclear Island guard house
62.	01UYF	Pass section building
63.	01UYG	Information center building
64.	01UYX	Electrical store building
65.	01UZJ	Nuclear Island fencing
66.	01UZX	Artificial reef
67.	01UZZ	Cable tunnel of normal operation system
68.	02UAK	220 kV power line carrier communications structures
69.	02UBG	Reserve power supply building
70.	02UBH	Oil and water emergency discharge tanks
71.	02UBZ	Cable channels of normal operation systems
72.	02UEK	Oil storage facilities
73.	02UEZ	Diesel oil pipeline duct
74.	02UGA	Desalinated water tank structure
75.	02UGD	Chemical laboratory
76.	02UGE	Waste water tank structure from chemical backwashing and conservation

Sl. No.	KKS Code	Description of Unit, building, structure
77.	02UGF	Fire-fighting water tank
78.	02UGH	Storm water pump house
79.	02UGM	Pump station
80.	02UGT	Gas-discharge stack
81.	02UGU	Storm water reservoir
82.	02UGW	Production and auxiliary building
83.	02UKH	Ventilation stack on 00UKS building
84.	02UPY	Bridge
85.	02UPZ	Cable channel of normal operation systems (Not Used)
86.	02USE	Hydrogen receivers structure
87.	02USZ	Cable channel of normal operation systems
88.	02UTZ	Cable tunnel of normal operation
89.	02UUA	Exhaust ventilation center of bus duct tunnels (06UAZ)
90.	02UUB	Plenum vent center of NO cable tunnels (01UBZ, 02UBZ)
91.	02UYE	Nuclear Island guard house
92.	02UZJ	Central diesel storage facilities fencing
93.	02UZX	Artificial reef
94.	02UZZ	Cable tunnel of normal operation system
95.	03UAF	Bus shunt reactors structures
96.	03UBG	Common-unit power supply building
97.	03UBH	Oil and water emergency discharge tanks
98.	03UBZ	Cable channels of normal operation systems
99.	03UEH	Oil and diesel receiving structure
100.	03UGA	Portable water tank structure
101.	03UGE	Waste water tank structure from chemical backwashing and conservation
102.	03UGF	Fire-fighting service water pump station
103.	03UGH	The pump stations in networks GUD consisting of 13 pcs.

Sl. No.	KKS Code	Description of Unit, building, structure
104.	03UGM	The pump stations in networks GMA consisting of 5 pcs.
105.	03UGT	Pump station of purified waste water
106.	03UGW	Sand trap
107.	03UKH	Ventilation stack on 00UKU building
108.	03USE	Hydrogen receivers structure
109.	03USZ	Cable channel of normal operation systems
110.	03UUA	Exhaust ventilation center of bus duct tunnels (05UAZ)
111.	03UUB	Exhaust vent center of NO cable tunnels (01UBZ, 02UBZ)
112.	03UZJ	Standby and common unit transformers fencing
113.	03UZW	Under ground water tank (1500 cum) (Township)
114.	03UZX	Artificial reef
115.	04UAF	Bus shunt reactors structures
116.	04UBG	Reserve and common-unit transformers structures
117.	04UBH	Oil and water emergency discharge tanks
118.	04UBZ	Cable channels of normal operation systems
119.	04UEH	Oil and diesel receiving structure
120.	04UGE	Neutralizing tank structure
121.	04UGT	The pump stations in sewerage networks consisting of 2 pcs.
122.	04UGW	Receiving reservoir
123.	04USE	Hydrogen receivers structure
124.	04USZ	Cable channel of normal operation systems
125.	04UUB	Vent shaft of NO cable tunnels (03UBZ, 04UBZ)
126.	04UZJ	Coupling autotransformers and bus reactors fencing
127.	05UAZ	Power output system 220 kV busdust tunnels for connection unit autotransformer
128.	05UBH	Oil and water emergency discharge tanks
129.	05UBZ	Cable channels of normal operation systems

Sl. No.	KKS Code	Description of Unit, building, structure
130.	05UEH	Varnish emergency discharge tank
131.	05UEJ	Intermediate Diesel storage structures
132.	05UGE	Neutralizing tank structure
133.	05UGW	Stabilizer
134.	05UKD	Common-unit diesel generator building
135.	05USZ	Cable channel of normal operation systems
136.	05UUB	Vent shaft of NO cable tunnel (06UBZ)
137.	06UAZ	Power output system 220 kV bus duct tunnels for connection unit autotransformer
138.	06UBZ	Cable channels of normal operation systems
139.	06UEH	Diesel oil emergency discharge tank
140.	06UEJ	Central Diesel storage facilities
141.	06UGW	Settler
142.	06USZ	Cable channel of normal operation systems
143.	06UUB	Plenum vent center of NO cable tunnel (07UBZ)
144.	07UBZ	Cable channels of normal operation systems
145.	07UEH	Column for diesel oil discharge
146.	07UGW	Reservoir for purified drains
147.	07USZ	Cable channel of normal operation systems
148.	07UZJ	Power line carrier communication structures fencing
149.	08UBZ	Cable channels of normal operation systems
150.	08UGW	Chloring contact tank
151.	08USZ	Cable channel of normal operation systems
152.	08UZJ	Power line carrier communication structures fencing
153.	09UBZ	Cable channels of normal operation systems
154.	09UGW	Sand area
155.	09USZ	Cable channel of normal operation systems
156.	09UZJ	Auxiliary buildings and structures area fencing

Sl. No.	KKS Code	Description of Unit, building, structure
157.	50UBA	Normal Operation Power Supply Building
158.	50UBF	Unit Auxiliary Transformers and Generator Transformers Structures
159.	50UBJ	Rolling tracks for transformers
160.	50UCA	The NO building of control system
161.	50UCC	RCPS rooms
162.	50UGC	Contaminated condensate tank structures
163.	50UGS	Backwashing water collection tank structures
164.	50UJA	Reactor building/Inner containment
165.	50UJB	Outer containment
166.	50UJC	PHRS heat exchangers room
167.	50UJE	Steam cell
168.	50UJG	Transport Portal
169.	50UKA	Reactor safety system. Basement
170.	50UKB	Ancillary systems. Lean-to building
171.	50UKC	Reactor Auxiliary & Main Control Room Building
172.	50UMA	Turbine Building
173.	50UMV	T & G Oil Building
174.	50UMW	TB emergency oil discharge tank
175.	50UPC	Intake structure
176.	50UPN	Seawater inlet pipeline
177.	50UPU	Forebay
178.	50UPX	Fish Protection Facilities
179.	50UPY	Bridge
180.	50UQA	Main pump house
181.	50UQE	Discharge pipelines of main cooling water structure
182.	50UQG	Outlet pipeline inlet portion
183.	50UQU	Outlet pipeline

Sl. No.	KKS Code	Description of Unit, building, structure
184.	50UQW	Outlet pipeline outlet portion
185.	50USA	Turbine Building ventilation center
186.	50USC	Air receivers structures for isolation valves
187.	51UAZ	Power output system 400 kV busdust tunnels
188.	51UBH	Oil and water emergency discharge tanks
189.	51UBZ	Cable channels of normal operation systems
190.	51UEH	Oil and diesel receiving structure
191.	51UEJ	Intermediate Diesel storage structures
192.	51UGB	De mineralized water storage tank structures
193.	51UGH	Drainage pump station
194.	51UGS	Backwashing water collection tank structures
195.	51UGZ	Process tunnel to tanks 51UGB-52UGB, 50UGC
196.	51UKD	Emergency power supply and control building
197.	51UKE	Distillate storage tanks structures
198.	51UKH	Ventilation Stack
199.	51UKZ	Cable tunnel of safety systems
200.	51ULD	Structure for lime cleaning waters receiving tank
201.	51UMY	Process trestle to 50UGS, 51UGS, 51ULD, 52ULD, 53ULD
202.	51UPZ	Cable channel of normal operation systems
203.	52UPZ	Cable channel of normal operation systems
204.	53UPZ	Cable channel of normal operation systems
205.	51UQC	Pump house of essential loads
206.	51UQD	Pressure pipelines of main cooling water structure
207.	51UQN	Discharge channel
208.	51UQX	Siphon well
209.	51UQZ	Essential loads pipelines tunnels
210.	51USF	Nitrogen receivers structure for Reactor Building needs
211.	51USZ	Cable channel of normal operation systems

Sl. No.	KKS Code	Description of Unit, building, structure
212.	51UUA	Exhaust ventilation center of bus duct tunnels (51UAZ - 54UAZ)
213.	51UUB	Plenum vent center of NO cable tunnels (51UBZ - 52UBZ)
214.	51UUP	Exhaust vent center essential loads pipelines tunnels (52UQZ)
215.	51UUQ	Exhaust vent center essential loads pipelines tunnels (51UQZ)
216.	51UUZ	Exhaust ventilation centre of SS cable tunnel (51UKZ)
217.	52UAZ	Power output system 400 kV bus duct tunnels (for C (B) phase of unit transformer)
218.	52UBZ	Cable channels of normal operation systems
219.	52UEH	Oil and diesel receiving structure
220.	52UEJ	Intermediate Diesel storage structures
221.	52UGB	De mineralized water storage tank structures
222.	52UGH	Drainage pump station
223.	52UGZ	Process channel to tank 51UGS
224.	52UKD	Emergency power supply and control building
225.	52UKE	Distillate storage tanks structures
226.	52UKZ	Cable tunnel of safety systems
227.	52ULD	Structures for control tank
228.	52UMY	Pedestrian overpass
229.	52UQC	Pump house of essential loads
230.	52UQD	Pressure pipelines of main cooling water structure
231.	52UQN	Discharge channel
232.	52UQX	Siphon well
233.	52UQZ	Essential loads pipelines tunnels
234.	52USF	Nitrogen receivers structure for Turbine Building needs
235.	52USZ	Cable channel of normal operation systems

Sl. No.	KKS Code	Description of Unit, building, structure
236.	52UUA	Exhaust ventilation center of bus duct tunnels (51UAZ - 54UAZ)
237.	52UUB	Exhaust vent center of NO cable tunnels (51UBZ - 52UBZ)
238.	52UUP	Exhaust vent center essential loads pipelines tunnels (52UQZ)
239.	52UUQ	Exhaust vent center essential loads pipelines tunnels (51UQZ)
240.	52UUZ	Exhaust ventilation centre of SS cable tunnel (52UKZ)
241.	52UZJ	Outdoor unit transformers fencing
242.	53UAZ	Power output system 400 kV bus duct tunnels (for B (Y) phase of unit transformer)
243.	53UBZ	Cable channels of normal operation systems
244.	53UEJ	Intermediate Diesel storage structures
245.	53UGH	Drainage pump station
246.	53UKD	Emergency power supply and control building
247.	53UKZ	Cable tunnel of safety systems
248.	53ULD	Structures for control tank
249.	53UQX	Siphon well
250.	53UQZ	Process pipelines channel
251.	53USZ	Cable channel of normal operation systems
252.	53UUA	Exhaust ventilation center of bus duct tunnels (51UAZ - 54UAZ)
253.	53UUB	Plenum vent center of NO cable tunnels (53UBZ - 54UBZ)
254.	53UUP	Plenum vent center essential loads pipelines tunnels (52UQZ)
255.	53UUQ	Plenum vent center essential loads pipelines tunnels (51UQZ)
256.	53UUZ	Exhaust ventilation centre of SS cable tunnel (53UKZ)

Sl. No.	KKS Code	Description of Unit, building, structure
257.	54UAZ	Power output system 400 kV bus duct tunnels (for A (R) phase of unit transformer)
258.	54UBZ	Cable channels of normal operation systems
259.	54UEJ	Intermediate Diesel storage structures
260.	54UKD	Emergency power supply and control building
261.	54UKZ	Cable tunnel of safety systems
262.	54UQX	Siphon well
263.	54UQZ	Process pipelines channel
264.	54USZ	Cable channel of normal operation systems
265.	54UUA	Plenum ventilation center of bus duct tunnels (51UAZ - 54UAZ)
266.	54UUB	Exhaust vent center of NO cable tunnels (53UBZ - 54UBZ)
267.	54UUP	Exhaust vent center essential loads pipelines tunnels (52UQZ)
268.	54UUQ	Exhaust vent center essential loads pipelines tunnels (51UQZ)
269.	54UUZ	Exhaust ventilation centre of SS cable tunnel (54UKZ)
270.	55UBZ	Cable channels of normal operation systems
271.	55UKZ	Cable tunnel of normal operation systems
272.	55USZ	Cable channel of normal operation systems
273.	55UUA	Exhaust ventilation center of bus duct tunnels (51UAZ - 54UAZ)
274.	55UUB	Plenum vent center of NO cable tunnels (55UBZ--58UBZ)
275.	55UUP	Exhaust vent center essential loads pipelines tunnels (52UQZ)
276.	55UUQ	Exhaust vent center essential loads pipelines tunnels (51UQZ)

Sl. No.	KKS Code	Description of Unit, building, structure
277.	55UUZ	Plenum ventilation centre of SS cable tunnel (51UKZ, 52UKZ)
278.	56UBZ	Cable channels of normal operation systems
279.	56UKZ	Cable tunnel of normal operation systems
280.	56USZ	Cable channel of normal operation systems
281.	56UUA	Plenum ventilation center of bus duct tunnels (51UAZ - 54UAZ)
282.	56UUB	Exhaust vent center of NO cable tunnels
283.	56UUP	Exhaust vent center essential loads pipelines tunnels (52UQZ)
284.	56UUQ	Exhaust vent center essential loads pipelines tunnels (51UQZ)
285.	56UUZ	Plenum ventilation centre of SS cable tunnel (53UKZ, 54UKZ)
286.	57UBZ	Cable channels of normal operation systems
287.	57UKZ	Cable tunnel of normal operation systems
288.	57USZ	Cable channel of normal operation systems
289.	57UUA	Exhaust ventilation center of bus duct tunnels (51UAZ - 54UAZ)
290.	57UUP	Exhaust vent center essential loads pipelines tunnels (52UQZ)
291.	57UUQ	Exhaust vent center essential loads pipelines tunnels (51UQZ)
292.	57UUZ	Exhaust ventilation centre of SS cable tunnel (52UKZ, 53UKZ)
293.	58UBZ	Cable channels of normal operation systems
294.	58UKZ	Cable tunnel of normal operation systems
295.	58USZ	Cable channel of normal operation systems

Sl. No.	KKS Code	Description of Unit, building, structure
296.	58UUZ	Exhaust ventilation centre of SS cable tunnel (51UKZ, 54UKZ)
297.	60UBA	Normal Operation Power Supply Building
298.	60UBF	Unit Auxiliary Transformers and Generator Transformers Structures
299.	60UBJ	Rolling tracks for transformers
300.	60UCA	The NO building of control system
301.	60UCC	RCPS rooms
302.	60UGC	Contaminated condensate tank structures
303.	60UGS	Backwashing water collection tank structures
304.	60UJA	Reactor building/Inner containment
305.	60UJB	Outer containment
306.	60UJC	PHRS heat exchangers room
307.	60UJE	Steam cell
308.	60UJG	Transport Portal
309.	60UKA	Reactor safety system. Basement
310.	60UKB	Ancillary systems. Lean-to building
311.	60UKC	Reactor Auxiliary & Main Control Room Building
312.	60UMA	Turbine Building
313.	60UMV	T & G Oil Building
314.	60UMW	TB emergency oil discharge tank
315.	60UPC	Intake structure
316.	60UPN	Seawater inlet pipeline
317.	60UPU	Fore bay
318.	60UPX	Fish Protection Facilities
319.	60UPY	Bridge
320.	60UPY	Bridge
321.	60UQA	Main pump house

Sl. No.	KKS Code	Description of Unit, building, structure
322.	60UQE	Discharge pipelines of main cooling water structure
323.	60UQG	Outlet pipeline inlet portion
324.	60UQU	Outlet pipeline
325.	60UQW	Outlet pipeline outlet portion
326.	60USA	Turbine Building ventilation center
327.	60USC	Air receivers structures for isolation valves
328.	61UAZ	Power output system 400 kV busdust tunnels
329.	61UBH	Oil and water emergency discharge tanks
330.	61UBZ	Cable channels of normal operation systems
331.	61UEH	Oil and diesel receiving structure
332.	61UEJ	Intermediate Diesel storage structures
333.	61UGB	Demineralized water storage tank structures
334.	61UGH	Drainage pump station
335.	61UGS	Backwashing water collection tank structures
336.	61UGZ	Process tunnel to tanks 61UGB-62UGB, 60UGC
337.	61UKD	Emergency power supply and control building
338.	61UKE	Distillate storage tanks structures
339.	61UKH	Ventilation Stack
340.	61UKZ	Cable tunnel of safety systems
341.	61ULD	Structure for lime cleaning waters receiving tank
342.	61UMY	Process trestle to 60UGS, 61UGS, 61ULD, 62ULD, 63ULD
343.	61UPZ	Cable channel of normal operation systems
344.	62UPZ	Cable channel of normal operation systems
345.	63UPZ	Cable channel of normal operation systems
346.	61UQC	Pump house of essential loads
347.	61UQD	Pressure pipelines of main cooling water structure
348.	61UQN	Discharge channel
349.	61UQX	Siphon well

Sl. No.	KKS Code	Description of Unit, building, structure
350.	61UQZ	Essential loads pipelines tunnels
351.	61USF	Nitrogen receivers structure for Reactor Building needs
352.	61USZ	Cable channel of normal operation systems
353.	61UUA	Exhaust ventilation center of bus duct tunnels (61UAZ - 64UAZ)
354.	61UUB	Plenum vent center of NO cable tunnels (61UBZ - 62UBZ)
355.	61UUP	Exhaust vent center essential loads pipelines tunnels (62UQZ)
356.	61UUQ	Exhaust vent center essential loads pipelines tunnels (61UQZ)
357.	61UUZ	Exhaust ventilation centre of SS cable tunnel (61UKZ)
358.	62UAZ	Power output system 400 kV bus dust tunnels (for C (B) phase of unit transformer)
359.	62UBZ	Cable channels of normal operation systems
360.	62UEH	Oil and diesel receiving structure
361.	62UEJ	Intermediate Diesel storage structures
362.	62UGB	Demineralized water storage tank structures
363.	62UGH	Drainage pump station
364.	62UGZ	Process channel to tank 61UGS
365.	62UKD	Emergency power supply and control building
366.	62UKE	Distillate storage tanks structures
367.	62UKZ	Cable tunnel of safety systems
368.	62ULD	Structures for control tank
369.	62UMY	Pedestrian overpass
370.	62UQC	Pump house of essential loads
371.	62UQD	Pressure pipelines of main cooling water structure
372.	62UQN	Discharge channel
373.	62UQX	Siphon well

Sl. No.	KKS Code	Description of Unit, building, structure
374.	62UQZ	Essential loads pipelines tunnels
375.	62USF	Nitrogen receivers structure for Turbine Building needs
376.	62USZ	Cable channel of normal operation systems
377.	62UUA	Exhaust ventilation center of bus duct tunnels (61UAZ - 64UAZ)
378.	62UUB	Exhaust vent center of NO cable tunnels (61UBZ - 62UBZ)
379.	62UUP	Exhaust vent center essential loads pipelines tunnels (62UQZ)
380.	62UUQ	Exhaust vent center essential loads pipelines tunnels (61UQZ)
381.	62UUZ	Exhaust ventilation centre of SS cable tunnel (62UKZ)
382.	62UZJ	Outdoor unit transformers fencing
383.	63UAZ	Power output system 400 kV busdust tunnels (for B (Y) phase of unit transformer)
384.	63UBZ	Cable channels of normal operation systems
385.	63UEJ	Intermediate Diesel storage structures
386.	63UGH	Drainage pump station
387.	63UKD	Emergency power supply and control building
388.	63UKZ	Cable tunnel of safety systems
389.	63ULD	Structures for control tank
390.	63UQX	Siphon well
391.	63UQZ	Process pipelines channel
392.	63USZ	Cable channel of normal operation systems
393.	63UUA	Exhaust ventilation center of bus duct tunnels (61UAZ - 64UAZ)
394.	63UUB	Plenum vent center of NO cable tunnels (63UBZ - 64UBZ)
395.	63UUP	Plenum vent center essential loads pipelines tunnels (62UQZ)

Sl. No.	KKS Code	Description of Unit, building, structure
396.	63UUQ	Plenum vent center essential loads pipelines tunnels (61UQZ)
397.	63UUZ	Exhaust ventilation centre of SS cable tunnel (63UKZ)
398.	64UAZ	Power output system 400 kV busdust tunnels (for A (R) phase of unit transformer)
399.	64UBZ	Cable channels of normal operation systems
400.	64UEJ	Intermediate Diesel storage structures
401.	64UKD	Emergency power supply and control building
402.	64UKZ	Cable tunnel of safety systems
403.	64UQX	Siphon well
404.	64UQZ	Process pipelines channel
405.	64USZ	Cable channel of normal operation systems
406.	64UUA	Plenum ventilation center of bus duct tunnels (61UAZ - 64UAZ)
407.	64UUB	Exhaust vent center of NO cable tunnels (63UBZ - 64UBZ)
408.	64UUP	Exhaust vent center essential loads pipelines tunnels (62UQZ)
409.	64UUQ	Exhaust vent center essential loads pipelines tunnels (61UQZ)
410.	64UUZ	Exhaust ventilation centre of SS cable tunnel (64UKZ)
411.	65UBZ	Cable channels of normal operation systems
412.	65UKZ	Cable tunnel of normal operation systems
413.	65USZ	Cable channel of normal operation systems
414.	65UUA	Exhaust ventilation center of bus duct tunnels (61UAZ - 64UAZ)
415.	65UUB	Plenum vent center of NO cable tunnels (65UBZ-- 68UBZ)
416.	65UUP	Exhaust vent center essential loads pipelines tunnels (62UQZ)

Sl. No.	KKS Code	Description of Unit, building, structure
417.	65UUQ	Exhaust vent center essential loads pipelines tunnels (61UQZ)
418.	65UUZ	Plenum ventilation centre of SS cable tunnel (61UKZ, 62UKZ)
419.	66UBZ	Cable channels of normal operation systems
420.	66UKZ	Cable tunnel of normal operation systems
421.	66USZ	Cable channel of normal operation systems
422.	66UUA	Plenum ventilation center of bus duct tunnels (61UAZ - 64UAZ)
423.	66UUB	Exhaust vent center of NO cable tunnels
424.	66UUP	Exhaust vent center essential loads pipelines tunnels (52UQZ)
425.	66UUQ	Exhaust vent center essential loads pipelines tunnels (61UQZ)
426.	66UUZ	Plenum ventilation centre of SS cable tunnel (63UKZ, 64UKZ)
427.	67UBZ	Cable channels of normal operation systems
428.	67UKZ	Cable tunnel of normal operation systems
429.	67USZ	Cable channel of normal operation systems
430.	67UUA	Exhaust ventilation center of bus duct tunnels (61UAZ - 64UAZ)
431.	67UUP	Exhaust vent center essential loads pipelines tunnels (62UQZ)
432.	67UUQ	Exhaust vent center essential loads pipelines tunnels (61UQZ)
433.	67UUZ	Exhaust ventilation centre of SS cable tunnel (62UKZ, 63UKZ)
434.	68UBZ	Cable channels of normal operation systems

Sl. No.	KKS Code	Description of Unit, building, structure
435.	68UKZ	Cable tunnel of normal operation systems
436.	68USZ	Cable channel of normal operation systems
437.	68UUZ	Exhaust ventilation centre of SS cable tunnel (61UKZ, 64UKZ)
438.	0UGX	Desalination plant
439.	00USY	Process trestle

NOTE:

Above is the tentative list for KKNPP Unit-5, Unit-6 and common buildings. The scope will cover works in any other building also which may be missed to be included in the above list.

13.0 REFERENCES

1. I02.KK56.0.0.PR.TT.PR009-Rev.3 - JOBS SPECIFICATION – ELECTRICAL SYSTEMS FOR KKNPP 5&6
2. I02.KK56.0.0.PR.TT.PR008-Rev.4 - SCOPE OF WORK – ELECTRICAL SYSTEMS FOR KKNPP 5&6

SECTION-4

ANNEXURE-A: COMPLIANCE CERTIFICATE OF TECHNICAL SPECIFICATION

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

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

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

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

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

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

Date: Bidder's Stamp & Signature

SECTION-4

ANNEXURE-B: DEVIATION/ CHANGE REQUEST OF TECHNICAL SPECIFICATION

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

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

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

Date: Bidder's Stamp & Signature

Signature Not Verified
Digitally signed by Gaurav Agarwal
Date: 2026.05.20 12:24:02 IST
Location: BHEL