



VOLUME – IA Part I & II

TECHNICAL CONDITIONS OF CONTRACT (TCC)

BHARAT HEAVY ELECTRICALS LIMITED



TENDER SPECIFICATION

BHEL: PSSR: SCT: 2184

TECHNICAL CONDITONS OF THE CONTRACT

FOR

Insulation works for Turbine, Piping, Equipments etc. including handling of materials at site stores /storage yard, transporting to site, inspection, Fabrication, pre-assembly, erection, alignment, welding, painting and application of refractory & insulation as per requirement or drawings at Unit#3 KUDANKULAM NUCLEAR POWER PROJECT, TAMILNADU



BHARAT HEAVY ELECTRICALS LIMITED

(A Government of India Undertaking)

Power Sector – Southern Region

TECHNICAL CONDITIONS OF CONTRACT (TCC)

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VOLUME - IA PART – I CHAPTER – I

PROJECT INFORMATION

1.1	PROJECT TITLE	KUDANKULAM NUCLEAR POWER PROJECT UNIT 3 & 4
1.2	PLANT CAPACITY	2X 1000 MWe
1.3	PACKAGE	TSS (TG & SECONDARY CYCLE AND SEA WATER SYSTEMS) PACKAGE
1.4	OWNER	NUCLEAR POWER CORPORATION OF INDIA LIMITED
1.5	PLANT LOCATION	KUDANKULAM PO, RADHAPURAM TALUK, TIRUNELVELI DISTRICT, TAMILNADU - 627106
1.6	NEAREST TOWN	NAGERCOIL (41KM)
1.7	NEAREST RAILWAY STATION	KANYAKUMARI (35KM)
1.8	NEAREST AIRPORT	TUTICORIN (131KM)

INSTRUCTIONS TO BIDDERS

- i. The Bidder shall visit project site and acquire full knowledge and information about conditions prevailing at site and in & around the plant premises, together with site conditions, transportation routes, various distances, all the statutory, obligatory, mandatory requirements of various authorities and all information that may be necessary for preparing the bid and entering into the Contract. All costs for and associated with site visits shall be borne by the bidder.
- ii. The information given here in this chapter is for general guidance and shall not be contractually binding on BHEL/Owner. All relevant site data /information as may be necessary shall have to be obtained /collected by the Bidder.
- iii. The contractor, in the event of this work awarded to him, shall establish an office at site and keep posted an authorized, responsible officer with valid Power of Attorney for the purpose of the contract. Any order or instructions of the 'Engineer' or his duly authorized representative, communicated to the contractor's representative at site office will be deemed to have been communicated to the contractor at his legal address.
- iv. No claim will be entertained by BHEL on ground of lack of knowledge and the contractor's rates shall be deemed to have taken this into account.

VOLUME - IA PART – I CHAPTER – II

SCOPE OF WORK

TECHNICAL SPECIFICATION

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Annexure-VI	Insulation Drawings

TECHNICAL SPECIFICATION AND SCOPE OF WORK

The scope of the work will comprise of but not limited to the following:

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1. BROAD SCOPE OF WORK

Insulation works for Turbine, Piping, Equipments etc. including handling of materials at site stores /storage yard, transporting to site, inspection, Fabrication, pre-assembly, erection, alignment, welding, painting and application of refractory & insulation as per requirement / as given in the drawings for **Unit#3 KUDANKULAM NUCLEAR POWER PROJECT, TAMILNADU**

List of abbreviations used in this tender is given in **Annexure-I**.

2. GENERAL

In general, the scope of work shall comprise of but not limited to the following:

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1. Study, preparation and submission of detailed work schedule such as level 3 and level 4 to meet the specific targets and agreed milestones as per contract. All work schedules and networks shall be prepared & submitted based on actual quantum of work indicating resources required by the contractor to achieve the agreed targets.
2. Training and qualification of contractor personnel: The contractor personnel shall be conversant with Russian codes and standards. Contractor quality personnel shall be assessed by NPCIL, before engaging them in work.
3. Establishing contractor's office and other infrastructure with communication facilities, labour canteen & rest room.
4. Facilities like site office and field offices, mock up area, test facilities, etc as required by the contractor shall be arranged by him at his own cost. Prior approval of the engineer shall be obtained in respect of locations, layout and details of these buildings. After the work is over, these temporary facilities shall be removed by the contractor at his expense to the satisfaction of the Engineer within the days specified by the engineer from the date of completion. All the activities of the contractor shall be confined to areas authorized by the Engineer-in-charge. The contractor shall be liable for any and all damage caused by him to the NPCIL Corporation's premises.

5. Receipt of free issue materials from BHEL/NPCIL's stores, uncrate, inspection, reporting deficiency if any to BHEL/NPCIL, shifting from BHEL/contractor's storage to erection site, handling of materials during erection/construction and inspection before erection of items including return of empty crating of FIM to BHEL/NPCIL's store.
6. Preparation of work procedures and QAP.
7. The terminal points decided by BHEL are final and binding on the contractor for deciding the scope of work and effecting the payment for the work done up to terminals.
8. Preparation of CCC and material accounting and submission to BHEL & NPCIL for acceptance.
9. All reports shall be entered in Construction management software provided by NPCIL/BHEL for material supply, erection activities, protocols, measurements & billing. Agency shall provide required data entry operators along with computers & printers with in the quoted rates.
10. Deployment of qualified manpower, supervisory staff and training & qualification of personnel and arrangement of Plant and Machinery, tools & tackles, scaffoldings, ladders, platforms etc.
11. Housekeeping, dewatering & preservation is in the scope of the contractor.
12. Preparation and submission of detailed work schedule to meet the specified targets using latest project management tools and facilities.

3. REFERENCE DRAWINGS, DOCUMENTS & SPECIFICATIONS:

1. The KKNPP-3&4 units are designed by Russian Federation. Accordingly, assembly, fabrication, erection, inspection of Insulation of all the pipelines, pipe fittings, valves, supports and all other components and all other technical requirements shall be as per the Russian Standards and Codes. This Technical Specification is compiled based on the Russian Standards and are only for the guidance of the contractor. Work shall be done based on the Working Documents and for more details contractor shall have to follow Russian NTD/GOST/SNiP/RD/OST/OTT/PNAEG/PiNAE/SN/VSN/TU/TY as specified in Working Drawings (WD) released for construction and manufacturer documents which will be progressively issued to the contractor during execution of work. The Russian Standards and codes are available with NPCIL Engineer In-charge's library for reference.
2. It is the responsibility of the contractor to study & understand all the pre-requisites & conditions like availability of work front, labour, material, consumables etc before the start of the work. BHEL/NPCIL will issue WD's from time to time to the contractor.
3. The specifications for execution of work are based on Russian standards and codes, which will be issued only to the successful bidder along with working documents.

4. In the event of conflicting requirements between the specification and drawings, the governing requirements shall be at the discretion of the ENC of the work. In the instance where contractor is unable to achieve the required technical parameters, he must apply to the ENC with full justification for the regularization of non-conformance. Any deviation from technical requirements must be recorded and duly approved by the Engineer in-charge.
5. Working drawings will be issued during the course of execution of work to match the progress of the work in the phased manner. The contractor shall prepare detailed fabrication / shop drawings where ever required based on the design drawings supplied by BHEL/NPCIL.
6. Any discrepancies or contradictions in, or omissions from drawings, specifications or other documents or any doubt arising as to the meaning or intent of any part thereof, shall be referred to the Engineer in-charge. Written instructions or explanations will then be issued by the engineer as soon as possible.
7. All dimensions shown on the drawings that are related to installed equipment or pertinent embedded parts shall be verified by the contractor by field measurement before the start of work.
8. In case the Contractor feels that the drawing issued by the Engineer does not provide sufficient details required to prepare shop drawings, the Contractor shall obtain the Engineer's consent in writing, to design the additional details and prepare the shop drawing from the design drawings issued to him. Where standard joints are not available, the Contractor shall design connections as per standard practice of design and shall get Engineer's approval prior to fabrication.
9. The shop drawings prepared by the Contractor shall be submitted to the Engineer for comments and approval. The Contractor shall also incorporate the comments offered by the Engineer or his authorized representative and resubmit the drawing to the Engineer for approval. The Contractor shall prepare and get approval of all the required drawings within the stipulated time schedule of the works.
10. Inadequacy in detailing in Engineer's drawing shall be brought to the notice of the Engineer within 3 (Three) days of receipt of drawings by the Contractor.
11. Whenever the contractor is unable to comply with the Engineer's requirements, whether it is dimensional or technical, or whenever field changes are inevitable for any reason, the Contractor must obtain the appropriate authorization from the engineer.
12. Design Concession Request (DCR) shall be raised for non-generic deviation and non-conformances and it has to be regularized as per Quality management system.

4. KKS code:

In KKNPP 3&4 all the Structures, Systems and Components (SSC's) are identified by a Unique non-language-based coding system known as KRAFTWERK KENNEZEICHEN SYSTEM (KKS). All the working documentations, drawings, technical specifications and other technical related documents issued to the contractor from time to time shall refer to these KKS codes. Complete list of KKS codes is available with Engineer In-charge which shall be made available to the Contractor on demand at the time of start of the work. The list of KKS codes of all the systems and structures which are part of this tender is given in **Annexure-II** to this section. Under the KKS coding system, apart from system and structures identification, each component/equipment in a system is identified by a certain code. It is the responsibility of the contractor to train his personnel in understanding the KKS codes. The non-familiarity or ignorance of KKS coding system will not relieve the contractor from his responsibility of successfully performing the said work.

5. BUILDING AND SYSTEM DESCRIPTION:

5.1 Building description:

The Insulation works covered under this tender document shall be in Turbine Building (UMA), Turbine & Generator Oil buildings (UMV), emergency oil discharge structure (UMW), Normal operation power supply building (UBA), process tunnels (UGZ) and nitrogen receiver structure (2USF), Main pump house (UQA) Essential load pump house (UQC), Intake structure (UPC), Fish protection facility (UPX), Siphon wells (UQX), Fore bay (UPU), Inlet pipeline (UPN), Essential load pipeline tunnels (UQZ), controlled access area waste water treatment plant (UGT,UGW), Reactor building (UJA,UKA), Diesel generator building (UKD), Chiller building (UQR), within the plant site of KKNPP- 3.

A brief description of all the associated buildings and structures are given in the **Annexure-III** of this section

5.2 System and equipment description:

The equipment & piping system for Insulation works covered under this tender document are related to TG & auxiliary and secondary cycle systems and sea water and its associated systems.

TG & auxiliary and secondary cycle systems mainly consist of Turbine and Auxiliary systems, Generator and Auxiliary systems, Steam Systems, Condensate Systems, Feed Water Systems, Oil and Gas systems and Supporting Systems.

Sea water and its associated systems mainly consists of Main sea water cooling system, Sea water cooling system for essential loads, Sea water cooling system for non-essential loads, Closed cooling water system for conventional area, Systems of dewatering, Screen and flume wash out systems, Common plant systems, Fish protection and diversion system, SS piping system for air supply at the pump houses and Controlled access area waste water treatment systems

A brief description of all the associated systems is given in the **Annexure-IV** of this section.

6. RECEIPT OF MATERIAL, SHIFTING, STORAGE:

6.1 Receipt and shifting of materials:

1. The scope of material shifting covers identification of material, preparation of CIV, clearance from EIC and its submission to BHEL/NPCIL's stores, receipt, handling, loading on to the truck/trailer, shifting of materials from BHEL/NPCIL's stores to contractor's store or erection site, unloading the material at contractor's store or erection site, uncrating, checking the completeness of items/physical damage(if any), preparation and submission of incoming material inspection report (IMIR) and its clearance from EIC, further shifting of materials from contractor's store to erection site and disposal of the crating/packing material at the designated place of the NPCIL's stores, returning of un-erected materials to NPCIL's stores. This work also includes arranging all the necessary tools and tackles, truck/trailer, plant and machinery, man power and consumables.
2. All such materials which are issued to the contractor by BHEL/NPCIL during the contract period shall be treated as Free Issue Material (FIM). The contractor shall make note of such items and draw the items from NPCIL stores on requisition. The free issue material will be issued against contractor issue voucher (CIV) at BHEL/NPCIL stores. The contractor shall prepare Contractor Issue Voucher (CIV) either using BHEL/NPCIL certified software's like IPMIS, IBA-CMM or manually using CIV book which shall be issued to contractor during the execution of work. Contractor shall establish facility for software-based material management system for free issue materials, compatible with the BHEL/NPCIL's software. The CIV should contain all the details of the requested material and the same shall be submitted to department of stores through EIC. It is the responsibility of the contractor to collect the requested material from the designated location of the BHEL/NPCIL stores once the materials is issued.
3. The Contractor shall draw the FIM from the BHEL/NPCIL's stores located within the plant premises or in the vicinity of the plant premises.

4. The Contractor shall be responsible for shifting of all the items / materials from the NPCIL's store / Contractor's store / shop to the place of work/ installation. In no case the material will be delivered by NPCIL/BHEL at the actual place of erection.
5. After receiving the materials contractor shall carry out uncrating, visual inspection to check for any damage, inspecting the contents for deficiency if any, checking for the completeness, preparation of Incoming material inspection report (IMIR), shifting up to erection site, handling and storage. Further shifting to the erection point, shifting of materials from contractor's store to erection site and disposal of the crating /packing material at the designated place of the NPCIL's stores will be the responsibility of the contractor. The FIM shall be issued in a lot, in packed/as received condition. No piecemeal issue/delivery shall be permitted.
6. Loading and unloading of materials shall be hoisted or skidded so as to avoid shock or damage. Under no circumstances materials shall be dropped. Pipe handled on skid ways shall not be skidded or rolled against other pipe. Dragging of unprotected equipment on the ground shall not be permitted.
7. In the erection place, some rooms (floor & walls) are provided with stainless steel liner. Contractor shall take extreme care while shifting and erecting the equipments and piping to avoid damage to the room liners. The scaffolding used in the area shall have rubber bushing to avoid scratch & dents on the liner and finished floors.
8. The contractor shall arrange all tools & tackles, machinery and hoisting required for loading, shifting and unloading of the materials. Wherever the contractor has to attach his hoisting equipments to project's existing structure written procedure of rigging operation must be submitted for the engineer's approval. In the work area where the engineer may have installed hoisting equipments in time, which is part of the project as permanent installation, the contractor may be permitted to utilize it free of charges for the execution of his work. The same does not apply in the event of the engineer's permanent hoisting equipment is not available or engaged for other work or being out of order. This shall not be the cause for claims of extra payment or an excuse for delays in executing the work. This facility is offered purely on the ground to increase safety of hoisting operations and to remove unnecessary congestions, if and where possible. The contractor shall check the lifting capacity of various hoisting equipments before taking up any erection.
9. Disposal of crating/packing materials to NPCIL store is in the scope of Contractor.

6.2 Storage of materials:

1. Attention is drawn to the fact that the environment at KK site is corrosive and therefore proper storage and its periodic monitoring by contractor has to be done at no extra cost. Contractor shall make storage arrangements to provide appropriate storage at site for all NPCIL/BHEL issued FIM's, Contractor's Plant & Machinery and Contractor's Equipments till the completion of the work. All the Plant & machinery, tools & tackles, hoisting equipments, manpower etc required for handling the materials at contractor's store, are in the scope of the contractor. Watch and ward shall be the responsibility of the contractor.
2. Once materials are issued to the contractor it is the responsibility of contractor in storing of any materials and pre-fabricated items at erection location in the building or enclosures providing adequate protection. All storage shall be orderly and executed in a way so as to eliminate mixing up of materials and possibility of damage prior to their installation in the field. No material shall be stored directly on the floor. Supports shall be provided below to ensure gap of 100 to 150 mm from ground. Materials received for fabrication, all identification marks pertaining to material specification and other details shall be retained until such time when it is inevitable to remove them by a pre- fabrication stage but immediately on completion of this stage the particular segment is to receive pipeline system code number. Special tags, bearing system code numbers provided on equipment and items like valves, etc. should not be removed or tampered with, lack or loss of above described identification marks shall be brought to the attention of the engineer.
3. The Contractor shall be responsible for security of all the FIM's stored at the contractor's stores till the completion of the work and acceptance by NPCIL. It is the responsibility of the contractor to maintain complete record of the list of materials at stores, maintain log books and entry/exit records for the material movement in and out of the contractor's warehouse/store. All such records which are required for material accounting and billing shall be prepared, recorded and maintained by the contractor either manually or by using licensed software's with prior approval of ENC. BHEL/NPCIL approved committee has every right to audit Contractor stores, records and his logbooks time to time during the execution of work, for which Contractor shall ensure and provide all such information and facilities on demand.

6.3 Identification, marking and segregation of material:

1. In NPCIL stores, all the equipments and pipelines are identified by their KKS codes and Item no's. It is the responsibility of the contractor to get the details of KKS codes, package no's, Item no's for such materials from NPCIL/BHEL. All the FIM's shall be stored at appropriate locations in contractor's stores, properly tagged and identified for segregation from other goods, properly protected and preserved as per manufacturers recommendations, properly marked with their KKS code, system Code, Item no. and item description like weight, material, type etc and the material locations shall be marked properly for easy identification and retrieval of the material at stores.
2. The contractor shall visually examine all materials being erected or being used in the fabrication and shall report any defects to the engineer. Any repair of materials shall be as per approval of the engineer's instructions. Any material not conforming to the specification and subsequently rejected should be suitably identified, stocked and disposed off as per the instructions of the engineer.
3. All materials to be used in Insulation works shall conform to the specification issued by the engineer. No substitution of equivalent materials permissible unless approved by Engineer. Manufacturer's certificates attesting compliance of the material with the specification shall be retained in the engineer's record for the project. The certification shall include identification details, a certified report of the results of all the required tests, examinations, and repairs performed on the material.
4. All loose parts/ accessories shall be properly identified, stored and re-assembled by the contractor.
5. The marking shall consist of the applicable specification number, Grade/Type, and any non-destructive testing. In those cases where size or shape prohibits, a marking code shall be used that identifies the material with the certification report.

7. SEQUENCE OF ACTIVITIES:

The sequence of erection shall be decided based on availability of erection fronts, drawings and equipments. In general, the sequence of the erection shall follow the overall project schedule of KKNPP-3. Generally, installation of equipments shall be taken up first followed with installation of piping and valve system. The following shall be the preferred sequence of installation.

- Painting of equipment and piping
- Equipment installation with support structures and inspection
- Installation and inspection of supports for large diameter piping.
- Erection of pre-fabricated large diameter piping spools (100 NB and above) and supporting them on already installed supports.
- Erection and field welding of the remaining piping (small diameter) and installation of their supports.
- Inspection, Testing and flushing of piping Circuits
- Anticorrosive coating of equipments and piping
- Insulation of equipment and piping

8. INTERFACING WITH OTHER AGENCIES AND TERMINAL POINTS:

8.1 Interfacing:

1. The civil construction work is under progress by other agencies, hence required co-operation shall be established by the mechanical contractor for smooth progress of work. Construction of civil works shall be continuing in other part of the same building where equipment and piping are being erected. Also other mechanical/electrical agencies related to ventilation, material handling equipments, common services, cable laying, ducting etc may also work in the same area. Hence for carrying out the above activities the co-ordination with other contractors/agencies working in that area for erection of ducting, cable tray, etc., will be required. This is to avoid unnecessary cutting and re-welding of ducting, cable trays, their supports, etc., for taking fabricated pipe spools in the required locations. Contractor shall not consider this type of parallel working as disturbance or hindrance to erection work.
2. All mechanical erection work covered under this specification shall be planned and executed as combined nature of civil, mechanical, electrical and instrumentation work. The civil construction and mechanical erection works shall be done in a sequential/combined manner. The work front for civil and mechanical contractor shall be available or released on completion of specified activities by each contractor on every activity and both contractors shall ensure that

their part of work is completed in time. No extra claim on account of any misunderstanding or not understanding the nature of work shall be entertained by BHEL/NPCIL.

3. As the scope of work involves erection of materials supplied by the contractor/BHEL as well as supplied by Russian Federation (Free issue Materials), the dimensional mismatches between the connecting components shall be suitably fabricated and joined by the contractor.

8.2 Terminal points:

The terminal points for the system piping with respect to the buildings shall be indicated on the working drawing. Generally terminal points will be the pipe penetration or the first isolation valve.

9. PREPARATION OF WORK PROCEDURES:

1. The contractor shall prepare and submit work procedures for fabrication, erection and inspection of all the Insulation works in his scope to EIC for approval. The procedures shall be prepared in line with the general Industry practice, Working Documents, acceptable codes and standards and to the requirements of Equipment Manufacturer/Designer. The procedures shall clearly define all the details pertaining to the type of testing, process of testing, the methodology adopted, special requirements, sequence of steps, fabrication requirements, assembly requirements, alignment process, quantum of testing, testing tools & consumables required, calibration requirements, testing parameters, sampling requirements, interpretation of results, defect rectification methodology.
2. Contractors shall ensure that all construction activities are performed following duly approved Procedures, methods and work instructions. All hazardous activities shall be duly identified, Procedures duly formulated for the same, approved and implemented, and continuously monitored for their effective implementation. Job Hazard Analysis (JHA) shall be undertaken, updated (if required) and documentation to this effect maintained.
3. Further, where complexity of the work or safety is involved, the contractor shall submit such work procedures when requested by the EIC. Any other procedure deemed necessary for work shall be submitted to EIC for acceptance.

10. MANUFACTURER'S INSTRUCTION & SUPERVISION AT SITE:

1. Manufacturer's instructions are special/specific instructions issued by the equipment manufacturer. Any such installation requirement specified by the Manufacturers, such as alignment, adjustments of particular items on the equipment etc. is included in contractor's scope of work. For any items (supplied by the engineer) of proprietary nature, the Engineer will issue the Manufacturer's data or instructions to the Contractor. Contractor shall follow the manufacturer's instructions/data for equipment/items supplied by contractor. The manufactures manual should be returned to NPCIL with deviation marked by the contractor on completion of work.
2. Wherever deemed necessary NPCIL may arrange supervisors of manufacturer representative during erection and testing of the equipment/system for pre determined period. The contractor is required to complete the erection of such equipment in a fixed time frame as per agreed schedule. Any delay in completion of work by the contractor within the agreed schedule shall be considered as delay in work. If any additional expenditure incurred by NPCIL on account of delay by the contract or on account of supervision front, shall be deducted from the contractor.

11. THERMAL INSULATION WORKS:

Supply of Insulation materials is in the scope of BHEL and shall be issued as FIM to the contractor.

- 11.1 Receipt of materials from all the BHEL stores and Transportation to erection site, stacking, storage and preservation.
- 11.2 Application of hot thermal insulation for the pipelines and equipments are in the scope of the Contractor. The technical requirements of insulation works are provided in **Annexure-V**. Insulation work shall be carried out as per the WD requirements and as per the instructions of EIC.
- 11.3 Application of refractory, wool insulation, sheet metal cladding, welding of hooks / supports to hold insulation and refractory's under this contract including but are not limited to the following TG, Piping & Equipments in TG & other associated Buildings.
- 11.4 Depending on the type of insulation material, thickness, type of equipment & pipelines and scope of work various BOQ items are made available.

- 11.5 In general, the Contractor's scope of work comprises, execution of thermal insulation works as per drawings, working documents, specifications and standards.
- 11.6 Preparation and submission of various procedures for NPCIL acceptance including preparation of Fabrication, erection methodology of insulation for critical equipments.
- 11.7 Establishment of adequate machinery and facilities, including material handling facilities, carrying out fabrication works envisaged in this tender, **ensuring erection and testing of all the pipelines, equipments are completed and coated with protective coatings before the start of insulation work**, cleaning and surface preparation of pipelines, valves, equipments, hangers, pins and supports to be insulated, pin welding on equipments and cross-over pipelines for installation of insulation after getting clearance from EIC, fabrication and welding of supporting devices like Shelf supports, ring supports, clamping ring yokes, wrapping of Aluminium foil of 0.10mm thickness over the stainless steel surfaces, Stitching of mats, joint sealing with sealants etc.
- 11.8 Application of Zinc chromate primer on supporting structure is part of scope of insulation work including touch up wherever required, supply and application of medium/high temperature painting on support devices, reinforcing elements and fasteners including touch up wherever required, providing removal type thermal insulation with toggle clips on pipe fittings like flange joints, valves, manholes, instrumentation points and for weld joints which are to be NDE tested periodically (Approx. 10% of total insulation area of pipe shall be provided with removal type insulation). No separate rate applicable for removal type insulation.
- 11.9 The insulation work shall be carried out by qualified and experienced manpower.
- 11.10 Scope includes providing P&M, welding machines, tools and tackles, material handling devices, cleaning aids, consumables (welding electrodes and filler wires), scaffolding, PPE's, etc required for the successful completion of the work in all aspects, as per the drawings and approved standard procedures. Only NPCIL approved welding consumables shall be used.
- 11.11 Contractor shall be responsible for storage, baking, control, calculation and monitoring of electrodes as per the requirements.
- 11.12 The terminal points decided by BHEL are final and binding on the contractor for deciding the scope of work and effecting the payment for the work done up to terminals
- 11.13 Application of insulation and removal of same for temporary piping under scope of erection of this contract is also included in the scope of the work. However, BHEL will supply the insulation materials free of cost.
- 11.14 The work shall conform to dimensions and tolerances given in various drawings and quality manuals provided by BHEL. If any portion of work is found to be defective in workmanship not

conforming to drawings or other stipulations, the contractor shall dismantle and redo the work duly replacing the defective materials at his cost, failing which the job will be carried out by BHEL by engaging other agencies / departmentally and recoveries will be effected from contractor's bill towards expenditure incurred including BHEL's overhead charges.

- 11.15 The contractor will have to follow the instructions provided in the technical manuals, drawings, and specifications provided by BHEL, to the contractor from time to time. In case of ambiguity or deviation the decision / clarification of BHEL Engineer will have to be followed.
- 11.16 All insulations and refractory materials including iron components and other sheets casing materials, etc., required as per drawing will be supplied by BHEL and the same have to be erected / applied as per the drawings and specifications of BHEL by the contractor.
- 11.17 Clean the Surface to be Insulated from Rust, Dust, Grease, Loose scale, Oil, Moisture, etc. Care shall be taken that flexible insulation is not unduly compressed. After insulating the equipment, the gaps / joints shall be filled with loose wool/ moulded insulation as applicable.
- 11.18 Painting of inner side of sheet metal covering over the insulation walls shall be carried out as per the specification /drawings. Sealing compound on cladding/ sheet metal joints shall also be carried out by the contractor.
- 11.19 It is the responsibility of the contractor to ensure that the insulation and refractory materials and sheet metal covering issued to him for application are well protected against loss or damage or weather conditions tending to affect its quality by the provision of close / semi closed sheds at his cost.
- 11.20 All the insulation and refractory materials and sheet metal covering etc., issued to the contractor shall be properly stored and handled before application due the same. If any damage occurs to the materials due to improper storage or due to any causes attributable to the contractor except for normal breakage or damaged material shall be to the cost of the contractor.
- 11.21 Contractor is liable for the exact accounting of the materials issued to him and any unaccountable losses shall be made good by him. The necessary accounting of the material issued will have to be furnished by the contractor periodically.
- 11.22 Contractor shall provide the required quantity of wire, nails and other materials for centering works at their cost.
- 11.23 Wherever iron components are to be welded, the contractor shall employ only approved qualified welders. All consumables tools and plants etc., required for the work shall be arranged by the contractor at their cost.
- 11.24 Contractor shall observe all precautions for laying and curing of Castable refractory. Any defective works found shall be re-laid by contractor at his own cost including materials.

- 11.25 Wool insulations are received at site as bonded and unbonded mattresses in standard sizes. These have to be dressed / cut to suit equipment / site work by the contractor.
- 11.26 Dressing of insulation bricks to suit site conditions curing the refractory concrete applied, sheet cladding over insulations, form the part of this work.
- 11.27 Removal type of insulation to be provided for valves fittings, expansion joints etc., as per the drawings or as directed by BHEL Engineer.
- 11.28 All piping insulations shall be carried out in such a manner as to facilitate removal of bolts nuts and washers from the flanges.
- 11.29 Concrete Mixer for refractory application is in the scope of the contractor.
- 11.30 Fabrication of covering sheets may be necessary like preparing the sheets to the sizes and shapes specified in drawings, beading, swaging, bevelling of sheets crowning of the sheets if necessary the same to supports over wool insulation with screws as specified in BHEL drawings or as instructed by BHEL Engineer.
- 11.31 Cladding sheets shall be suitably pressed along with diagonals to form diamond shape so as to improve the strength of the sheets, to avoid humpiness and to give aesthetic look.
- 11.32 Plates, bars, rods and other materials that are to be cut, and re-welded from the fabricated places to suit erection requirements for which no extra payment will be made to the contractor.
- 11.33 A log book shall be maintained by the contractor for the clearance of the area for application of refractory and insulation. If the contractor does the work on his own accord without prior permission the area should be redone at his cost.
- 11.34 The contractor shall draw only one week's requirement of material for their work from BHEL stores and keep them in their semi-closed shed near to the work area. The materials required for a particular space of work only shall be taken to the work spot. At the end of the day's work the leftover or unused materials shall be taken back to their semi-closed shed for keeping the materials safe. Necessary records shall have to be maintained by the contractor in respect of the above drawls / deposits, on daily basis as instructed by BHEL.
- 11.35 Wastages allowance for the materials issued are envisaged as follows:
- i. Castable refractory - 2%
 - ii. Insulation bricks & mortar - 2%
 - iii. Wool mattresses - 2%
 - iv. Cladding sheets - 5%
- 11.36 Making structural supporting works for pourable insulation, laying pourable insulation, adhering to all specifications and instructions shall be the responsibility of the contractor.

- 11.37 Upon completion of daily work, the contractor shall remove from the vicinity of work all scrap packing materials rubbish, unused and other materials and deposit them in places to be specified by BHEL Engineer. Also, the contractor will demolish all the hutments, sheds, offices, constructed by him and shall clean the debris after the contract is over. In the event of his failure to do so, the same will be arranged / removed by BHEL Engineer and the expenses incurred with overhead will be recovered from the contractors.
- 11.38 Welding of hooks as per pitch, applying red oxide paint to the welded portion as directed as per drawings before application of mineral wool mattresses will have to be done by the contractor.
- 11.39 Application of Castable refractory between tubes around burners on ceiling and as directed by Engineers and as per detailed drawings and specifications will have to be done by the contractor.
- 11.40 If necessary the hooks may have to be made from the rods, raw materials supplied in running lengths. The contractor may have to carry out this work also and use the same hooks.
- 11.41 Wherever additional clamps, frame works, etc., are required to be fabricated and installed even though not indicated in the drawings shall be fabricated and installed at their cost. Only steel materials shall be given by BHEL free of cost, consumables like electrodes, gases etc., are to be arranged by the contractor at his cost.
- 11.42 Contractor has to arrange required fire retardant covering material at their cost to protect the insulation materials drawn from BHEL before and after erection.
- 11.43 The contractor shall provide any fixtures, concrete blocks / wooden sleepers, etc., which are required for temporary supporting of the insulation materials at site.
- 11.44 In case of any class of work for which there is no such specifications as laid down in the contract, the work shall be carried out in accordance with instructions and requirements of the BHEL engineer at the quoted rates only.
- 11.45 The temporary structures / items welded to permanent members / pipes are to be cut and removed without any damage. Any damage so to be made good by the contractor at his cost.

12. QUALITY ASSURANCE & TESTING:

12.1 General requirements

1. The work under this contract/package covers Insulations works of Turbine, Piping & Equipment's, which demands highest degree of quality and reliability standards. In line with these requirements the contractor shall have documented quality assurance system to assure the quality at all stages of procurement, handling, storage, cleaning, pre-fabrication, erection, inspection and testing.

2. Contractor shall prepare QAP for all the erection activities at site and submit for approval of NPCIL.
3. The Contractor shall provide all required services and resources to establish and maintain quality of workmanship during erection.
4. The contractor shall perform his internal inspection / testing before offering the system for BHEL/NPCIL's inspection. Only after ensuring that his inspection/test results are satisfactory, contractor shall offer the system for BHEL/NPCIL's inspection.
5. The inspection requirements will be indicated in detail in the working drawing and specifications.
6. Contractor shall not undertake any pre-fabrication job outside the Project area unless otherwise it is permitted by the EIC. All items fabricated outside the Project and all materials to be supplied by the Contractor are subject to EIC's Quality Surveillance.
7. During work the Contractor must keep records on certification of personnel, material control, operational control, acceptance control. Record formats must be unified, and should be prepared before start of work.
8. The Contractor shall have a dedicated group of experienced and qualified inspection engineers and inspectors responsible for assuring quality assurance and quality surveillance program at their work, their vendors/manufacturing works and fabrication, erection and testing work at site.
9. NPCIL/BHEL shall carry out audit in all phases of the work i.e. procurement, pre-fabrication, erection, inspection, examination and testing.
10. NPCIL or its authorized representative(s) shall carry out Quality surveillance in all phases of the work. They will have free access to all areas where works involving the concerned contracts/purchase orders are in progress. This includes access necessary to verify the implementation of all aspects of the Quality Assurance Program as well as access to Sub-contractor's facilities.

13. HOUSEKEEPING, CLEANLINESS & DEWATERING:

1. Contractor shall keep the area clean and materials segregated neatly in coordination with other contractors. The scraps and wooden boxes shall be cleared from the working areas. When work is going on, it is the responsibility of the contractor to maintain clean environment by maintaining good housekeeping.
2. The contractor shall engage adequate cleaning personnel with machinery such as vacuum cleaner for cleaning. Cleaning shall be done on day to day basis. All the waste collected shall be stored in sealed container and to be removed on weekly basis. 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 EIC.

3. Handling, Shifting & disposal of the waste generated during construction, installation, 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 EIC. Also, housekeeping and dewatering of the area under the control of the contractor shall be a part of the contractor's scope of work.

13.1 Debris Disposal:

Involves Collection of debris from various floors of buildings, shifting and disposal to waste yard which includes activities like survey of the buildings, identification, collection and removal of dust, electrode waste, welding waste, cutting waste, grinding waste, packing material, cement debris, aggregate, waste sheets, cut pieces of wires/cable etc. from inside and outside of buildings and disposal at designated dump yard. This work also includes providing man power, P&M, all tools & tackles required for completion of work, making & maintenance of reports as per tender specification and as per the instructions of the EIC.

13.2 Scrap Disposal:

Involves collection of scrap (metal & wooden) from various floors of buildings, shifting and disposal to waste yard which includes activities like survey of the buildings, identification, collection, segregation of SS, CS, wood, paint, insulation, concrete and removal of metal scrap, cut pieces, wooden scrap, woods etc. from inside and outside of buildings and disposal at waste yard. This work also includes providing man power, P&M, all tools & tackles required for completion of work, making & maintenance of reports as per tender specification and as per the instructions of the EIC.

13.3 Surface Cleaning of equipments and pipeline:

Involves cleaning of external surfaces of all equipments, pipelines & valves etc in all the floors of buildings which includes activities like removal of dust, unwanted sticking, foreign particles and other forms of dust, from the surface of equipment, pipelines, valves etc including providing all necessary cleaning aids and appliances. This work also includes arranging manpower, consumables and all other required tools and tackles required for the completion of work as per tender specification and as per the instructions of the EIC.

13.4 Sweeping & Mopping:

Involves Sweeping and mopping of all the floors and stair cases of buildings including providing all necessary cleaning aids like brooms, duster, buckets, collecting trays or any other appliances as directed from time to time for the satisfactory execution of above mentioned work. This work also includes arranging manpower, consumables and all other required tools and tackles required for the completion of work as per tender specification and as per the instructions of the EIC.

13.5 Dewatering:

In order to keep continuity of the work contractor shall carry out the dewatering in various buildings under this contract to remove the accumulated water and pump the water to the designated wells or locations as instructed by the Engineer in Charge (EIC). The arrangement of dewatering pump and required connecting hoses, manpower and all other required tools and tackles are in contractor's scope. During excavation, dewatering with well points and / or deep tube wells at foundations and other areas of the site is not permitted where a build-up in the opinion of the EIC obstructs the progress of work, leads to unsanitary conditions by stagnation, retards the speed of construction, is detrimental to the safety of men, materials, structures, equipment and such other causes.

The contractor shall ensure that the excavated areas and the structure pipes are free from water at all stages of construction and shall take all necessary precautions and measures to exclude ground water and water from other sources such as underground streams, aqua forms, springs, artesian, precipitate or infiltrations from the surface flows water drained during and after hydro test etc. so as to enable the work etc. be carried out in reasonably dry condition in accordance with the specifications and the construction schedule

Note: Housekeeping and dewatering is part of scope of work and no additional cost will be paid. It is the responsibility of the contractor to ensure good housekeeping failing of which penalty as applicable will be levied.

14. GENERAL TECHNICAL REQUIREMENTS:

The general technical requirements are based on norms, standards and practices followed for such jobs. The EIC shall have the right to amend the existing and to issue additional specifications whenever the need arises. In the event that certain technical requirements are not described in the engineer's specification, the contractor shall request the EIC, prior to starting any fabrication to clarify governing requirements.

15. SCAFFOLDING:

It is the responsibility of the contractor to arrange for scaffolding materials, making, assembly and dismantling at his own cost where ever work at height is involved as part of his scope of work. The contractor has to arrange the necessary scaffold pipes/H-frames, clamps, platforms, mesh, footings, guard rails and all such material required for the construction of scaffolding. Only standard scaffolding materials and platforms are allowed for use to work at height. Each scaffold and scaffold component must support without failure its own weight and at least four times the maximum intended load applied or transmitted to it. Utmost care must be taken while making the scaffolding and it is the duty of the contractor to construct & maintain healthy scaffoldings with guard rails, fall arrestors, cross bracings, footings, platforms etc during the progress of work. The structural members, poles, legs, posts, frames, and uprights, must be plumb and braced to prevent swaying and displacement. All the scaffolding works need to be supervised by an expert who is familiar with the scaffolding requirements and its shortcomings. The contractor has to display placards on all the scaffoldings indicating the condition of the scaffold. Before the actual use of scaffolding, contractor has to arrange for the inspection of the scaffoldings and get clearance from the concerned NPCIL officials as per the procedures laid down at the site. Contractor shall ensure that all his contract workers are trained by a qualified person, to recognize the hazards associated with the type of scaffold being used and how to control or minimize those hazards. The training must include fall hazards, falling object hazards, electrical hazards, proper use of the scaffold, and handling of materials.

16. RECORDS AND REPORTS:

16.1 Records:

The Contractor shall maintain records pertaining to his scope of work in compliance with all drawings and technical requirements. The records shall be in a proper format as indicated by the EIC. The Contractor shall submit the copies of such-records to the EIC within 7 days from completion of any particular work, and prior to submitting bill for progressive payments. The Contractor will have a system of record to facilitate easy traceability of all such records. These records shall be subjected to the inspection of engineers, auditing group, AERB, Russian representatives etc. Soft (scanned) copies for the all the reports, records shall be made and submitted to BHEL/NPCIL.

16.2 Reports:

The contractor shall submit on weekly basis, to the EIC three (3) copies of following reports indicating the details like system wise progress, fabrication/erection progress, system testing status, QA activities, etc.

- a. Insulation fabrication & erection progress reports
- b. General statement of activities
- c. Weekly report on items on critical paths

In addition to above, the following reports shall be submitted to the EIC every month:

- i. Daily, weekly, fortnightly and monthly progress reports
- ii. Monthly planning report
- iii. Three and Six months rolling schedules

All reports shall be statistical and on tabulated form indicated by the EIC.

17. COMPLETION OF WORK AND SUBMISSION OF CCC & MATERIAL ACCOUNTING:

17.1 Completion of work:

As far as technical requirements are concerned, the contractor's work shall be considered completed when the Insulation works have passed all examinations, inspections and test requirements and complete in all respects in accordance with drawings and specifications. The contractor shall be responsible for rectifying the defects and deficiencies revealed during testing or commissioning of the systems, on the joints, lines completed, in consultation with the EIC and QS so as not to delay other works or testing.

17.2 Construction Completion Certificate (CCC):

The contractor shall submit CCC in hard binder enclosing the relevant documents needed for attesting the completion of work for each system in the approved format for verification and acceptance of ENC. Along with the hard copy of final CCC the contractor shall submit scanned copy in soft form (.pdf format). The following are the list of relevant documents but not limited to.

1. System descriptions
2. Manufacturers instruction / literature
3. As-built drawing information
4. Important correspondence
5. List of WD (with rev. no.) including FCN, ECN & DCN, certified
6. Test Certificate from manufacturers for all the materials supplied by the contractor.
7. Reports generated during manufacturing, fabrication, erection and testing related to Insulation works.
8. Inspection/test report/investigation, field tests, concreting reports etc.
9. Drawings/ documents/ reports relevant to the works.
10. All statutory clearances

CCC documents as detailed above in soft form shall also require to be maintained on regular basis along with progress of the work. The completed files along with soft copy shall be subjected to verification by EIC and periodic audit (6 months) by a committee constituted by NPCIL. After all the above information are compiled, verified by the EIC and certified for submission, the 'Construction Completion Certificate' and 'System Transfer from Construction to Commissioning' in the prescribed format along with the System /Equipment History Docket shall be transferred for NPCIL records and reference. Final completion certificate will be issued only after the ENC has accepted all CCC's and after other provisions of general contract conditions are duly met. Along with the hard copy of final CCC the contractor shall submit scanned copy in soft form (.pdf format). The cost towards preparation of CCC is deemed to be included in the quoted rates.

17.3 Material accounting:

Contractor shall establish all necessary infrastructures (computer terminals, network, and other hardware) for software based material management system for the free issue materials, compatible with the BHEL/NPCIL's software. Contractor shall prepare material accounting taking into the consideration of materials issued through various CIV, consumed through various erection reports returned back to BHEL/NPCIL's stores through COV and tally the

quantities and submit to BHEL/NPCIL for acceptance. For this purpose, during execution of work, the contractor shall ensure that the erection reports are prepared as instructed by BHEL/NPCIL.

Along with the hard copy of material accounting statement, the contractor shall submit soft copy in MS excel format and scanned copy in .pdf format.

Annexure - I

List of Abbreviations

ANNEXURE-I**ABBREVIATIONS**

AC	Alternating Current
AERB	Atomic Energy Regulatory Board
AFWP	Auxiliary Feed water Pump
BDBA	Beyond Design Basis Accidents
BM/BOM	Bill of material
BRU-K	Fast acting steam dump system with discharge into the turbine condenser (FSDV –C)
BRU-A	Fast acting steam dump system with discharge into atmosphere (FSDV – A)
BRU-D	Fast acting steam dump system with discharge into De-aerator (FSDV – D)
CCC	Construction Completion Certificate
CCR	Central Control Room
CCV	Contractor's Credit Voucher
CCW	Condenser Cooling Water
CEA	Central Electricity Authority
CEP	Condensate Extraction Pump
CIV	Contractor's Issue Voucher
CRR	Circuit Release Report
C&MM	Contracts and Material Management
CoManas	Corporate Management System
CS	Carbon Steel
DCN/ECN/FCN	Design Change Notice/ Engineering Change Notice /Field Change Notice
DD	Detailed Drawing
DM	Demineralized Water
DPR	Detailed Project Report
DPT	Dye Penetrant Testing
DBA	Design Basis Accidents
DC	Direct Current
DFT	Dry Film Thickness
DN	Nominal Dia
EIC / ENC	Engineer In-charge

EP	Embedded part
EPGS	Electronic Part of the Governing System
EDFWP	Electric Drive of the Feed Water Pump
EOT	Electric Overhead Travelling
FAR	Flange Alignment Report
FIM	Free Issue Material
FME	Foreign Material Exclusion
FS	Flow Sheets
GCC	General Conditions of Contract
GSC	Gland steam condenser
GAN	GOSTATOMNADZOR – Russian Regulatory Board
GOST	Russian National Standard
GA	General Arrangement
GTAW	Gas Tungsten Arc Welding
HDPE	High Density Poly Ethylene
HPC/HPR	High Pressure Cylinder/High Pressure Rotor
HPH	High Pressure Heater
HTS	Hydro Technical Structure
HV	High Voltage
I & C	Instrumentation and Control
ID	Inner Dia
IR	Insulation Resistance
IBA	Integrated Business Application
IBR	Indian Boiler Regulatory
IGC	Inter Granular Corrosion
IPMIS	Integrated Project Management & Information System
IMIR	Incoming Material Inspection Report
JIT	Joint Inspection Team
JHA	Job Hazard Analysis
LPC/LPR	Low Pressure Cylinder/Low Pressure Rotor
LPH	Low Pressure Heater
KKNPP	Kudankulam Nuclear Power Project
KKS	KRAFTWERK KENNEZEICHEN SYSTEM (Codification system followed by Russian for identification of buildings, equipments, structures)

	materials and systems etc. in nuclear power plant)
KLT	Kerosene Leak Test
KV	Kilo-Volt
MDR	Major District Road
MIV	Material Issue Voucher
MCV	Material Credit Voucher
MSR	Moisture Separator Reheater
MT	Metric Tonne
MWe	Megawatt electrical
NDE/NDT	Non Destructive Examination/Testing
NPCIL	Nuclear Power Corporation of India Limited
NTD	Normative technical documentation (Russian standards)
NRV	Non Return Valve
OBE	Operation Beyond Earthquake
OD	Outer Dia
ODC	Over Dimensional Consignment
OMTI	Fire-resistant Oil
P & ID	Process and Instrument diagrams.
PSAR	Preliminary safety analysis reports
PPE	Personnel Protective Equipment
PQR	Procedure Qualification Record
P&M	Plant and machinery
QA	Quality Assurance
QAP	Quality Assurance Plan
RA bill	Running Account bill
RT	Radiographic Testing
RTD	Resistance Temperature Detector
SCC	Special Conditions of Contract
SCPP	Secondary Cycle Piping
SMAW	Shielded Metal Arc Welding
SOQR	Schedule of Quantities and Rates
SS	Stainless Steel
SSE	Safe shutdown earthquake
STG	Shaft Turning Gear

STD	Standard Transfer Document
SWS	Sea Water Systems
TCG	Turbine Control Gear
TDFP	Turbine Drive for Feed Pump
TG	Turbine Generator
Ti	Titanium
TSI	Turbovisory Instruments
TSS	TG & Secondary Cycle and Sea water systems
UDP	Unit Demineralisation Plant
UT	Ultrasonic Testing
VBT	Vaccum Box Testing
VTF	Valve Testing Facility
WCMS	Work Contracts Management System
WD	Working Document
WIR	Weld Inspection Report
WPS	Welding Procedure Specifications

Annexure - II

List of KKS Codes

ANNEXURE-II**List of associated KKS codes:**

KKS Code	System Designation
GHA	Servo motor cooling water system
GMA	Oil containing water sewerage system
JEA50	SG level monitoring and pipeline steam humidity
LA.	Feed water systems
LAA	Feed water collecting and de-aeration system
LAB	Main feed water piping system
LAC	Feed water pump system
LAD	HP regeneration system
LAH	Auxiliary feed water piping system
LAJ	Auxiliary feed water pump system
LAV	EDFP lube oil system
LB.	Steam piping system
LBA	Main steam piping system
LBA90	Temporary system of pre-starting steam line blow-off
LBB	System of superheat steam piping in LP cylinder (including steam re-heater)
LBF10	BRU-SN system
LBF50-60	BRU-D system
LBG	Auxiliary steam piping system
LBG10-70	Auxiliary steam line system
LBG90	HPH preheating system
LBJ	Steam moisture separation system in LP cylinder
LBK	BRU-A system
LBQ	HP steam extraction piping system
LBR	TDFP steam supply system
LBS	LP steam extraction piping system
LBW	Turbine sealing steam system
LBW10-20, 60-90	Turbine sealing steam system (including valve stems)

LBW30-50	TDFP sealing steam system (including valve stems)
LC.	Condensate systems
LCA	Main condensate piping system
LCA70	System of main condensate supply to the deaerator and of auxiliary pipelines
LCA90	System for pre-starting flushing of the condensate and feeding line
LCB	Main condensate pump system
LCC	LP heaters system
LCE	Condensate injection to BRU-K system
LCG	TDFP turbine condensate pump system
LCH	HP heater condensate system
LCJ	LP heater condensate system
LCM	Turbine hall drains system
LCM10-70	Turbine hall drains system (condensate collecting and return)
LCM80-90	Turbine hall drains system (condensate collecting and return for active water treatment)
LCN	HP steam piping drains system
LCO	Non Condensate gases removal from CEP1 st , CEP2 nd and LCT Pumps HX Casing
LCP	Turbine hall demineralized water system
LCR	TDFP turbine condensate system
LCS	Re-heater heating steam condensate system
LCT	MS/SR moisture separator condensate system
LCW	Sealing and cooling steam drains system
LCX	Feeding pipeline of NRV with servomotor
LD.	Condensate polishing systems (UDP)
LDB	Autonomous dematerializing plant system
LDF	Turbine condensate deironing and polishing demineralization system (UDP)
LDN	Component cooling water chemistry control system
LDP	Spent resins from UDP regeneration and flushing system
LDR	UDP washing and regeneration water system
LF.	Common installations for steam, water, gas cycles
LFN	Secondary working fluid correction treatment system

LST	Balancing piping of moisture separator re-heater for separate
MA.	Steam turbine plant
MAA	HP cylinder system
MAC	LP cylinder system
MAG	Turbine condensers system
MAJ	Air removal system
MAK	Jacking oil system
MAL	Turbine drain system
MAM	Seal leak-off steam system
MAN	BRU-K system
MAQ	Main turbine oil vapour removal system
MAV	Main Turbine Generator lube oil system
MAX	Main Turbine governing oil system
MKG	Generator hydrogen cooling system
MKW	Seal oil system
MVA10-40	Turbine hall loads lubricant supply system
MVA50	Emergency lubricant discharge system
MVA60-70	Mineral oil supply system
MVM	Turbine hall loads lubricants leak collecting system
MXN	BRU-K governing oil system
O-System	Exhaust system
PG.	Closed cooling water system for conventional area
PGB	Closed cooling water system for conventional area
PGB00-70	Closed cooling water system for normal operation loads
PGB80-90	Closed cooling water system for oil coolers
QJ.	Central gas supply, also inert gas
QJB50	Nitrogen supply and distribution in turbine hall
QJC	Hydrogen supply
QJC10	System for supplying hydrogen and distribution it in the turbine hall
QU.	Secondary automated chemical monitoring system
QUA	Automated chemical monitoring system for feedwater systems
QUB	Automated chemical monitoring system for steam systems
QUC	Automated chemical monitoring system for condensate systems
QUD	Sampling system for the auxiliary steam generation

QUG	Automated chemical monitoring system for unit demineralizing plant systems
QUH	Sampling system for secondary cycle and condensate polishing plant
SC.	Stationary process air systems
SCB10	Compressed air supply and distribution systems in turbine hall (for generator gas station)
XA.	TDFP Turbine
XAC	Turbine drive for feed pumps
XAG	Condensing system for TDFP turbine
XAQ	TDFP oil vapour removal system
LVA/XAV	TDFP lube oil system
<u>PA.</u>	<u>Main cooling water system</u>
PAA	Mechanical cleaning system
PAB	Main cooling water piping system
PAB90	Auxiliary piping of valves for "inlet - outlet" of air from turbine condenser
PAC	Main cooling water pump
PAS	Turbine and lifting pumps ejectors
PAY	System for measuring pressure differential at water and level lattices and screens in the facilities for cooling water intake and supply
PAX	Pressure air supply to pressure differential gauge and water level gauge
<u>PC.</u>	<u>Cooling water system of non-essential loads</u>
PCB	Cooling water piping system of non-essential loads
PCC	Cooling system of cooling water pump of non-essential loads
PCB51,52	Cooling water system of NPP diesel power plant
<u>PE.</u>	<u>Cooling water system of essential loads</u>
PEA	System of mechanical cleaning
PEB	Cooling water piping system of essential loads
PEC	Cooling system of cooling water pump of essential loads
PEX	System of air supply to the instruments measuring the pressure differential and water levels in PEA system

PEY	System of air supply to the instruments measuring the pressure differential and water levels in PEC system
<u>PU.</u>	<u>System of common plants</u>
PUA	System for pumping out of pump house flow circuit of main cooling water and cooling water of non-essential loads
PUD	System for pumping out of pump house flow circuit of cooling water of essential loads
PUE	System for drain water pumping out from pump houses of essential loads
PUK	System for washout of PAA system revolving screens
PUJ	System for washout of trashrack tray of median purification of PAA main system
PUP	System for washout of trash rack tray of median purification and PEA system revolving screens
PUQ	Tunnel discharge water drain system
PUV	Oil supply system of pump houses
PUN	Sea water supply system to Chlorination plant
PUL	Fish diversion ejector power supply system
PUS	Cooling system of fish pump
PUM	Airlift power supply system
PUT	Fish protection facility service rooms drainage
PUX	System of air supply to the instruments measuring the pressure differential and water levels in intake structure.
GML	Drainage water pumping out from main pumping house
SCD	Compressed air system
UMA	Turbine Building
UMV	T & G Oil Building
UMW	TB emergency oil discharge tank
1UGZ	Process tunnel to tanks 1UGB, 2UGB, UGC
2UGZ	Process channel to tank 1UGS
UQA	Main pump house

UQC	Essential load pump house
UQD	Pressure pipelines of main cooling water structure
UQE	Discharge pipelines of main cooling water structure
UQG	Inlet portal of discharge pipeline
UQN	Discharge channel
UQR	Chiller building
UQU	Discharge Pipeline
UQW	Outlet portal of discharge pipeline
UQX	Siphon wells
UQZ	Essential loads pipeline tunnels
UPC	Intake structure
UPK	Chlorination plant
UPU	Fore bay
UPX	Fish protection facility
UGW	Controlled access area waste water treatment plant
UJA/UKA	Reactor building
1-4UKD	Emergency power supply and control building
05UKD	Common station diesel generator building

Annexure - III

Buildings description

ANNEXURE-III**BUILDING DESCRIPTION****1. UMA-Turbine building:**

Turbine building (UMA) is a reinforced concrete structure of approximate size 94.4 m by 57 m in plan and is approximately 46 m high. The building has two levels of basement at elevation – 7.2 m and -4.200 m levels and above ground at elevations 0.000, +6.0 m, +7.8m, +10 m (structural floor), +16.0 m, +20.0 m and +28.7 m.

Details of some of the major equipment located at various floors of UMA are as given below;

Floor	Equipment
-7.2 m	Condenser, CEP-1, CEP-2, LCM Tank etc
-4.2 m	Debris filters, Ball Cleaning Filters for TDFP's etc
0.0 m	MSR's, HP & LP Heaters, TDFP Condensers etc
+6 m	EDFP's, TDFP's, AFWP etc
+7.8 m	Condenser Ejectors, Gland Steam Condenser etc
+10.0 m (Platform)	MKG system Evaporator, Refrigeration unit, PGB tank compensator etc
+16.0 m	HP and LP turbines, UDP system, Generator etc
+20.0 m (Platform)	Steam Dump Valves from Ring Header etc
+28.7 m	De-Aerator column and storage tank etc

The details of elevations and equipment locations provided are just for reference. Actual elevations and equipments per floor shall be as per the original drawings issued for KK 3&4.

2. UMV-T&G oil building:

Turbine and Generator Oil building (UMV) is a reinforced concrete structure of approximate size 14 m by 12 m in plan and is approximately 45 m high. As the name implies, the building houses the various oil systems of Turbine and Generator namely MAV, MAK, MKW etc. The building has two levels of basement at elevation – 7.2 m and -3.6 m levels and above ground at elevations 0.0 m, +3.9 m, + 8.1 m, + 12.3 m, +16.8 m and + 22.1 m

Details of some of the major equipment located at various floors of UMV

Floor	Equipment
-7.2 m	PGB system Pipelines,
-3.6 m	Submergible pump
0.0 m	BRU-K oil tank, Oil governing system pump, MKW pumps and filters, MVA system for oil filling to tanks etc
+3.9 m	MKW oil tank, Oil coolers etc
+8.1m	Oil Coolers and storage tank of Lube oil System etc
+12.3 m	Exhaust fans for vapor evacuation etc
+16.8 m	MKW filters etc
+22.1 m	MKW Damper tanks (on Platform at +24.5 m)

The details of elevations and equipment locations provided are just for reference. Actual elevations and equipments per floor shall be as per the original drawings issued for KK 3&4.

3. UMW-Turbine building emergency oil discharge structure :

The Emergency Oil discharge tank (UMW) is a rectangular underground concrete structure with metal casing. The tank is located at the basement location of -5.000 m outside to the south of UMA building. The dimensions of the tank are 8.8 m x 4.8 m x 4.55 m. The main purpose of the structure is to facilitate for the storage or discharge of oil under emergency conditions from UMV building. The tank is provided with hatches and breather for the discharge of oil vapours to atmosphere. The details of elevations and equipment locations provided are just

for reference. Actual elevations and equipments per floor shall be as per the original drawings issued for KK 3&4.

4. 2UGZ- Process tunnel:

The process tunnel (2 UGZ) connecting Turbine building (UMA) south side and UGS structure for LDR tank. The tunnel is of size 780mm width x 1450 mm height and is provided for accommodating LDR pipelines. The top of the tunnel is covered with concrete slabs with water proofing.

5. 1UGZ- Process tunnel:

The process tunnel (1 UGZ) connecting Turbine building (UMA) west side, UGB & UGC structure for LCP & LCM tank respectively. The tunnel is of size 4200 mm width x 3500 mm height and is provided for accommodating LCP & LCM pipelines.

6. 2USF –Nitrogen receivers structure:

The nitrogen receivers structure is a concrete foundation structure of size 7000 mm x 3200 mm on the south side of turbine building for installation of 2 nos of nitrogen receiver tanks (QJB).

7. UQA -Main pump house:

Main pump house UQA is provided within the nuclear island in the zone of common access on the coast of the Gulf of Mannar. The pump house will be connected with the intake structure UPC through the inlet pipeline, UPN, and forebay UPU. It consists of a substructure and superstructure. The substructure is dimensioned in plan 91.50 m x 47.80 m and superstructure 91.50 m x 16.00 m, height of the superstructure being 16.00 m. Contraction joints will divide the main pump house UQA into four sections. The first section of 33.00 m x 25.40 m size in plan will be intended for pump units PCC and heat exchangers. The second and third sections of 23.00 m x 47.80 m size in plan each, will be intended for installation of six pump units PAC, while the fourth section of 12.50 m x 25.40 m size in plan will serve as a service bay.

The main pump house technologically is connected with the turbine building, UMA, by six underground reinforced concrete pipelines of the system PA.

It consists of intake part with equipment and a set of mechanical cleaning devices PAA installed therein and rooms for pump units and other equipment. The intake part is 42.00 m wide and 26.90 m long along the flow. The intake part is divided by piers into six water cleaning lines. Each line, 5.00 m wide, will be provided with secondary screens and fine-mesh rotary screens as well as with slots for installation of bulkheads.

The bottom of the intake part is at EL. -11.000 m, the top of it - at EL. +7.550 m where stationary screen raking mechanisms and fine-mesh rotary screen drive will be installed. All water cleaning lines adjoin a cross-wise inlet channel from which all pump units of systems PA and PC will get suction.

The substructure for pump units and other equipment is a reinforced concrete underground building, 20.90 m x 91.50 m size in plan consists of four main floors. The floors will be located at EL. - 7.350 m, - 3.300 m, +2.850 m and +7.650 m.

The main pump axis will be at EL. - 6.300 m. Pump unit motors for PAC and PCC pumps, will be located at EL. +7.650 m. The axis of pump units PCC of the cooling water system of non-essential loads PC will be at EL. - 3.500 m. At the entry of the pump suction pipe bulkheads will be installed to provide dismantling the pumps after dewatering the suction chamber.

The main pump house accommodates six pump units of main cooling water system (PAC), three pump units PCC together with heat exchangers of cooling water system for non-essential loads PC, and common devices for cooling water systems PU.

Total eight pump units of the secondary and fine-mesh rotary screens of the screen cleaning system will be located at EL. +2.850 m. Water will be taken from the cross-wise inlet channel at EL. minus 4.000 m through a separate water conduit 2.50 m x 2.00 m. Two pumps for dewatering the wet gallery will also be installed at EL. +2.850 m.

8. UQC -Essential load pump house:

The cooling water system of essential loads PE consists of four independent physically separated channels. Two pump houses will serve one unit, so that one pump house is designed to be a common element for two channels of PE system

Each pump house of essential loads UQC will consist of superstructure and substructure. The substructure will be 19.20 m x 32.40 m in plan, the superstructure 19.20 m x 16.00 m.

The maximum depth of setting the substructure with respect to the ground levelling EL. +7.550 m will be 16.65 m. The height of the superstructure will be 11.45 m.

The pump house of essential loads technologically will be connected to the reactor building UJA and emergency power supply and control building UKD through the tunnels intended for the pipelines of essential loads UQZ.

The pump house of essential loads 1UQC will be of two sections: an intake portion 33.00 m x 22.40 m in size and the rooms for installing pump units 19.20 m x 32.40 m in size.

Pump house 2UQC: Intake portion is 12.50x22.40 m in size, and a room for pump units, 19.20 m x 32.40 m in size. The intake portion of each pump house has one water cleaning line, 3.00 m wide, connected with cross-wise inlet channel of the same unit.

Secondary screens and rotary fine-mesh screen as well as the slots for bulkheads installation are located within the area of water cleaning line. The intake portion bottom is at EL. - 7.000 m, top at EL. +7.550 m whereat fixed raking mechanisms of screens and rotary fine mesh screens drive are installed.

The other unit (pump units room) houses the forebay connecting with cross-wise inlet channel of PE system and cross-wise channel of PA system, 2.50 m x 2.00 m in size which may be considered as the second line of water supply line for each pump house of essential loads, UQC.

One water cleaning line in the intake portion and the cross-wise inlet channel are designed to pass jointly a discharge of 8380 m³/hour required for two channels of PE system

The pump units and other equipment will be housed in an underground reinforced concrete building of four main floors located at ELs. -4.200 m; +1.800 m and +7.650 m. A stairway located between the two independent channels will

interconnect the floors. Entrance to each room on the staircase side will be provided only through a watertight door.

Cooling water system of essential loads PE with two pump units PEC and common devices for cooling water systems PU are located in UQC building.

The pumps provided for washing the secondary and fine-mesh rotary screens will be located at EL. +7.650 m. Water will be taken from forebay connected with the crosswise inlet channel at EL. - 6.400 m through a special chamber, 2.50 m x 2.00 m, where a slot for the bulkhead is provided. The suction chamber of these pumps is located from EL. minus 4.200 m to +1.000 m.

9. UPC -Intake structure:

The intake structure is located in the Gulf of Mannar within the water area enclosed by breakwater dyke 0 UZQ and distant from the shore-line to 329.70 m South. The intake structure UPC is integrated with the initial section of the fish-protection facilities UPX equipped with airlift. Flow velocity at the entry to the intake structure UPC equals 0.69 m/s.

10. UPX- Fish protection facility:

The fish protection facility UPX is located right behind the intake structure UPC within the breakwater dyke 0 UZQ upstream of the sea water inlet pipe UPN. It is intended to prevent both fish and zooplankton from entering the intake structure and is suitable for continuous operation

Each FCVS (fish protection concentrator with vertical separator) section is designed as an open reinforced concrete flume with contracting vertical walls in plan .

The FCVS sections are divided by vertical walls. The thickness of the side walls is 2.00 m at the top, that of intermediate walls is 1.50 m and of the flumes-concentrators 1.00 m. Between the walls of the fish-diversion facility flumes above the entry to the pipeline UPN two two-storey pump control buildings will be provided. The ground floor at el. minus 4.400 m will house the pumps for ejecting the flow in the fish-diversion facility (one in each room). To supply water to the pumps intake openings outgoing to the pipeline UPN will be provided in the lower flooring of the ground floor. The first floor at EL.+1.000 m will accommodate pump motors, pump control system as well as compressors for the airlift (one in each

room) creating an air-bubble curtain at the entry to the FCVS. The pumps are interconnected by a pipeline equipped with a branch pipe with an ejector nozzle in each flume. The compressors are also interconnected by headers – air ducts with horizontal perforated pipes placed in front of inlet sills of each FCVS section.

11. UQX- Siphon wells:

The siphon wells are incorporated in the structure of the cooling water supply system UQ and will serve as conjugation structures between the pressure pipes of PA, PC and PE cooling water systems and discharge channels UQN. Four siphon wells - 1UQX, 2UQX, 3UQX and 4UQX located at the construction facilities site in the free access zone will serve each NPP unit. Each siphon well includes a cooling water receiving chamber and a weir.

The receiving chamber of siphon well 1UQX of the main cooling water system PA will have six sections, each of which connected through a transition section to one of main condenser cooling water discharge pipelines PAB, 2200 mm diameter. At the entry the chamber will have a weir with the crest at EL. +4.600 m providing the required vacuum in the turbine condensers.

Since the maximum design downstream level is 5.10 m higher than the crest elevation, the weir is provided with slot structures for bulkhead gates. A steel scaffolding with electric movable hoist and walkways on both sides of the weir will be erected on the piers for handling the gates. To store two bulkhead gates a gate storage room will adjoin the siphon well.

The receiving chamber of siphon well 2UQX of the cooling water system PA will have one section to which cooling water will be supplied through pipeline PAB89, 1200 mm in diameter. At the exit the receiving chamber will have a weir with the crest at EL. +5.5m.

The siphon wells 2UQX and 3UQX are located on both sides of the discharge channel 1UQN. From siphon wells 4UQX water is discharged to the Gulf of Mannar through discharge channels 2UQN.

12. UPU- Fore bay:

The fore bay UPU is a common structure for the PA, PC and PE systems. It is 43.40 m long is located between the sea water inlet pipeline UPN and main pump house UQA whose open section, 35.90 m long is widened from 13.30 to 56.00 m..

13. UPN- Inlet pipeline:

The inlet pipeline UPN is located between fish-protection facilities UPX and fore bay UPU.

14. UQZ- Essential load pipeline tunnels:

Essential loads pipelines tunnels UQZ are meant for ensuring protection of pipelines system PEB against external impacts (fill soil, ground waters, transport and extreme loads on the NPP territory), as well as for access to pipelines during operation and repairs.

Tunnels will be located in the common-access area and in the controlled-access area of the NPP nuclear island. They will run from the essential loads pump houses 1UQC & 2UQC to the reactor building UJA and emergency power supply and control buildings 1-4UKD. Tunnels will be laid underground 12.00 m deep near building 1UQC & 2UQC and 4.00 m deep near buildings 1-4UKD. Pressure and discharge pipelines PEB10 and PEB20 will be laid in tunnels 1UQZ bending around the reactor building from the west. Pressure and discharge pipelines PEB30 and PEB40 will be laid in tunnels 2UQZ located in the east side of the reactor building. All tunnels are through.

15. 0 UGW- Sewage water biological cleaning station of the controlled access area

Sewage water biological cleaning station of the controlled access area 0 UGW includes the structures of Pump house with receiving tank (01UGW), Auxiliary-production building (02 UGW), Sand-trap (03UGW), Receiving tank (04UGW), Bio-filter (GQD06BB001, GQD06BB002), Stabilizer (05UGW001, 05UGW002), Sediment tank (06UGW001-06UGW004), Cleaned wastes container (07UGW), Contact tank (08UGW001, 08UGW002), Sand bed (09UGW), Sludge beds (01UGT), Gas release tube (11 UGW) and Pump house of the cleaned wastewater (03UGT).

Biological cleaning station (0UGW) is designed for complete wastewater biological cleaning at bio-filters with plastic packing (GQD06BB001, GOD06BB002), self-oxidation of excessive bio-film in stabilizers (05 UGW001, 05 UGW002), water disinfection by electrolytic sodium hypochlorite, dewatering of excessive bio-film at the sludge beds (01UGT) and dewatered sediment disinfection by composting.

The main process equipment of biological cleaning station (0UGW) is as follows: bio-filters (GQD06BB001, GOD06BB002), pumps (GQD05AP001, GQD05AP002, GQD08AP001, GQD08AP002, GQD15AP001, GQD15AP002, GQD16AP001, GQD16AP002) to be mounted in the auxiliary-production building (02 UGW), which also contains laboratory switchboard room, personal service rooms and air-ventilation chamber.

Annexure - IV

Systems description

ANNEXURE-IV**SYSTEM DESCRIPTION****TURBINE GENERATOR & SECONDARY CYCLE SYSTEMS:**

1. FEED WATER SYSTEMS: **(LA)**
2. STEAM SUPPLY SYSTEMS: **(LB)**
3. CONDENSATE SYSTEMS: **(LC)**
4. CONDENSATE POLISHING SYSTEMS **(LD)**
5. TURBINE SYSTEMS **(MA)**
6. GENERATOR SYSTEM **(MK)**
7. COOLING WATER PLANT **(PA/PG)**
8. GAS SYSTEMS & EXHAUST SYSTEMS **(QJ/SC/O)**
9. SECONDARY AUTOMATED CHEMICAL MONITORING SYSTEM **(QU)**
10. OIL SYSTEMS

SEA WATER SYSTEM SYSTEMS:

11. MAIN SEA WATER COOLING SYSTEM **(PAB)**
12. SEA WATER COOLING SYSTEM FOR ESSENTIAL LOADS **(PEB)**
13. SEA WATER COOLING SYSTEM FOR NON-ESSENTIAL LOADS **(PCB)**
14. SYSTEMS OF MECHANICAL CLEANING DEVICES **(PAA & PEA)**
15. CLOSED COOLING WATER SYSTEM FOR CONVENTIONAL AREA **(PGB)**
16. SYSTEMS OF DEWATERING **(PUA, PUB, PUD, PUE, PUQ & GML)**
17. SCREEN AND FLUME WASH OUT SYSTEMS **(PUK, PUJ & PUP)**
18. COMMON PLANT SYSTEMS **(PUV, PUN & SCD)**
19. FISH PROTECTION AND DIVERSION SYSTEM **(PUL, PUM, PUS, PUX & PUT)**
20. INSTRUMENTATION SYSTEM AT THE PUMP HOUSES **(PAX, PAY, PEX & PEY)**
21. CONTROLLED ACCESS AREA WASTE WATER TREATMENT SYSTEMS **(UGW)**

1. **FEED WATER SYSTEMS: (LA)**

The Feed Water System is intended for supplying feed water (300 to 6000 t/h) from De-aerator to Steam Generators. The feed water system consists of the following sub-systems:

- Feed water collecting and de-aeration system (LAA)
- Main feed water piping system (LAB)
- Feed water pump system (LAC)
- HP regeneration system (LAD)
- Auxiliary feed water piping system (LAH)
- Auxiliary feed water pump system (LAJ)
- Turbine drive of Feed pumps (XAC)

De-aerator (LAA): De-aerator is intended for the removal of dissolved gases from feed water and for maintaining the inventory of hot water. De-aeration system consists of, De-aerating column (LAA10AC001), De-aerator storage tank (LAA10BB001), live steam / bleed steam inlet line for heating, condensate inlet line, feed water suction line to boiler feed pump, valves and pipelines. The main heating steam flow is supplied to the de-aerator through the connections in the de-aerator column, feeding them under the lower jet plate and the steam-gas mixture (vapor) is discharged through the connections located in the upper part of the column. De-aerator compartment has dimensions in plan 12 x 94.4 m. Height of 7950 mm, Weight (water-free) of 250 MT, full weight of 800 MT, Absolute working pressure of 1.1 MPa, Design temperature of 184 deg C, rated capacity of 6000 T/h. The equipments are located in B-C compartment of TB with de-aerator tank at +29.77 m elevation and de-aerator column at +33.55 m elevation. The casings of the de-aerator column and the de-aerator tank are made of carbon steel. The perforated plate of the de-aerator column, as well as the perforated part of the fitting and bubble pipes in the de-aerator tank are made of corrosion-resistant steel (grade 12X18H10T or 08X18H10T as per GOST 5632).

Turbo Drive (XAC): The steam turbine type is of variable speed (2800-3150 rpm) and is designed to drive directly the main feed water pump and booster pump through the reduction gear. The turbine drive consists of single cylinder, single flow type consisting of internal and external casings with 5 pressure stages HP side and 4 pressure stages in LP side. Designed steam flow through stop valve is 54.2 t/hr with absolute pressure 7.267 kgf/cm² and temperature 250 deg. C. It is erected on the vibration isolated TG Deck in which the total foundation deck with the main feed and booster pumps is supported over the 24 nos. of vibro-isolators (spring supports). There are two turbine drives (XAC10, 20AN001) for feed water pumps in each unit of KKNPP-3&4. The drive

turbines are located at B-C bay of TB at + 6.0 m elevation. The steam from the common header from MSR outlet is supplied to stop valve block from which it is admitted to turbine drive through two governing valves.

TDFP Condenser: The TDFP condensers (XAC10, 20 AC001) are single pass two flow condenser intended to condense the exhaust steam from the turbine drive with sea water for cooling on tube side. The condensers are designed for the online tube cleaning system. The TDFP condensers are located in B-C bay at +0.00 m elevation of TB. Shell of the steam section is a welded steel construction with exhaust section of Turbine drive connected by a reducer to be welded with stiffeners upper part of the shell while hot well with the condensate discharge pipe union is in the lower part. Front and rear water box are connected by flange joints respectively. Cooling water reducers are to be welded with inlet and outlet water boxes. The material of water box parts is corrosion resistance steel, that of tube plates carbon steel plates with titanium cladding on the water box side. The cooling water tubes are made of titanium. Overall dimensions of condenser is 7675 (L) x 2885 (W) x 3370 (H) mm and overall weight is 24.2 MT and reduction section weight is 5.3 MT. Cooling water flow through condenser is 5700 m³/hr., Maximum rate of steam flow through condenser is 54.2 T/hr. Absolute pressure in the condenser steam space at the nominal mode of operation is 10 KPa.

Out of four **feed water pipelines (LAB)** coming out of the de-aerator, two are connected to the suction lines of two Turbo driven Booster pumps (LAC10, 20 AP001) through suction filters (LAC10,20AT001). The discharges of the booster pumps are connected to the suction of the Turbo driven Main Feed water pumps (LAC10, 20 AP002). The discharge pipelines of the Turbo driven Main Feed water pumps combine into the common header before the high-pressure heaters. From the common downstream ring header of high-pressure heaters feed water is supplied through four pipelines to the steam generators. Another two lines from de-aerator are connected to the suction lines of standby electric feed water pumps (LAC30, 40 AP001) through suction filters (LAC30, 40 AT001).

Auxiliary feed water system (LAH) intended for supplying feed water during start – up/ shutdown condition consists of Auxiliary feed pump (LAJ01AP001) and mesh type filter at feed pump suction located at + 6.0 m elevation of TB and pipelines with valves. The feed water from the de-aerator is extracted by two pipelines, which joins to form a common header for pump suction. The pump discharges into common discharge header. The pump has a re-circulation line connected to the de-aeration column.

High Pressure Regeneration System (LAD) is intended for regenerative heating of the feed water and consists of High pressure heaters №5A, 5B (LAD11AC001 & LAD12AC001) and High pressure heaters №6A & 6B (LAD21AC001 & LAD22AC001) and Pipelines and Valves. These heaters are of tube and shell type heat exchangers, vertical type each having the size of 2.6 m diameter and 10.27 m height and approx. 112 MT weight. HPH-5A & 6A are arranged in series and working parallel with HPH-5B & 6B. Thus Regenerative heating of feed water is carried out in two HPH stages and by two parallel lines (groups). Feed water is supplied to regenerative high pressure heater tube side by feed water pumps. Steam bleed from HP turbine is supplied to HP heaters shell side for feed water heating and heating steam condensate from HP heaters is sent to condenser or de-aerator. All HPHs are located in TB at 0.0 m Elevation.

The feed water system (LA) is connected to various systems such as JEA, LBG, LBQ, LCA, LCG, LCH, LCM, LCN, LCP, LCR, LCS, LCT, LCW, LFC, LFN, MAG, PAB, QUA and vapour discharge lines.

2. **STEAM SUPPLY SYSTEMS: (LB)**

The live steam supply system is intended to supply steam from steam generators to the Turbine high pressure cylinder (HPC) and Re-heaters of MSR. The steam supply system consists of the following sub-systems.

- Main steam piping system (LBA)
- System of superheat steam piping in LP cylinder (including steam re-heater)/ Live steam supply pipeline to MSR (LBB)
- High pressure reducing system (LBF)
- Auxiliary steam piping system (LBG)
- Steam moisture separation system in LP cylinder (LBJ)
- BRU-A system (LBK)
- HP steam extraction piping system (LBQ)
- LP steam extraction piping system (LBS)
- Turbine sealing steam system (LBW)

LBA system consists of four main live steam lines (DN 600) with other cross-connections, Steam Generator Pulse Safety Device (SGPSD - 2 for each steam line), fast acting steam isolation Valve (FSIV- one for each steam line) , motor operated isolation valve (MOIV-one for each steam line), steam discharge valve to atmosphere (BRU-A- one for each steam line), main steam valves (MSV—one for each steam line), steam dump valve to condenser (BRU-K -6 nos.), steam dump valve to de-aerator

(BRU-D - two nos.), steam dump valve to Auxiliary header (BRU-SN - one no). **LBB system** consists of pipelines and valves for supplying live steam to re-heaters of MSR for super heating the dry steam after moisture separation. Live steam at a pressure of 6.27 MPa from the four steam generators is fed along four DN 600 mm main steam lines to the turbine via four groups of stop and control valves. Steam from the interconnecting pipe between the main steam lines enters the MSR. Steam lines from MOIV to the turbine stop and control valves, as well as connecting pipes between the main steam lines, including lines of steam supply to the BRU-SN, reheating supply, BRU-K & BRU-D are located in the TB. The stop and control valves installed in the turbine hall at + 16.0 m elevation of TB. The BRU-K lines are located at +7.8 m elevation of TB, BRU-A & BRU-D are located at +20m elevation of TB. The LBA and LBB system are connected to JEA, LBG, LBJ, LCM, MAG and BRU-K system.

LBF system is intended for drawing steam from LBA and supplying it into De-aerator steam header and Aux steam header. The system consists of 3 nos. of fast acting type Steam valves which are connected to the Main steam circuit (LBA). Steam is supplied to de-aerator for heating steam purpose through 2 nos. of BRU-D valves LBF50AA201, LBF60AA201. Steam is supplied to the auxiliary steam header from the main steam lines through BRU-SN- LBF10AA201 valves. All Valves are motorized control valves of size DN 150 erected on metal structure foundation at 16.0 m elevation and fixed by the foundation studs arrangement.

Auxiliary steam line system (LBG) is designed for supplying steam to De-aerator, Turbine seals, Turbines of turbine driven feed pump, ejectors of turbine drive, valve seals. The LBG system consists of fast-acting steam dump valve with discharge to auxiliary header (BRU-SN) and De-aerator heating steam header (BRU-D), pipelines and valves and is connected to the Main steam line (LBA), Auxiliary boiler and steam supply lines from the other working units. The Piping and valves of the LBG 10-70 pipelines are located in the TB with the BRU-SN and BRU-D valves located at +20 m elevation of TB. LBG system is connected to LAA, LBA, LBF, LBR, LBW, LCM, BRU-A system and BRU-D system.

System of moisture separation and steam reheating (LBJ) is intended for moisture separation of working steam leaving the HPC and reheating the steam, drying and superheating of wet steam downstream HP cylinder of turbine supplied to LPC up to 250°C. There are four nos. moisture separator re-heaters (LBJ 10 – 40 AT 001) in each unit. Moisture separator re-heaters are connected to LAA, LAB, LBB, LCS, LCT, MAA, MAC and MAJ.

The LST system is intended for the balancing of shell side pressure of for all the 4 moisture separator and re-heater and it is connected to separated moisture drain tank (1 no) and also maintaining same pressure in MSR and drain tank. The LST system consists of piping and valves. LST system is located in the TB UMA at-7.2mtr elevation and connected to MSR condensate separator System (LCT).

Steam discharge valve to atmosphere (BRU-A) is intended to protect the steam generator and live steam pipelines from over-pressure by discharging steam to the atmosphere. There are four main steam headers and each header is provided with one number steam discharge valve to atmosphere (BRU-A). Each valve is provided with an anti-noise plate at the downstream. The LBS system is connected to the ring header of LBA and exhaust system pipelines (O-system).

LBQ system is intended to supply extraction steam to the High Pressure Heaters for regenerative heating of the main condensate. The steam is extracted from the 2nd and 3rd stages of the HP turbine and is supplied to the HPH-6 and HPH-5 respectively through LBQ system. At bleed lines the non-return valves and shut-off gate valves are installed for protection against water ingress. The system pipelines, valves and supports are located in the TB. The LBQ System is connected to LAA LAD, LAB, MAL and MAJ. Each steam extraction pipeline from HPC to HPH and de-aerator has a device of water-film linear separator that separates the moisture to the collector.

LBS system is intended to supply extraction steam to the LP heaters. The LBS System is connected to LCC.

LBR Steam supply system is intended to supply steam for running Turbine drive of feed water pumps. Super heated steam is supplied after MSR for running the drive turbine. All the pipelines and valves associated with located at B-C bay of Turbine compartment. The LBR are connected to LBG, LBJ, LCW and PGB.

Turbine Sealing System (LBW) is provided to prevent steam leakage into the turbine hall through the clearances of the turbine end glands as well as to prevent the ingress of air into the casings when there is vacuum inside turbine cylinders and to prevent steam leakage from the turbine valve stems.

The leak off system (MAM) is provided to collect and remove steam-air mixture and to supply it to the gland steam condenser (GSC). Condensate of steam entering GSC is drained into the condenser through the water seal with height of 15 m. Steam air mixture is removed from the gland steam condenser by the ejector. The source of sealing steam during normal operation is the de-aerator and during start-up, auxiliary header. LBW and MAM system includes the gland steam condenser (1 no.) located at+

7.8 m elevation of the TB, piping and valves. Turbine Sealing System is connected to LAA, LBG, LCA, MAA, MAC, MAJ and MAL.

Steam generator level and steam pipeline humidity control system (JEA) is designed for monitoring moisture content in Steam Generator and also to correlate the SG level with control room indicators. The system consists of NaNO₃ storage tank, dosing pump, SS pipelines and valves, located at -7.200 m elevation of Turbine building. The pump and the tanks are to be erected on elevated metal structure platform. The system is connected to LBA, LCP, JEA10-40, LBA, and LDP.

3. **CONDENSATE SYSTEMS: (LC)**

The condensate system is intended for transferring the condensate from condenser to the de-aerator through low pressure heaters using condensate extraction pumps. The condensate system consists of the following sub-systems:

- Main condensate piping system (LCA)
- Main condensate pump system (LCB)
- LP heaters system (LCC)
- Condensate injection to BRU-K system (LCE)
- TDP turbine condensate pump system (LCG)
- HP heater condensate system (LCH)
- LP heater condensate system (LCJ)
- Turbine Hall drains system (LCM)
- HP steam piping drains system (LCN)
- Non Condensate gases removal from CEP1st, CEP2nd and LCT Pumps HX Casing (LCO)
- Turbine Hall de-mineralized water system (LCP)
- TDP turbine condensate system (LCR)
- Re-heater heating steam condensate system (LCS)
- MS/SR moisture separator condensate system (LCT)
- Sealing and cooling steam drains system (LCW)
- Sealing and cooling steam drains system (LCX)

Main condensate system (LCA) is intended for transferring the condensate from condenser to the de-aerator through unit de-mineralizing plant and low pressure heaters using condensate extraction pump system (LCB). The CEP-1 will ensure condensate flow from condenser hot-well to LPH-2 and CEP-2 will ensure condensate flow from LPH-2 to De-aerator. The system also serves for maintaining the level in the de-aerator and in LP heaters. The LCA system consists of First stage condensate extraction pumps (3 nos.), Second stage condensate extraction pump

(3nos.), De-aerator level regulating valves (6 nos.), LPH-2 level regulating valves (6 nos.), throttling devices, pipelines and valves. The equipments of LCA/LCB system like CEP-I, CEP-II, Hydro lock of LPH-2 are located in TB (UMA) at -7.2 m. The system is connected to LAA, LBS, LCC, LCS, LCT, LDF and MAJ.

Low pressure regeneration system (LCC) is provided for heating the condensate in a series of low pressure heaters by steam extracted from the intermediate stages of the turbine through steam extraction system (LBS). The regeneration system heats the condensate gradually in each LPH with the help of steam extractions from LP cylinder and HP cylinder. Removal of heating steam condensate from the low pressure heaters are done by the **low pressure heaters condensate system (LCJ)**. The system consists of LPH-1 (3 nos. inbuilt in condenser), LPH-2 (1 no.) of the mixing type, hydro lock of LPH-2 (1 no.), LPH-3 (1 no.), LPH-4 (1 no.), relief valves, throttling devices, piping & isolation valves. The Hydro lock of LPH-2 is located at -7.2 m elevation and LPH-2, LPH-3 & LPH-4 are located at 0.0 m elevation of TB, LPH-1(in built in condenser neck) at +9.2 m elevation of TB. The connected systems are LAA, LCA, LCT, LDF, MAJ and MAG.

Condensate injection to BRU-K system (LCE) is intended to supply condensate from condensate extraction pump (CEP 2nd stage) to LP cylinder exhaust hood spray for cooling the LP turbine blades, for de-superheating of condenser steam dump valves BRU-K during the dumping of steam to condenser and the valve sealing for the isolation valves of the systems like LCA, LCB, PAS, MAJ, MAL, MAN & LCT. The system consists of fine filters located at +7.8 elevations in TB, throttling devices, pipelines and valves.

LCG system supplies condensate water to the ejectors to evacuate the heat generated in the ejectors during operation. The condensate after cooling the ejectors is sent to either LPH-2 or to the main condenser. The LCG system consists of Condensate Electric pumps (4 nos.), condensate level controller (2 nos.), pipelines and valves. LCG Condensate pumps, Hydro lock are located in UMA at -7.2m elevation and condensate level controller is located at 0 m elevation. The LCG system is connected to LCA system.

Turbine hall drains system (LCM) comprises of two systems LCM 10-70 and LCM 80-90. LCM 10-70 is mainly intended for the collection of secondary circuit drains into the drain collecting tanks and subsequently returns to the secondary circuit. The LCM system includes LCM tanks (3 nos.), expansion tank (1 no.), heat exchangers (3 nos.), pumps (3 nos.), pipelines, hydro lock & valves. The LCM10-70 system equipments like Drain collecting tanks are located at elevation (- 4,050 m), drain

pump centerlines are at (- 6,570 m), condensate coolers No.1 and No.2 are at (- 6,040 m), drain expansion tank is at (+1,940 m), drain expansion tank steam cooler is at (+8,000 m) in the TB UMA. LCM system is connected to GMA, GNR, LCA, LCP, LCQ, LDB, LFN, MAG, PAB, PGB, QUA, QUB, QUC, QUG and QUH.

HP steam piping drain system LCN is intended for removal of condensed moisture from the main steam pipelines upstream of MSV, BRU-K valves, main steam line and returns the drained water into secondary circuit de-aerator/ condenser to minimize the DM water losses and the separated steam is vented from the LCN tank to the bypass of main steam valve to minimize thermal losses. LCN system consists of HP drain tank LCN01BB001 located at UMA +0.0 m, piping and valves. The system is connected to systems of LAA, LAB, LBA, LCM10-70, MAG, MAL and MAN.

LCO system is intended for the removal of air from the suction line of the LCB pumps and discharge to the condenser and to the LPH-2 and suction line of the LCT pump and discharge to the moisture separator condensate storage tank. LCO system is located at -7.2 m elevation of TB. The LCO System is connected to LCA, LCC and LCT.

Demineralised make-up Water Supply System (LCP) is intended to supply demineralised make-up water to chemical water treatment pumps, its distribution to the main condenser, other equipments & pipelines such as TDFP condenser, stator water cooling system etc, to the De-aerator. The LCP system consists of, two nos. of pumps, pipelines and valves. The demineralised water is supplied to the TB through two DN150 pipelines of GCF system. The pumps discharge is also connected to auxiliary Boiler feed pumps cooling circuit and to the cooling circuit of Turbine driven feed pumps (TDFPs). LCP system, except DM water resource tanks, is installed in the building of turbine compartment UMA. Pumps are installed at the elevation of - 7.2 m of TB. LCP system is connected to JEA, LAB, LAJ, LCA, LCG, LCM, LCR, LDB, LDP, LDR, LFN, MAG, MKF and QUH.

LCR system is designed to pump and remove the condensate water from the TDFP Condenser and direct it to the main condenser of turbine by gravity through the hydraulic seal. LCR system consists of piping and hydrolock.

Moisture separator and Re-heater condensate system (LCS/LCT) is intended to collect the separated moisture into the drain tank and pumping it further to the main condensate line. and to collect the heating steam condensate and supply it to the secondary circuit by pumping it into the feed water pipeline. The LCT and LCS systems consist of at UMA +1.2 m, separated moisture collecting tank (1 no.) at UMA (-) 4.9 m, re-heater Condensate drain tank (1 no.) at UMA +0 m, moisture Separator

Condensate Drain Pumps (3 nos.) at UMA (–) 7.2 m, re-heater condensate drain pump (hydraulic driven - 1 no.) at UMA (–) 5.185, piping and valves. Each HPC - MSR bypass pipe is provided with a water-film separator before the extracted moisture collector (LCT50BB001).

LCW System is intended for draining of condensate from governing valve and LBW pipe lines. The system consists of piping and valves and is located at UMA +6 m elevation. LCW system is connected to LBR, PGB, XAC and XAG.

LCX system is intended for supplying power water to non return valves by feeding the condensate to the valves of LBS and LBQ lines. The condensate water is supplied from the CEP 1st stage pump discharge and is sent to the LCX valve station located at +0 m elevation of the TB. LCX system consists of piping, valves and throttling devices. The connected pipelines with its isolation gate valves are located at +7.8 m of the TB. The drained water is sent to LCM. The system is connected to Condensate System LBS, LBQ and LCA.

4. **CONDENSATE POLISHING SYSTEMS (LD)**

Condensate polishing system is intended for purification of condensate. The following are the sub-systems of condensate polishing system

- Autonomous demineralization plant system (LDB)
- Turbine condensate de-ironing and polishing demineralization system UDP (LDF)
- Component cooling water chemistry control system (LDN)
- Spent resins from UDP regeneration and flushing system (LDP)
- UDP washing and regeneration water system (LDR)

LDB system is intended for purification of contaminated condensate from LCM system. Equipment of LDB system is located in TB and consists of contaminated condensate pumps (2 nos.) located at - 7.2 m elevation of TB, mixed-bed polishers (LDB10AT001,2) with internal regeneration located at +16 m elevation of TB, filter traps, pipelines and valves. Each mixed-bed polisher has diameter of 2.3 m, height of 5.0 m and weight of 3.92 MT. Condensate from contaminated condensate tank of LCM system is delivered to filters by means of contaminated condensate pumps (2 nos.), and discharged to mixed-bed polisher (2 nos.) for LDB system is connected to GNR, LCM, LDP and LDR.

LDF system is intended to provide maintenance of water chemistry for operating fluid of the secondary side and polish 100 % of the turbine condensate. LDF system consists of groups of cation filters (LDF 11-15 AT 01), mixed-bed filters (LDF21-25AT001), traps, pipelines and valves. Equipment of system LDF are located at level + 16.0 m elevation of B-C grid of TB. Each filter has diameter of 3.4 m, height of 4.5 m

and weight of 12.5 MT. LDF system is connected to LCA, LDP, LDR, ACB, QUG and QUH.

LDN system is intended for control of chemistry of PGB system by addition of tri-sodium phosphate solution. LDN system consists of Tri sodium phosphate solution tank (1 no.) receiving Tri sodium phosphate solution from QCR system and DM water from LDP system and pumps (2 nos.) with anti-pulsating device. LDN system is connected to LDP, PGB and QCR.

LDP system is intended for regeneration of resins from mixed-bed filters from the mixed bed of LDF system. LDP system consists of filter-regenerators (LDP10,20AT001), filter for unloading of medium layer of ionite (1 no.) sulphuric acid gauging tanks (2 nos.), caustic soda gauging tanks (2 nos.), drain tank (sump), rinsing water pumps (2 nos.), dosing pumps for sulphuric acid (2 nos.), dosing pumps for alkali (2 nos.), drain tank pumps (2 nos.), mixers, anti-pulsating devices, pipelines and valves. Each LDP filter has diameter of 2.7 m, height of 6.3 m and weight of 7.9 MT. The equipment of system LDP is located in TB with tanks, chemical dosing pumps at el. 0.000 m, rinsing water pumps, filter-regenerators, filter for unloading of medium layer of ionite are at el. +16.0 m. LDP system is connected to GNR, LCP, LDB, LDF, LDP, SCB, QCD, QCF and QCQ systems.

LDR system is intended for collection and removal of rinsing water regeneration of ion exchange resins of mixed-bed filters. LDR system consists of rinsing and regeneration water pumps (2 nos.), pumps for backwashing water pumping out (2 nos.) pipelines and valves. Main equipment of system LDR is located in TB UMA at –7.2 m elevation with rinsing water tank, check tanks and backwashing water collection tanks are outside at 0.0 m elevation. LDR system is connected GNR, KPF, KPK, LCP, LDB and LDF.

LFN system is designed to maintain the quality of the secondary working fluid water chemistry in accordance with the norms of quality by adding chemicals to the feed water system. LFN system consists of hydrazine solution tank (2 nos.), ammonia solution tank (2 nos.), dosing pump of ammonia (2 nos.) and dosing pump of hydrazine (3 nos.), anti pulsating devices, pipelines and valves. The system supplies Hydrazine and Ammonia to LAB, LAH and LCA systems for maintaining water chemistry. LFN system is connected to LAB, LAH, LCA, LCP, LDP, LDR, QCF & QCE.

5. **TURBINE SYSTEMS (MA)**

The following are the sub systems of Turbine system.

- HP turbine System (MAA)

- LP turbine System (MAC)
- Turbine Bearing System (MAD)
- Condenser (MAG)
- Turbine air removal system (MAJ)
- Turbine drain system (MAL)
- Seal leak-off steam system-Gland steam condenser (MAM)
- BRU-K System (MAN)

The turbine K-1000-60/3000-2 is a steam condensing, compound 1000 MW turbine of four-cylinder configuration (HPC+3 LPC) with intermediate moisture separation and steam reheat, with rotational speed of 50 s⁻¹ (3000 rpm) and is intended to drive directly the alternating current generator of type TBB-1000-2T3 mounted on the same vibration isolated foundation deck with the turbine at KKNPP 3&4. HPC Impulse type and LPC is impulse-reaction. The turbine is designed to operate as a unit with saturated steam at the reactor rated thermal power of 3000 MW.

The total length of the turbine without generator is about 41 m. Assembled mass of turbine without condenser is 1440 MT. The turbine together with the generator is located in the machine hall operating floor level at + 16.0m of TB on a common vibro-isolated foundation. Dimensions of the foundation in plan view are 60.6 × 13.2 m. The HP and LP steam admission valves are also located at the level of the turbine operating floor as well as governing box and governing column. The major components of turbine are outer and inner casings of HP cylinder bottom half and top half, Diaphragms and diaphragm holders of HP and LP cylinder, HP and LP rotors with semi-couplings, Bearing pedestals with bearings, Front, middle and rear outer and inner casings of LP cylinder bottom half and top half, LP rotor expansion bellows, LP steam inlet compensator (bellows), LP Steam extraction compensator (bellows) and Glands of HPC & LPC.

HPC is of double flow type consisting of internal and external casings with 5 pressure stages in each HPC flow (2 x 5 stages). Internal HPC casing is inserted into the external casing and fixed in position by keys. The joints between steam inlet pipes of the internal and external HPC casings are of telescopic type and are provided with piston rings as packings.

The diaphragms of the first and the second stages of both steam flows are situated in the internal casing of HPC. The diaphragms of the rest of the stages are situated in 6 diaphragm holders (three diaphragm holders for each steam flow, each diaphragm holder having a diaphragm) and are installed in the external HPC casing.

There are steam extraction pipes for feed water regenerative heating in the lower part of external HPC, the steam is extracted from the extraction chambers behind the second stages of HPC to HP heater-6, behind the third stages of HPC to HP heater-5 and behind the fourth stages to the de-aerator.

After HPC the steam is admitted from each HP steam exhaust pipe through four pipes to four moisture separator and re-heaters where moisture is separated and reheated.

The reheated steam from MSR is admitted to three **LPC** preceded by six low pressure valve blocks. Each valve block consists of two butterfly valves. The first valve performs the function of the shutoff valve while the second functions as a control valve. Steam to each LPC is let into the lower half of the middle part by means of two symmetrical pipes with reference to the turbine axis. To create additional force towards the closure of butterfly valves of control and shutoff valves of LPC in addition to spring-hydraulic servo motors of LPC valves there are steam servo motors.

All the three LPC of the turbine are of double flow type with internal casings and external casings and each flow consists of five stages (2 x 5 x 3). The LPC outer casing consists of three parts, middle part and two symmetrical exhaust sections (Front & Rear). The middle part of the external cylinder holds inner casing and is fixed in position by vertical and horizontal keys. The inner casing contains diaphragms of the first four stages of right and left flows. Exhaust sections of external casings holds the welded diaphragms of the last stage i.e., the fifth stage. The mass of assembled LPC without LP Rotor is 85 MT.

The steam from the chambers after the second stages of LPC is admitted to the steam extraction pipeline to LP heater-3 (LCC30AC001). The steam from the chambers after the third stages of LPC is admitted to the steam extraction pipeline to LP heater - 2 (LCC20AC001).

The steam is extracted from all LPC from the chambers after the fourth stage is admitted to three in-built LP heater -1 (LCC11,12, 13AC001) one for each LPC.

The exhaust steam from LPC gets into the condenser. LPC exhaust sections are connected to the condenser by means of welding. For LPC exhaust section cooling during the start up of the turbine as well as during the operation with small loads there exists a spray water-cooling system with a ring collector with injectors in every LP cylinders. There are relief valves of diaphragm type (bursting diaphragms) on the top of LPC casing.

HP rotor is a forged single piece and has no central canal. The mass of HP rotor is 36 MT. Side plates and half-coupling's flange at the side of LPC is forged together with the shaft. Blades of all stages have integral bands with trapezoidal inserts. HPC end

seals are of labyrinth type and represents rows of step like grooves on HPR. Sealing segments are installed into sealing casings. All seals of diaphragms are also similar.

LP rotors are of forged single piece and have no central canal. The mass of LP rotor is 80.5 MT. Side plates and half-coupling's flanges are forged together with the shaft. Blades of the first three stages have integral bands with wire inserts. The blades of the fourth stage have integral bands; the blades have one wire bond. The blades of the last stages also have integral bands; these blades have two wire bonds. The blades of the first two stages are with T-shape blade roots. Blades of the third, fourth and fifth stages have fir-tree blade roots. The length of the blades on the last stages of LPC is 1200 mm and root diameter is 1800 mm. LPC end seals are of straight flow type. At the location of the seals the shaft is smooth. Sealing segments are installed into sealing casings. All seals of diaphragms are also similar.

The bearing pedestals of all the bearings of the turbine (MAD) rest on foundation frames and are fixed in relation to foundation frames by means of cross and longitudinal keys. HP external cylinder is installed on the first and second bearing pedestals over palm key blocks. The position of the HP casing fixed by keys on the second bearing pedestal allows the HP casing to expand towards the governing unit. The centre line of the HPC is fixed by vertical keys on bearing pedestals.

All LP cylinders rest on foundation frames. Vertical keys on foundation frames in longitudinal direction fasten the LPC edgways enabling them to move in longitudinal direction. The position of LPC-1, LPC-2 & LPC-3 is fixed by transverse keys situated on the front foundation frames of the front casing of LPC-1, LPC-2 & LPC-3 respectively, enabling the LPC-1, LPC-2 & LPC-3 to expand towards the generator.

The shaft line of the turbo unit consists of four turbine rotors (one HPR and three LPR) resting on eight support pads (bearings) and a generator rotor resting on two support pads (bearings). All the rotors of the turbine are connected with the help of semi-coupling. The pad of the bearing no. 2 is of support and stop (Journal cum thrust bearing) type.

The turbine is equipped with a shaft turning gear (MAK50AE001) installed at the pedestal cover of the bearing no. 2 to provide rotors rotation at 1 rpm for uniform heating and their uniform cooling of rotors during start up and shut down to prevent rotors from deformation. Steam Turbine system is connected to LAD, LBA, LBJ, LBQ, LBS, LBW, LCA, LCC, LCE, MAA, MAG, MAL, MAK, MAM, MAN, MAQ, MAV, MAX and MKA.

Main condenser (MAG) is double flow- single pass, shell and tube type heat exchanger consisting of three casings located under each of the LP cylinder, their

longitudinal axis being perpendicular to the longitudinal axis of the turbine. The condenser casing is spring-mounted and is joined to the LP turbine by welding. The condenser casing is made of carbon steel sheets by welding.

There are 3 nos. of condensers per unit. Each condenser is of box type construction with divided water box design. The steam space is of rectangular construction with integral air cooling section from where air and other non-condensable gases are drawn out with the help of **Air evacuation system (MAJ)**. Each condenser has 30000 nos. of titanium tubes. Each tube has size of 25 mm x 0.6 mm x 15000 mm. 235000 m³/hr of cooling water is circulated through all the three condensers. Design temperature of cooling water is 31°C and inlet pressure of cooling water is 1.3 Kg/cm². Dry mass of condenser is 485 X 3 T. Mass of cooling water is 380 X 3 T. Mass of condensate in steam space is 70 X 3 T. Total heat transfer area of condenser is 96000 sq.m. Mass of water in steam space during hydraulic tests is 1000 x 3 T.

The tubes of the heat-transfer surface are titanium, and tube plates are made of carbon steel clad with titanium on the seawater side. Water chambers are made of stainless steel by welding. Tightness of the condenser is provided by expansion of cooling tube ends in the tube plates and welding to titanium cladding of the tube plates. Intermediate partitions are arranged in the steam space of the casing so as to eliminate dangerous forms of tube oscillations. The condenser has lens-type expansion joints made of stainless steel to compensate for thermal expansions of carbon steel and titanium. The condenser is delivered in 63 major sub assemblies which are to be assembled in-situ during erection. Titanium tubes will be delivered as a separate package. Installation, expansion and welding of tube ends to tube plates shall be carried out by the contractor after assembly of the condenser. The dry condenser (3 Nos.) mass is 1750 MT.

Each condenser is mounted on spring supports and welded to the exhaust of the LPC. The condenser is having a slope of 2° towards the water outlet side so that the tubes are drained automatically into the condenser water box. Each main condenser consists of sub assemblies such as spring supports (4 nos.), hot well (1 no. in 3 pieces) tube boards (4 nos.), tube system (2 nos. in 4 pieces), side walls (2 nos. in 12 pieces), front & rear walls (6 nos.), water chamber (4 nos.), condenser tubes (30000 nos.) condensate collection tank (1 no.), connection branch pipe (5 nos.) etc., and are to be welded at site.

Condenser is located at -1.59 m elevation of the turbine building and is connected to LP turbine, PAB, MAJ, PAS, LCA, LBJ, MAL, MAN, LCJ, LCP, MAM, LCR, LCM, QUC, LAD, LCT, LCS, LCH, LCN.

Air evacuation system (MAJ) is intended to build up vacuum by evacuating steam–air mixture from the turbine condenser and to create the required rarefaction in the gland steam condenser (GSC), upper area of the condenser water chambers.

MAJ system consists of Main water-jet ejectors (4 nos), water-jet ejector of GSC (1 no), water-jet ejectors of the circulation system (2 nos), lifting pumps (4 nos), piping and valves. MAJ system is connected to PAB, LCP, LCA, LCC, LAD, LBJ, MAN, MAL, MAM and PAS.

The turbine drain system (MAL) is to remove moisture accumulating at lower points of steam piping and turbine parts (valves, turbine cylinders, etc) and direct it to drain expansion tanks and further to condenser. MAL system consists of high pressure drain expansion tank (1 no), low pressure drain expansion tank (1 no), piping and valves. High pressure drains are collected directed to high pressure expansion tank and that of low pressure drains to low pressure expansion tank. The MAL system equipment and piping are located in the turbine hall is connected to MAJ, LCN, MAN, LAD, LCC, LBJ and LBW.

Steam dump (MAN) to condenser BRU-K valves (6 nos.) are mounted at +7.8 m elevation on Main condenser. Each condenser is provided with 2 nos. of BRU-K valves. These valves are horizontal in position and fixed to the condenser steam dump nozzle by welding. These valves are for steam dumping into condenser during operational exigencies. Each BRU-K valve is provided with servomotor operated by BRU-K oil control system MXN. BRU-K valve is connected LBA, LCE, MAG and MXN.

6. **GENERATOR SYSTEMS (MK):**

The following are the sub-systems of Generator systems

- Generator (MKA)
- Exciter (MKC)
- Generator bearing (MKD)
- Stator water cooling system of generator (MKF)
- Generator hydrogen cooling system (MKG)
- Seal oil system for Generator (MKW)

The generator is a non-salient-pole synchronous electrical machine consisting stator which includes a core and a winding connected to the external power system and rotor which carries a field winding supplied with rectified current. Heat generated from the stator winding is removed by DM water, and from rotor winding and stator core with hydrogen. Bearings and shaft seals are cooled by oil.

Weight of rotor is 90.3 T. Wound stator with supporting lifting brackets (maximum weight for erection) without end parts is 335 T. Weight of other assembly components such as end part, end shield, foundation plate, bearing pedestals, gas coolers, exciter etc is 184.7 T. The total weight of the Generator including exciter is 610 T. Power factor of Generator is 0.9. Stator voltage is 24 KV. Stator current is 26730 A. Speed of rotation is 3000 rpm with frequency of 50 Hz. No. of the stator winding phases is 3. No. of the stator winding terminals is 9.

Major components of Generator are explained below,

Stator Casing: The gas-tight stator casing consists of three parts: one middle and two end parts. The middle part contains stator core and winding and the end parts are contains vertical gas coolers, stator winding terminals and water supply pipelines for stator winding cooling, and electric heaters. The stator ends are closed by external shields, where the shaft oil seals are also fastened. All three parts are rested upon the foundation with the help of supporting lifting brackets, which are removed during transportation.

Stator core and winding: The stator core is made of laminations of steel sheet of 0.5 mm thick and stacked on core building longitudinal bars. The surfaces of laminations are coated with insulating varnish. The stator winding is bar-type winding of a three-phase type with two parallel branches. The phases are connected in double star. The winding terminals are located at the bottom (line) and (neutral) at the top. The winding bars consists solid and hollow copper strands and DM water is circulated through the hollow strands for cooling the winding.

Rotor: The rotor shaft made off a single-piece forging of special steel. It consists of a shaft and field winding located in its slots. On the turbine side a half-coupling is put onto the shaft for connection with the turbine rotor. On the exciter side inside the shaft the current supply devices are placed. The field winding coils consists of four conductors. The coils are located in slots of the shaft and with insulation. The winding is held in slots with wedges and in the end parts with retaining rings. For cooling the rotor, two rows of ventilating ducts in the diagonal direction are provided. The cooling gas goes in the slot section through the wedges.

The stator and rotor winding insulation is of "F" class and the highest admissible temperature of generator active parts is of "B" class.

Support Bearing: The generator support bearing located on the exciter side is of a pedestal type with a ball-type self-aligning liner. The inner surface of the liner is coated with antifriction material. The bearing is forced lubricated. The high-pressure oil is

supplied to bearing for the rotor jacking. In emergency condition when all the lubrication electric pumps fail to operate, oil is supplied from emergency lube tank.

Shaft Oil Seal: To prevent leakage of hydrogen along the rotor shaft from the stator casing, the shaft O-ring oil seals are mounted on the external shields of the generator. The shaft oil seals are of a ring type. Sealing oil under a pressure exceeding the hydrogen pressure in the generator is supplied to the seals, thus the seal oil flowing towards the stator side prevents the escape of hydrogen from the generator.

Gas Coolers: Gas is cooled in four gas coolers installed vertically inside the end parts of the stator casing. The gas coolers consist of bimetallic finned tubes. DM water is supplied to the coolers for gas cooling.

Exciter: The generator is excited from a brushless exciter coupled with the generator shaft and consisting of a three-phase inverted-type synchronous generator. The alternating current is rectified with the help of a set of rotating semi-conducting rectifiers — diodes. The 3MWe AC exciter is driven by the main synchronous machine and has stationary field and rotating 3-phase armature. The 3-phase power from the AC exciter is fed, along the main shaft, to the rotating diodes rectifiers mounted on the same shaft. The output from these rectifiers is also given along the main shaft, to the main alternator field, without any slip-rings and brushes.

Generator stator water cooling system (MKF) is intended for the removal of heat generated due to I^2R losses in stator windings of generator. Cooling of these components is done by DM water, which flows inside these hollow components in a closed loop. Since stator water comes into direct contact with high voltage stator windings it should have conductivity of 5-10 μ S/cm. The system consists of Electric pump units (MKF02,03AP001), Heat exchangers (MKF12,13AC001), Mechanical filters (MKF21-23AT001, MKF01,50AT001), Magnetic filters (MKF31-35AT001), Ion exchange filters (MKF50,51AT001), Gas traps (MKF45 AX001), Water tank (MKF01 BB001), Hydraulic seal (MKF05 BB001), pipelines and valves.

The Equipments of Tank and Ion exchange filters are located at 0.000 m elevation and mechanical, magnetic filters are located at 7.800 m ele and pumps are located at - 7.200 m elevation in the Turbine building (UMA). The system is connected to MKA, LCP, PGB, MKG, QJB, SCB, LCM and QUH.

Generator hydrogen cooling system (MKG) is to remove the heat from the generator rotor. Hydrogen is circulated inside generator by fans attached to rotor and this hydrogen in turn is cooled by intermediate cooling water (PGB00-70) system. In order to reduce the presence of moisture in the hydrogen, a refrigerating plant type dryer is provided in the system. The system consists of hydrogen coolers (4 nos.), gas

control post (1 set), refrigerating units (2 nos.), evaporating devices (2 nos.), liquid level detectors (2 nos.), gas analyzers, separators (2 nos.), instrumentation, piping and valves. MKG is connected to MKF, QJB and QJC.

Generator shaft seal oil System (MKW) is intended to prevent the gas escape from the generator casing which is filled with hydrogen. For this oil is supplied continuously in seals. Also necessary pressure difference between sealing oil and gas is maintained in all modes of the generator operation, including Barring Gear operation. The system consists of Seal oil tank (1MKW01BB001), Electric pump units (MKW01-03AP001), Oil Coolers (MKW12,13AC001), Mechanical filters (MKW16,17AT001), Magnetic filters (MKW21,22 AT001), Pressure regulators (MKW30,60BP001), Damper tanks (MKW30,60BB001), Hydraulic seal tank (MKW66,67,71AT001), Hydrogen separator (MKW70 AT001), pipelines and valves. The location of the equipments are Seal oil tank (1MKW01 BB001), Oil Coolers (MKW12, 13 AC001) and MKW71 AT001 are located at +3.9 Mel of UMV building, Electric pump units (MKW01-03AP001) and Hydraulic seal tank (MKW66, 67AT001) are located at 0.0 Mel of UMV building, Damper tanks (MKW30,60BB001) are located at +24.5 Mel of UMV building and the system is connected to MVA, PGB and MKG.

7. **COOLING WATER PLANT: (PA/PG)**

The following are the cooling plant systems.

- Main cooling water system (PAB)
- The ejector power water supply system (PAS)
- The intermediate closed loop cooling water system (PGB)

Main cooling water system (PAB) is to remove heat from turbine condensers (3 nos.) and turbine drive condensers (2 nos.) and water supply to ejectors lifting pumps (4 nos.). The system consists of inlet sea water cooling pipelines (6 nos.) each of size 2200 mm diameter connected inlet of main condensers. Branches of size 630 mm diameter (4 nos.) from 2200 mm diameter pipelines are connected to turbine drive condensers. After heat removal, the sea water is discharged through of independent discharge pipes (6 nos.) each of size 2200 mm diameter from main condenser and discharge pipelines of size 630 mm diameter (4 nos.) from turbine drive condensers are connected to 2200 mm diameter pipelines. All these pipelines are coated with special anticorrosive coating. PAB system is connected to PCB and PAS.

The ejector power water supply system (PAS) is to supply power water to the main ejectors of main condenser vacuum system, ejectors of condenser water boxes and ejectors of gland steam condenser for creating vacuum. The system consists of lifting pumps (4 nos.), ejectors for main condensers water box (2 nos.), pipelines and

valves. PAS system is connected to cooling water system (PAB), vacuum system (MAJ) and main condenser (MAG). The lifting pumps are located in 0.00 m elevation and the ejectors are located at +7.8M elevation of turbine building (UMA).

The intermediate closed loop cooling water system (PGB) is for removal of heat from various sources in Turbine building. The system depending on the loads to which the de-mineralized water is supplied is divided into PGB 00-70 for normal operation loads and PGB 80-90 for oil coolers.

PGB 00-70 in turbine building consists of expansion tank (1 no.) located in +19 m of TB, pipelines & valves. The system PGB 00-70 removes heat from generator stator water coolers, generator gas coolers, exciter air coolers, bus duct coolers, gas analyzer sample dryers, coolers of turbine-driven feed water pumps, booster pumps & electric driven feed pumps, end seals, electric feed water pump motor air coolers, auxiliary feed water pump motor coolers and bearing coolers, drain flash tank condensate cooler, Sludge condensate cooler, bearing and motor coolers of separated moisture transfer pumps, bearing and motor air coolers of first & second stage condensate extraction pump, coolers of secondary automatic chemical monitoring system for feed water, steam systems, condensate water and DM water.

PGB 80-90 in turbine building consists of expansion tank (1 no) located in +11.5 m of TB, pipelines and valves. The system PGB 80-90 cools the turbine lubrication oil coolers, turbine governing oil coolers, BRU-K control oil coolers, generator seal oil coolers, stand-by feed water electric pump oil coolers, TDFP oil coolers and TDFP reducer oil coolers.

Servomotor cooling water system (GHA) is intended for cooling the servomotors of various valves in secondary systems in Turbine building (UMA). The cooling water supply is provided from the PGB system for all the servomotors and the returns lines of GHA pipelines after cooling servomotors are connected to PGB outlet lines.

8. GAS SYSTEM & EXHAUST SYSTEMS (QJ/SC/O):

The following are the Gas systems in Turbine buildings.

- Nitrogen supply and distribution system in turbine hall (QJB)
- Hydrogen supply and distribution system in turbine (QJC)
- Compressed air supply and distribution system (SCB)
- The O-system (Exhaust systems)

Nitrogen supply and distribution system in turbine hall (QJB) is intended to supply nitrogen to generator through MKG systems and to protect the DM water against contact with air in MKF system equipments. QJB system consists of nitrogen

receiver tanks (2 nos.), pipelines and valves. QJB system Pipelines are routed from 0.000 m elevation to 7.800 m elevation in UMA and is connected to MKF and MKG.

Hydrogen supply and distribution system in turbine (QJC) hall is for providing hydrogen to generator hydrogen cooling system (MKG) and consists of pipelines and valves. QJC system is connected to hydrogen feed system (QJC) and generator hydrogen cooling system (MKG).

Compressed air supply and distribution system (SCB) is for purging of generator hydrogen cooling system(MKG), blow down of generator water cooling system (MKF), and for air scouring of unit de-mineralization plant filters (LDF,LDP) and consists of piping and valves.

The O-system (Exhaust systems) is for discharging high pressure steam and low pressure non-condensable steam vapour from the outlet of relief valves and tanks to atmosphere in UMA building. This system consists of pipelines, supports and its supporting metal structures from the outlet of relief valves and tanks to the exhaust point above the turbine hall roof. O-system is connected to LBG, LBW, LBA, LCM, LBJ, XAC and XAG.

9. **SECONDARY AUTOMATED CHEMICAL MONITORING SYSTEM (QU):**

The computer aided chemical control system for the secondary circuit is for preparation of samples, measurement of parameters and monitoring the chemistry of various systems in turbine building as given below;

- QUA: Automated chemical monitoring of feed water systems
- QUB: Automated chemical monitoring system for steam systems
- QUC: Automated chemical monitoring of condensate systems
- QUG: Automated chemical monitoring of condensate polishing plant
- QUH: Sampling system for secondary side de-mineralized water systems

The QU System Consists of pump for taking condensate samples from the condenser (6 nos), sampling preparation and instrumentation system (28 nos) pipelines valves and collecting trays. All the pipelines and valves are located in the Turbine Building UMA. The QU system is connected to LAB, LBA, LCA, LCM and LDF. Sampling system for secondary side de-mineralized water systems is for preparation of samples from various systems such as LCP, LAA, and MAG & PGB. QUH system contains sampling heat exchanger (9 nos.), sample collection trays (6 nos.), pipelines and valves. The QU system is connected to LAA, LCP, MAG and PGB.

10. OIL SYSTEMS:

The following are the sub-systems of oil systems.

- Jack oil System (MAK)
- Oil Vapours removal piping from lubrication system (MAQ)
- Lube oil system (MAV)
- Governing oil system (MAX)
- Turbine hall loads lubricant supply system (MVA)
- Oil pumps (MVB)
- Auxiliary oil system of Governing System (MVC)
- Auxiliary oil system of control BRU-K System (MVD)
- Turbine hall loads lubricant leaks collecting system (MVM)
- Governing oil system (MXN)
- EDFP oil system (LAV)
- TDFP1&2 oil System (LVA)
- Oil system equipments for TDFP (XAV)

Jacking oil and barring gear system (MAK) is intended to supply high pressure oil to turbine-generator (TG) journal bearings. The system consists of rotor jacking oil screw pumps (MAK11,12 AP001) with built-in start-up and safety valves, barring gear (MAK50AE001), dosing devices at all the bearings which consist of filter, NRV, and orifice. Oil from oil coolers of TG lubrication system (MAV) is fed to suction of jacking oil screw pumps located on the lube oil tank (+8.1m el) and supplied to all bearings via dosing devices. Jacking oil pumps are submerged into the tank with oil supply to the suction from the header downstream of the lube oil coolers located in oil building (UMV). System is connected to MAD, MAV and MKD.

MAQ system is intended for removal of oil vapour from oil systems in TB. The exhaust oil vapour is admitted to the atmosphere through filters and the condensed oil from the filter is drained in to the main oil tank through the drain pipeline of the respective systems. The system consists of exhaust fans MAQ10AN001 located at +14.670 m elevation of UMV building and MAQ20AN001 located at +6.695 m elevation of UMA building and MAQ30AN001 located at +9.520 m elevation of UMV building. The MAQ system pipelines are located from 0.0 m to +45.000 m elevation of UMA building. The MAQ system is connected MAD, MAV, MAX and MXN.

Turbine generator lubrication system (MAV) is intended to provide lubrication oil for turbine, generator and exciter bearings; for turbine generator emergency oil supply, to supply oil to TG rotor jacking oil system and to prevent oil vapour egress from the oil tank and the bearing casings into the turbine hall. The system consists of

Oil tank MAV10BB001, Oil pumps with AC motor MAV11,12AP001, Oil pump with DC motor MAV13AP001 (emergency), Oil pump for oil circulation and filtration MAV18AP001, Exhauster MAQ10AN001, Oil coolers MAV21-24AC001, Fine filters MAV16,17AT001. The oil tank with the capacity of 70 m³ is made up of carbon steel and lined with stainless steel. The tank is divided into a “dirty” and a “clean” compartments by two rows of screen filters. The oil tank and associated equipment (pumps, filters, oil coolers) are located in at +8.1m elevation of UMV building and Oil vapor exhauster is located at +17 m elevation of turbine operating floor. The system is connected to MAD, MAK, MKD, MVA and PGB.

Control oil supply system (MAX) is intended to supply the hydraulic part of the governing system with proper amount of control oil to the turbine and to supply oil to the components of the hydraulic part of the governing system from the weighted accumulators. The system consists of governing system tank MAX10BB001, governing system pumps MAX11,12AP001, exhaust fan for oil vapour evacuation MAX20AN001, oil coolers MAX71,72AC001, spring-weight accumulator MAX31,32AK001, fine filter MAX35AT001, pump for oil filtration MAX16AP001, valves and Piping. The Governing oil tank, oil pumps, coolers and filters are located in a separate room called governing oil supply system room in UMA building +3.0 Mel. All other equipments are located at +16 Mel (HP turbine front pedestal). The system is connected to HP & LP stop and control valves, MSR heating steam valve, MSR discharge valve, Front pedestal of main turbine, MAQ, PGB, MVA and MVC.

Auxiliary oil system of Governing System (MVC) is intended for removal of sediments, foreign particles, impurities, dust etc., from the governing oil system of TG (MAX) in Turbine Building. The system consists of governing oil system filtration and circulation pump (MVC23AP001) and fine filter (MAX35AT001). This is achieved by circulation of governing oil from the tank by filtration and circulation pump (MVC23AP001) and passing through the fine filter (MAX35AT001). Governing oil system filtration and circulation pump and filters are located in a separate room called governing oil supply system room in UMA building +3.0 m elevation. All the piping of the above system is covered in MAX system MVC23AP001 at +3.0 mtr (UMA) and the system is connected to TG Governing oil system (MAX), Turbine hall loads lubricants supply system (MVA10).

Auxiliary oil system of control BRU-K System (MVD) is intended for removal of sediments, foreign particles, impurities, dust etc., from the governing oil system of BRU-K (MXN) in Turbine Oil Building. The system consists of BRU-K oil system

filtration and circulation pump (MVD24AP001), Fine filter (MXN35AT001). This is achieved by circulation of governing oil from the tank by filtration and circulation pump (MVD24AP001) and passing through the fine filter (MXN35AT001). BRU-K oil system filtration and circulation pump and filters are located in a separate room called BRU-K governing oil supply system room in UMV building + 0.0 m elevation. All the piping of the above system is covered in MXN system MVD24AP001 at +0.0 mtr (UMV) and the system is connected to BRU-K Governing oil system (MXN), Turbine hall loads lubricants supply system (MVA10).

Governing oil system for BRU-K valves (MXN) is intended to govern the operation of steam dump valve to condenser (BRU-K) by supply of pressurized oil to the control blocks (MAN51 & 61) of turbine bypass system. MXN system consist of BRU-K system storage oil tank (MXN10BB001), Servo motors of BRU-K valves (MAN11-13AA501, MAN21-23AA501), BRU-K system oil supply pumps (MXN01,02AP001), Oil vapor removal exhaust fan (MAQ30AN001), Oil coolers (MXN41,42AC001), Fine filter (MXN35AT001), Re circulation and filtration pump (MVD24AP001). BRU - K oil tank, oil pumps, coolers and filters are located in a separate room called BRU - K oil supply system room in UMV building 0.00 m elevation. All other equipments and related pipe lines are located in UMA building at +7.8 m elevation and the systems are connected to MAN, MAQ, PGB, MVA, and MVD.

Oil supply system for EDFP (LAV) is designed for forced lubrication of the Electric Driven Feed pump motor and bearing unit. Oil system is of modular type and its equipments are mounted on a common frame and consist of oil tank with oil warm-up system and two oil pumps, oil cooler, two oil filters and pipeline system with valves. There are partitions mounted inside the tank for stabilization of oil flow and intensification of air removal from oil. Removal of sediment shall be carried out through a valve located in the lower part of the tank. Oil motor-pump unit is designed for oil feed into oil supply system. Oil cooler is intended for cooling of oil with the help of turbine hall intermediate cooling water system (PGB80-90). The LAV system equipments are located in turbine building (UMA) B-C compartments at +4.00mtr elevation. The LAV system is connected MVA and PGB.

TDFP oil system (LVA) is of the self-contained type independent of the main turbine oil supply system. It is intended to provide for the lubrication and heat transfer from the drive turbine bearings, reduction gear, bearings of the main feed and pre-

switched on feed (booster) pumps, couplings, barring gear bearings, and also to supply oil to the hydraulic mechanical actuator of the automatic governing and protection system of the drive turbine. The equipments of LVA systems are located in Turbine building (UMA) B-C Compartments with Turbine drive at +6.0m, Main oil tank at +0.0 m elevation, Emergency oil tank +17.0 m and Oil pump, Drain tank and Oil coolers at -7.2m elevation.

TDFP vent system (XAQ) is intended to remove the oil vapors in TDFP's, main oil tank, Reduction gear, Pump coupling and Drain header and consists of oil trap and centrifugal fan at +22 m elevation with interconnecting pipelines.

Oil system equipments for TDFP (XAV) consists of main oil tank (1 no.), drain oil tank (1 no.), emergency oil tank (1 no.), oil supply pumps (2 nos.), regulating pumps (1 no.), recirculation pumps (1 no.), and filters(2 nos.), for each TDFP connected to TDFP oil system LVA. All the equipments are located in B-C bay of turbine building at various elevations.

Turbine hall loads lubricant supply system (MVA) is subdivided as Turbine hall lubricant supply system (MVA10-40), Emergency lubricant discharge system (MVA50) and mineral oil supply system for shaft seals of turbo generator (MVA60-70).

Turbine hall lubricant supply system (MVA10-40) consists of carbon steel pipelines for filling of oil in main Turbine lube oil tank (MAV10BB001), Turbine governing oil tank (MAX10BB001), TDFP oil tanks (XAC10,20BB001), EDFP oil tanks (LAV30,40BB001), BRU-K control oil tank (MXN10BB001) and discharge pipelines for draining of oil from TDFP oil tanks (XAC10,20BB001) and EDFP oil tanks (LAV30,40BB001) with pump (MVA27AP001), recirculation and drain pipelines of main turbine lube oil tank (MAV10BB001) with pump (MVB20AP001), Turbine governing oil tank (MAX10BB001) with pump (MVC23AP001), BRU-K control oil tank (MXN10BB001) with pump (MVD24AP001).

Emergency lubricant discharge system (MVA50) consists of carbon steel pipelines for emergency draining of oil from main Turbine lube oil tank (MAV10BB001), BRU-K control oil tank (MXN10BB001) and seal oil tank (MKW01BB001) to emergency lubricant discharge tank (UMW) through buried pipelines. Wrapping coating of buried pipelines is to be carried out.

Mineral oil supply system for shaft seals of turbo generator (MVA60-70) consists of carbon steel pipelines for filling of oil in seal oil tank (MKW01BB001) and discharge pipelines for draining of oil with pump (MVA70AP001). MVM pipelines are the drains from the bearing pedestals of main turbine are interconnected forming a common header leading to removable drain tank in 0.0 m of UMV.

The MVA system pipelines are located in Turbine Building (UMA) from 0.0 m to +6.0 m elevation and grid A to C axis 2 to 9 & Turbine oil building (UMV) from -4.2 m to +8.1 m elevation and grid A to A1 axis 7 to 9, and the equipment are located in Turbine & oil buildings (UMA,UMV) at various elevations. This system is interconnected to MAV, MXN, MAX, MKW, MKW and LAV.

11. Main sea water cooling system (PAB):

The main cooling water system is once through system seawater supply system intended for the heat removal from steam in turbine condensers and feed water pump condensers. Cooling sea water will be supplied from the intake through water conveyance system to the common fore-bay. From the fore-bay (UPU) water flows to the common cross-wise inlet channel through secondary and fine mesh rotary screens. From the cross-wise inlet channel, through six condenser cooling water pumps, seawater is supplied to the condensers of the turbine compartment through sea water piping and flows back to sea through siphon wells (UQX), discharge pipe UQU and outlet portal UQW.

Each of 6 pumps supplies $\frac{1}{6}$ part of the required discharge via a separate pipeline, 2200 mm in dia. to half-one out of three twin condensers. The water heated in the condensers shall be returned to the Gulf of Mannar via 6 independent discharge pipes, 2200 mm in dia. and siphon wells separate for each pipe.

Apart from cooling water supply of the turbine condensers the main cooling water system supplies water to feed pumps condensers and to those of the ejectors.

12. Sea water cooling system for essential loads (PEB):

This system is intended to remove heat from the intermediate circuits of heat exchangers in the reactor building UJA and intermediate circuit of the diesel-generator building and safety-related system 1-4UKD. The system for each unit consists of 4 nos. of individual channels of cooling water.

13. Sea water cooling system for non-essential loads (PCB):

This system is intended for heat removal from the intermediate circuit of turbine building normal operation heat exchangers, the intermediate circuit of heat exchangers of oil-filled equipment of the turbine, the intermediate circuit of chillers, the compressors cooling system of compressor building, the cooling system of common-station diesel generators and as service water supply to ejector system in turbine building.

14. System of mechanical cleaning devices (PAA & PEA):

The system of mechanical cleaning devices PAA is intended for cleaning the main condenser sea water cooling system (PAB) and sea water cooling system for non-essential loads (PCB). The system of mechanical cleaning devices PEA is intended for cleaning the sea water cooling system for essential loads (PEB). Both PAA & PEA clean the sea water from floating debris and biomass with a size more than 4 mm entering into the above systems. It consists of the three sequential stages of water cleaning i.e. coarse screens, secondary screens & rotary fine mesh screens. Provision is made in the system for the isolation of various chambers by suitable gates at various locations in order to carry out inspection & cleaning etc.

15. Closed cooling water system for conventional area (PGB):

These Intermediate circuit closed cooling water systems for conventional area (PGB01, PGB10, PGB80 & PGB84) are to provide cooling water for the equipment located in the UMA turbine building, UKC building, the special laundry UKW, UKS building for reprocessing and interim storage of solid radioactive waste and for cooling oil system of turbine building compartment. Heat exchangers (intermediate circuit to sea water), pumps are located in UQA building. Process heat exchangers (intermediate circuit to process system) are located in various other buildings.

16. Systems of dewatering (PUA, PUD, PUE, PUQ & GML):

The stationary pumping out system PUA is intended for dewatering the water path of the pumps of the main cooling water system PAC and the pumps of the non-essential loads cooling water PCC including the pressure pipelines PAB and PCB. The PUA system is common for PAC and PCC systems.

For discharge portions of pipelines PAB, PCB, PEB and siphon wells portable submersible pumps will be used which can be placed at the bottom of the foundation slabs of the structure to be dewatered.

For dewatering the sea water path of the pump units of the essential loads cooling water system PEC and pressure portions of the pipelines PEB a stationary pumping out system PUD is provided

PUE system is intended to remove drainage water from the pump houses of essential loads 1UQC and 2UQC. The drainage water pumping out system is designed separate for each house where essential loads pump units will be installed. GML and PUQ system are meant for collecting and pumping out drains from main pump house and tunnels.

17. Screen and flume Wash out System (PUK, PUJ and PUP):

The system is designed for washing off the debris sticking to the underwater part of the rotary mesh screens. The PUK system includes two groups of pump units for washing. Each group consists of two pumps, one of which is service and the other is standby & also includes supply pressure pipelines & valves for pipes.

The system PUJ is designed for washing out trash in the flume. The trash removed by a stationary raking machine from secondary screens will be put in common flume where from it will be washed with water of PUJ system and collected in trash bin for disposal.

The system PUP is designed for removal (washing) of the debris retained by the secondary screens and rotary meshes of the mechanical cleaning system of cooling water for essential loads (systems PEA).

18. Common plant systems (PUV, PUN & SCD):

PUV system is for Oil supply to pump houses, PUN system is Sea water supply system to Chlorination plant and SCD is compressed air system.

19. Fish protection system (PUL, PUM, PUS, PUX & PUT):

Fish-protection system comprised of fish diversion ejector water system (PUL), airlift supply system (PUM) with auxiliary system such as pump motor winding, bearing oil cooling system (PUS) and drainage system is provided to divert fishes from entry to the cooling water system. PUM compressors are provided to supply compressed to air lift system for fish protection. The airlift system is located in the downstream breakwater dyke of water intake area consisting of three sections - two services, one standby - with straight-flow open fish-diversion facility operated by a hydraulic ejector.

20. Instrumentation system at the pump houses (PAX, PAY, PEX and PEY):

These instrumentation systems are for measurement of pressure differential on screens and meshes and water levels in cooling sea water supply at the pump houses UQA, 1UQC and 2UQC. The systems serve to make measurements and follow up the pressure differential at the screens and meshes of the cooling sea water mechanical cleaning devices and water levels in all the cooling water supply structures to the pump units of PAC, PCC and PEC.

21. Controlled access area waste water treatment plant (UGW):

This system is a waste water treatment plant provided for treatment of sewage water collected from various buildings of controlled access area and transported through outdoor pipe line network of sewage water (GQD) to the plant. The equipment and pipe lines of the system shall be issued as free issue material to the contractor for erection.

Annexure - V

Technical specification for Thermal Insulation Works

Note:

Insulation supply is in the scope of BHEL.

Materials will be issued as Free issue material (FIM).

Application of Insulation is in the scope of the Bidder.

ANNEXURE-V**HOT THERMAL INSULATION****1.0 Technical requirement:**

This section defines the general technical requirements pertaining to supply, installation and performance guarantee of thermal insulation of the piping, equipments and valves in various systems of KKNPP 3&4.

These specifications are for guidance of contractor. The actual work shall be done based on working documents (WDs), Indian standards / Russian standards. The Russian standards are available with Engineer In-charge's library for reference.

2.0 Reference Documents :-

Erection of thermal insulation on process system equipments and piping shall be done as per working drawing supplied progressively during installation phase and working document and drawings. The working documents (set of drawings and documents) will generally contain necessary information for erection, fabrication of insulation on pipeline and equipments. The Working documents like General Arrangement drawings for insulation of equipments, pipelines and valves are given in section VI. The erection requirements shall be specified in WD. Reference documents are listed below.

IS: 277	: Galvanized steel sheets (plain and corrugated) Specification
IS737	: Aluminum sheet / Foil
IS: 8183	: Specification for bonded mineral wool.
IS:9842	: Preformed bi-section insulation test methods
IS: 3144	: Mineral wool thermal insulation materials-method of test
IS: 15402	: Specification for Ceramic fiber blanket insulation
IS: 14656	: Ceramic fiber products test methods.
IS:14164	: Code of practice for the application and finishing of thermal Insulating material at temperature above 80 deg C and up to 700 deg C
IS7173	: Self tapping screws

IS:3346	: Method of determination of thermal conductivity of thermal Insulation material.
IS:5688	: Method of test for preformed block type and pipe covering Type thermal insulation.
IS:5724	: Method of test for thermal insulating cements.
IS:9743	: Specification for thermal insulating finishing cement
IS: 9489	: Method of test for thermal conductivity of thermal insulation by means of heat flow meter.
IS: 10556	: Code of practice for storage and handling of thermal insulation materials.
R01.KK.0.0.TI.TT.OK.WD001: Initial technical requirements for thermal insulation materials, articles and structures.	
R01.KK.1.0.0.TI.OK.WD001: Heat insulation of pipe lines and equipment Drawings	
PROJECT NO.EL-38 : Thermal insulation of steam turbine K-8-0/65,IIA	
PROJECT NO.EL-61 : Thermal insulation of steam turbine K-1000-60/3000-	

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3.0 **Scope of Work:**

Procurement and supply of materials meeting technical requirements as per specifications, installation and performance guarantee of thermal insulation of the piping, equipments, valves, and associated items for various systems in secondary cycle at KKNPP unit 3&4 . The technical details of work to be performed by the contractor will be elaborated in working document, which will be issued to the contractor progressively. NPCIL will provide area for construction of contractor's insulation stores and prefabrication shop.

4.0 **General Description**

4.1. **General description thermal insulation**

Thermal insulation is provided for piping, equipments and valves to minimize the heat transfer from it. Apart from selecting good insulation material, workmanship during pre-fabrication and erection is also very important in insulation applications. Heat leakage source of all forms are to be identified and thermal bridges avoided by developing thermal breaks of ceramic fiber paper where ever possible. Brief description of item to be insulated is given below .

1. Thermal insulation must be provided for external surfaces of all equipments, steam turbines, piping and pipe fittings Secondary Cycle systems of turbine building , and its auxiliary structures with following system temperature, unless otherwise specified
 - a) Above plus 45⁰C located in the Turbine Building , and auxiliary structures are to be insulated
 - b) Tubing of I & C pulse system need not be thermally insulated.
2. When ambient temperature is plus 25⁰C, temperature on surface of insulation should not exceed the following.
 - a) Plus 45⁰C for facilities located in side building
 - b) The difference of turbine's metal temperatures between top and bottom surfaces should not exceed 30⁰C
 - c) The sound level on the distance of 1m from turbine shall be in the range of 80-85 decibels.
3. The thermal insulating structure must ensure thermal protection of all components and equipments of the insulated facilities and prevent formation of local elevated and lowered temperature areas on the surface of the thermal insulating structure.
4. Valves, hatches flange connections, bellows and welds are to be heat insulated, if equipment, pipe on which they are installed is heat insulated.

4.2. Requirements of Thermal insulating layer

1. Material and components used for thermal insulation layer must retain thermal, physical characteristics, and structure during the operation process and must meet the following requirements.
 - a) Belong to non combustible materials.
 - b) Provide for heat flow through the insulated surface of equipment and pipes in accordance with the preset operating conditions or the standardized heat flow rate.
 - c) be resistant against cracking and warpage
 - d) do not cause corrosion of insulated surfaces;

- e) do not emit during operating process any hazardous, fire risk and explosive gaseous substance or gaseous substance with objectionable odour in quantities exceeding the limiting concentrations;
 - f) Be bio-stable, do not emit during operating process any pathogenic bacteria, viruses and funguses.
2. For equipments and piping, the thermal insulating materials and components of the Thermal insulation layer shall be from inorganic materials and conforming to the main properties as given in Tables for specific applications.
 3. As mentioned in Section-V, approximately 10% of total insulation area of pipe shall be provided with removal type insulation on weld joints for components of equipment, pipelines and valves (hatch covers, flange connections of equipment, valves, certain welds in pipelines and compensators), where ISI is to be performed, and where rating plates are attached on equipment housings.
 4. For thermal insulation for equipment and pipe lines, which are subjected to impacts and vibration throughout service life (pumps, turbines, valves, fans etc.,) use of mineral wool is not permitted.
 5. For thermal insulation of pipeline dia 57mm and less, it is permitted to use ceramic fiber ropes.
 6. For thermal insulation of equipments and pipelines with temperatures above 250°C, multiple layer thermal insulation shall be provided and also outer layer seams must overlap the inner seams.
 7. Insulation mats shall be enclosed in ceramic / glass fabric cloth prior to fixing of mats on the surface to be insulated.
 8. In case of multiple layer application of mats where temperature is above 250°C, the upper and lower layers shall be of mats enclosed in ceramic / glass fabric.
 9. For cleaning of Stainless Steel surface, Acetone or kerosene with chloride content less than 25ppm shall be used.
 10. Thermal insulating system consists of the following main components:
 - a) Thermal insulating mats made of mineral wool or ceramic Fiber Blankets wrapped in glass fabric.
 - b) Fastening elements like bracing wire, pins and support devices (ancillary materials), support devices mounted on pipelines and equipments before insulation to rule out deformation and sliding down of thermal insulating layer .
 - c) Covering layer (Metal cladding), Cement plastering: The covering layer (Metal

Cladding) on insulation is required for to provide protection from atmospheric precipitation and mechanical damage. Cement plastering shall be provided on Turbine & its components for both thermal insulation and noise control.

5.0 Material Specification

5.1. Thermal Insulation Layer of Ceramic Fiber blankets

Table 1

Thermal insulating material of Steam turbine	Value for Superfine basalt fiber (Russian)	Value for Indian equivalent Ceramic Fiber blankets
Density, kg/cub.m,	75	96
Compaction factor at erection for flat surface	1.5	1.2
Compaction factor at erection for pipe	1-1.2	1-1.2
Calculated heat conductivity in the structure, W/m ⁰ C	$\lambda_K = (0.041 + 0.00029 t_m)$	$\lambda_K = (0.041 + 0.00029 t_m)$
Application temperature, ⁰ C	400	400
Sorption humidity, % not greater than	0.2	0.2
Content of water soluble chlorides (by mass) % not greater than	0.03	0.03
Content of free alkalis reduced to caustic soda (by mass)% not greater than	0.02	0.02
Content of non fibrous impurities	0	Particles having the same composition as the fiber are not considered as impurities
Average diameter of fiber (micro meter) not greater than	3.0	3.0
Application for temperature not greater than ⁰ C	400	400
Tm=(tw+45)/2-average temperature of thermal insulating layer deg C, where tw-coolant temperature deg C		

Tm = (tw+45) / 2 - average temperature of thermal insulating layer deg C,

5.2. Insulation materials for thermal insulation of pipelines and vibrating equipments:

Table 2

Parameters for thermal insulating material	Value for Superfine basalt fibre (Russian)	Value for Indian equivalent Ceramic Fibre blankets
Density of article, Kg/cum, not greater than	50.0	64
Compaction factor during erection	1.5	1.2
Heat conductivity, W/(m deg C) at (22±5) deg C not greater than	0.038	0.038
Calculated heat conductivity in the structure, W/(m deg C)	$\lambda_k = (0.035 + 0.00017 \cdot t_m)$	$\lambda_k = (0.035 + 0.00017 \cdot t_m)$
Sorption humidity, % not greater than	0.2	0.2
Content of water soluble chlorides (by mass) % not greater than	0.03	0.03
Content of free alkalis reduced to caustic soda (by mass) % not greater than	0.02	0.02
Content of non-fibrous impurities	0	Particles having the same composition as the fiber are not considered as impurities
Average diameter of fibre (micro meter) not greater than	3.0	3.0
Application for temperature not greater than deg C	600	600
* $t_m = (t_w + 45)/2$ - average temperature of thermal insulating layer deg C, where t_w - coolant		

5.3. Thermal Insulating Layer of Mineral wool**Table 3**

Parameters for thermal insulating material	Value for sewn mats made of mineral wool (Russian)	Value for Indian equivalent Mineral wool Mats
Density of article, kg/cum, not greater than	135	120+/-15%
Compaction factor during erection	1.2	1.2
Heat conductivity at (22+5) deg C, W/(m ,deg C), not greater than	0.04	0.04 at 50 ° C
Calculated heat conductivity in the structure, W/m deg C	$\lambda_K = (0.049 + 0.0002 \cdot t_m^*)$	
Sorption humidity, % by weight, not greater than for initial thermal insulation material	2	2
Content of organic matter, % by weight not greater than	2	2
Water resistance pH, not greater than	4	7-9
Content of non fibrous impurities with size greater than 0.25mm, %	6	10
Average diameter of fiber (micro meter) not greater than	6	6
Acidity modulus	1.6	Max 1.6(1.3 to 1.4)
Application for temperature not greater than ° C	450	450
Soluble Chloride content (PPM) not greater than		25
$t_m = (t_w + 45)/2$ - average temperature of thermal insulating layer deg C, where t_w - coolant temperature deg C		

5.4. Thermal insulating ropes**Table 4**

Parameters for thermal insulating material	Value for energy thermal insulation cords in roving loom (Russian)	Value for Indian equivalent Ceramic rope
Density, Kg/cum, not greater than	200	200
Compaction factor during erection	1.0	1

Heat conductivity at(22 +5) deg C ,W/(m deg C), not greater than	0.06	0.06
Calculated heat conductivity in the structure, W/m ° C	$\lambda_K = (0.04 + 0.000161 \text{ tm}^*)$	$\lambda_K = (0.04 + 0.000161 \text{ tm}^*)$
Sorption humidity, % by weight, not greater than	1	1
Flexibility, free envelopment of pipe with diameter, mm, not less than	15	15
Contents of organic matter by weight, %,not greater than	0.8	0.8
Application for temperature not greater than ° C	400	400
$\text{tm} = (\text{tw}+45)/2$ -average temperature of thermal insulating layer deg C, tw-coolant temperature deg C200		

5.5. Thermal insulating material for space filling

In order to preclude occurrence of direct thermal bridges and cold bridges the space fillers made of non-combustible pressed material (thermal insulating cardboard) based on basalt superfine fiber with inorganic binding agent/ceramic fiber paper are installed between the insulated surface, support devices and covering layer of thermal insulation structure. Material requirement are as below.

Table 5

Parameters for thermal insulating material	Value for Superfine basalt fiber card board (Russian)	Values for Indian equivalent Ceramic Paper
Density, kg/cum, not greater than	200	200
Heat conductivity, W/(m ° C) at temperature 22+5 ° C, not greater than	0.038	0.038
Sorption humidity, % by weight, not greater than	5.0	5
Content of organic binding agent by weight, %	0.0	7%
Thickness, mm	4.0	4
Application for temperature range, ° C	From (-)260 to (+) 700	From (-)260 to (+) 700

5.6. Glass Fabric and stitching thread :

Fabric enclosure and stitching thread materials for manufacturing blankets shall be of Glass fabric / Ceramic fabric and Glass threads / Ceramic threads respectively.

- a) Specification for Glass fabric T-23
- b) Material : Fibre Glass cloth
- c) Weave : Plain
- d) Thickness : 0.5 to 0.6mm mm
- e) Density : 600 GSM +/- 5%
- f) Threads/Inch : Warp-40, Weft-15 or Warp-28, Weft-18
- g) Working Temperature : 600⁰ C (Min)

Wrapping fabric used on thermal insulation must not have coarse defects (be cut or frayed) and needled by threads or roving lengthwise.

5.7. Metal Cladding:

As covering layer, following materials can be used .

Galvanized steel sheets (min 275 gsm zinc coated) as per IS 277 for all the piping and equipments other than steam turbine components and cross over piping .

Aluminum alloy sheet conforming to IS 737-2008 of designation 31000 with condition H6 shall be used as a covering layer of thermal insulation in steam turbine components. Size of Aluminum sheet for the insulation covering layer of steam turbine components and cross over piping shall be 0.8 mm thick x 1000 mm wide.

Self tapping screws shall be as per IS:7173 with protective coating (cadmium 5 micron or equivalent).

5.8. Sealant

Covering layer joint sealing material shall be MAS 94 or equivalent mastic compound as per relevant standards. Covering layer joint is sealed with sealing material to prevent any ingress of water to insulation layer.

5.9. Wire mesh

Twisted wire gauge N15-1.6 or welded wire mesh as per IS 4948 of 15 x 15 square pitch x 1.6 mm shall be used over the layer of insulation mat . It is permitted to use aluminum bands of ¾" x 0.5mm thick at a spacing of 300 mm over the outer layer of insulation mats with additional bands of ¾" x 0.5 mm thick at a spacing of 500mm over the aluminum cladding in place of wire mesh layering.

5.10. Plaster

For the plaster, Perlite sand with density 80 kg/cu.m, grain size 1.25 mm or fine grade perlite with particle size of 95% in the range of 0.106 to 1.25mm, Portland cement M-400 or Grade 43 ordinary Portland cement and water have to be used in right proportion. Following is the properties of Perlite cement plaster:

Table-6

Parameters	Value
1. Density, kg/cu.m,	300
2. Calculated heat conductivity in the structure, W/m deg C	$\lambda_K = (0.041 + 0.00029 t_m)$
3. Application for temperature not greater than , deg C	600

5.11. Protective Painting

Inner surface of the GI sheet covering on insulation shall be coated with an protective coating of the following brand or equivalent approved by the engineer and coating thickness shall be as per the manufacturers recommendation / relevant standards.

- a. Tufkote etch primer (M/s. Shalimar paint) or
- b. Bison wash primer (M/s. Berger paints) or
- c. Amerlock 400 (M/s. Goodlass Nerolac)

6.0 Thermal insulation for main steam turbine components

The work consists mounting of pre-fabricated mats on turbine casing, valves, cross over piping by fastening with bracing wires or wire pins in multiple layers as per the requirements of working documents. The scope includes cleaning of equipment, pipe surface, supply and laying of Al foil(on SS surface), welding of pins, supply, prefabrication of mats made by wrapping the required thickness of ceramic fiber blankets in glass fabric stitched with glass threads, compaction and laying of multiple layers of ceramic pre-fabricated mats to the required thickness, sewing the joints between mats together with glass threads, supply and laying of wire mesh, and cement plastering, supply , fabrication, and mounting of support racks, metal cladding and its corrosion protection, joint sealing of cladding, oil resistant painting on plastering, inspection.

HP turbine & Turbine drive components to be insulates are as below:

- a) High pressure turbine cylinder (HPC)
- b) Drive Turbine for feed pumps
- c) High pressure regulating valves
- d) High pressure stop valves
- e) Steam lines (SS cross over piping) from HPC to MSR
- f) Low pressure valves blocks
- g) Middle part of the low pressure cylinder (LPC)
- h) Steam lines (CS cross over piping) from MSR to LPC
- i) Steam discharge valves.
- j) Heating steam regulation valve
- k) Acoustic isolation of HPC and LPC housing

The insulation thickness, cladding thickness, single or double layer of cement plastering, Al foil etc., shall be done as per working documents and requirements of the manufacturer of the equipment. Typical multi layer insulation with cement plastering is shown for understanding the nature and scope of work.

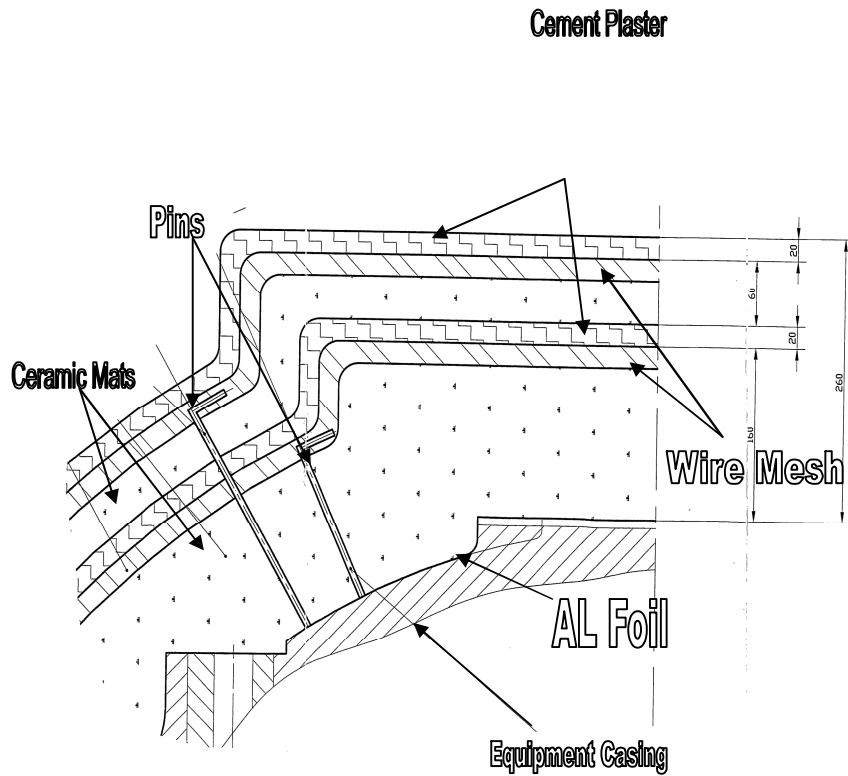


Fig1: Typical Multi Layer Insulation with Cement Plastering

6.1. Basic materials.

Thermo-acoustic insulation consists the following materials;

- Basalt super thin fiber (BSF) / Ceramic fiber stitched blankets(table-1)
- Glass fabric
- Glass thread or wire
- Aluminum foil of 0.10mm thickness
- Plaster of Perlite sand & portland cement
- twisted wire gauze
- Oil resistant painting based on polyvinylacetate dispersion of silvery color / equivalent on the plastered surfaces

- h) 4mm Dia Carbon steel pin shall be welded to surfaces to the turbine components prior to start of application of insulation mats.
- i) After full drying of the plaster , oil resistant painting to be done with the combination of materials given in the table -8 below in two coat application or Indian equivalent
- j) Aluminum foil of 0.10mm thickness as per relevant IS standard shall be used for wrapping over the stainless steel surfaces to be insulated as per the drawing.

Consumption of materials for 1 Sqm of plaster with thickness 20 mm

Table-7

The name of materials	Qty, Kg.
Perlite sand with density 80 Kg/ cu m.	3.15
Portland cement M-400 or Grade 43	2.85
Water	2.0

Consumption of materials for 10 Sqm of Polyvinylacetate covering

Table-8

No.	The name of materials	Qty, Kg.
1.	Polyvinylacetate dispersion DB 48/4C, DB 47/7C, DB 40/20C	3.200
2.	Ammonium chloride technical (I or II sort)	0.032
3.	Ortho phosphorus acid terminal type B II sort	0.054
4.	Silver dye stuff	0.060
5.	Water - fobic silica organical liquid GKJ-10, GKJ-11	0.054
6.	Water	1.600

6.2. Application

- a) Application and finishing of thermal insulation of the main steam turbine and Drive turbine for feed pump components is to be executed in full conformity with the

normative working documents, relevant standards and requirements of the manufacturer documents.

- b) The manufacturer's document consists assembly drawings of thermo-acoustic insulation and its application on main steam turbine, drive turbine, valves, cross over piping etc., The contractor has to prepare and submit the detailed procedure to NPCIL for approval before the start of work.

7.0 Piping and equipment Insulation

The work consists mounting of pre-fabricated mats on equipment and pipelines in single or multiple layers as per the requirements of working documents. the scope includes cleaning of equipment, pipe surface, supply and laying of Al foil (on SS surface), welding of pins, supply, prefabrication of mats made by wrapping the required thickness of mineral wool/ceramic fiber blankets in glass fabric stitched with glass threads, compaction and laying of multiple layers of pre-fabricated mats to the required thickness, sewing the joints between mats together with glass threads, supply and laying of wire mesh, and cement plastering, supply, fabrication, and mounting of support racks, metal cladding and its corrosion protection, joint sealing of cladding, oil resistant painting on plastering and inspection.

7.1. Thermal Insulation of piping of dia \leq 57mm:

For thermal insulation of pipelines of diameter 57 mm and less, thermal insulating rope / Ceramic fiber cords are to be used. Ropes are of the following diameters: 20, 30, 40, 50 & 60 mm. Deviations in diameter are allowed to be (+) 3mm. Ropes are to be supplied in coils. Roving made of glass threads are used as loom materials. In case of non availability of higher diameter rope, it is permitted to use multiple layer to build up the thickness. All stainless steel equipments and pipelines shall be provided with Aluminum foil prior to insulation.

The material specification shall be as per the requirements mentioned in table-4.

7.2. Erection of Insulation on pipelines and equipments:

1. Prerequisite

- a) Completion of pipe joints & hook up joints welding and its NDT examination.
- b) Insulation work on piping and equipment shall only be done when the system has been completely tested and cleared for insulation work by the Purchaser.
- c) Completion of painting and surface preparation on CS/SS surface.
- d) Carbon steel surfaces of piping and equipments to be insulated will be provided with anticorrosive painting. However, any painted surface area found peeled off or damaged and weld joints of insulation supports shall be coated with suitable high temperature resistance protective painting. The painted surface to be insulated shall be thoroughly cleaned and dried prior to fixing of insulation layer.
- e) Stainless steel surfaces of piping and equipments to be insulated shall be cleaned by acetone or kerosene with chloride contents not exceeding 25 ppm. After cleaning, the surface shall be wrapped carefully with aluminum foil of 0.10mm thick ensuring no direct contact of insulating material or no points for water entry from insulation system to the pipe / equipment surface.

7.3. Installation of insulation system

The thermal insulating mats shall be installed tightly to the insulated surface and shall be compacted down to the designed thickness. Compaction factors shall be as per specification, and designed thickness are given in the various SOQRs.

Application of Thermal insulation system consisting insulation mats/ thermal insulating cords, support devices, fastening elements, metal cladding etc on equipment and pipelines shall be done as per the drawings R01.KK.1.0.0.TI.OK.WD001 and technical requirements of document R01.KK.0.0.TI.TT.OK.WD001.

Detailed methodology for each type of insulation along with proposed quality plan shall be prepared submitted for approval before commencement of any insulation work. The Contractor shall submit application procedures for each type of insulation for acceptance by the engineer and carry out the work as per drawings

7.4. Insulation thickness :

The insulation thickness, indicated in the schedule of quantities and rates (SOQR) given in the tender document, shall be provided by the contractor. Preference will be given to the insulation materials having lower thermal conductivity (K value) and the

materials involving easier application and maintenance. The basis of selection of insulation thickness for various operating temperature, piping and equipment are given in the working document (TV). In case, no insulation thickness is specified in working documents for any of the system, the thickness of the insulation shall be provided as per the Table -09 given below.

Insulation thickness (in mm) for hot insulation (For reference only)

Table-09

PIPE SIZE NB-MM	TEMPERATURE (°C)				
	UP TO 100	101-150	151-200	201-250	251-310
15	25	25	40	50	60
20	25	25	40	50	60
25	25	25	40	50	70
32	25	30	40	60	70
40	25	30	40	60	70
50	25	30	50	60	80
65	25	30	50	60	80
80	25	40	50	70	80
100	25	40	50	70	90
125	25	40	60	70	90
150	25	40	60	80	100
200	25	40	60	80	100
250	25	40	60	80	110
300	25	40	60	90	110
350	25	40	60	90	110
400	25	40	70	90	120
450	25	40	70	90	120
500	25	40	70	90	120
550	25	50	70	90	120
600	25	50	70	90	120
>600 & EQUIPMENT, FLAT SURFACE	25	50	70	90	120

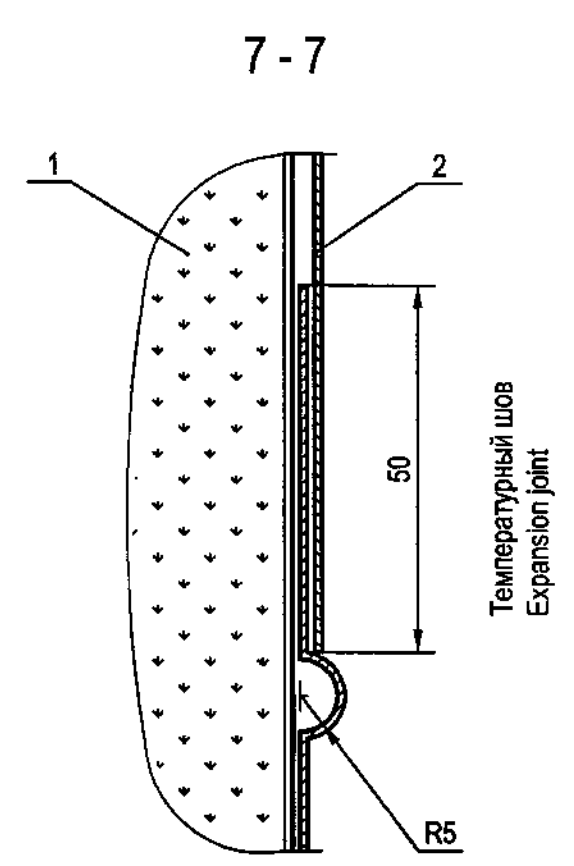
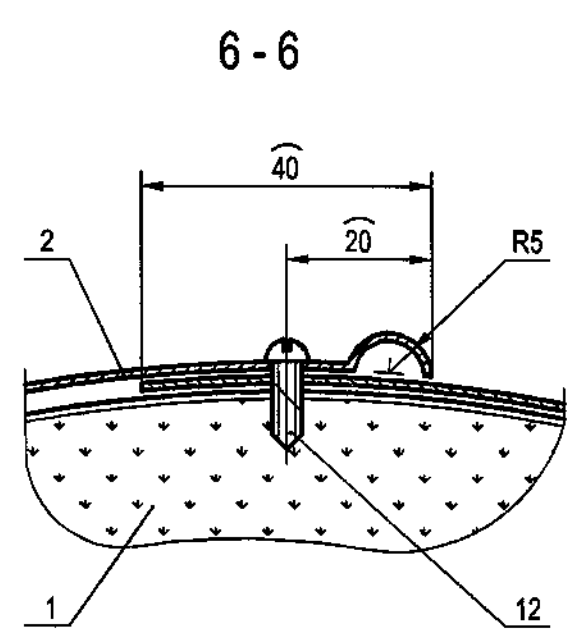
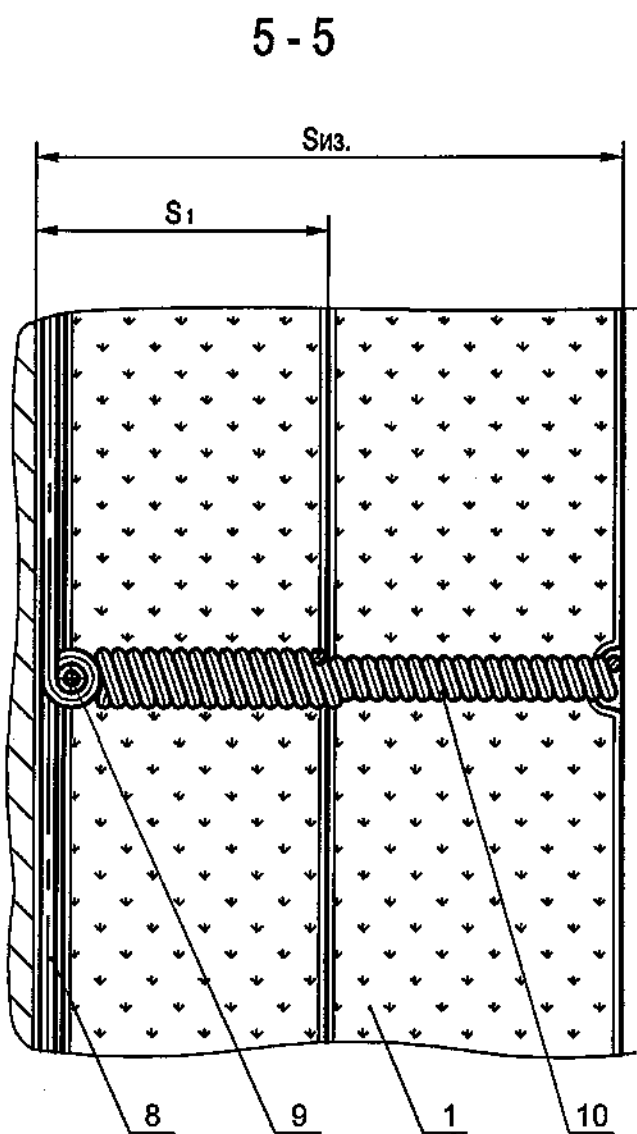
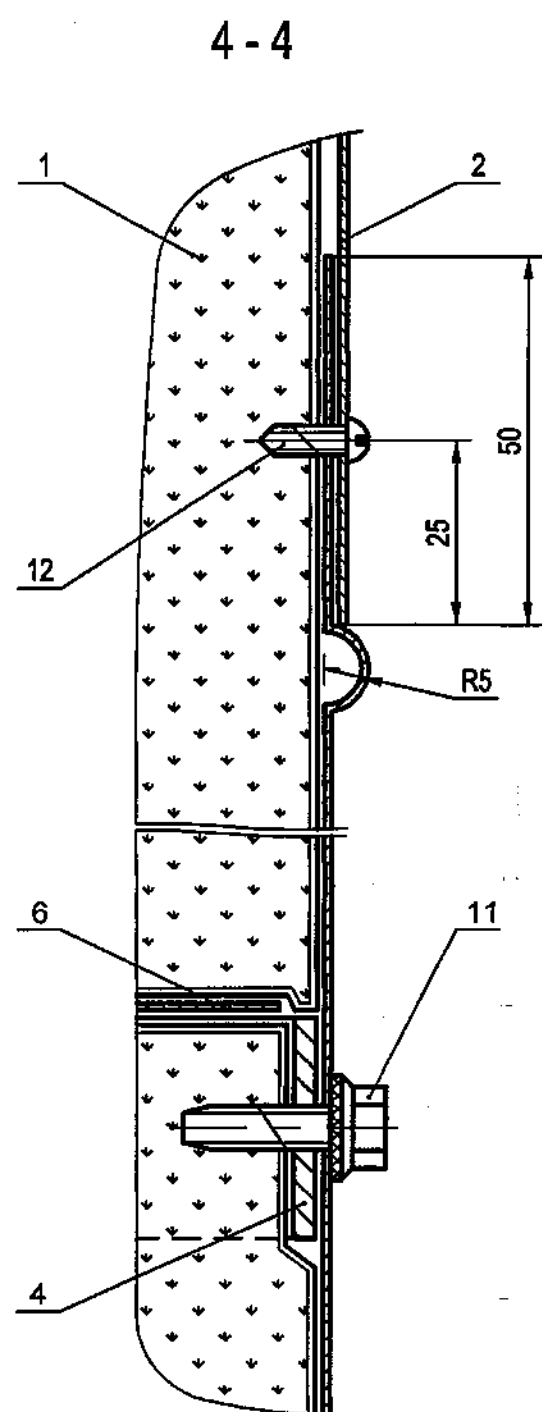
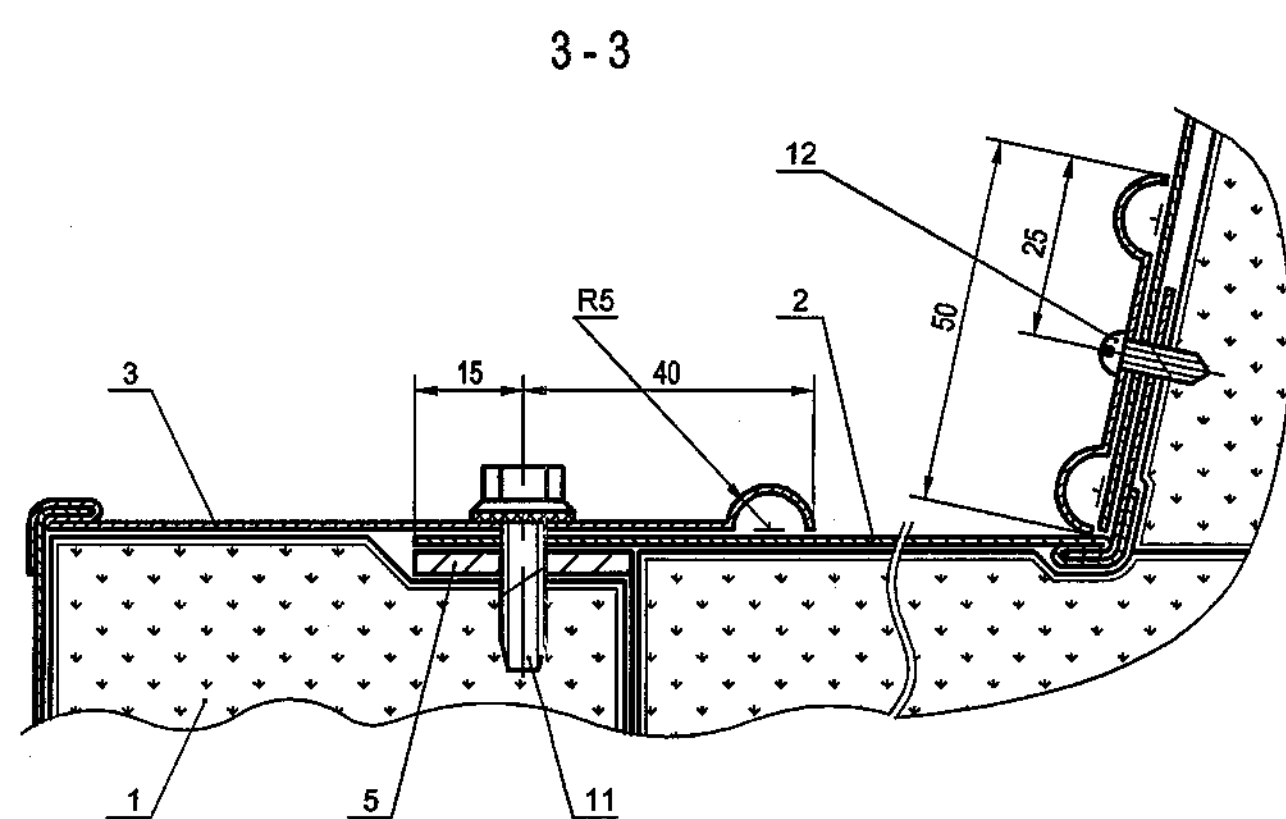
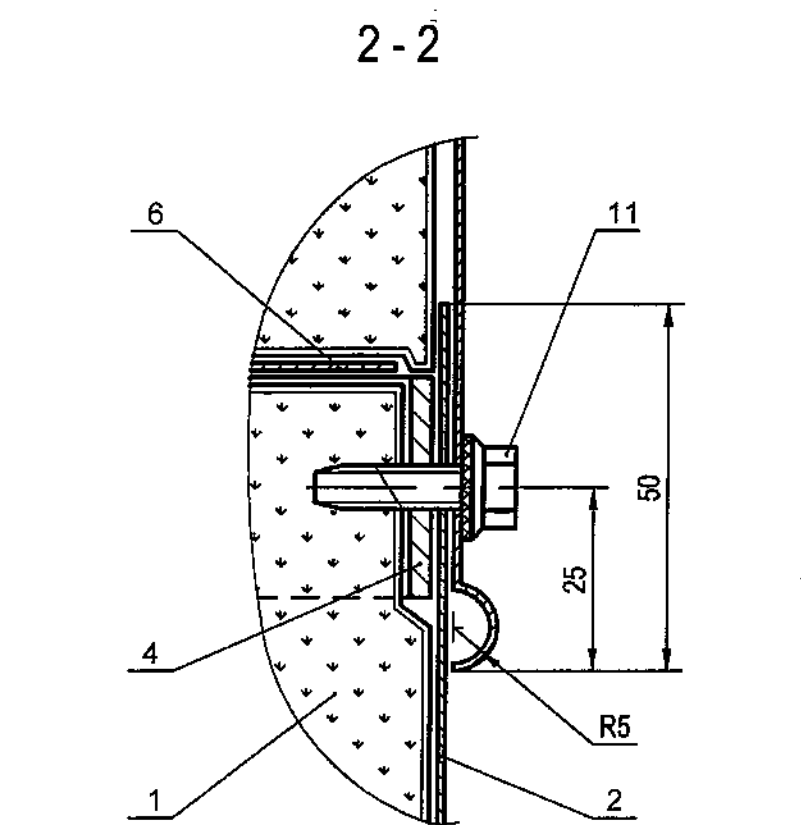
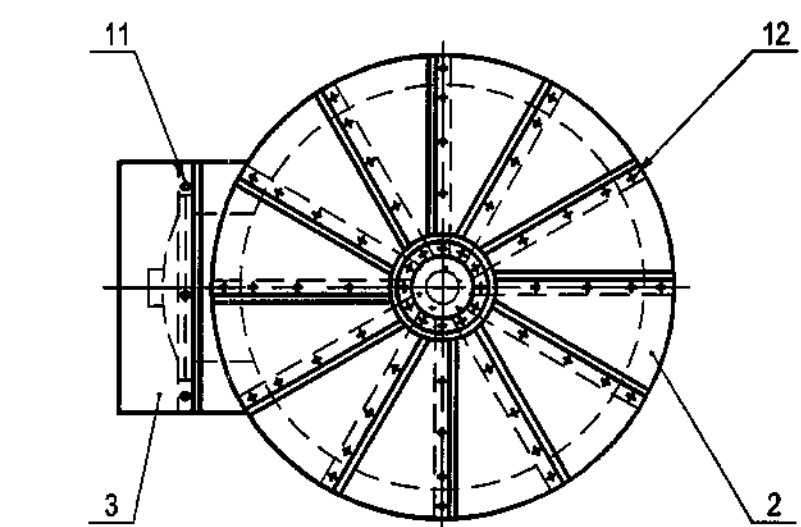
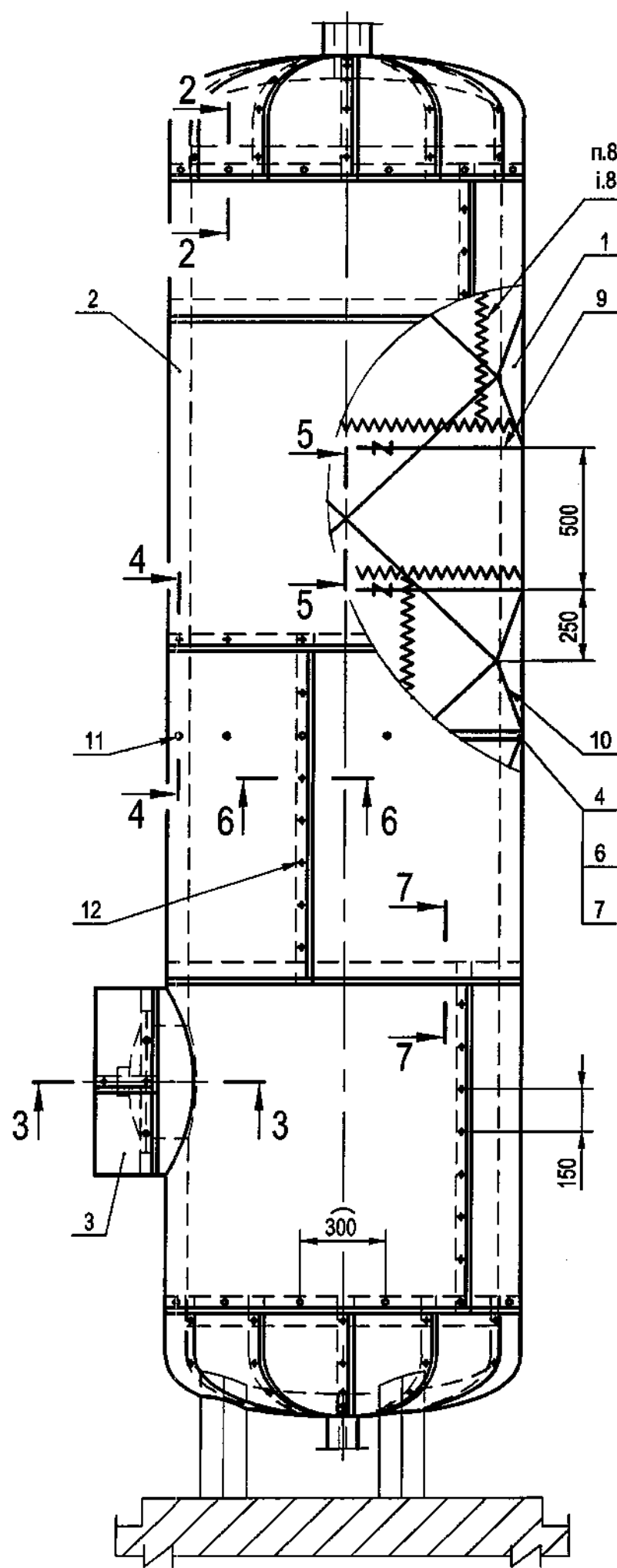
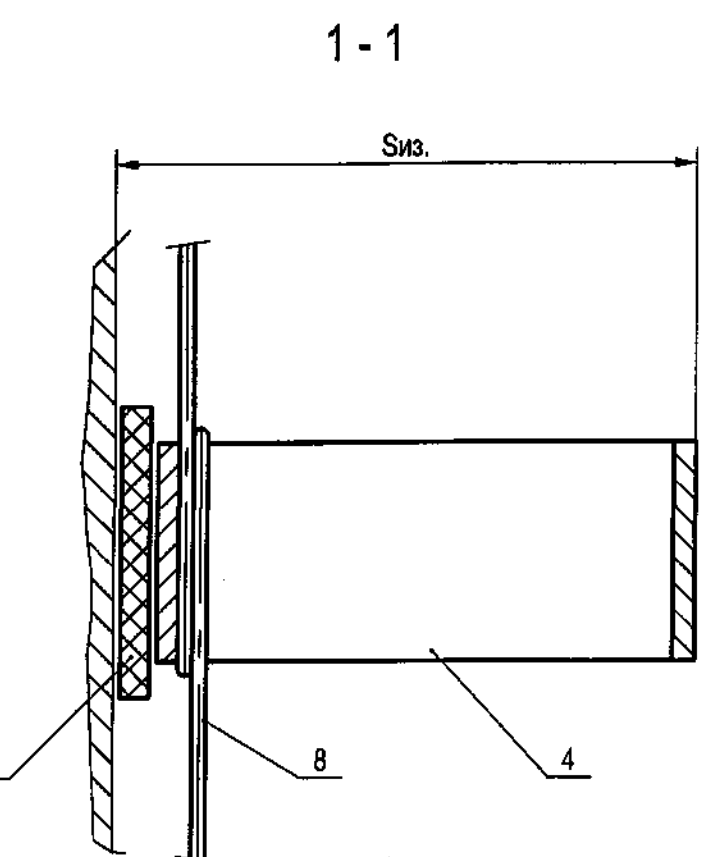
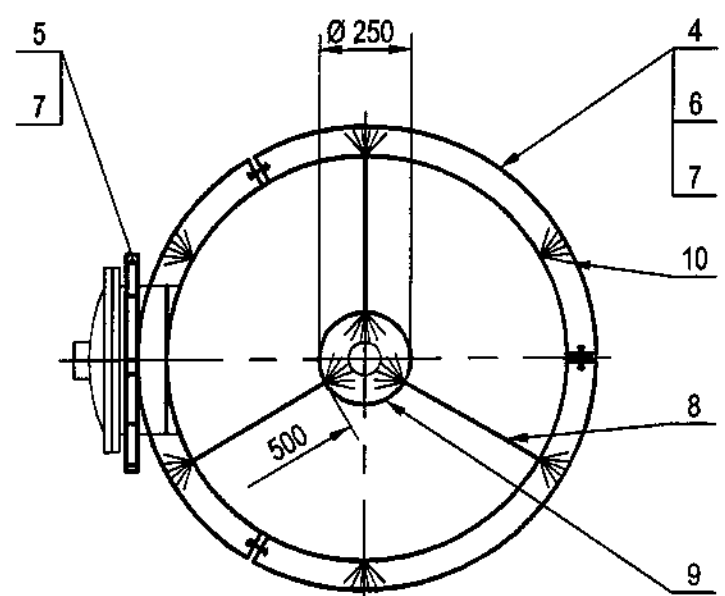
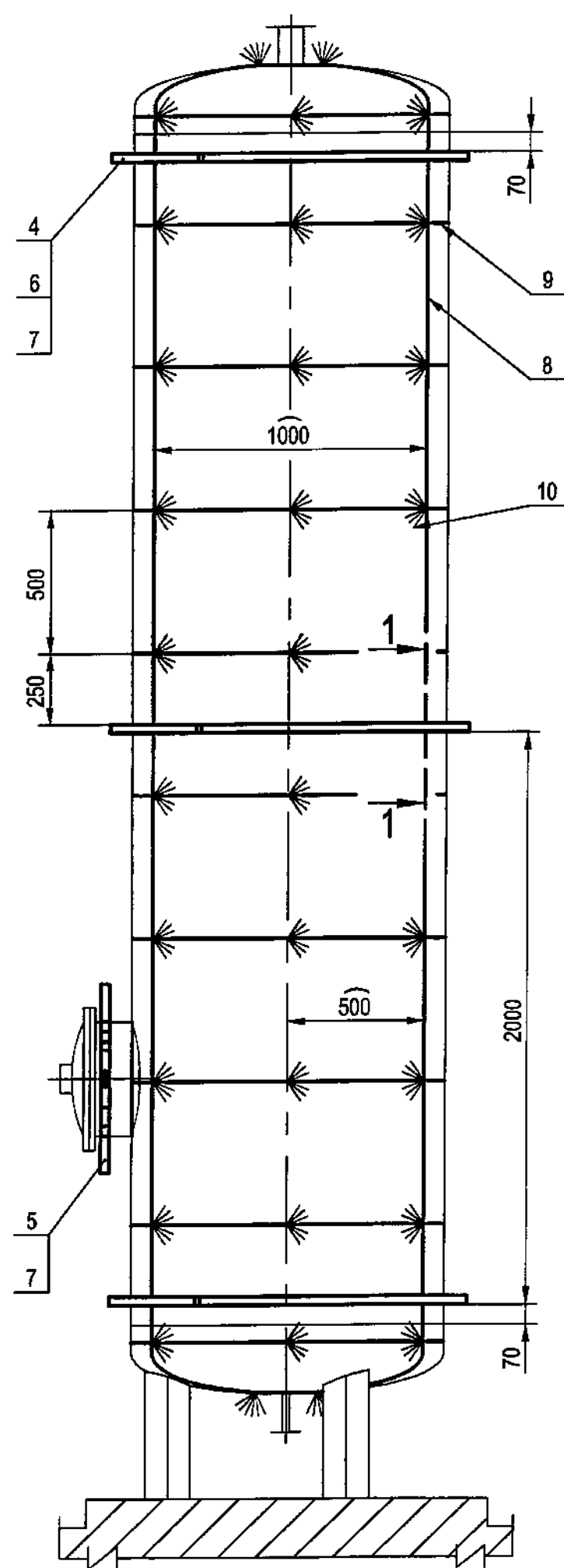
Insulation thickness given in Table-09 has been calculated based on the following parameters as given below;

Table10

Ambient temperature	35 deg C
Surface temperature	50 deg C
Wind velocity	0 m/s
Emissivity	0.60 (for GI cladding)
Material	Mineral wool mats 150kg/m3

7.5. Other requirements:

- a) Insulation shall be neatly applied with all edges tightly butted and joints shall be staggered. All joints and gaps shall be closely filled with the respective insulating material.
- b) The insulated surface areas of equipment and running lengths of pipes are estimated, in the schedule of quantities & rates in tender document only for the guidance of the Bidders.
- c) Measurement of insulation shall be as per IS 14164.
- d) Contractor shall not carry out any welding on the piping or equipment until permission is given by engineer.



СПЕЦИФИКАЦИЯ SPECIFICATION

Поз. Pos.	Обозначение Designation	Наименование Name	Кол. Qty	Масса Mass, kg	Примечание Note
Единицы Unit	Общая Total				
1	-	Маты в стеклоткани Mats in glass fabric	-	-	Смотри пункт 2 See item 2
2	-	Металлопокрытие (лист) Metal covering (sheet)	-	-	Смотри пункт 2 See item 2
3	R01.KK.1 0.0.TI. OK.WD001, лист 51 sheet	Кожух люка Hatch casing	-	-	Смотри пункт 2 See item 2
4	R01.KK.1 0.0.TI. OK.WD001, лист 46 sheet	Опорная полка Support rack	-	-	
5	R01.KK.1 0.0.TI. OK.WD001, лист 28 sheet	Опорное кольцо Support ring	-	-	
6	R01.KK.1 0.0.TI. OK.WD001, лист 47 sheet	Диафрагма (лист толщиной 0,8 мм) Diaphragm (sheet 0,8 mm thick)	-	-	
7	-	Прокладка (картон толщиной 4 мм ТУ 21-5328981-08-93) Gasket (cardboard 4 mm thick ТУ 21-5328981-08-93)	-	-	
8	-	Струна (проволока Ø2 мм) String (wire Ø2 mm)	-	-	Смотри пункты 5,6 See items 5,6
9	-	Кольцо (проволока Ø2 мм) Ring (wire Ø2 mm)	-	-	Смотри пункты 5,6 See items 5,6
10	-	Стяжка (проволока Ø2 мм) Tie-rod (wire Ø2 mm)	-	-	Смотри пункты 5,6 See items 5,6
11	ОСТ 34 13.016-88 ОСТ 34 13.016-88	Болт самонарезающий М6х20 Self-tapping bolt M6x20	-	-	
12	ГОСТ 10621-80 ГОСТ 10621-80	Винт самонарезающий 4x12.01.029 Self-tapping screw 4x12.01.029	-	-	

- 1 Sиз., S - толщины теплоизоляционных слоев.
- 2 Материал и толщина теплоизоляционного слоя (поз. 1) и металлопокрытия (поз. 2 и 3) указаны в "Исходных технических требованиях к теплоизоляционным материалам, изделиям и конструкциям" R01.KK.0.0.TI.TT.WD001 и технологических ведомостях.
- 3 Установку опорных полок и опорных колец смотри на листах 28 и 46.
- 4 Разгружающие устройства (поз. 4 и 5) изготовленные из углеродистой стали подлежат антикоррозионной защите.
- 5 При выполнении тепловой изоляции оборудования изготовленного из нержавеющей стали применить струны (поз. 8), кольца (поз. 9) и стяжки (поз. 10) из проволоки 2,0-ТС ГОСТ 18143-72.
- 6 При выполнении тепловой изоляции оборудования изготовленного из углеродистой стали применить струны (поз. 8), кольца (поз. 9) и стяжки (поз. 10) из проволоки 2,0-О-Ч ГОСТ 3282-74.
- 7 По поверхности теплоизоляционных слоев допускается применение бандога с пряжкой (лист 40) взамен кольца (поз. 9).
- 8 В качестве сшивки для матов:
 - в обкладке из кремнеземной ткани КТ-11 применить нить кремнеземную К11С6-180 (ТУ 6-48-52-90);
 - в обкладке из стеклоткани Т-23 применить нить стеклянную крученную комплексную ЕС6-28х1х2(100) (ГОСТ 8325-78).

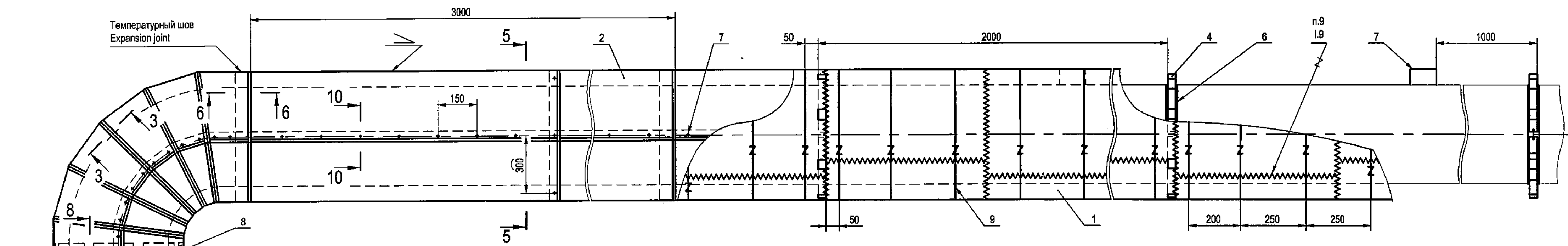
- 1 Sиз., S - thicknesses of heat-insulating layers.
- 2 The material and thickness of heat-insulating layer (pos. 1) and metal covering (pos. 2 and 3) are indicated in the "Initial technical requirements for thermal insulation materials, articles and structures" R01.KK.0.0.TI.TT.WD001 and in technological and mounting sheets.
- 3 For arrangement of support racks and support rings see sheets 28 and 46.
- 4 Unloading devices (pos. 4 and 5) made of carbon steel are subject to anticorrosive protection.
- 5 When performing heat insulation of the equipment made of stainless steel, 2,0-TS wire strings (pos. 8), rings (pos. 9) and tie-rods (pos. 10) GOST 18143-72 shall be used.
- 6 When performing heat insulation of the equipment made of carbon steel, 2,0-O-Ch wire strings (pos. 8), rings (pos. 9) and tie-rods (pos. 10) GOST 3282-74 shall be used.
- 7 Over the surface of heat-insulation layers it is allowed to use bandage with a buckle (sheet 40) instead of wire ring (pos. 9).
- 8 As stitching for mats:
 - in jacket made of silica fabric, mark КТ-11, silica thread К11С6-180 (ТУ 6-48-52-90) shall be used;
 - in jacket made of glass fabric mark Т-23 glass twisted complex thread ЕС6-28х1х2(100) (GOST 8325-78) shall be used.



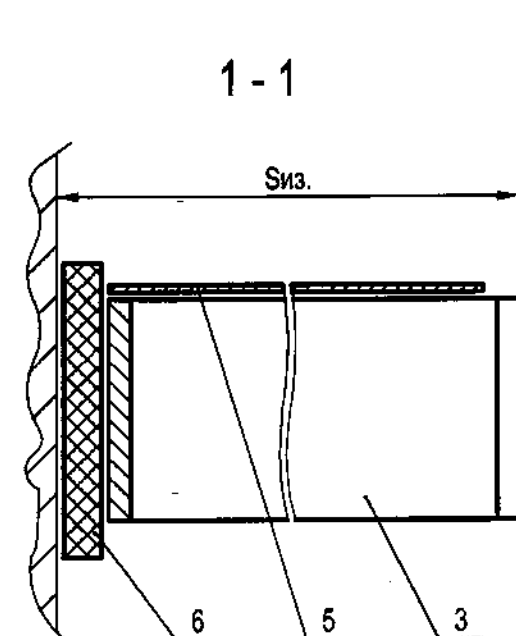
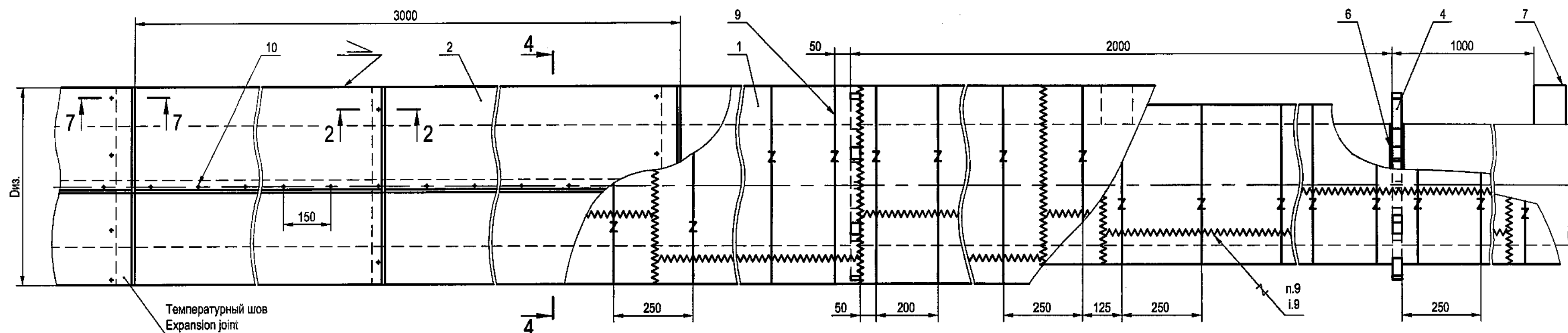
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Изм.	№	Лист	№	Подпись	Дата	Изм.	№	Лист	№	Подпись	Дата
Rev.	Nat.	Sheet	Doc. No.	Signature	Date	Rev.	Nat.	Sheet	Doc. No.	Signature	Date
Утвердил	Approved	Kazachkova				Утвердил	Approved	Kazachkova			
Н. контр.	Inspector	Sinityn				Н. контр.	Inspector	Sinityn			
Разработ.	Designed	Nikitina				Разработ.	Designed	Nikitina			
Оборудование вертикальное диаметром менее 1200 мм. Изоляция матами. Спецификация. Разрезы 1-1, 2-2, 3-3, 4-4, 5-5, 6-6, 7-7. Vertical equipment of less than 1200 mm in dia. Insulation by mats. Specification. Sections 1-1, 2-2, 3-3, 4-4, 5-5, 6-6, 7-7.						Стадия Лист Листов Phase Sheet Sheets WD 59					
FSUE "Atomenergoproekt" Moscow 2004						формат А2х3					

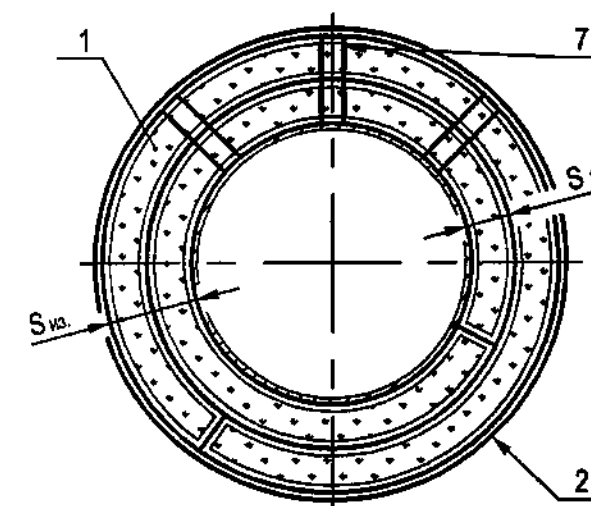
ИЗОЛЯЦИЯ В ОДИН СЛОЙ
ONE-LAYER INSULATION



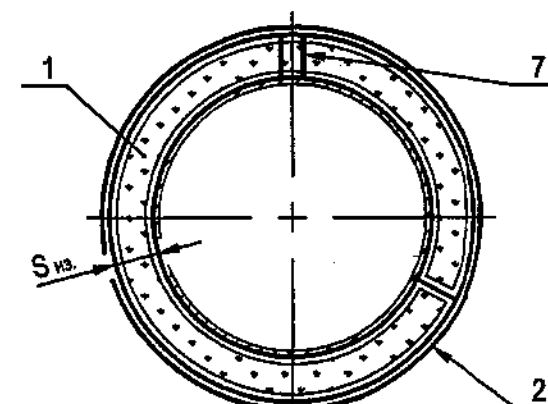
ИЗОЛЯЦИЯ В ДВА СЛОЯ
TWO-LAYERS INSULATION



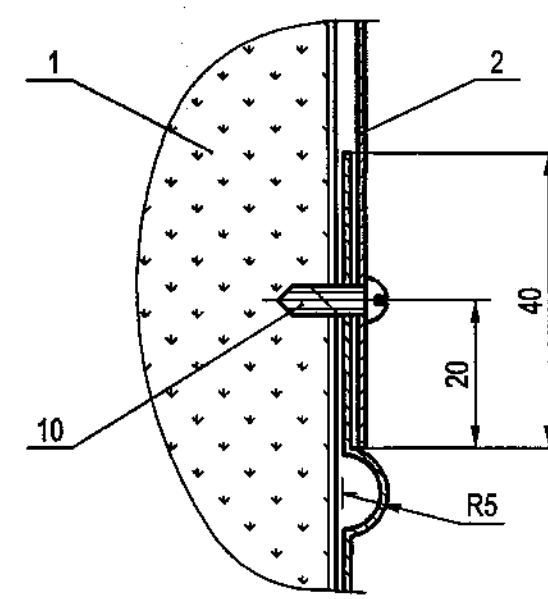
4 - 4
При Двз. > 350 мм
At Двз. < 350 мм



5 - 5
При Двз. < 350 мм
At Двз. > 350 мм

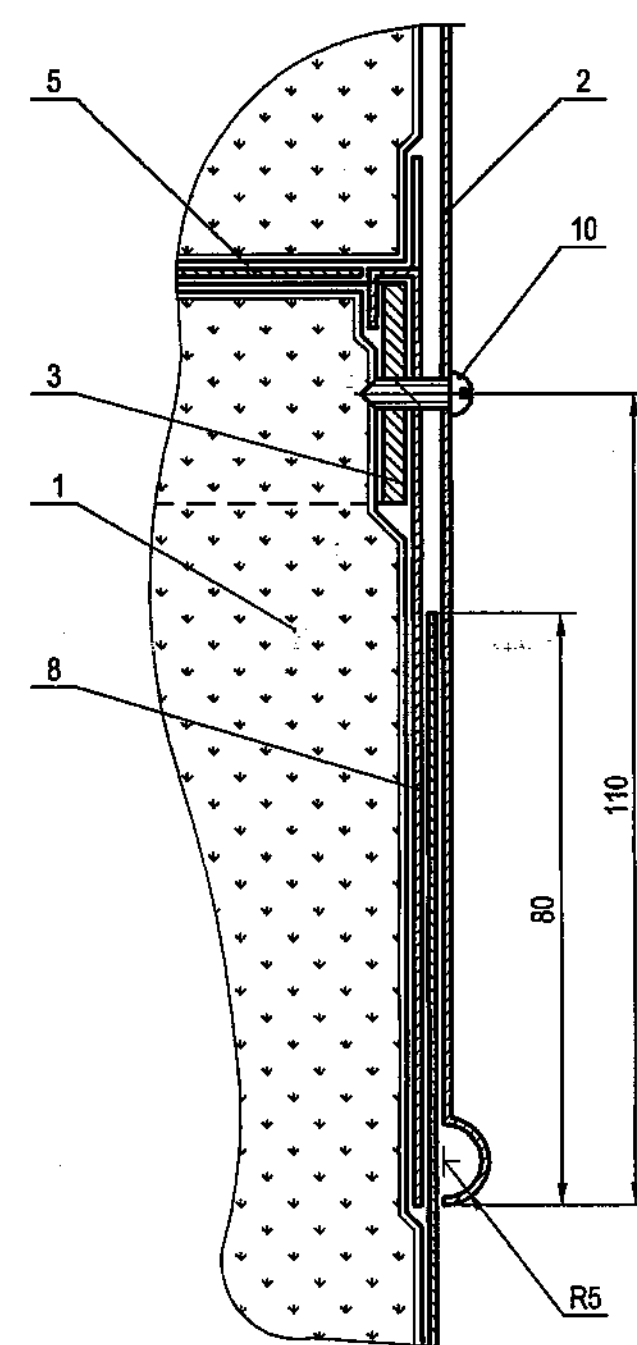


9 - 9

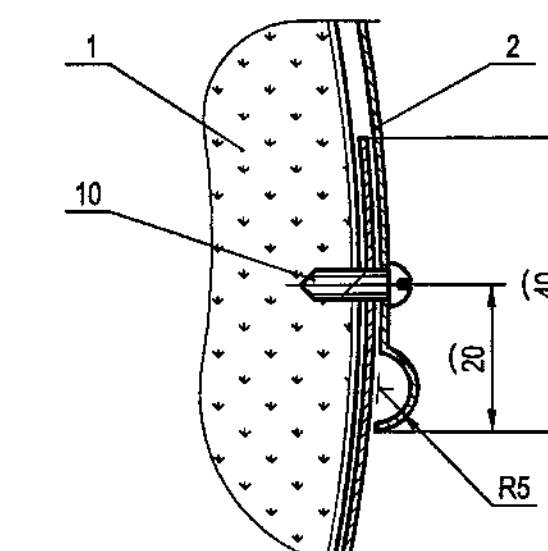


8 - 8

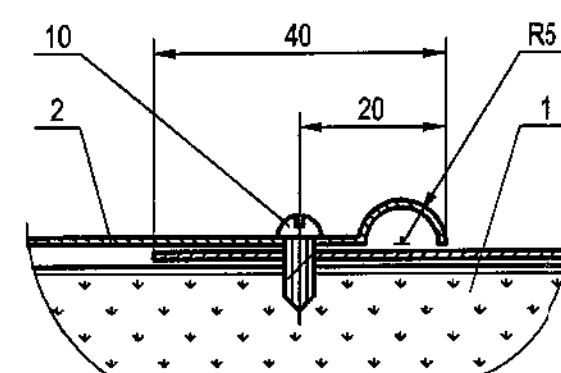
Для трубопроводов Ø57...820 мм
For pipelines Ø57...820 mm



10 - 10

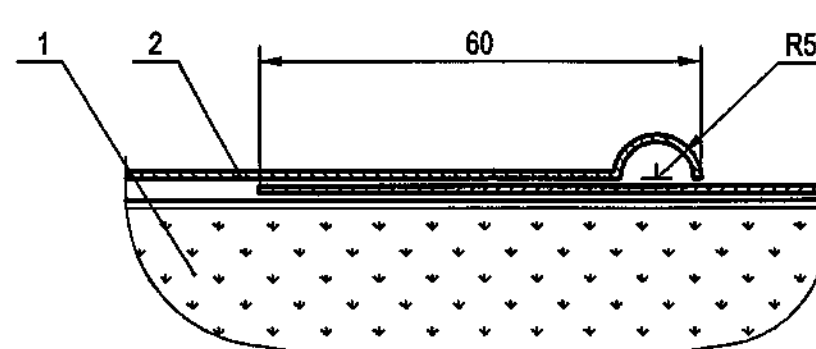


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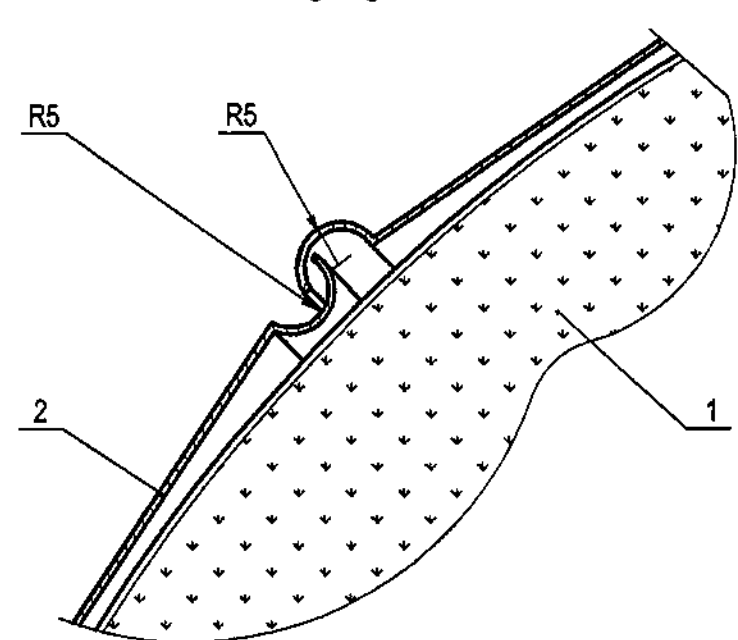


6 - 6

Температурный шов для трубопроводов Ø10...530 мм
Expansion joint for pipelines Ø10...530 mm

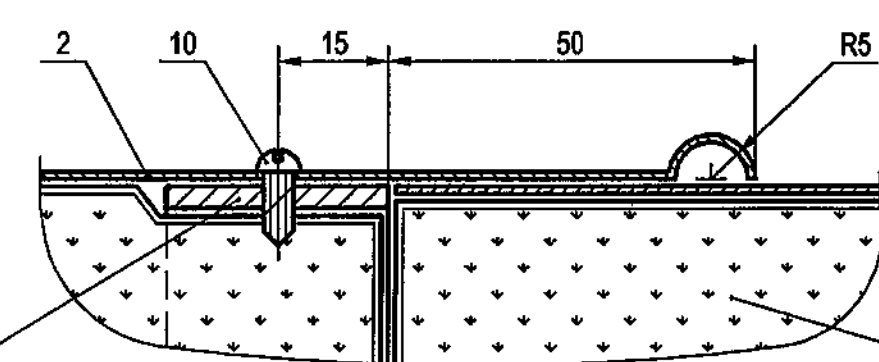


3 - 3



7 - 7

Температурный шов для трубопроводов Ø630...820 мм
Expansion joint for pipelines Ø630...820 mm



СПЕЦИФИКАЦИЯ
SPECIFICATION

Pos.	Обозначение Designation	Наименование Name	Кол. Q-ty	Масса Mass, kg	Примечание Note
Pos.	Designation	Name	Q-ty	Unit	Total
1	-	Маты в стеклоткани Mats in glass fabric	-	-	Смотри пункт 2 See item 2
2	-	Металлопокрытие (лист) Metal covering (sheet)	-	-	Смотри пункт 2 See item 2
3	R01.KK.1 0.0.TI. OK.WD001, лист 27 sheet	Опорная полка Support rack	-	-	-
4	R01.KK.1 0.0.TI. OK.WD001, лист 28 sheet	Опорное кольцо Support ring	-	-	-
5	R01.KK.1 0.0.TI. OK.WD001, лист 29 sheet	Диафрагма (лист толщиной 0,8 мм) Diaphragm (sheet 0,8 mm thick)	-	-	-
6	-	Прокладка (картон толщиной 4 мм ТУ 21-5328981-08-93) Gasket (cardboard 4 mm thick ТУ 21-5328981-08-93)	-	-	-
7	R01.KK.1 0.0.TI. OK.WD001, лист 30 sheet	Скоба опорная Support clamp	-	-	-
8	-	Манжета (лист) Gland (sheet)	-	-	Смотри пункт 10 See item 10
9	-	Кольцо (проволока Ø2 мм) Ring (wire Ø2 mm)	-	-	Смотри пункты 6,7 See items 6,7
10	ГОСТ 10621-80 GOST 10621-80	Винт самонарезающий 4x12.01.029 Self-tapping screw 4x12.01.029	-	-	-

- 1 Сиз., S - толщины теплоизоляционных слоев;
Двз. - диаметр изолированного трубопровода.
- 2 Материал и толщина теплоизоляционного слоя (поз. 1) и металлопокрытия (поз. 2) указаны в "Исходных технических требованиях к теплоизоляционным материалам, изделиям и конструкциям" R01.KK.0.0.TI.TT.WD001 и техномонтажных ведомостях.
- 3 Установку опорных полок, опорных колец и опорных скоб смотри на листах 27, 28 и 30.
- 4 Разгружающие устройства (поз. 3, 4, 7) изготовленные из углеродистой стали подлежат антикоррозионной защите.
- 5 На горизонтальных участках трубопроводов Ø630 мм и более при толщине изоляции 80 мм и более установить кольца опорные с шагом 2000 мм.
- 6 При выполнении тепловой изоляции трубопроводов изготовленных из нержавеющей стали применить кольца (поз. 9) из проволоки 2,0-ТС ГОСТ 18143-72.
- 7 При выполнении тепловой изоляции трубопроводов изготовленных из углеродистой стали применить кольца (поз. 9) из проволоки 2,0-О-Ч ГОСТ 3282-74.
- 8 Допускается применение бандаж с пряжкой (лист 40) взамен кольца (поз. 9).
- 9 В качестве шнурки для матов:
- в обкладке из кремнеземной ткани КТ-11 применить нить кремнеземную К11С6-180 (ТУ 6-48-52-90);
- в обкладке из стеклоткани Т-23 применить нить стеклянную крученную комплексную ЕС6-28х1х2(100) (ГОСТ 8325-78).
- 10 Манжету (поз. 8) изготовить из материала металлопокрытия.

- 1 Сиз., S - thicknesses of heat-insulation layers;
Двз. - pipeline diameter with insulation.
- 2 The material and thickness of heat-insulating layer (pos. 1) and metal covering (pos. 2) are indicated in the "Initial technical requirements for thermal insulation materials, articles and structures" R01.KK.0.0.TI.TT.WD001 and in technological and mounting sheets.
- 3 For arrangement of support racks, support rings and support clamps see sheets 27, 28 and 30.
- 4 Unloading devices (pos. 3, 4, 7) made of carbon steel are subject to anticorrosive protection.
- 5 On horizontal sections of pipelines Ø630 mm and more with insulation thickness of 80 mm and more, support rings with 2000 mm pitch shall be installed.
- 6 When performing heat insulation of pipelines made of stainless steel, 2,0-TS wire rings (pos. 9), GOST 18143-72, shall be used.
- 7 When performing heat insulation of pipelines made of carbon steel, 2,0-O-Ch wire rings (pos. 9), GOST 3282-74, shall be used.
- 8 It is allowed to use bandage with a buckle (sheet 40) instead of wire ring (pos. 9).
- 9 As stitching for mats:
- in jacket made of silica fabric, mark КТ-11, silica thread К11С6-180 (ТУ 6-48-52-90) shall be used;
- in jacket made of glass fabric, mark Т-23, glass twisted complex thread ЕС6-28х1х2(100) (GOST 8325-78) shall be used.
- 10 The gland (pos. 8) shall be used of metal covering material.

Package Number 1 116 124
File: R01.KK.1 0.0.TI.OK.WD001_08-0

R01.KK.1 0.0.TI.OK.WD001

АЭС "КУДАНКУЛАМ" БЛОК
NPP "KUDANKULAM" UNIT

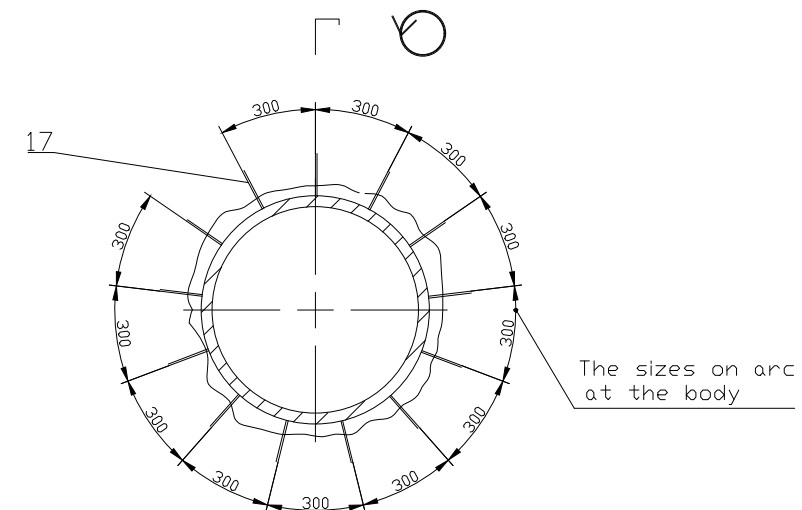
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Изм.	Н.уч.	Лист	Н.док.	Подпись	Дата	Стадия	Лист	Листов
Rev.	N.pat.	Sheet	Doc. No.	Signature	Date	Phase	Sheet	Sheets
Утвержден Approved				Kazachkova		WD	8	
Н. контр. Inspector				Sinitsyn				
Разработ. Designed				Nikitina				

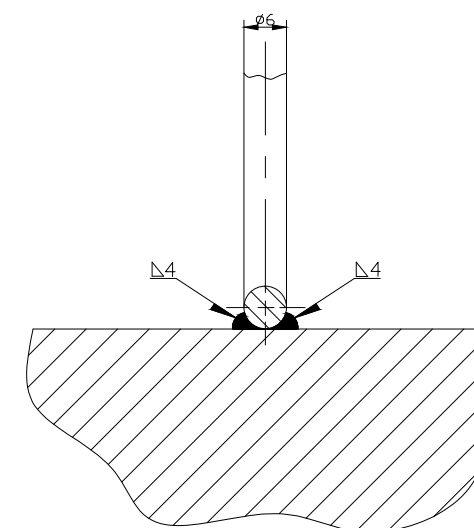
Трубопроводы Ø10...820 мм. Изоляция матов. Спецификация. Разрезы 1-1...10-10
Pipelines Ø10...820 mm. Insulation by mats. Specification. Sections 1-1...10-10

FSUE
"Atomenergoproekt"
Moscow 2004
формат А1

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The sizes on arc
at the body



Symbols

- + The places for welding of pins

- 1.The parts of framework pins end shelf to weld on SHP body.
- 2.Hand welding ГОСТ 9467-75.
3. * Sizes for reference only
- 4.The numbers of position are correspond by numbers in proces chart.

						3A. 61.03.00.00 AD						
Change Sheet	IN	Polocum	Signat	Date	Thermaquastic insulation of turbine					Litt.	Mass.	Scale
Designer					K-1000-60/3000-2						-	1:2
Check					Insulation and framework							
Inspector										Sheet		Sheets
Approved					C H P							

[illegible]

VOLUME-IA PART – I CHAPTER – III

FACILITIES & CONSUMABLES IN THE SCOPE OF CONTRACTOR / BHEL

(SCOPE MATRIX)

Sl.No	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
1.3.1	PART I			
1.3.1.1	ESTABLISHMENT			
1.3.1.1.1	FOR CONSTRUCTION PURPOSE:			
1.3.1.1.1.1	Open space for office	Yes		Free
1.3.1.1.1.2	Open space for storage	Yes		Free
1.3.1.1.1.3	Construction of bidder's office, canteen and storage building including supply of materials and other services		Yes	
1.3.1.1.1.4	Bidder's all office equipment, office / store / canteen/Consumables.		Yes	
1.3.1.1.1.5	Canteen facilities for the bidder's staff, supervisors and engineers etc		Yes	
1.3.1.1.1.6	Fire fighting equipment like buckets, extinguishers Etc		Yes	
1.3.1.1.1.7	Fencing of storage area, office, canteen etc of the bidder		Yes	
1.3.1.1.2	FOR LIVING PURPOSES OF THE BIDDER			
1.3.1.1.2.1	Open space for Labour colony	Yes		As provided by NPCIL
1.3.1.1.2.2	Living accommodation		Yes	
1.3.1.2	ELECTRICITY			Chargeable Basis
1.3.1.2.1	Electricity For construction Purposes			Prevailing rate of TANGEDCO
1.3.1.2.1.1	Single Point source	Yes		
1.3.1.2.1.2	Further distribution for the work to be done which include supply of materials and execution		Yes	
1.3.1.2.2	Electricity for the office, stores, canteen etc of the bidder which include:		Yes	

1.3.1.2.3	Distribution from single point including supply of materials and service		Yes	
1.3.1.2.4	Supply, installation and connection of material of energy meter including operation and maintenance		Yes	Calibration certificate to be provided
1.3.1.2.5	Duties and deposits including statutory clearances for the above		Yes	
1.3.1.2.6	Demobilization of the facilities after completion of works		Yes	
1.3.1.3	WATER SUPPLY			
1.3.1.3.1	For construction purposes		Yes	
1.3.1.3.2	Water supply for bidder's office, stores, canteen etc		Yes	
1.3.1.4	LIGHTING			
1.3.1.4.1	For construction work (supply of all the necessary materials) At office storage area At the preassembly area At the construction site /area		Yes	
1.3.1.4.2	For construction work (Execution of the lighting work / arrangements) At office storage area At the preassembly area At the construction site /area		Yes	
1.3.1.5	COMMUNICATION FACILITIES for site operations of the bidder			
1.3.1.5.1	Telephone, Fax, internet, internet, email etc		Yes	
1.3.1.6	COMPRESSED AIR SUPPLY			
1.3.1.6.1	Supply of Compressor and all other equipments required for compressor & compressed air system including pipes, valves, storage systems etc		Yes	
1.3.1.6.2	Installation of above system and operation & maintenance of the same		Yes	
1.3.1.6.3	Supply of the all the consumables for the above system during the contract period		Yes	

Sl.No	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
1.3.2	PART II			
1.3.2.1	ERECTION FACILITIES			
1.3.2.1.1	Engineering works for construction	Yes		In consultation with BHEL
1.3.2.1.2	Providing the erection drawings/ documents for all the equipment covered under this scope	Yes		
1.3.2.1.3	Drawings for construction methods		Yes	
1.3.2.1.4	As-built drawings – wherever deviations observed and executed and also based on the decisions taken at site.		Yes	
1.3.2.1.5	Shipping lists etc for reference and planning the activities	Yes		
1.3.2.1.6	Fabrication shed (only empty shed)	Yes		Equipments for fabrication is in Bidder scope.
1.3.2.1.7	Preparation of site erection schedules and other input requirements		Yes	In consultation with BHEL
1.3.2.1.8	Review of performance and revision of site erection schedules in order to achieve the end dates and other commitments		Yes	
1.3.2.1.9	Weekly erection schedules		Yes	
1.3.2.1.10	Daily erection / work plan		Yes	
1.3.2.1.11	Preparation of preassembly bay		Yes	
1.3.2.1.12	Periodic visit of the senior official of the bidder to site to review the progress so that works are completed as per schedule. It is suggested this review by the senior official of the bidder should be done once in every two months.		Yes	

1.3.3 LAND FOR SITE OFFICE

- 1.3.3.1 Minimum open space as made available by customer will be provided at free of charges to the contractor, for construction of temporary office shed, storage area, storage shed, work shop etc. inside the plant area. All the arrangements will be subject to the approval of Engineer prior to setting up of such facility.
- 1.3.3.2 The contractor's office shall be semi permanent structure and built with standard construction materials. No make shift structures are permitted. The facilities to be built by the contractor shall be aesthetically pleasing and shall match with the general surrounding of KKNPP site.
- 1.3.3.3 Location and area requirement for office / storage sheds shall be discussed and mutually agreed to.
- 1.3.3.4 Any development of fabrication yard, storage area, etc. shall be done by the contractor within the quoted rates of the contract.

1.3.4 ELECTRICITY:

- 1.3.4.1 Construction power will be provided to the contractor – one point at each unit of required capacity from BHEL Panel board located in Turbine building of unit-3 & 4 and one point for Contractor office & storage area from nearest BHEL Panel board by BHEL on chargeable basis at the applicable rate of TANGEDCO under LT tariff. The present LT tariff rate of TANGEDCO is
 - a) Consumption charges: The prevailing rate of TANGEDCO is Rs.12.00 per unit
 - b) Fixed MD charges as applicable per month
 - c) Electricity Tax on total amountThe TANGEDCO tariff and tax may vary from time to time and same shall be charged to the contractor. Digital Energy meter capable of recording KVA, KWh & Maximum demand shall be installed by the contractor on the distribution panel for measuring the consumption. Any dispute regarding consumption, the BHEL engineer's decision is final. The contractor shall make their own arrangement for further distribution to the site of work using armored Power cable and MCB distribution boards.
- 1.3.4.2 Contractor to maintain log sheet with BHEL engineering in charge signature for weekly/ monthly power consumption and healthiness of ELCB.
- 1.3.4.3 Provision of distribution of electrical power from the given points to the required places with proper distribution boards, approved cables and cable laying including supply of all

materials like cables, switch boards, pipes etc., observing the safety rules laid down by electrical authority of the State/ BHEL / their customer with appropriate statutory requirements shall be the responsibility of the tenderer / contractor.

- 1.3.4.4 BHEL is not responsible for any loss or damage to the contractor 's equipment as a result of variations in voltage / frequency or interruptions in power supply.
- 1.3.4.5 Necessary "Capacitor Banks" to improve the Power factor to a minimum of 0.9 shall be provided by the contractor at their cost. Penalty if any levied by customer on this account will be recovered from contractor's bills.
- 1.3.4.6 As there are bound to be interruptions in regular power supply, power cut/load shedding in any construction sites, contractor should make their own arrangement for alternative source of power supply through deployment of adequate number of DG sets at their cost during the power breakdown /failure to get urgent and important work to go on without interruptions. No separate payment shall be made for this contingency.
- 1.3.4.7 All electrical installations/works shall be carried out by qualified electricians under supervision GOVT approved electrical contractor as per IE Guide lines and Safety procedure of NPCIL. The same shall be maintained properly and regular periodic maintenance shall be carried out to ensure healthiness of electrical system.
- 1.3.4.8 All cabling and installations shall be subject to the approval of the Engineer/Safety Engineer and shall comply in all respects to the appropriate statutory requirements given in the following.
 - i. Indian Electricity Act 1910 (as amended/latest)
 - ii. Electricity Supply Act 1910 (as amended/latest)
 - iii. Indian Electricity Rules 1956 (as amended/latest)
 - iv. TNEB regulations (latest)

For this purpose, the Contractor shall provide full specifications of the equipments and the layout drawings. Approval of the Engineer does not relieve the Contractor's responsibility from complying with any or all other conditions laid down in this section.

1.3.4.9 DOMESTIC POWER SUPPLY FOR LABOUR CAMP

The Contractor shall make his own arrangements to obtain and distribute the power supply from TNEB/TANGEDCO for the labour colony and other domestic purposes. All internal wiring shall be done as per the requirements of relevant Indian standards. Any duty, deposit involved in getting the Electricity for labour colony shall be borne by the bidder.

1.3.5 CONSTRUCTION WATER

- 1.3.5.1 BHEL/NPCIL will not be able to supply water at plant site to the contractor. The Contractor shall make his own arrangements to meet the desired quality and quantity of construction water demand at his own cost from outside. Bore well is not permitted inside the plant area.
- 1.3.5.2 Contractor shall ensure quality of water used for construction as per relevant standards and shall submit periodic test certificates from NPCIL approved laboratories for the same. Contractor shall lay and maintain water supply lines to their construction site.
- 1.3.5.3 Contractor to construct suitable storage tanks to meet at least four day's water requirements at site. The contractor shall provide necessary number and capacity of electrical / diesel operated high lift pumps to ensure supply of water at the highest point of the structure.
- 1.3.5.4 The quality of the water shall meet the domestic purpose as per relevant IS standards. Periodical checking shall be done to ensure the quality of water being supplied.

1.3.6 DRINKING WATER

Drinking water shall be arranged by the Contractor at their cost from outside of KKNPP.

1.3.7 LIGHTING FACILITY

- 1.3.7.1 Adequate lighting facility and illumination level in line of Rule - 11 of Atomic Energy (Factories) Rules 1996 for buildings and outside area such as flood light, hand lights and area lighting shall be provided by the contractor at his own cost at the site of erection, at the storage of his materials and equipment and at temporary access roads within the working area. The contractor shall obtain the approval of the Engineer for the lighting arrangement prior to installation. The lighting fixtures used shall be of good quality with all its systems and control gears working in good condition.
- 1.3.7.2 The lighting network to be established during the construction phase shall be of semi - permanent nature using pre-fabricated channels, conduiting or cleating of cables etc. Hanging or indiscriminate looping of lighting cables is not acceptable and Engineer reserves the right to disconnect any lighting network carried out in an unsafe and untidy manner. Any recommendations given by the Engineer in this regard to improve the safety and aesthetic appearance of the electrical installations shall be binding on the Contractor.

- 1.3.7.3 All the electrical safety requirements stipulated at site from time to time shall be adhered and complied in order to ensure complete electrical safety of all installations as well as operation, control and protection etc.,
- 1.3.7.4 Contractors are encouraged to explore the possibility of using renewable and green energy sources such as solar energy and LED lighting in their premises at site and labor camp.

1.3.8 LAND FOR STAFF AND LABOUR CAMP

1.3.8.1 Land will be given, by **NPCIL** for the Contractor's colony. Land will be made available for the period of Contract. The Contractor shall make his own arrangement for water supply, electric supply, sanitation, access road and general cleanliness of his colony. All these amenities shall be got approved by the Engineer-in-Charge of BHEL and NPCIL prior to construction of the camp. The Contractor shall not permit any of his personnel to maintain any living quarters within the NPCIL land other than the land allotted for colony. In case the land allotted for setting up the camp / colony is on lease, the contractor shall pay the appropriate municipal taxes / duties as applicable.

In respect of any land allotted to the Contractor for purposes of or in connection with the Contract, the Contractor shall be a licensee subject to the following and such other terms and conditions as may be imposed by licensor:

- i) that he shall pay a nominal license fee of Rs..1 per hectare per year or part of a year for use and occupation, in respect of each and every separate area of land allotted to him.
- ii) that such use or occupation shall not confer any right of tenancy of the land to the Contractor.
- iii) that the Contractor shall be liable to vacate the land on demand by the Engineer-in-Charge.
- iv) that the Contractor shall have no right to any construction over this land without the written permission of the Engineer-in-Charge. In case, he is allowed to construct any structure he shall have to demolish and clear the same before handing over the completed work unless agreed to the contrary. On completion of work, the Contractor shall handover the land duly cleaned to the Engineer-in-Charge. Until and unless the Contractor has handed over the vacant possession of land allotted to him for the above purposes, the payment of his final bill shall not be made. The Contractor shall be made liable to pay at the rate of Rs. 5,000 per week as a penalty for the use and occupation of land beyond 6 months from the date of physical completion of work.

- i) **In addition, the following Clause is applicable:**The Land for labour camp provided by NPCIL is at a distance of 1.6KM (approx) from plant Main gate & out side the project area but within the the over all plant boundary.
- ii) Contractor has to construct the labour camp with all required facilities in line with NPCIL/GOVT guide lines. Labour camp shall have spacious labour living rooms with adequate ventilation, toilet & both room blocks, canteen, Medical centre, common recreation hall with TV & some indoor game arrangement.
- iii) Contractor shall maintain the labour camp in neat and clean condition till completion contract at his cost
- iv) The contractor has to connect sewage from his labour camp to this facility through associated sewer line provided with necessary intermediate inspection chambers at his own cost.
- v) After completion of works, contractor shall at his own cost promptly dismantle all structures to restore the land to the original condition and vacate the area.
- vi) The Contractor shall provide adequate facilities for medical aid and treatment for his staff and workers engaged on the Project.
- vii) Contractor may note that a lot of trees are planted in the Project area. It shall be the Contractor's responsibility to ensure the prevention of cutting/felling of plantations by the workers employed by him. The Contractor will be penalized as decided by Engineer if it is found that his labours / employees are responsible for cutting /felling of plantations.

1.3.9 ONLINE SITE CONSTRUCTION MANAGEMENT SYSTEM

- i. Minimum 1 computer (along with one operator per PC) for online material management, reporting of daily progress, billing and other similar activities, within the quoted rate.
- ii. Computers shall have latest configuration of Windows.

1.3.10 SECURITY OF CAMP:

The following actions shall be taken by the Contractor to have adequate security and discipline at camp area:

- i) The contractor shall furnish a statement in every quarter showing the number of people permitted and occupying the area allotted by the Corporation.
- ii) The contractor shall control unlawful activities in the camp.

- iii) Contractor shall provide adequate security coverage and will be responsible for identification of people belonging to them and shall only allow people into the labour camp who are authorized by them.

1.3.11 WATER FOR LABOUR CAMP

BHEL/NPCIL will not be able to supply water to the contractor's labour camp. The contractor shall make his own arrangements to provide the same at his own cost. Borewell is not permitted in labour camp area. The quality and quantity of the water supplied at labour camp shall be as per WHO drinking standards.

1.3.12 CONSUMABLES:

- i. All consumables like gas, electrodes, wrap cloth, chemicals / lubricants for contractor's T&Ps, MMEs etc required for the job shall be arranged by the contractor at his cost.
- ii. Any special electrodes / consumables supplied by the manufacturing units for the respective packages / equipments will be issued free of cost. All other consumables, filler wires, electrodes (special & ordinary), gas, paint, etc. are to be arranged by the contractor at his cost.
- iii. All consumables to be used for the job shall have to be approved by BHEL prior to use.
- iv. In the event of failure of contractor to bring necessary and sufficient consumables, BHEL shall arrange for the same and recover the expenses incurred from the dues payable to contractor. Recoveries shall be actual expenses incurred plus 5% overheads or as defined in TCC.
- v. Contractor to obtain prior approval of BHEL/NPCIL, before procurement regarding, suppliers, type of electrodes etc. On receipt of the electrodes at site, it shall be subject to inspection and approval by BHEL/NPCIL. The contractor shall inform BHEL/NPCIL details regarding type of electrodes, batch number and date of expiry etc.
- vi. Other erection consumables such as wrap cloth, tapes, jointing compound, grease, lubricants, petrol, CTC / other cleaning agents, grinding and cutting wheels are to be provided by the contractor. Scaffolding materials and pre-assembly materials, hardware items etc required for temporary works such as supports, scaffoldings, bed are to be arranged by the contractor. Sealing compounds, gaskets, gland packing, wooden sleepers, for temporary work, required for completion of work shall be arranged by the contractor.
- vii. For all the temporary structures, contractor shall supply all the materials including welding electrodes and consumables.

1.3.13 MATERIAL SUPPLY BY BHEL/NPCIL (Free issue material):

- i. BHEL will supply the materials/equipments from their respective manufacturing units which are to be executed / incorporated in the permanent system. The actual quantities to be issued will be indicated in working documentation or to be worked out from the drawings by the contractor. The materials shall be released in phased manner depending on the planning / availability of areas based on the schedule of project.
- ii. The free issue supply materials issued to the contractor for the work shall not be used or diverted for any other work either on temporary basis or in a replacement basis. Contractor shall ensure that clear and distinct markings made on the free issue items are not obliterated. Contractor shall provide separate area in his works for stocking and storing these materials while these are in his custody.

1.3.14 GASES

- i. All the required gases like Oxygen / Acetylene / Argon / Nitrogen required for work shall be supplied by the Contractor at his cost. It shall be the responsibility of the contractor to plan the activities and store sufficient quantity of these gases. Non-availability of gases cannot be considered as reason for not attaining the required progress.
- ii. BHEL reserves the right to reject the use of any gas in case required purity is not maintained.
- iii. The contractor shall submit weekly / fortnightly / monthly statement report regarding consumption of all consumables for cost analysis purposes.
- iv. The contractor shall ensure safe keeping of the inflammable cylinder at a separate place away from normal habit with proper security etc.

1.3.15 STATUTORY REQUIREMENTS

Kudankulam Nuclear Power Project is guided by Central government rules and regulations.

Contractor shall comply all statutory regulations of State / Central Governments and NPCIL like Pradhan Mantri Rojgar Protsahan Yojana (PMRPY) scheme, Pradhan Mantri Garib Kalyan Yojana (PMGKY) scheme etc. Any guide lines / orders/notifications/ circulars issued by statutory body of both central /state governments and NPCIL from time to time is applicable for this contract. Any recovery by NPCIL towards non compliance of above and dual benefit to contractor of any govt announced scheme will be passed to the contractor .

1.3.16 FAIR WAGES

The bidders shall note that the minimum rates of remuneration to the various categories of workmen to be deployed under this contract shall not be less than the following:

- i. Higher of the minimum wages as declared by the Labour Authority of Centre/State
- ii. from time to time for the respective category of workmen to be paid. The contractor
- iii. shall pay to his workmen any increase in the minimum wages as notified from time to time during the period of contract.
- iv. The contractor has to provide free transport facility to his workmen.
- v. Bonus as per the statutory requirements (at present @ 8.33% of the wages) shall be paid to the workers separately either once or twice in a year (as per present regulation). Wage ceiling for calculation of bonus is minimum wage for the scheduled employment, as per para 15 (i) or Rs 7000/- , whichever is higher. Any changes as per statutory requirement shall be complied with from time to time.
- vi. EPF shall be paid as per the statutory requirements for all the workers (at present @ 13.15% of the wages by limiting the maximum wages as Rs.15000/-, even for those whose wages is more than Rs. 15000/-). Contractor should mandatorily have EPF registration irrespective of number of workers to be engaged by him. Further, contractor has to ensure PF coverage to all his workers at KKNPP irrespective of their exemption as per rules. He shall ensure regularly depositing of EPF as per prevailing statutory norms for the workmen deployed for the subject work and proof of deposit shall be produced along with monthly R.A. bills for processing of the next R.A. bill. The contractor shall comply with all the existing/revised provisions of the employee's provident funds and miscellaneous provisions Act, 1952. The contractor should maintain record of statutory EPF amount deposited in the respective EPF accounts of his workers and submit the same with every RA Bill. Contractor is also required to submit EPF returns details of all workers employed in this contract in the prescribed forms 3A, 6A and 12A to the EPF authority with copy to the Engineer.
- vii. Contractor shall make payments to the workmen only through Bank. For this purpose, the Contractor shall ensure that all the workers are having a bank account and if not, he shall facilitate the worker for opening of an account. In isolated cases, if it is not possible to make payments to any workers through Bank account, the approval of KKNPP Unit Head shall be obtained for making the payment by cash. In the event of cash payment to any contract workers, the same shall be witnessed by an official of NPCIL HR section duly authorized by the Head of HR group of KKNPP. Every month the Contractor shall submit

documentary evidence (Bank statement of deposit of amount in each worker's bank account) to Engineer for verification, in the absence of which processing of next RA bill will not be done.

1.3.17 OTHER FACILITIES

Adequate water less urinals shall be arranged by the contractor within quoted rates, with proper disposal arrangement.

1.3.18 CONTRACTOR'S OBLIGATION ON COMPLETION:

On completion of work, all the temporary buildings, structures, pipe lines, cable etc. shall be dismantled and leveled and debris shall be removed as per instruction of BHEL by the contractor at their cost. In the event of their failure to do so, the expenditure towards clearance of the same will be recovered from the contractor. The decision of BHEL Engineer in this regard is final.

VOLUME-IA PART-I CHAPTER- IV
TIME SCHEDULE

1.4.1 TIME SCHEDULE

- 1.4.1.1. The entire work of Insulation works for Turbine, Piping, Equipments etc. including handling of materials at site stores /storage yard, transporting to site, inspection, pre-assembly, erection, alignment, welding, painting and application of cement plastering & insulation as per requirement / drawings etc., at Unit-3 Kudnkaulam Nuclear Power Project shall be completed within **13 (Thirteen)** months from the date of commencement of work at site.
- 1.4.1.2. During the total period of contract, the contractor has to carry out the activities in a phased manner as required by BHEL to achieve the milestone events as programmed.
- 1.4.1.3. The erection work shall be commenced on the mutually agreed date between the bidder and BHEL engineer and shall be deemed as completed in all respect only when agreed mutually between bidder & BHEL. The decision of BHEL in this regard shall be final and binding on the contractor. The scope of work under this contract is deemed to be completed only when so certified by the site Engineer.
- 1.4.1.4. The contractor is required to refer Form 15 – Monthly performance evaluation of contractors in Volume-1 book-2 for all the instructions to be taken immediately after receipt of LOI.

1.4.2 COMMENCEMENT OF CONTRACT PERIOD

The date of commencement of contract period shall be the mutually agreed date between the bidder and BHEL engineer to start the work. In case of discrepancy the decision of BHEL engineer is final.

1.4.3 MOBILISATION FOR ERECTION AND TESTING

- 1.4.3.1 The activities for erection, testing etc shall be started as per directions of Construction Manager of BHEL.
- 1.4.3.2 The contractor has to augment his resources in such a manner that following major milestones of erection & testing are achieved on specified schedules mentioned below.

1.4.4 TENTATIVE MILESTONE SCHEDULE FOR UNIT 3

Sl. No.	Milestone Description	Milestone Month (Tentative) for Unit 3
1	Start of work	1 st Month
2	Insulation work completion for Piping & Equipment's	08 th Month
3	Insulation work completion for Main Turbine	12 th Month
4	Completion of Contractual Obligations	13 th Month

1.4.4.1 In order to meet the schedule in general, and any other intermediate targets set, to meet customer/ project schedule requirements, Contractor shall arrange & augment all necessary resources from time to time on the instructions of BHEL Engineer.

1.4.4.2 In case the project is to be advanced, the erection works in the scope of the contractor is to be advanced to meet the project requirement. No extra payment whatsoever shall be paid on this account.

1.4.5 MAJOR INTERMEDIATE MILESTONES

Sl. No.	Intermediate Milestone Description	Completion from the contractual date of start of the work at site	Intermediate Milestone
1	Insulation work completion for Equipment & Piping for Unit-3	08 th Month	M1
2	Insulation work completion for Main Turbine for Unit-3	12 th Month	M2

1.4.6 PENALTY FOR INTERMEDIATE MILESTONES

- M1 and M2 shall be intermediate milestone of this work.
- In case of slippage of these identified Intermediate Milestones, Delay Analysis shall be carried out on achievement of each of these two Intermediate Milestones in reference to Form 14.
- In case delay in achieving each M1 milestone is solely attributable to the contractor, 0.5% per week of executable contract value* limited to maximum 1% of executable contract value will be withheld.

- iv. In case delay in achieving each M2 milestone is solely attributable to the contractor, 0.5% per week of executable contract value* limited to maximum 1.5% of executable contract value will be withheld.
- v. Amount already withheld, if any, against slippage of M1 milestone, shall be released only if there is no delay attributable to contractor in achievement of corresponding M2 milestone.
- vi. Amount required to be withheld on account of slippage of identified intermediate milestone(s) shall be withheld out of respective milestone payment and balance amount (if any) shall be withheld @10% of RA Bill amount from subsequent RA bills.
- vii. Final deduction towards LD (if applicable), on account of delay attributable to contractor shall be based on final delay analysis on completion / closure of contract. Withheld amount, if any due to slippage of intermediate milestones shall be adjusted against LD or released as the case may be.
- viii. In case of termination of contract due to any reason attributable to contractor before completion of work, the amount already withheld against slippage of intermediate milestones shall not be released and be converted in to recovery.

Note: * Executable contract value: - Value of work for which inputs/fronTS were made available to contractor and were scheduled for execution till the date of achievement of that milestone.

1.4.7 CONTRACT PERIOD

The contract period for completion of entire work under scope shall be **13 months** from the “COMMENCEMENT OF CONTRACT PERIOD” as specified earlier for completion of the entire work under this package.

1.4.8 GUARANTEE PERIOD

Guarantee period of 12 (Twelve) months shall commence from the date of completion of the entire work as specified in contract, as certified by BHEL Engineer.

VOLUME-IA PART-I CHAPTER-V

TERMS OF PAYMENT

1.5.1 Advance for Mobilization is not applicable for this tender.

1.5.2 Terms of Payment

BOQ item no	The following percentage of quoted rates of BOQ items will be paid on submission of respective reports along with RA bill after completion of relevant activities of the work on pro-rata basis.			
	Stage	1	2	4
	Work	45%	50%	5%
1.1 to 1.19	Application of multiple layer ceramic fibre insulation with cement plastering for HP turbine & Turbine drive components.	Pre fabrication Report	Application Report	CCC & Material Accounting Statement.
2.1 to 2.11	Application of mineral wool insulation on CS/SS pipelines and equipment's.	Pre fabrication Report	Application Report	CCC & Material Accounting Statement.
2.12	Application of mineral wool insulation on temporary pipeline.	Pre fabrication Report	Application Report – 30% Removal – 20%	CCC & Material Accounting Statement.
3.1 to 3.3	Application of ceramic wool insulation on rotary equipment's.	Pre fabrication Report	Application Report	CCC & Material Accounting Statement.
4.1 to 4.2	Application of insulation on CS/SS piping with cords.	Pre fabrication Report	Application Report	CCC & Material Accounting Statement.

Notes to Terms of payment:

- For PVC, ORC, RA Bill payment, Retention amount and Performance Security Deposit, please refer Part-II, Chapter-1: Corrections / Revisions in Special Conditions of Contract, General Conditions of Contract and Forms & Procedures of Technical Conditions of Contract (Volume-I Book-I).

VOLUME-IA PART-I CHAPTER – VI

FACILITIES TO BE PROVIDED BY BHEL

- 1.6.1** **Empty shed will be provided by BHEL** to contractor at free of cost on sharable basis for establishing fabrication shop. Any partition required shall be carried out by the contractor at his cost. Allotment will be made by BHEL on need basis based on site requirement.
- 1.6.2** Any other Tools & Plants, testing facilities. Measuring instruments which are required for satisfactory completion of the work has to be arranged by the contractor.
- 1.6.3** In case of non-availability of the above, due to any unavoidable reason, like breakdown, overhaul etc., the contractor shall make arrangement at his own cost to meet the erection schedules. No extra claim will be admitted due to the non-availability of any of the above equipment. No delay in execution of work shall be accepted on this account.
- 1.6.4** The Contractor shall be responsible for the safe and proper use of the facility issued to him.
- 1.6.5** The contractor shall return the erection facilities provided to him by BHEL in good working condition as and when so desired by BHEL. (Completion or reduction in work load) for diversion for other work.
- 1.6.6** If at any time it is noticed that contractor is not using any of the facilities properly according to the instructions of BHEL, BHEL will have the right to withdraw any and all such equipment and facilities.
- 1.6.7** Any loss / damage to any or part of the above facility shall be to contractor's account and the expenditures on these accounts will be recovered from contractor's bills in case contractor fails to make good the loss.

VOLUME - IA PART – I CHAPTER – VII

T&P's AND MME's TO BE DEPLOYED BY CONTRACTOR

1.7.1 The following indicative Tools & Plants (T&P) shall be arranged by the contractor within the quoted rate for execution of the scope of works covered under this contract.

S. No.	Description	Qty.
01	Trailer	As per site requirement
02	Pick and carry crane – (12 to 16 MT)	
03	Scaffolding pipes	
04	Weaving machine/Motorized stitching machine	
05	Shearing machine	
06	Forming machine for insulation	
07	Folding machine for insulation	
08	Welding machines	
09	Electric winch 1T / 2T / 3T	
10	Mother oven	
11	Portable oven	

1.7.2 T&Ps mentioned above is tentative requirement considering parallel working in all areas mentioned in scope of work. However, mobilization schedule and quantity / numbers as mutually agreed at site for T&Ps, have to be adhered to. Numbers / time of requirement of T&Ps will be reviewed time to time by BHEL site and contractor will provide required T&Ps / equipments to ensure completion of entire work within schedule / target date of completion without any additional financial implication to BHEL. Vendor shall give advance intimation and certification regarding capacity etc. prior to dispatch of heavy equipments. Also, on completion of the respective activity, demobilization of T&P in total or in part can be done with the due approval of engineer in charge. Retaining of the T&P's during the contract period will be mutually agreed in line with construction requirement.

1.7.3 All the tools & plants , Measuring Monitoring Equipment (MME) , special tools which are required for this scope of work are to be arranged by the contractor within the quoted rates.

1.7.4 Depending upon the nature of work and availability of facilities locally, contractor may have to arrange for a temporary workshop for facilitating uninterrupted progress of work.

1.7.5 For handling at store and transportation, contractor shall make his own arrangement.

- 1.7.6** For transportation, material handling, loading & unloading of all components / equipments, the contractor has to make his own arrangements at his own cost. All necessary T&P such as, Trailers, Cranes Winches, welding generators, Slings, Jacks, Sleepers etc. are to be arranged by the contractor.
- 1.7.7** All the T & P, cranes, lifting tackles including wire ropes, slings, shackles and electrically operated equipment shall be got tested by NPCIL approved competent person of statutory authority. Test certificates obtained from the statutory authority shall be submitted to BHEL/NPCIL for their review and approval. NPCIL Safety clearance shall be obtained before they are actually put on use.
- 1.7.8** The age of all contractor deployed cranes shall be within 10 years as on date of deployment. Contractor has to provide documentary proof for the age of the crane at the time of deployment to the BHEL Engineer.
- 1.7.9** Crane operators deployed by the contractor shall be tested by BHEL/NPCIL before he is allowed to operate the cranes. The crane load test has to be conducted before deployment as per statutory guidelines.
- 1.7.10** The crane operators deployed must be capable of independently operating Hydraulic/Mechanical Crawler / Tyre mounted Cranes of respective categories. The crane operators must have relevant experience in Operation of Hydraulic/Mechanical Crawler / Tyre Mounted Cranes in respective categories & hold valid HMV / TRANS license. Should be able to read and interpret the operation and maintenance manual, boom load chart, boom angle and other indicating devices. Operator shall have latest Physician's certification for their physical fitness in vision with/without Lenses & adequate hearing with or without hearing aid. The operator hired by the contractor may be tested by BHEL/NPCIL Engineer for the suitability of the crane operation during any point of time while executing the contract.
- 1.7.11** The contractor to furnish a list of Tools and plants including tractors/trailers/trucks etc. which contractor proposed to deploy for this work.
- 1.7.12** Usage of wooden scaffolding material is prohibited.
- 1.7.13** In the event of non-mobilization of Tools, Plants, Machinery, Equipment, Material or non-availability of the same owing to breakdown and as a result progress of work suffered, BHEL reserves the right to make alternative arrangement (available or higher capacity) in line with SCC clause no. 4.2.1.7 and hire charges shall be applicable as under:

Case 1: BHEL provides its own Capital T&P: If BHEL provides owned T&P then BHEL, hire charges (as per BHEL norms) will be recovered from the contractor as per the prevailing BHEL Corporate hire charges applicable as per following cases

- In case the T&P is specifically listed in “T&Ps to be deployed by Contractor”, ‘Rates of hire charges applicable to outside agencies other than contractors working for BHEL’ will apply.
- In case the T&P is not specifically listed in “T&Ps to be deployed by Contractor”, ‘Rates of hire charges applicable to contractors working for BHEL’ will apply. The hire charges of Capital Tools & Plants are exclusive of operating expenses e.g., Operator, fuel & Consumables and the same shall be arranged by the contractor at his cost.

Case 2: BHEL provides hired T&P: In all cases other than that specified in SI No. 1 above, actual expenses incurred by BHEL along with applicable overheads will be back-charged to the contractor.

The present rates of BHEL’s Corporate Crane hire charge, are enclosed in part II of Technical Conditions of Contract. This may get revised further as per the BHEL corporate guidelines. The prevailing rates as on date of execution shall be applicable.

VOLUME - IA PART- I CHAPTER - VIII BILL OF QUANTITY			
KUDANKULAM NUCLEAR POWER PROJECT TG & SECONDARY CYCLE AND SEA WATER SYSTEMS (TSS) PACKAGE			
UNIT 3 - INSULATION WORKS BOQ			
Item No.	Work Description	UOM	Quantity
	Thermal Insulation Works		
1	<p><u>Application of multiple layer ceramic fibre insulation with cement plastering for HP turbine & Turbine drive components:</u> <u>Materials will be issued as Free issue material (FIM) by BHEL.</u> Application of insulation system with stitched mats of ceramic fibre of density 96kg/cum in single layer or in multiple layers enclosed in glass fabric, metal cladding, ceramic paper and aluminium foil, supporting components like pins, support racks, metal flats etc joint sealing, bandage, steel wire stitching/reinforcing, twisted steel wire mesh layering, zinc chromate painting on supporting structure, 2 x 20 mm thick cement plastering (portland cement with perlite sand), oil resistant painting on plastering for HP turbine & Turbine drive components with various categories and thickness in sub items, preparation of reports, inspection, temperature measurement on insulated surface and work completion as per the drawings, documents and specification with acceptance of BHEL & NPCIL Erection Incharge.</p> <p>The work scope includes shifting of materials from BHEL/NPCIL stores to site location, handling, inspection at store, preparation of IMIR (incoming material inspection report), fabrication of insulation mats & metal cladding, fabrication of supporting devices, stitching, cleaning, welding and touch-up painting of supporting devices, application, arrangement of man power, qualification of procedures, scaffolding and platforms, tools & tackles, P&M, supporting materials, paints, consumables including welding electrodes.</p> <p><u>Note:</u> 1. In some places, removable type insulations with toggle clips are required for flange joints, valves, manholes, instrumentation points, etc. In such cases, where removable type insulation are installed, no separate payment shall be made. 2. Material supplies is in the scope of BHEL. Materials will be issued as Free issue material (FIM). 3. All required consumables is in the scope of the contractor.</p>		
1.1	Lower Half of HP turbine in 4 layers of insulation + 2 layers of cement plastering with total thickness of 300 mm	Square Meter	33.0
1.2	Lower Half of Turbine drive in 4 layers of insulation + 2 layers of cement plastering with total thickness of 320 mm	Square Meter	15.0
1.3	Upper Half of HP turbine in 3 layers of insulation + 2 layers of cement plastering with total thickness of 240 mm	Square Meter	35.0
1.4	Upper Half of Turbine drive in 3 layers of insulation + 2 layers of cement plastering with total thickness of 260 mm	Square Meter	15.0
1.5	Valve's of LPC in 3 layers of insulation + 2 layers of cement plastering with total thickness of 260 mm	Square Meter	65.0
1.6	Flange joint of HP turbine in 3 layers of insulation + 1 layers of cement plastering with total thickness of 220 mm	Square Meter	13.0
1.7	Regulation & Automatic gate valve's body of HPC, Automatic gate valve's body, Throttle valve's body of Turbine drive, Flange joint of TDFP, Heat steam regulation valve body (LBB) in 3 layers of insulation + 1 layers of cement plastering with total thickness of 240 mm	Square Meter	133.0
1.8	Front and Rear seals of HPC in 2 layers of insulation + 1 layers of cement plastering with total thickness of 140 mm	Square Meter	8.0
1.9	Front and Rear seals of LPC and steam out valve body (MSR discharge valves- 4 nos.) in 2 layers of insulation + 1 layers of cement plastering with total thickness of 180 mm	Square Meter	50.0

**KUDANKULAM NUCLEAR POWER PROJECT
TG & SECONDARY CYCLE AND SEA WATER SYSTEMS (TSS) PACKAGE**

UNIT 3 - INSULATION WORKS BOQ

Item No.	Work Description	UOM	Quantity
	Thermal Insulation Works		
1.10	Middle part and flange joint of LPC in 1 layers of insulation + 1 layers of cement plastering with total thickness of 100 mm	Square Meter	165.0
1.11	Steam to & from seals of LPC(LBW&MAM) in 1 layers of insulation +1 layers of cement plastering with total thickness of 130 mm	Square Meter	18.0
1.12	Valve's cover of HPC,LPC,Heat steam(LBB),Turbine drive and steam supply pipeline to HPC (MAA)+Compensator from MSR in 3 layers of insulation with Al cladding (with inside protective coating) total thickness of 220 mm	Square Meter	123.0
1.13	TDFP cross over pipes + Steam out valve's cover in 2 layers of insulation with Al cladding(with inside protective coating) total thickness of 160 mm	Square Meter	213.0
1.14	Steam to HPH-6 from HPC in 2 layers of insulation with Al cladding(with inside protective coating) total thickness of 140 mm	Square Meter	10.0
1.15	Steam to HPH-5, Dearator from HPC in 2 layers of insulation with Al cladding(with inside protective coating) total thickness of 130 mm	Square Meter	25.0
1.16	Steam to LPH-2,3 from LPC in 2 layers of insulation with Al cladding(with inside protective coating) total thickness of 110 mm	Square Meter	45.0
1.17	Pipes from HPC to MSR(SS cross over) in 1 layers of insulation+ 1 layers of cement plastering+ 1 layers of insulation with Al cladding(with inside protective coating) total thickness of 180 mm	Square Meter	753.0
1.18	Pipes from MSR to LPC(CS cross over) in 1 layers of insulation+ 1 layers of cement plastering+ 2 layers of insulation with Al cladding(with inside protective coating) total thickness of 240 mm	Square Meter	1,210.0
1.19	Housing of Turbine & Bearing pedestal's in 1 layers of insulation with steel gauze(wire mesh) thickness of 60 mm	Square Meter	445.0

**KUDANKULAM NUCLEAR POWER PROJECT
TG & SECONDARY CYCLE AND SEA WATER SYSTEMS (TSS) PACKAGE**

UNIT 3 - INSULATION WORKS BOQ

Item No.	Work Description	UOM	Quantity
	Thermal Insulation Works		
2	<p><u>Application of mineral wool insulation on CS/SS pipelines and equipments:</u> <u>Materials will be issued as Free issue material (FIM) by BHEL.</u> Application of insulation system with stitched mats of mineral wool with density of 120 Kg/Cum. enclosed in glass fabric, GI metal cladding with inside protective coating, supporting components (support ring is applicable for 325mm OD and above, flat and pin welding for equipments), binding wire, riveting, joint sealing with sealant, wrapping of aluminum foil (0.1mm thick) on SS pipe/equipment surface, ceramic cord bandage, mat stitching, steel wire stitching, zinc chromate painting on supporting structure, with various categories and thickness in sub items, preparation of reports, inspection, temperature measurement on insulated surface and work completion as per the drawings, documents and specification with acceptance of BHEL & NPCIL Erection Incharge. The work scope includes shifting of materials from BHEL/NPCIL stores to site location, handling, inspection at store, preparation of IMIR (incoming material inspection report), fabrication of insulation mats & metal cladding, fabrication of supporting devices, stitching, welding and touch-up painting of supporting devices, cleaning, application, arrangement of man power, scaffolding and platforms, tools & tackles, qualification of procedures, supporting materials, paints, P&M, consumables including welding electrodes.</p> <p><u>Note :</u> 1. In some places, removable type insulations with toggle clips are required for flange joints, valves, manholes, instrumentation points, etc. In such cases, where removable type insulation are installed, no separate payment shall be made. 2. Material supplies is in the scope of BHEL. Materials will be issued as Free issue material (FIM). 3. All required consumables is in the scope of the contractor.</p>		
2.1	CS pipes with mineral wool with single layer up to 50 mm thickness.	Square Meter	5,634.0
2.2	SS pipes with mineral wool with single layer up to 50 mm thickness.	Square Meter	240.0
2.3	CS pipes with mineral wool with single layer above 60mm ≤ T ≤ 90mm thickness.	Square Meter	10,021.0
2.4	SS pipes with mineral wool with single layer above 60mm ≤ T ≤ 90mm thickness.	Square Meter	159.0
2.5	CS pipes with mineral wool with double layer 60mm ≤ T ≤ 120mm thickness.	Square Meter	7,626.0
2.6	SS pipes with mineral wool with double layer 60mm ≤ T ≤ 120mm thickness.	Square Meter	282.0
2.7	CS equipments with mineral wool with single layer up to and including 50 mm thickness.	Square Meter	450.0
2.8	SS equipments with mineral wool with single layer up to and including 50 mm thickness.	Square Meter	116.0
2.9	CS equipments with mineral wool with single layer 60mm ≤ T ≤ 90mm thickness.	Square Meter	2,160.0
2.10	CS equipments with mineral wool with double layer on 60mm ≤ T ≤ 120mm thickness.	Square Meter	673.0
2.11	SS equipments with mineral wool with double layer 60mm ≤ T ≤ 120mm thickness.	Square Meter	23.0
2.12	CS pipes with mineral wool with single layer up to 50 mm thickness (without cladding and supporting components) on temporary pipeline for flushing including removal, reuse (max 3 times) and disposal after flushing.	Square Meter	842.0

**KUDANKULAM NUCLEAR POWER PROJECT
TG & SECONDARY CYCLE AND SEA WATER SYSTEMS (TSS) PACKAGE**

UNIT 3 - INSULATION WORKS BOQ

Item No.	Work Description	UOM	Quantity
	Thermal Insulation Works		
3	<p><u>Application of ceramic wool insulation on rotary equipments:</u> <u>Materials will be issued as Free issue material (FIM) by BHEL.</u> Application of insulation system with stitched mats of ceramic wool with density of 64 Kg/Cum enclosed in glass fabric, GI metal cladding with inside protective coating, supporting components, binding wire, riveting, joint sealing, wrapping of aluminum foil (0.1mm thick) on SS equipment surface, mat stitching, steel wire stitching, zinc chromate painting on supporting structure, with various categories and thickness in sub items, preparation of reports, inspection, temperature measurement on insulated surface and work completion as per the drawings, documents and specification with acceptance of BHEL & NPCIL Erection Incharge. The work scope includes shifting of materials from BHEL/NPCIL stores to site location, handling, inspection at store, preparation of IMIR (incoming material inspection report), fabrication of insulation mats & metal cladding, fabrication of supporting devices, stitching, welding and touch-up painting of supporting devices, cleaning, application, arrangement of man power, scaffolding and platforms, tools & tackles, P&M, qualification of procedures, paints, supporting materials, consumables including welding electrodes.</p> <p><u>Note :</u> 1. In some places, removable type insulations with toggle clips are required for flange joints, instrumentation points, etc. In such cases, where removable type insulation are installed, no separate payment shall be made. 2. Material supplies is in the scope of BHEL. Materials will be issued as Free issue material (FIM). 3. All required consumables is in the scope of the contractor.</p>		
3.1	Single layer up to 50mm thickness.	Square Meter	45.0
3.2	Single layer of 60mm ≤ T ≤ 120mm thickness	Square Meter	110.0
3.3	Double layer 60mm ≤ T ≤ 120mm thickness	Square Meter	15.0

**KUDANKULAM NUCLEAR POWER PROJECT
TG & SECONDARY CYCLE AND SEA WATER SYSTEMS (TSS) PACKAGE**

UNIT 3 - INSULATION WORKS BOQ

Item No.	Work Description	UOM	Quantity
	Thermal Insulation Works		
4	<p><u>Application of insulation on CS/SS piping with cords :</u> <u>Materials will be issued as Free issue material (FIM) by BHEL.</u> Application of insulation system with insulating cords of density 200 kg/cum in roving loom made of Glass thread / ceramic wool, superfine basalt / ceramic fibre, GI metal cladding (0.5 mm thick) with inside protective coating, riveting, joint sealing, wrapping of aluminum foil (0.1mm thick) on SS pipeline surface, with various categories and thickness in sub items, preparation of reports, inspection, temperature measurement on insulated surface and work completion as per the drawings, documents and specification with acceptance of BHEL & NPCIL Erection In charge. The work scope includes shifting of materials from BHEL/NPCIL stores to site location, handling, inspection at store, preparation of IMIR (incoming material inspection report), fabrication of metal cladding, fabrication of supporting devices, application, qualification of procedures, arrangement of man power, scaffolding and platforms, tools & tackles, paints, P&M, consumables including welding electrodes.</p> <p><u>Note :</u> 1. In some places, removable type insulations with toggle clips are required for flange joints, valves, instrumentation points, etc. In such cases, where removable type insulation are installed, no separate payment shall be made. 2. Material supplies is in the scope of BHEL. Materials will be issued as Free issue material (FIM). 3. All required consumables is in the scope of the contractor.</p>		
4.1	Insulation of CS piping upto 70 mm thickness	Square Meter	3,125.0
4.2	Insulation of SS piping upto 70 mm thickness with wrapping of aluminium foil (0.1 mm thk)	Square Meter	1,525.0

VOLUME - IA PART – I CHAPTER – IX

SAFETY

1.9.0 SAFETY CLAUSE/CONDITIONS:

1.9.1 PROJECT SAFETY PLAN

A project specific Health and Safety plan shall be developed by the Contractor and submitted for approval from BHEL, prior to commencement of the work.

1.9.2 SAFETY ORGANIZATION OF THE CONTRACTOR:

The following minimum requirement shall be fulfilled:

Sr. No.	Manpower per Shift	No. of Safety Officers to be appointed per shift	No. of Safety Supervisors to be appointed per shift
1	Up to 20	01	01
2	21 to 100	01	02
3	101 to 200	01	03
4	201 to 350	02	04
5	351 to 500	02	05
6	Above 500	1 for every addl. 500 workers in addition to number mentioned against Sr. No. 5	1 for every addl. 200 workers in addition to number mentioned against Sr. No. 5

In addition to the requirement of safety officer and supervisors as mentioned, contractor shall deploy safety sevaks in sufficient nos. to suitably provide safety coverage of entire area of work in line with the quantum of field works and nos. of locations. The safety sevaks shall be technical persons with diploma or ITI qualifications and shall be provided with back pack consisting of PPE's and shall continuously monitor the safety aspects at site and shall report any safety lapses immediately.

Safety work permits shall be applied by contractor through IPMIS (computerized software tool).

1.9.3 QUALIFICATION OF SAFETY PROFESSIONAL SHALL BE AS FOLLOWS:

- **SAFETY OFFICER:**

Degree in Engineering and Diploma in Industrial Safety, recognized by the Central / State Government

- **SAFETY SUPERVISOR:**

Diploma in Engineering and Diploma in Industrial Safety recognized by the Central/ State Government or 6 years supervisory experience.

Note: All the Safety personnel shall be accepted after the assessment by NPCIL.

1.9.4 TRAINING REQUIREMENTS

- i. The Contractor shall provide mandatory Industrial Safety Training to all workmen.
- ii. The Contractors shall establish their own safety training centre having adequate seating capacity and infrastructure for training.
- iii. Induction safety training shall be provided to all personnel of the Contractors within the first three days of entry into plant site, failing which the workmen shall not get plant entry pass for further extended period.
- iv. After the induction safety training, the workmen should undergo refresher training once in every six months. Safety training card in prescribed format shall be issued to all workmen after completion of training.
- v. The duration of the training shall be minimum four hours. The typical syllabus for the training is as follows:
 - a) Hazards at construction sites. Use of personal protective equipment and their practical demonstration. Mock drill to ensure proper use of PPEs. Need for preventing accidents.
 - b) Aims and Objectives of safety, pep talk, and housekeeping. Safety Work Permit and Authorization to work on system equipment. Height Pass training and briefing about hazard prompt list.
 - c) DOs and DON'Ts on construction activities. Briefing about location of First aid/Fire station/Safety Section and their telephone numbers. Good safety practices of NPCIL projects.
 - d) Films on construction safety and feedback.
- vi. The safety supervisors and the safety engineers will have to undergo refresher safety training in safety supervision and accident prevention techniques conducted by National safety Council or other recognized institutions once in a year.

1.9.5 REQUIREMENTS AND SPECIFICATION OF PPES

- i. Contractor shall submit a list of PPEs that shall be used during the course of the work, to BHEL before the commencement of work.
- ii. Contractors must maintain adequate stock of Personal Protective Equipment (PPE) and safety gears such as safety nets, fall arrestor systems, safety barricades, signage etc. conforming to relevant Indian standards (or relevant international standards), required to be used during execution of the work.
- iii. These PPE's, tools and appliances must be inspected quarterly by Safety officer / Supervisor of Contractor and records of such inspection shall be submitted to BHEL along with monthly safety report.

1.9.6 PERSONAL PROTECTIVE EQUIPMENT

1.9.6.1 GENERAL

- a) Although the primary approach in any safety effort is that the hazard to the workmen should be eliminated or controlled by engineering methods rather than protecting the workman through use of personal protective equipment (PPE). Engineering methods could include design change, substitution, ventilation, mechanical handling, atomisation etc. Under those situations when it is not possible to introduce any effective engineering methods for controlling hazards, it is necessary that workman use appropriate type of PPE. For example, in construction work there is the possibility of a hand tool, a bolt, or some loose material to fall from an elevated level and striking the head of workman working below. It is therefore necessary that construction worker wear a safety helmet. It is for such situations, both the Factories Act 1948 and the Atomic Energy (Factories) Rules, 1996 have provisions for use of appropriate type of PPE.
- b) It is thus recognised that use of PPE is an important and necessary consideration in the development of a safety programme. Once the safety professional decides that PPE is to be used by workmen, it is essential to select right type of PPE and management should ensure that workman uses it and also PPE is correctly maintained.

1.9.6.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

- a) All personal protective equipment as considered necessary should be made available for the use of the persons employed on the site and maintained in a condition suitable for immediate use. Also, adequate steps should be taken by engineer-in-charge to ensure proper use of PPE.

- b) All the PPEs in use should be as per relevant IS standards as referred in the AERB safety guidelines on 'PPE'(AERB/SG/IS-3).
- c) All persons employed at the construction site should use safety helmets. Safety helmet should be with BIS mark and should have its headband with back support and chin strap.
- d) Workers employed on mixing asphaltic materials, cement and lime mortars should use protective goggles, protective foot wears, hand gloves and respirators as required.
- e) Persons engaged in welding and gas-cutting works should use suitable welding face shields. The persons who assist the welders should use suitable goggles. Protective goggles should be worn while chipping and grinding.
- f) Stonebreakers should use protective goggles. They should be seated at sufficiently safe distances from one another.
- g) Safety goggles should be of shatterproof type and with zero power.
- h) Persons engaged in or assisting in shot blasting operations and cleaning the blasting chamber should use suitable gauntlets, overalls, shatterproof and dust-proof goggles and self-contained breathing apparatus set.
- i) All persons working at heights more than 2.5 m above ground or floor and exposed to risk of falling down should use full body harness safety belts, unless otherwise protected by cages, guard railings, etc. In places where the use of safety belts is not feasible, suitable net of adequate strength fastened to substantial supports should be used.
- j) When workers are employed in sewers and inside manholes that are in use, it should be ensured that the manholes are opened and are adequately ventilated at least for an hour. After it has been well ventilated, the atmosphere inside the space should be checked for the presence of any toxic gas or oxygen deficiency by a competent person and recorded in the register before the workers are allowed to get into the manholes. A pilot team should enter the area donning self-contained breathing apparatus (SCBA). The manholes opened should be cordoned off with suitable railing and provided with warning signals or caution boards to prevent accidents. There should be proper illumination in the night. Depending upon the work situation, the facility should provide PPE including the SCBA as recommended by Head, industrial safety.

1.9.7 WORK PRACTICES

1.9.7.1 GENERAL

- a) Prior to taking up the day's work, Pre-Job Briefing/Pep talks will be carried out by Contractors' Site Engineer, Safety officer, Safety Supervisor or Site in charge involving all the workers.
- b) The Contractor shall make arrangements for adequate and qualified supervision during the execution of jobs.
- c) The Contractor shall ensure that safety work permits are taken for each high-risk job as per project procedures.
- d) Job Hazard Analysis (JHA) shall be carried out for all high-risk jobs or as advised by BHEL/NPCIL Engineer-in-charge or Safety Officer.

1.9.7.2 WORK AT HEIGHT

- a) For carrying out work at height of more than 2.5 meters above floor/ground level, height pass should be provided for all the workers involved in the work as per procedure, which includes ascertaining medical fitness by Registered Medical Practitioner and worker's physical test etc. If any worker is found working at height without required height pass, penalty as per Sr. No.5 of Annexure -1 shall be imposed.
- b) Height work permit shall be obtained for all the works carried out on temporary staging, platforms etc. above a height of 2.5 meters from stable floor or ground floor. All implements used for height work such as scaffold, access stairs/ladders, platform, railings etc should be certified by concerned Engineer prior to its use and to the effect that they should have a display card as "Safe for use". Wood, bamboo or other combustible materials shall not be used for making staging/scaffolds.
- c) The minimum 1m width of working platforms shall be maintained. All scaffolds or staging shall have guard rails, mid rails and toe boards. Safe means of access by means of portable or fixed ladders, stairways or ramps shall be provided for all workplaces at height. Cross bracings or frames of scaffold shall not be permitted as means of access.
- d) Safety nets, fall arrestor system, lifelines and other such additional safety measures commensurate with the location and nature of work shall also be provided. Full body safety harness with double lanyard shall only be allowed for work at height.

1.9.7.3 ELECTRICAL SAFETY

- a) All electric supply lines and electrical apparatus used at site shall be of sufficient ratings for power, insulation and estimated fault current and of sufficient mechanical strength, for the duty which they may be required to perform under the environmental conditions of installation, and shall be constructed, installed, protected, worked and maintained in such a manner as to ensure safety of human beings, animals and property. All such material and apparatus shall conform to requirements under relevant codes of Bureau of Indian Standards.
- b) Earth pits in accordance with Rule 61 of Indian Electricity Rules, 1956 and as specified in IS 3043:1987, shall be provided and maintained at Contractor's work premises. Healthiness of earthing shall be checked physically at least once in a month and earth pit resistance shall be measured at least once in 6 months.
- c) All power distribution boards, electrically operated equipment/tools, cables, power extension boards etc. shall be inspected every month for ensuring their healthiness. Inspection stickers shall be affixed on all such equipment/tools.
- d) Metal clad power sockets and plugs shall be used at worksites for extension of power to equipment. MCBs shall be used as isolation switch as well as overload protection device. Flexible cables used for extension of power shall be double sheathed three core type. Twisted insulated wires shall not be used for this purpose. The cables used shall be free of joints as far as practically possible. Where joints are essential, the same shall be made as per standard industrial practices. Joints made with insulating tapes shall not be allowed at workplaces.
- e) Earth leakage protection shall be provided to all electrical equipment/ tools/ appliances using ELCB (sensitivity 30mA). ELCBs shall be inspected every month for their healthiness. Apart from the power distribution boards, all extension boards shall also be provided with ELCBs. The specifications for power distribution boards and extension boards shall be in accordance with the requirements of NPCIL.
- f) If use of electrical energy is required for execution of the work, the Contractor shall deploy qualified and licensed electrician(s). Minimum qualification for such electrician shall be ITI in electrical trade. He should also possess electrician/wireman license issued by concerned state government authority.
- g) At least one portable fire extinguisher (DCP or CO₂) shall be provided near each power distribution board.
- h) Rubber mats conforming to IS:15652 shall be used in front of all Power distribution boards.

- i) Rubber hand gloves conforming to IS:4770 and Safety shoes shall be used by personnel working on electrical systems

1.9.7.4 MATERIAL HANDLING

- a) All machinery, tools and tackles used for material handling such as cranes, chain pulleys, slings, shackles etc. shall be inspected at least once in 12 months by a Competent Person and records of such inspection shall be maintained. All machinery, tools and tackles used for material handling shall be conspicuously marked with safe working load, date of inspection/test and next due date for inspection/test.
- b) All tools and tackles used for material handling shall be inspected once in a month at site prior to use and damaged/faulty/worn out equipment/tackles shall be immediately removed from the worksite.
- c) Operation of cranes, fork lift trucks, winches etc. shall be carried out only by operators authorized for the purpose. Trained, experienced and authorized signalmen shall be deputed to give signals to the operators of material handling equipment. Except the designated signalmen, no one should be allowed to give signals during material handling operations.
- d) All cranes, fork lift trucks, winches etc. shall be thoroughly inspected once in a month at site by the Contractor.

1.9.7.5 WELDING, GAS CUTTING AND OTHER HOT WORKS

- a) Welding machines, gas cutting sets, blow torches, gas cylinders and accessories etc. as well as the connections shall be inspected for their healthiness prior to use.
- b) The return cable of arc welding machine shall be connected to the job. Connecting the return cable to nearest earthed structure shall not be permitted for this purpose. Standard connectors shall be used for connecting welding cables to the welding machine. The current regulator shall also be connected using standard connectors. Use of unsafe means to connect welding cables or regulator shall be avoided.
- c) Welding cables shall be free from joints. In unavoidable cases, the joints shall be adequately insulated both thermally and electrically.
- d) Flashback arrestors shall be provided at torch end as well as cylinder end in gas cutting sets.
- e) Suitable trolleys shall be used to securely keep and shift the oxygen and DA/LPG cylinders.

- f) Industrial LPG cylinders shall only be used for hot work. Domestic or commercial LPG cylinders shall not be used for this purpose.
- g) At least one fire extinguisher shall be provided at each location of hot work.
- h) All the gas cylinders shall be painted as per standard colour coding. Valve caps shall be provided on cylinder, when not in use.
- i) Gas cylinders shall not be dropped or rolled.
- j) During carrying out hot works, suitable fire preventive measures like, removal of combustible material from the work area, use of fire-resistant blankets etc. shall be strictly followed.

1.9.8 SAFE STORAGE OF MATERIAL

- a) Contractors shall ensure suitable and adequate place for storage of their material as well as material issued by BHEL/NPCIL. The storage shall be done as per the standard storage requirements based on physical and chemical properties of the material.
- b) Steel structural material, reinforcement rods etc. shall be properly stacked with adequate spacers. The height of the stacked material shall be restricted so as to maintain stability of the pile.
- c) Gas cylinders shall not be stored in open places exposed to sunlight & rain. Storage of gas cylinders shall be done in designated sheds/rooms. Empty and filled cylinders shall be stored separately. Flammable gas cylinders shall not be stored along with oxygen cylinders. Valve caps shall be provided on the cylinders and adequate chaining arrangement shall be provided for protecting the cylinders against falling.
- d) Flammable liquids shall be stored in pre-designated areas having adequate ventilation and firefighting arrangements.
- e) Corrosive chemicals shall be stored in accordance with the instructions given in Material Safety Data Sheet (MSDS). First aid measures for neutralizing the effects of the chemical shall be made available near the storage area.
- f) Smoking of beedi/cigarettes shall be strictly prohibited and sources of ignition shall be strictly controlled in storage areas.

1.9.9 FIRE PROTECTION AND FIREFIGHTING ARRANGEMENTS

- a) In accordance with the nature of material used during the execution of the job, suitable fire protection and firefighting arrangements, shall be ensured by the Contractor.
- b) Based on the fire load, sufficient numbers of portable fire extinguishers shall be made available at worksites.

- c) All unwanted combustibles shall be removed from the worksites on daily basis.

1.9.10 TRANSPORTATION OF MAN AND MATERIAL

- a) Contractor shall ensure safe movement of man and material as well as vehicles within site premises as per applicable rules/regulations. Non-roadworthy vehicles shall not be allowed at worksites.
- b) Vehicles used for transportation of material shall not be used to transport workers.
- c) Overloading of vehicles shall be strictly prohibited.
- d) Protective helmets (IS 4151:1993) shall be used by all two-wheeler drivers.
- e) Vehicles shall have a valid registration, fitness and PUC certificates. Drivers shall have valid driving license.
- f) Vehicles shall be inspected for healthiness once in a month.
- g) Material transported on flat bed trailers shall be properly lashed to prevent fall of material.
- h) Transportation of ODC/OWC material shall be done only with prior permission from BHEL & NPCIL. Adequate warning flags/lights and escorts shall be provided during such movements.
- i) Reversing horns shall be provided in all vehicles.

1.9.11 WORK SPECIFIC SAFETY MEASURES

1.9.11.1 GENERAL

- a) The occupier should ensure that safety precautions are taken during the execution of awarded work and work areas are maintained safe at all times. At the end of each shift and at all times when the work is suspended, it should be ensured that the work area is left safe in such a way that no materials and equipment that can cause damage to existing property, personal injury or interfere with the other works of the project or station are left in an unsafe manner.
- b) The occupier should ensure to provide and maintain all lights, guards, fencing, warning signs, caution boards and other safety measures and provide for vigilance as and when necessary for the protection of workers and for the safety of others. The caution boards should also have appropriate symbols.
- c) Adequate lighting facilities such as floodlights, hand lights and area lighting should be provided at the site of work, storage area of materials and equipment and temporary access roads within the working area.

- d) All works should be planned so as to avoid interference with other facilities, works of other contractors or sub-contractors at the site. In case of any interference, necessary coordination should be ensured for safe and smooth working.
- e) It should be ensured that the instructions given by the safety officer or his designated nominee regarding safety precautions, protective measures, housekeeping requirements, etc. are complied with. The safety officer with due intimation to engineer-in-charge should have the right to stop the work, if in his opinion, proceeding with the work will lead to an unsafe and dangerous condition. Engineer-in charge should arrange to get the unsafe condition rectified and/ or provide appropriate protective equipment.
- f) Engineer-in-charge should ensure that each job with a hazard whether small or big is intimated to the safety officer of the facility well before it is taken up.
- g) The facility should be fully responsible for non-compliance of any of the safety measures or requirements, implications, injuries, fatalities, dangerous occurrences and compensation arising out of such situations or incidents.
- h) Maximum duty hours of an individual should be as per the Factories Act 1948 or its latest amendment.
- i) Illumination levels should be as per the statutory requirements.

1.9.11.2 ROCK BLASTING

- a) All blasting operations should be carried out on the basis of procedures approved by Head, industrial safety and engineer-in charge. All works in this connection should be carried out as per BIS specification/code (IS 4081: 1986. Title: - Safety code for blasting and related drilling operations (First Revision)). Barricades, warning signs etc. should be placed on the roads/open area.
- b) Blasting permit should be obtained from Head, industrial safety at least one day before the blasting operation and precautions mentioned there in shall be ensured by the engineer-in-charge before blasting operation.
- c) The blaster should have a licence from competent authority under Explosive Rules, 1983 for blasting work. It should also be ensured that he knows about the risks involved.
- d) Blasting should be done under the supervision of competent engineer/ supervisor.

- e) Blasting in the open site should only be carried out during fixed hours every day/fixed day in the week between sunrise and sunset. Residents of adjacent area should be informed in advance about the blasting schedule.
- f) No blasting should be undertaken during thunderstorm.
- g) Necessary precaution should be taken to ensure the stability/integrity/ safety of the adjacent structure by limiting the peak particle velocity.
- h) No loose material, such as tools, drilling equipment, etc. should be left on the surface to be blasted. Proper muffling arrangement of the blasting area should be ensured to avoid flying of blasted material.
- i) Authorised blaster should personally ensure that all the personnel/ equipment has been removed from the blasting area before the blasting operations.
- j) Blasting area should be free of detonating gas, inflammable objects, sparking or damaged wiring system, stray currents and static electricity.
- k) All electrical lines in blasting area should be de-energised.
- l) Entry of unauthorised personnel should be prevented by displaying warning signs.
- m) In case of misfire, no person should be allowed to approach the blasting site unless it is inspected and cleared by a competent engineer/supervisor.
- n) Explosives and blasting material should be stored only in clean, dry, well-ventilated, suitably constructed bullet/ magazine which should be fire resistant and securely locked. Stock book should be kept accurate and maintained. Licence should be obtained for storage of explosive as per the Explosives Act, 1884.
- o) Blasting caps, electric blasting caps or primers and detonators should not be stored in the same box, container or room with other explosives.
- p) Precautions against lightening should be provided in accordance with Indian Electricity Rules, 1956 (amended in 2000).
- q) The explosives should be transported in specially designed vehicles bearing a special sign or inscription entitled 'DANGER EXPLOSIVES'. Also, detonators separated from other explosive should be transported in a separate compartment.

1.9.11.3 EXCAVATION, TRENCHING AND EARTH REMOVAL

- a) Before taking up excavation work, necessary permission should be obtained from the engineer-in-charge with reference to existing underground services.
- b) The engineer-in-charge of the works should exercise full care to ensure that no damage is caused by him or his workmen, during the operation/excavation etc., to the existing water supply, sewerages, power or telecommunication lines or any other services or works. He should provide and erect before construction, substantial barricades, guardrails, and warning signs around the work area. He should also furnish, place and maintain adequate warning lights, display board, signals etc., as required.
- c) All trenches 1.2 m or more in depth should at all times be supplied with at least one ladder for every 30 m along the trench. Ladders shall extend from bottom of the trench to at least 1 m above the surface of the ground.
- d) The sides of the trench/pit in soil, which are 1.2 m or more in depth should be stepped back to give suitable slope (angle of repose) or securely held by timber bracing or appropriate shoring/support, to avoid the danger of soil slides from collapsing. The excavated material should not be placed within 1.5 m or half of the depth of the pit whichever is more from edges of the trench/pit. Cutting should be done from top to bottom. Under no circumstances mining or undercutting should be done.
- e) Workers should not be exposed to the danger of being buried by excavated material or collapse of shoring. Measures to prevent dislodgment of loose or unstable earth, rock or other material from falling into the excavation by proper shoring shall be ensured.
- f) The stability and safety of the excavation, adjacent structures, services and other works should be ensured.
- g) All excavated area should be fenced off by suitable railing and installation of caution board to warn the persons from slipping or/ falling into the excavation pit/ mound.
- h) All excavated areas shall have an illumination level of at least 20 lux for night work and a red danger light shall be displayed at prominent place near the excavation site to warn approaching traffic and men.
- i) For removal of earth from an earth mound/excavated heap a written permission should be obtained from the engineer-in-charge of the work. As far as practical, earth should be removed

mechanically. Wherever manual removal of earth is involved, earth should be removed from the top by maintaining a slope equal to the angle of re-pose of the earth. Such work should be constantly supervised to ensure that no under-cutting is done and to ensure that no person is trapped.

- j) Dumping of excavated soil should be done at a specified area under proper supervision with respect to signaling, illumination and safety clearance.
- k) It should be ensured that at a construction site of a building or other construction work, every vehicle or earth moving equipment is equipped with a) silencers, b) tail lights, c) power and hand brakes, d) reversing alarm e) search light for forward and backward movement, which are required for the safe operation of such vehicle or earth moving equipment and f) the cab of the vehicle or earth moving equipment is kept at least one meter from the adjacent face of a ground being excavated. g) indicator etc.
- l) It should be ensured that when a crane or shovel is traveling, the boom of such crane or shovel is in the direction of such travel and the bucket or scoop attached to such crane or shovel is raised and without load, except when it is traveling downhill.
- m) Before loading or unloading power trucks or trailers attached to tractors, the brakes should be applied and if vehicle is on a sloping ground, the wheels should be blocked. Handcart should not be used for the transfer of construction/erection materials in the construction area. However, if the exigency demands urgent transfer of light materials a small handcart may be permitted with the prior approval of the engineer-in-charge.

It should be ensured that at a construction site of a building or other construction work:

- (i) All transport or earth moving equipment and vehicles are inspected at least once in a week by responsible persons and in case any defect is noticed in such equipment or vehicle, it is immediately taken out of service.
- (ii) Safe gangways are provided for to and fro movement of building workers engaged in loading and unloading of lorries, trucks, trailers and wagons.
- (iii) All earth moving equipment, vehicles or other transport equipment be operated only by such persons who are adequately trained and possess such skills as required for safe operation of vehicles or other transport equipment.

(iv) Trucks and other equipment are not loaded beyond their safe carrying capacity, which should be clearly marked on such trucks and other equipment.

(v) No unauthorised person rides the transport equipment employed in such work.

It should be ensured at a construction site of a building or other construction work that:

(i) A shovel or an excavator whether operated by steam or electric or by internal combustion used for such work is constructed, installed, operated, tested and examined as required under any law for the time being in force and the relevant national standards.

(ii) Buckets or grabs of power shovels are propped to restrict the movement of such bucket or grabs while being repaired or while the teeth of such bucket or grabs are being changed.

It should be ensured at a construction site of a building or other construction work that:

(i) An operator of a bulldozer before leaving – applies the brakes, lowers the blade and ripper and puts the shift lever into neutral. (

ii) A bulldozer is parked on level ground at the close of the work.

(iii) The blade of a bulldozer is kept low when such bulldozer is moving uphill.

(iv) Bulldozer blades are not used as brakes except in an emergency.

It should be ensured at a construction site of a building or other construction work that:

(i) A tractor and a scraper are joined safely at the time of its operation

(ii) The scraper bowls are propped while blades of such scraper are being replaced.

(iii) A scraper moving downhill is driven in low gear.

It should be ensured at a construction site of a building or other construction work that:

(i) Before a road roller is used on the ground, such ground is examined for its bearing capacity and general safety, especially at the edges of slopes such as embankments on such grounds.

- (ii) A roller is not moved downhill with the engine out of gear.

Vehicle carrying excavated material should have proper cover over the driver's cabin.

1.9.11.4 SAFE MEANS OF ACCESS/PLATFORMS

- a) Adequate safe means of access and exit should be provided for all work places, at all elevations.
- b) Suitable scaffolds should be provided for workmen for all works that cannot be done safely from the ground, or from solid platform except such short duration work that can be done safely from ladders. Bamboo/wooden scaffolding should not be permitted.
- c) Where the platform for working is more than 2.5 m above ground, the width of the platform should be minimum 1 m.
- d) Ladder should be of rigid construction having sufficient strength for the intended loads. Wooden/bamboo/rope ladders should not be permitted. All ladders should be maintained in good condition. The ladders should be fixed to the ground or rigid platforms. An additional person should be engaged for holding the ladder, if ladder is not securely fixed. Ladder shall be extended from floor to at least one meter above the platform.
- e) A portable ladder should be given an inclination not steeper than 1 in 4 (1 horizontal and 4 vertical). Ladders should not be used for climbing while carrying materials in hands. While climbing both the hands should be free.
- f) Any working platform on scaffolding or staging more than 2.5 m above the ground or floor should have a guard rail attached, bolted, braced at least 1 m high above the floor or platform of such scaffolding or staging along with mid-rail.
- g) Only metal platforms are allowed for any working platform. The platform should be rigidly fixed at both ends to prevent sliding, slipping or tilting.
- h) The guardrail should extend along the entire exposed length of the scaffolding with only such opening as may be necessary for the delivery of materials. Standard railing should have posts not more than 2 m apart and an intermediate rail halfway between the floor or platform of the scaffolding and the top rail. Such scaffolding or staging should be so fastened as to prevent it from swaying from the building or structure. Scaffolding and ladder should conform to IS 3696 (Part 1): 1987 and (Part II): 1996.

- i) Working platforms of scaffolds should have toe boards at least 15 cm in height to prevent materials from falling down.
- j) A sketch of the scaffolding proposed to be used should be prepared and approval by the engineer-in-charge obtained prior to start of erection of scaffolding. All scaffolds should be examined by engineer in-charge before use.
- k) Working platform, gangways and stairways should be so constructed that they should not sag unduly or unequally and if the height of the platform or gangway or stairway is more than 2.5 m above ground level or floor level. They should have adequate width for easy movement of persons and materials and should be suitably guarded.
- l) No single portable ladder should be used for access to a height of more than 4.5 m. For ladders up to 3m in length the width between styles (side bars)/width in the ladder should in no case be less than 300 mm. For longer ladders this width should be increased by at least 20 mm for each additional meter of length. Step/rungs spacing should be uniform and should not exceed 300 mm. Portable ladder should be used only for access to work place. In case work place is higher than 4.5 meters, pre-fabricated steel staircase should be used.

1.9.11.5 WORK AT HEIGHT

- a) Person to work at height should be medically fit and should have height pass issued by safety section. (Appendix A Part A, B and C). Safety training should be imparted before working at height.
- b) Safety work-permit system for working at height should be obtained from industrial safety section.
- c) At elevated places, secure access and foothold should be provided. Adequate and safe means of access and exit should be provided at all work places for all elevations. Means of access may be portable or fixed ladder, ramp or a stairway. The use of crosses, braces or framework, as a means of access to the working platform should not be permitted.
- d) Linear movement at height should be reduced to minimum. In case of such movement provision for anchoring the safety belt should be made.
- e) Where barricades cannot be installed, a safety net of adequate strength should be installed close to the level at which there is a danger of fall of personnel/fall of objects.
- f) In case where 'work at height' is on asbestos roof, crawling board, roof ladder should be used to walk across the asbestos roof.

1.9.11.6 ELECTRICAL SAFETY

- a) All electrical installations shall comply with the appropriate statutory requirements given below and shall be subject to approval of the electrical engineer and safety officer.
 - i. The Electricity Act, 2003
 - ii. The Indian Electricity Rules 1956 (as amended in 2000)
 - iii. The National Electricity Code 2008
 - iv. Atomic Energy (Factories) Rules, 1996
 - v. Other relevant rules of statutory bodies and power supply authority
 - vi. Relevant standards of BIS

In addition to the above statutory provisions, the clauses indicated in this document shall also be complied.

- b) It shall be the responsibility of the user seeking temporary power supply to indicate in writing, if any of the clauses (requirements noted in above regulations and in this document) are conflicting with each other and for which the user cannot decide the course of action regarding safe installation, commissioning, operation, maintenance and decommissioning of the electrical installations.
- c) The electrical engineer and safety officer of the facility providing temporary power supply shall interpret the concerned conflicting clauses and approve in writing the safe course of action.
- d) The Application Form-1 (Form-1A, 1B and 1C) as mentioned in Appendix-B should be submitted by the user for getting the temporary power supply.
- e) After installation of temporary electrical panels, wiring works by the user, certificates as per Form-1D (Appendix-B) should be submitted to the provider.
- f) Certificate of safety officer and authorisation of electrical engineer for energisation of temporary power supply should be filled as per Form-1E (Appendix-B).

1.9.11.7 MATERIAL HANDLING AND LIFTING MACHINES AND TACKLES

- a) It should be made compulsory to supervise jobs like lifting/placing/ loading/unloading/carrying/transporting etc. of heavy material by qualified supervisor having knowledge about hazards involved and precautions to be taken for such job.

- b) The line managers should ensure that the material handling equipment used is adequate to handle the load.
- c) Manual pulling of heavy equipment and trolley loaded with heavy material is not to be permitted.
- d) Stacking and handling of heavy materials should be done on a firm ground to prevent settlement.
- e) No lifting machine and no chain, rope or lifting tackle, except a fiber rope or fiber rope sling, shall be taken into use in any factory for the first time in that factory unless it has been tested and all parts have been thoroughly examined by a competent person. A certificate of such a test and examination specifying the safe working load or loads and signed by the person making the test and the examination has been obtained and is kept available for inspection.
- f) Use of lifting machines and tackles should conform to relevant BIS requirements [IS 13367 (Part 1): 1992 Reaffirmed 2003, IS 4573: 1982 (Reaffirmed 2000) and IS 13834 (Part 1): 1994 Reaffirmed 2003 etc. The accessories and the attachments, anchorages and supports etc. should be ensured in healthy conditions by regular inspections at defined frequencies.
- g) Every rope used in hoisting or lowering materials or as a means of suspension should be of good quality and adequate strength and free from any defect. This should be ensured by regular inspection as per IS 2762: 1982- Specification for wire rope slings and sling legs (first revision).
- h) Every crane operator or lifting appliance operator should be authorised. No person under the age of 18 years should be in charge of any hoisting machine or give signal to an operator of such machine.
- i) In case of every lifting machine (and of every chain, ring, hook, shackle, swivel and pulley block used in hoisting or as a means of suspension) the safe working load should be ascertained and clearly marked. In case of a lifting machine having a variable safe working load, each safe working load and the conditions under which it is applicable should be clearly indicated. No part of any machine should be loaded beyond the safe working load except for the purpose of testing. This should be approved by the engineer-in-charge and head, industrial safety.
- j) In case of facilities machines, the safe working load should be notified by the engineer-in-charge. As regards the contractor's machines, the contractor should declare the safe working load of the machine to the engineer-in-charge whenever he brings any machinery to site of work and get it verified by the engineer-in-charge, supported by a valid test certificate by the competent person.

- k) Thorough inspection and load testing of lifting machines and tackles should be done in the presence of competent person at least once in every 12 months and records of such inspections and testing should be maintained.
- l) No mobile crane should be allowed to move under live high-tension power transmission line.
- m) While lifting loads, cranes should be located on level ground.
- n) A thorough load analysis should be carried out before using cranes in tandem.
- o) Motors, gear transmission, couplings, belts, chain drives and other moving parts of hoisting appliances should be provided with adequate safeguards. Hoisting appliances should be provided with such means, which will reduce the risk of any part of a suspended load becoming accidentally displaced or lowered.
- p) It should be ensured that the cabin of the lifting machine in outdoor service:
 - (i) Is made of fire-resistant material,
 - (ii) has a suitable seat, a footrest and protection from vibration,
 - (iii) affords the operator an adequate view of the area of operation,
 - (iv) affords the operator adequate protection against the weather, and
 - (v) Is provided with fire extinguisher.

1.9.11.8 WELDING AND GAS CUTTING

- a) Welding and gas cutting operations should be done by qualified and authorized persons only.
- b) Safety work permit should be obtained (wherever necessary like presence of flammable or combustible material etc.) before flame cutting/welding is taken up.
- c) Welding and gas cutting should not be carried out in places where flammable or combustible materials are kept and where there is danger of explosion due to presence of gaseous mixtures. In case the requirement cannot be avoided, specific approval and procedure should be ensured and adequate precautions should be taken.
- d) Welding and gas cutting equipment including hoses and cables should be maintained in good condition.

- e) Barriers should be erected to protect other persons from harmful rays from the work. When welding or gas cutting is done in elevated positions, precautions should be taken to prevent sparks or hot metal falling below on persons or combustible materials.
- f) Suitable type of protective clothing consisting of fire resistant gauntlet gloves, leggings, boots and aprons should be provided to workers as protection from heat and hot metal splashes. Face shields with filter glasses of appropriate shade should be worn.
- g) Adequate ventilation should be provided while welding, brazing and cutting the metals like zinc, brass, bronze, galvanised or lead coated material.
- h) Welding and gas cutting on drums, barrels, tanks or other containers should be taken up only after ascertaining that they have been emptied, cleaned thoroughly and made free of flammable material.
- i) Fire safety measures should be available as required near the location of welding/cutting operations.
- j) Flash back arrestor should be provided with gas cutting and gas welding sets.
- k) For electric (Arc) welding the following additional safety precautions should be taken:
 - i. When electrical welding is undertaken the return lead of welding machine should be directly connected to the job invariably.
 - ii. Provision must be in place in electric welding machine to prevent physical contact with live parts.
 - iii. The welding cables and power cables should be routed separately to avoid entanglement.
 - iv. The electric welding set should have suitable earth connections. There should be an electrical isolation device in the input power supply side on the welding machine.
 - v. Double gauges should be used for all gas cylinders used for cutting/ welding. Pressure gauges/regulators should be in healthy condition.

1.9.11.9 ROTARY CUTTERS/GRINDERS

- a) All portable cutter/grinders should be provided with the wheel guard in position.
- b) Grinding wheels of specified diameter only should be used on all grinders in order to limit the prescribed peripheral speed.
- c) In pedestal grinder, the gap between tool rest and grinding wheel should be maintained less than 3 mm.
- d) Goggle/face shield should be used during grinding operation.
- e) No grinding wheel should be used after its expiry date.
- f) Ear muff/ear plug should be used during the welding/cutting jobs.
- g) Portable appliances, which are powered by single phase AC supply, shall be provided with three-core cable and three pin plug, otherwise the whole body should be double insulated.
- h) Safety work permit should be obtained (wherever necessary like presence of flammable or combustible material etc.) before grinding is taken up.
- i) Fire safety measures should be available as required near the location of grinding operations.

1.9.11.10 CONCRETE MIXING EQUIPMENT

- a) Cement bags should be stacked on wooden planks in dry and leak proof area, 150 mm to 200 mm from the floor and 450 mm away from walls. Height of the stack should not be more than 15 bags or 1.5 meters whichever is lower. Width of the stack should not be more than 4 bags or 3 meters. Lateral loading of the walls of the storage room by stacking should not be permitted. Stacking of the bags should not be used as a working platform.
- b) Shuttering and supporting structures should be of adequate strength and approved by engineer-in-charge. This should be ensured before concrete is poured.
- c) If the mixer has a charging skip the operator should ensure that the workmen are out of danger before the skip is lowered.
- d) Adequate walking platforms (as per the AERB directives) are to be provided in the reinforcement area to ensure safe walking for pouring concrete on the roof.

- e) When workmen are working/cleaning the inside of the drum of mixer, the power of the mixer should be switched off and “Do not operate” tag should be provided. The plant operation and cleaning of mixing pan should be carried out as per equipment supplier’s instructions.
- f) Interlocks between the cover and the mixer rotor shall be established to ensure that the agitator does not start when the cover is in open condition.
- g) It should be ensured that moving parts of the elevators, hoists, screens, bunkers, chutes and grouting equipment used for concrete work and of other equipment used for storing and transporting of ingredients of concrete are securely fenced to avoid contact of workers with such moving parts.
- h) It should be ensured that screw conveyors used for cement, lime and other dusty material are completely enclosed.
- i) Workers engaged for handling bulk cement in a confined place should be provided with tight fitting goggles, approved respirators and protective clothing, which will fit snugly around the neck, wrist and ankles.

The following should be ensured for every pipe carrying pumped concrete:

- i. The scaffolding carrying a pipe for pumped concrete should be strong enough to support such pipe at a time when such pipe is filled with concrete or water or any other liquid and to bear safely all the building workers who may be on such scaffold at such time.
- ii. Securely anchored at its end point and each curve on it.
- iii. Provided with an air release valve near the top of such pipe; and securely attached to a pump nozzle by a bolted collar or other adequate means.

The following should be ensured while using the electric vibrators in concreting work at a construction site of a building or other construction work such that:

- i. Such vibrators are earthed.
- ii. The leads of such vibrators are heavily insulated.
- iii. The current is switched off when such vibrators are not in use.

For obtaining a clearance for first pour of concrete and regular operation of ready-mix concrete (RMC) plant, checklist given in Appendix-C shall be submitted to AERB along with the application for clearance.

1.9.11.11 PAINTING

- a) Appropriate breathing air respirators should be provided for use by the workers when paint is applied in the form of spray, or a surface having lead paint is dry rubbed or scraped.
- b) Only the quantity of paint, thinner and polish required for the day's work should be kept at the work spot. Excess storage should not be permitted at the work spot.
- c) Smoking, open flames or sources of ignition should not be allowed in places where paints, varnish, thinner and other flammable substances are stored, mixed or used. A caution board, with the instructions written in national language and regional language, 'SMOKING - STRICTLY PROHIBITED' should be displayed in the vicinity where painting is in progress or where paints are stored. Symbols should also be used on caution boards.
- d) All electrical equipment of paint storage room should be of explosion proof design. Suitable fire extinguishers/sand buckets should be kept available at places where flammable paints are stored, handled or used.
- e) When painting work/hot resin mix is done in a closed room or in a confined space, adequate ventilation should be provided and ensured. In addition, suitable respirators should be provided. No portable electric light or any other electric appliance of voltage exceeding 24 volts should be permitted for use inside any confined space. Walkie-talkie or other means of communication should be provided. Rescue arrangement like full body harness with lifeline, tripod with pulley and extra BA sets should be available.
- f) The workers should use PVC gloves and/or suitable barrier creams to prevent the skin contact with Epoxy resins and their formulations used for painting.

1.9.11.12 DEMOLITION

- a) Before any demolition work is commenced and also during the progress of the work, all roads and open area adjacent to the work site should either be closed or suitably cordoned. Appropriate warning signs should be displayed for cautioning approaching persons/ vehicles.
- b) Before demolition operations begin, it should be ensured that all the service lines are de-energized.

- c) Persons handling demolition operations shall use appropriate PPE.
- d) All demolition operations should be carried out with safe and duly approved procedures which shall include following but not limited to:
 - i. No masonry/material should be permitted to fall in such masses or volume or weight so as to endanger the structural stability of any floor or structural support.
 - ii. No wall, chimney or other structure or part of a structure is left unguarded in such a condition that it may fall, collapse or weaken due to wind pressure or vibration.
 - iii. No floor, roof or other part of the building should be overloaded with debris or materials as to render it unsafe.
- e) After the demolition, the debris and other materials collected should be disposed safely and not permitted to be dropped freely.
- f) Entries to the demolition area shall be restricted to authorised persons wearing safety helmets and safety shoes.

1.9.11.13 TRAFFIC

- a) All the vehicles moving at sites should conform and comply with the requirements of Motor Vehicles Act, 1988 and the Rules made there under. All the drivers/operators of vehicles should possess valid driving license as per Motor Vehicles Act, 1988 or its latest amendment.
- b) The facility should conduct operations so as to interfere as little as possible with the use of existing roads at or near locations where the work is being performed. When interference to traffic is inevitable such as road cutting or transit unloading of heavy equipment etc. notice of such interference should be given to the engineer-in-charge and safety officer well in advance with the details of start of the work and time required.
- c) A cleaner/assistant must be available for all heavy vehicles whenever vehicles move forward as well as in the reverse direction. All vehicles should be fitted with proper reverse horns, back view mirrors and indicator signals.
- d) Facility should ensure that the assessment of the driver's visual ability is carried out as per Rule 55 of the Atomic Energy (Factories) Rules, 1996/guidelines of advisory committee on occupational health (ACOH), AERB or as per the latest amendments in statutes.

- e) Effective speed breakers with yellow stripes on the roads to regulate the speed at the vulnerable points should be installed. Effective barricading with adequate caution signs should be placed to warn the vehicle drivers whenever the jobs are carried out on the road.
- f) All vehicles moving at the site should have roadworthiness certificate issued by the concerned authority.
- g) Special limit boards and caution boards indicating turns should be installed wherever necessary.
- h) In general, the following maximum speed limits should be specified and implemented. Vehicles speed limits should be as per Motor Vehicle Act or 20 Km/h. Extra precautions and care should be exercised particularly during heavy material/equipment movements.
- i) Safety awareness programmes should be conducted for all the drivers of the light, medium and heavy vehicles.

1.9.11.14 WORK IN RADIATION AREA

The facility should follow the stipulated procedure under Atomic Energy Radiation Protection Rules, 2004 and AERB safety manual on 'Radiation Protection for Nuclear Facilities' (AERB/NF/SM/O-2) regarding work in the radiation area and other works related with radiography.

1.9.11.15 WORK IN AND AROUND WATER BODIES

- a) When work is done at a place where there is risk of drowning, all necessary rescue equipment such as life buoys and life jackets should be provided and kept ready for use.
- b) All necessary steps shall be taken for prompt rescue of any person in danger and adequate provision should be made for prompt first-aid treatment of all injuries likely to be sustained during the course of the work. Proper record of entry/exit to and from water bodies shall be maintained on shift basis and search operation shall be conducted as soon as any person is detected to be missing.
- c) Caisson Work
 - (i) Safe means of access should be provided to the place of work in the caisson and adequate means should be provided to safely reach the top of caisson in the event of inrush of water
 - (ii) The work relating to construction, positioning, modification or dismantling of caisson shall be done under the supervision of a responsible person

1.9.11.16 FIRE SAFETY

- a) All provisions for fire safety shall be complied as per AERB safety standard on 'Fire Protection Systems for Nuclear Facilities' [AERB/ NF/SS/FPS (Rev. 1)].
- b) All necessary precautions should be taken to prevent outbreak of fires at the construction site. It should be ensured that all hot work is carried out under valid work permit.
- c) Combustible materials such as wood, cotton waste, oil, coal, paints, chemicals etc., should be segregated and kept to the required bare minimum quantity at work place.
- d) Containers of paints, thinners and allied materials should be stored in a separate room which should be well ventilated and free from excessive heat, sparks, flame or direct rays of the sun. The containers of paint should be kept covered or properly fitted with lid and should not be kept open except while using.
- e) Adequate number of trained persons from approved fire training centre required to extend fire safety coverage should be ensured.
- f) Fire extinguishers as approved by the engineer-in-charge/in-charge of fire station/safety-in-charge should be located at the construction site at appropriate places.
- g) Adequate number of trained workmen in fire fighting who can operate fire extinguishers should be ensured.
- h) Portable fire extinguishers with periodic inspection, maintenance and re-filling complying with the mandatory requirements should be ensured.
- i) Availability of adequate water for fire fighting should be ensured.
- j) Implementation of the provisions of various statutory licenses for storing gas cylinders, petroleum products, explosives etc. as per the relevant acts and rules should be ensured wherever required.

1.9.11.17 ENVIRONMENTAL SAFETY

Relevant provisions of the state/central statutory authority regarding environment protection should be adhered to.

1.9.12 PUBLIC PROTECTION

The Facility should make necessary provisions to protect the public. He should be bound to bear the expenses in defence of every action or other proceedings at law that may be brought by any person for

injury sustained owing to neglect of any precaution required to be taken to protect the public. He should pay for the any such damage and cost which may be awarded in any such suit, action or proceedings to any such person, or the amount, which may be fixed as a compromise by any such person.

1.9.13 SAFETY OF VISITORS

- a) Visitors for the project shall be given health and safety induction before they are allowed in to the construction project. It shall include the minimum PPE to be used, hazards and risks at the work area, restricted areas of entry, emergency response arrangements, etc.
- b) Visitors shall always be accompanied by one of the employees of the project site.
- c) Visitors shall not be allowed in the hazardous areas unless they are competent and trained to work in such areas.

1.9.14 HOUSEKEEPING

- a) The Contractor shall at all times keep his work spot, site office and surroundings clean and tidy from rubbish, scrap, surplus materials and unwanted tools and equipment.
- b) Welding and other electrical cables shall be so routed as to allow safe traffic by all concerned.
- c) No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or the public. The Engineer-In-Charge may require the Contractor to remove any materials which are considered to be of danger or cause inconvenience to the public. If necessary, the Engineer-In-Charge may cause them to be removed at the Contractor's cost.
- d) At the completion of the work, the Contractor shall have removed from the work premises all scaffoldings, surplus materials, rubbish and all huts and sanitary arrangements used/installed for his workmen on the site.
- e) The Engineer-In-Charge has the right to stop work if the Contractor fails to improve upon the housekeeping after having been notified.
- f) It should be recognised that a proper place for everything and everything in its place is maintained for a good housekeeping.
- g) The material required for immediate use only should be brought to the designated workplace and stacked properly and labelled suitably.

- h) All work spots, site office and surroundings should all times be kept clean and free from debris, scrap, concrete muck, surplus materials and unwanted tools and equipment. A day-to-day collection and disposal of scraps/debris should be done safely at designated place.
- i) Electrical cables, leads and hoses should be so routed as to allow safe traffic by all concerned. Cable should be preferably supported on the brackets fixed along the wall to maintain safe access. Wherever routing on the floor cannot be avoided, care should be taken to ensure mechanical protection of these cables and safe access is not disturbed.
- j) No material on any work place should be so stacked or placed or disposed off as to cause danger, inconvenience or damage to any person or environment.
- k) All unused scaffoldings, surplus/scrap materials and equipment/ systems like temporary electrical panels etc. should not be allowed to accumulate and shall be removed from the premises at the earliest.
- l) Accumulation of water/oil spillages on the floor or any other workplace should be avoided.
- m) Proper aisle space marking should be provided in all workplaces.

1.9.15 OTHER STATUTORY PROVISIONS

Notwithstanding the clauses in the above subsections, there is nothing in these clauses to exempt the Facility from the provisions of any other act or rules in force in the Republic of India. In particular, all operations involving the transport, handling, storage and use of explosives should be as per the standing instructions and conform to the Indian Explosives Act, 1884 and the Explosives Rules, 1983. Handling, transport, storage and use of compressed gas cylinders and pressure vessels should conform to the Gas Cylinder Rules 2004 and Static and Mobile Pressure Vessels (Unfired) Rules 1981. In addition, The Indian Electricity Act 2003 and Indian Electricity Rules 2005, the Atomic Energy Act, 1962, the Radiation Protection Rules, 2004, the Atomic Energy (Factories) Rules, 1996 and AERB safety manual on 'Radiation Protection for Nuclear Facilities' (AERB/NF/SM/O-2) should be complied with.

1.9.16 PENALTY STRUCTURE FOR NON-COMPLIANCE OF SAFETY REQUIREMENTS

The safety requirements to be followed at worksites are not limited to those mentioned above. All statutory safety requirements mandated under various applicable Acts and Rules enacted by the Government of India shall invariably be followed at KKNPP. Violation of statutory requirements

shall attract punitive/penal actions. In addition, the safety violations during the execution of the present contract will be used as one of the factors for the performance evaluation of the Contractor, which in turn will be used for evaluation of future contracts.

Similarly, the requirements brought out in AERB Safety Guidelines 'Control of Works', which is a part of the contract documents, shall also invariably be followed.

Violation of such statutory and regulatory requirements shall attract a penalty mentioned in Annexure-1 under respective categories.

Detailed procedures, guidelines, manuals etc. on various aspects of industrial safety periodically issued by NPCIL as a part of the continual improvement process, shall also be followed by the Contractors.

All concerned Section Heads/Engineers-in-charge of the works contract shall be responsible for implementation of these instructions during all stages of execution of the work.

The quantum of penalty to be imposed shall be recommended during monthly Sectional Safety Committee meetings, based on the status of compliance of Safety Related Deficiencies (SRD) reports issued to respective Contractors. The committee shall assess the status of compliance of SRD reports by carrying out survey of workplace. Concerned Engineers-in charge shall deduct the recommended amount of penalty from the monthly RA bill.

PENALTY STRUCTURE FOR NON-COMPLIANCE OF SAFETY REQUIREMENTS

Sl. No	Safety Parameters	Penalty structure for noncompliance of safety requirement
1.0	<u>Safety Professional</u> Penalty for not deploying minimum nos. of Safety Professional	Safety Officer - Rs 1500 per day per Safety officer Safety Supervisor- Rs 1000 per day per Safety Supervisor <i>Note: The penalty will also be imposed in case of absence of deployed safety personnel without acceptable replacement. However, the work will be stopped if regular safety personnel is not deployed back within 7 days.</i>
2.0	<u>Safety Training</u> <ul style="list-style-type: none"> ➤ Worker found without safety induction training or refresher training ➤ Worker found without safety training card 	Rs 1000 per violation
3.0	<ul style="list-style-type: none"> ➤ Non-compliance of Pre-job Briefing, non-availability of JHA, Safety Work Permit or Safe Working Procedure for high risk jobs. 	Rs 1000 per violation

4.0	<ul style="list-style-type: none"> ➤ Not providing required PPEs to the workmen ➤ Not using PPEs or using PPEs in incorrect manner or using defective PPEs. 	<p>Rs 2000 per violation</p> <p>Rs 500 per violation</p>
5.0	<p><u>Work at Height</u></p> <ul style="list-style-type: none"> ➤ Workers working at height without height pass. ➤ Working at height without Height work permit ➤ Working at height without safe means of access ➤ Width of platform less than 1m Not providing adequate handrails, mid rails & toe guards ➤ Not providing adequate anchorage point for safety harness 	Rs. 10,000 per violation
	<ul style="list-style-type: none"> ➤ Unsafe working platform ➤ Not providing safety nets, fall arrestors, life line etc. where required ➤ Using uncertified scaffolds/working platforms ➤ Not providing inspection tags on scaffolds/working platforms 	Rs. 10,000 per violation
6.0	<p><u>Electrical Safety</u></p> <ul style="list-style-type: none"> ➤ Use of unsafe/damaged /nonstandard electrical equipment/appliances ➤ Drawing power supply from power socket without plug ➤ Drawing power without or bypassing ➤ ELCB ➤ Faulty/inadequate earthing ➤ Unsafe cable joints ➤ Use of non-standard power distribution boards, extension boards ➤ Not carrying out periodic inspection of electrical system/equipment (without inspection stickers on PDBs, extension boards, power tools etc.) ➤ Not providing fire extinguisher & rubber mat near PDBs. ➤ Using polycarbonate switches, plugs and sockets instead of metal clad sockets and plugs ➤ Non-deployment of electrician 	Rs 20,000 per violation

7.0	<u>Material Handling</u> <ul style="list-style-type: none"> ➤ Use of machinery, tools and tackles not having valid inspection certificate ➤ Use of faulty/damaged material handling equipment ➤ Operation of MH machine/equipment by unauthorized personnel ➤ Not deploying trained signalmen ➤ Not displaying safe working load, date of inspection and next due date on material handling equipment 	Rs 15,000 per violation
8.0	<u>Welding, Gas cutting and other hot works</u> <ul style="list-style-type: none"> ➤ Using faulty/unsafe welding, gas cutting, hot work equipment ➤ Using earthed structure as welding return circuit ➤ Un-insulated joints in welding cable Not using flashback arrestor in gas cutting set ➤ Not ensuring colour coding or valve cap on cylinders ➤ Unsafe handling of gas cylinders Not following fire prevention measures 	Rs 5000 per violation
9.0	<u>Safe storage of material</u> <ul style="list-style-type: none"> ➤ Unsafe stacking of structural steel material, reinforcement rods etc. ➤ Unsafe storage of gas cylinders, non-chaining of cylinders ➤ Unsafe storage of flammable/ corrosive liquids 	Rs 1000 per violation
10.0	<u>Fire protection and Fire fighting arrangements</u> <ul style="list-style-type: none"> ➤ Not providing fire protection and fire fighting arrangements ➤ Not providing adequate numbers of fire extinguishers ➤ Not removing unwanted combustibles from worksites 	Rs 5000 per violation

11.0	<u>Transportation of man and material</u> <ul style="list-style-type: none"> ➤ Using material transport vehicle for transporting people ➤ Overloading of vehicle ➤ Two-wheeler drivers not using protective helmet ➤ Vehicles used without valid certificates ➤ Unsafe transportation of material Vehicles with faulty reversing horns, head lamps, horns, brakes etc. 	Rs 1000 per violation
12.0	<u>Housekeeping</u> <ul style="list-style-type: none"> ➤ Non compliance of Housekeeping requirements. ➤ Urinating/defecating in non designated places ➤ Spitting in workplaces. ➤ Smoking in workplaces ➤ Writing graffiti in workplaces ➤ Temporary sheds in unauthorized places 	Rs 1500 per violation

APPENDIX-A

APPLICATION FOR HEIGHT PASS

PART- A

Group/Section: _____

Agency: _____

1. Applicant's Name : _____
2. Facility address : _____
3. Residential address : _____
4. Age : _____
5. Sex : _____
6. Height : _____
7. Gate Pass No. : _____
8. Name of contractor/agency with whom engaged at present : _____
9. Height pass required for work at _____ m. Height
10. Description of present job : _____
11. Previous experience of working at height : _____

S.No.	Name of the Employer	Duration of Employment	Work Experience
1.			
2.			

12. Does the applicant suffer from any of the following ailments? (If yes details to be given):
- (a) Blood pressure _____ (b) Epilepsy _____
- (c) Flat foot _____
- (d) Frequent headache or reeling sensation _____
- (e) Mental depression _____ (f) Limping gait _____
- (g) Aerophobia _____

Declaration:

I hereby declare that the above information furnished by me is true and correct. I shall always wear the safety belt and tie the life-line whenever working at unguarded heights of 3 m and above. I shall not misuse the height pass issued to me or transfer it to any other person. I shall never come to duty or work at height/depth under the influence of alcohol/drugs.

Date: _____

Name: _____

Sign: _____

(Applicants name and signature or loss time injury (L.T.I) incase he cannot sign. In case of LTI an authorised person shall explain each point/item to the individual and certify on that behalf below the LTI)

I certify that I am satisfied with the above certification of the individual for the application of height pass and request for issue of height pass to him.

Name : _____

Sign :
(Agency Concerned)

Countersigned by: _____

Section Head (Facility)

PART- B

MEDICAL FITNESS CERTIFICATE

Certified that I, Dr. _____ have examined Shri _____
_____ aged _____ on (date) _____ who has signed
below in my presence. General & physical examinations of Shri. _____
_____ do not reveal any abnormality. He does not suffer from any acute/
chronic skin disease or any contagious or infectious disease. His eye sight is normal
with/without glasses. In my opinion, Shri _____ is physically
and mentally fit for working at height.

Details of examinations are given below:

Personal attributes:

1. Height: _____
2. Chest: _____
3. Weight: _____
4. Hearing: _____
5. Sight: _____
6. Skin: _____
7. Heart beating: _____

Medical aspects:

1. Urine: _____
2. Blood pressure: _____
3. Epilepsy: _____
4. Flat foot: _____
5. Frequent headache
or reeling sensation: _____
6. Mental depression: _____
7. Limping gait: _____
8. Aerophobia: _____

Name: _____

Sign : _____

Rubber Stamp of
Medical Practitioner
with Reg. No. _____

Signature of workman: _____

PART-C

INDUSTRIAL SAFETY SECTION

(Considering the above medical certificate, the applicant has appeared on the following practical tests conducted by industrial safety section and the results are given below (strike off whichever is in-applicable)

- (a) Wearing a safety belt and tying the rope knot : Pass/fail
- (b) Walking over a horizontal structure at 3 m. : Pass/fail
height wearing a safety belt
- (c) General physique (OK/Not OK)

The above applicant's performance in the above tests has been satisfactory/unsatisfactory due to the following.

So I certify and issue this height pass to Shri _____
with Registration No. _____ in the height pass register. This is valid for one year
from the date of issue i.e. up to _____

Date:

Name:

Sign.:

Scientific Assistant (Safety)

Safety Officer

APPENDIX-B

FORM - 1

APPLICATION FOR TEMPORARY POWER SUPPLY AND USE OF ELECTRICITY AT WORK SITE DURING CONSTRUCTION [Prescribed under clause 4.6(d)]

1.	Name and address of user.	
2.	Reference of tender or work order (if applicable)	:
3.	Name & designation of tender/work order issuing authority.	:
4.	Power supply application number [†]	:
5.	Name and designation of tender/work order/work supervising authority (engineer-in-charge).	:
6.	Expected date of commencement of temporary supply	:
7.	Expected date of decommissioning of temporary supply	:
8.	Voltage level (LV/MV/HV)	
9.	Type of connection (1Ph/3Ph)	
10.	Connected load (Kw)	
11.	Maximum demand (KVA)/Power factor	
12.	Single line diagram* of proposed power distribution scheme along with equipment data sheet (downstream installation after point of connection).	Enclosed (Form-1A)/Not enclosed
13.	Name of overall supervisor and available qualified Staff	Enclosed (Form-1B)/Not enclosed
14.	Auxiliary equipment data sheet (meters, fire extinguisher, first aid box etc)	Enclosed (Form-1C)/Not enclosed
15.	Name and designation of provider's representative to whom the application is addressed.	:
16.	Name and designation of authorized signatory of user, who had submitted this application	:

† Power supply application number shall be different for same user with multiple applications for temporary supply

* All the drawings and tables shall be signed by user's representative indicated against 16 above.

Signature of authorised signatory of user

Signed endorsement of work order
supervising authority indicated
against 5 above.

FORM - 1A

**EQUIPMENT DATA SHEET FOR OBTAINING TEMPORARY POWER
SUPPLY AND USE OF ELECTRICITY AT WORK SITE DURING
CONSTRUCTION**

(Prescribed against item-12 of form-1)

Name and address of user:

Power supply application

Number:

Amendment No:-

References:- Single line diagram (SLD) of the power distribution scheme with all equipment details (Attach the SLD)

1. Identity	2. Type	3. Make & model	4. Manufacturer's S.No	5. Fixed/ Portable	6. Size	7. Last used date	8. Last test date	9. Latest test data	10. Rating

Signature of authorised signatory of user

Explanation of column headers:

1. Identity:- Identification mark/number/tag of equipment in single line drawing and layout drawing. Every equipment in single line drawing and layout drawing shall have suitable identification mark/number/tag.
2. Type:- Cable/CB/MCB/MCCB/ELCB/transformer/lightning arrestor/earthing station/earthing connection/motor/lighting fixture/switch/fuse/switch, socket box etc.
3. Make and model:- manufacturer's name and corresponding model no.
4. Manufacturer's S. No:- serial number and date in name plate if available. Else NA
5. Fixed/portable:- Equipment is installed/laid/anchored to surface or portable.
6. Size:- depending upon type of equipment and as desired by provider representative e.g. length for cables or all dimensions if heavy equipment like transformer.
7. Last used date. date of last use else NEW
8. Last test date. latest test date by user or by manufacturer if NEW
9. Latest test data:- IR, HV, resistance, functional test data depending upon the type of equipment as desired by provider's representative.
10. Rating:- name plate rating of equipment like voltage, current, power (apparent, active, reactive), IP of enclosure, size(cable cross section) etc. depending upon the type of equipment and as desired by provider's representative.

FORM - 1C**AUXILIARY EQUIPMENT DATA SHEET FOR OBTAINING
TEMPORARY POWER SUPPLY AND USE OF ELECTRICITY
AT WORK SITE DURING CONSTRUCTION****(Prescribed against item-14 of form-1)**

Name and address of user:

Power supply application

Number:

Amendment No:-

Reference:- Layout drawing No. / _____

1. Identity	2. Type	3. Make and model	4. Manufacturer's S. No	5. Fixed/ Portable	6. Size	7. Last used date

Signature of user's representative

Explanation of column headers:

1. Identity:- identification mark/number/tag of equipment in layout drawing.
2. Type:- earthing rod/megger/multi meter/earth resistance meter/fire extinguisher/s and bucket/first aid box/resuscitation chart/rubber mat etc.
3. Make and model:- manufacturer's name and corresponding model no.
4. Manufacturer's S. No:- serial number and date in name plate if available. Else NA
5. Fixed/portable:- equipment is installed/laid/anchored to surface or portable.
6. Size:- depending upon type of equipment and as desired by provider representative.
7. Last used date. NEW for new equipment. NA for passive devices like chart/mat etc.

FORM-1D

[Prescribed under clause 4.6(e)]

Name of user agency

Power supply application number:-

CERTIFICATE BY THE LICENSED ELECTRICAL CONTRACTOR

Certified that subject installations have been carried out by us or checked by us and is in accordance with I.E. Rules. The documents submitted with subject temporary power supply application (Form-1) is verified by us and the complete installation confirms to these documents.

We shall periodically inspect/check the installation so that no unsafe situation arises during use of this temporary power supply system. We understand that for the entire duration of existence of this temporary power supply system we shall be responsible for any unsafe installation, operation, maintenance, testing of the same which results into any loss of life or material. We shall immediately report to the provider's representative and ensure de-energisation of supply if any unsafe situation arises during use of this temporary power supply system.

Signature of the authorised signatory of licensed electrical contractor

Rubber seal of licensed electrical contractor

Date

CERTIFICATE BY THE USER

Certified that my/our installations have been carried out in accordance with the I.E. Rules and that I/We have employed competent agency/staff to handle the installations which is strictly as per the staff data sheet submitted in Form-1B.

We understand that for the entire duration of existence of this temporary power supply system we shall be responsible for any unsafe installation, operation, maintenance, testing of the same which results into any loss of life or material. We shall immediately report to the provider's representative and ensure de-energisation of supply if any unsafe situation arises during use of this temporary power supply system.

Signature of the authorised signatory of user

Name of signatory

Date

FORM -1E

[Prescribed under clause 4.6(f)]

CERTIFICATE BY THE SAFETY OFFICER

Certified that I have inspected the electrical installation referred here in after satisfying myself about the safe condition of the installation, I hereby recommend that the service connection be given to the contractor.

Signature of the safety officer

Name:

Date:

AUTHORISATION BY THE ELECTRICAL ENGINEER

The subject power supply application along with completed installation, necessary certificates (as per Form-1 of Appendix-B) is scrutinised by us. The proposal found to be in order and the installation can be energised on _____ in presence of your designated overall supervisor as indicated in Form-1B. Enclosed herewith the test report data sheet Form-1F. You are requested to carry out the periodic testing of equipment and submit the test report periodically as per this form.

Signature of the electrical engineer
of provider

Name of signatory

Date

FORM - 1F**TEST/MAINTENANCE REPORT DATA SHEET OF EQUIPMENTS OF
TEMPORARY POWER SUPPLY SYSTEM AT WORK SITE DURING
CONSTRUCTION****(Prescribed against form-1E)**

Name and address of user:

Power supply application

Number:

Amendment No:-

1. Identity	2. Type	3. Last tested date	4. Next due date of any test	5 Frequency of IR test	6 Frequency of HV test	7. Frequency of earth resistance test	8. Other tests

Signature of electrical engineer of provider

Explanation of column headers:

1. Identity:- identification mark/number/tag of equipment in single line drawing and layout drawing. Every equipment in single line drawing and layout drawing shall have suitable identification mark/number/tag.
2. Type:- Cable/ CB/ MCB/ MCCB/ ELCB/transformer/lightning arrester/earthing station/ earthing connection/motor/lighting fixture/switch/fuse/switch, socket box etc.
3. Last test date: - latest test date indicated in Form-1A.
4. Next due date of any test:- as worked out by frequency of tests indicated in subsequent columns.
5. Frequency of IR test:- required frequency depending upon type of equipment and location of installation. NA if not required after installation.
6. Frequency of HV test:- required frequency depending upon type of equipment and location of installation. NA if not required after installation.
7. Frequency of earth resistance test:- required frequency depending upon type of equipment and location of installation. NA if not required after installation.
8. Other tests: - name and description of any other essential tests/maintenance activity and required frequency depending upon type of equipment and location of installation. NA if not required after installation.

VOLUME - IA PART – I CHAPTER – X

NPCIL SECURITY RULES & MEDICAL MANAGEMENT

1.10.1 SECURITY RULES

It may be noted that the construction site is within the purview of the Central Industrial Security Force / other security agency engaged by NPCIL. The contractor shall follow all security rules as may be framed by Corporation from time to time regarding removal / movement of materials, equipment and personnel to and from site.

1.10.1.1 ENTRY/ EXIT OF MANPOWER

To ensure traceability/identity each and every person engaged by the contractor will be required to furnish bio-data of labourers / staff in standard format which includes individual photograph, name, present and permanent address, identification mark, and any of the following identity proofs for issue of temporary pass for period of maximum 15 days.

- a) Voter ID
- b) Aadhar Card
- c) Ration Card
- d) Passport
- e) Bank Account Passbook of any Nationalized Bank
- f) Any document certified by a Gazetted Officer which provides photo identity and address of the individual
- g) Driving License
- h) Identity certificate from Native Village Administrative Officer or Elected Panchayat President
- i) PAN Card

Within 15 days of issue of temporary pass the Contractor shall submit the police verification certificate and Medical fitness certificate along with standard application format for issue of Regular pass (RFID).

For regular entry pass, the contractor engineer / supervisor / staff & labors must obtain the Police verification certificate and regular pass cannot be issued without police verification. 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.

Minors or physically unfit persons shall not be deployed for the work. On completion of work or on leaving of labour, the RFID cards shall be returned back to NPCIL. **Penalty of Rs 3000 per RFID card (or as revised from time to time) will be levied for non-return / loss of RFID cards/ Damage of RFID. The RFID passes not used for a period of 30 days will be disabled in the system preventing entry of said person. This can be re-validated only through separate approval.**

The contractor and his personnel shall abide by all security measures imposed by the NPCIL from time to time. Contractor shall also follow all rules and regulations applicable to the area being declared / pronounced from time to time by the authorities of existing Nuclear Power Station in the vicinity or any other statutory orders. The contractor, his employees and agents shall not disclose any information or drawings furnished to him by Corporation. Any drawings, reports and other information prepared by the contractor / by Corporation or jointly by both for the execution of the contract shall not be disclosed without prior written approval of the NPCIL. **No mobile phone with camera is allowed inside the plant premises.**

On completion of the contract, it shall be the responsibility of contractor to collect the regular passes (RFID) from labourer and return to the Security Section. The contractor shall obtain a certificate in this regard from SECURITY and submit it to EIC along with submission of the final bill.

1.10.1.2 ENTRY/ EXIT OF MATERIALS

During the entry and exit of all the materials brought by contractors at KKNPP 3&4 Project site, the details shall be entered in the Material entry/exit register maintained at security gate. One copy of documents pertaining to materials being taken inside shall be kept with security. While taking the material out, this shall be cross-checked with the inward documents and confirmed.

Contractors will be allowed to take their materials in/ out of the construction areas from/ to their workshops inside plant premises through material movement format approved by the Project Manager/ Site- in-charge of the contract. For taking materials onward/outward of KKNPP-3&4 Project Site areas (in/ out of the main plant boundary), gate pass in standard format shall be approved through NPCIL. The contractor shall print gate pass book in quadruplicate in approved format of NPCIL for the entry/exit of materials to/from project premises.

Loading of materials belonging to contractors inside plant premises, on to trucks/ tractor-trailers/ any other vehicles for taking out of plant premises shall be carried out in the presence of security personnel. A formal request for deployment of security personnel stating the time of loading of

materials should invariably be sent to security through Engineer well in advance. Contractor's Project Manager/ Site in-charge shall issue a certificate certifying that contractor's materials are only being loaded / shifted out of plant premises.

1.10.1.3 Entry/ Exit of Vehicles

Entry and exit of contractor's vehicles at KKNPP-3&4 Project site shall be controlled through vehicle pass and the application shall be submitted in standard format.

Free issue materials could be loaded/ unloaded at Central Stores/ Warehouse between 0900 hours and 1700 hours with the approval of Engineer on the request submitted by the Contractor.

Entry pass for contractor's vehicles will be issued on submission of valid registration, insurance and driving license of driver.

1.10.1.4 Mobile Passes

Contractors' staff / labour shall be allowed to carry basic model mobile without camera/data card /internet facility in to KKNPP-3&4 Project site areas only on approval. However, entry of mobile in main plant area will be limited / not permitted. The mobile pass issued shall be restricted from time to time. They shall submit the application for mobile pass in standard format through Engineer.

1.10.1.5 Photography in Project Premises

Photography in Project Premises is strictly Prohibited.

1.10.2 EMERGENCY PREPAREDNESS DRILL

KKNPP- 3 to 4 is in the vicinity of operating units KKNPP 1&2. KKNPP Unit 1&2 performs annual mock emergency exercises in accordance with the stipulations of Atomic Energy Regulatory Board as a part of emergency preparedness plan.

All the contractor's workmen engaged for KKNPP 3 to 4 works may have to undergo awareness program on emergency preparedness which shall be arranged by NPCIL. The contractor's workmen may require assembling in the identified areas and registering their presence for accounting purpose as on when required. The rates quoted by contractor shall include the cost of delay due to such interruptions.

1.10.3 LABOUR EMPLOYMENT

EMPLOYMENT OF UNSKILLED PERSONS FROM AMONG THE DISPOSSESSED FAMILIES

In addition to Contractor's own labour force, he shall also employ unskilled laborers out of suitable persons from the families within Kudankulam Nuclear Power Project areas whose lands have been acquired for setting up the Project. It is also encouraged to employ the local labour /staff from the neighbourhood of the Project to the maximum possible extent.

1.10.4 CORPORATE SOCIAL RESPONSIBILITY

The contractor shall note the fact that Kudankulam Project is located in an area which is surrounded by many villages. The contractor may have to carry out welfare activities in these villages to generate goodwill among the people. A few projects may be taken up in the villages under Corporate Social Responsibility Scheme of Contractor's organization as per provisions of section 135 of Company's Act 2013.

1.10.5 MEDICAL MANAGEMENT

FIRST AID CENTRE & AMBULANCE FACILITY

One First aid centre and Ambulance service are equipped by BHEL inside the Plant Premises. Services of the same will be extended to the workers/ staff injured /ill, while working, in side plant area. Running expenditure to be shared among contractors of BHEL on proportionate basis of contract value. BHEL engineer decision is final in this regard.

In addition to above the contractor has to make following own arrangements with in their quoted rates

MEDICAL FACILITIES

- a) Medical facilities conforming to the provisions of the Atomic Energy (Factories) Rules, 1996 should be provided at all work sites.
- b) Well maintained first aid boxes should be kept at each location of the work by the contractor and availability of the personnel trained in first aid should be ensured.
- c) The facility management/contractor shall make arrangements for the first aid and medical services for the injured or ill persons for prompt attention or aid.
- d) The arrangement can be made by the contractor or an agreement can be in vogue with the facility.

- e) Display of emergency contact numbers of important persons and hospitals and route map of site shall be maintained at designated places.
- f) It should be ensured by the occupier that occupational health monitoring of contract workers is carried out as per provisions of the Factories Act 1948 as per the latest amendment and the stipulations/directions given by Atomic Energy Regulatory Board from time to time.

1.10.5.1 MEDICAL MANAGEMENT OF SERIOUS INJURIES

- a) In case of serious injuries, the injured should be shifted to the nearest first-aid centre at site immediately. The opinion of medical officer/ certifying surgeon should be sought immediately for medical management.
- b) After providing the first aid treatment the injured should be shifted to designated medical facility of the site/hospital for further medical assistance, in an ambulance along with a nursing attendant.
- c) The doctor at the medical facility of the site/hospital attending the case shall assess the extent of injuries and render immediate medical aid. If the situation warrants trauma/special care the injured shall be shifted to the referral hospital, having all the requisite facilities for specialised treatment in ambulance along with a medical attendant.
- d) A list of such referral hospitals for specialised medical management facilities for the injured persons should be available with the project management/Head, industrial safety and Head, medical services of the site for ready reference.

VOLUME-IA PART-I CHAPTER – XI

PROGRESS OF WORK

(All the works mentioned here under shall be carried out within the accepted rate unless otherwise specified.)

- 1.11.1 Refer forms F -14 to F-18 of volume I D (Forms & Procedure) of volume -I Book-II. Plan and review will be done as per the formats. These should be submitted on monthly basis with duly signed by BHEL and Contractor.
- 1.11.2 Contractor is required to draw mutually agreed monthly erection programs in consultation with BHEL well in advance. Contractor shall ensure achievement of agreed program and shall also timely arrange additional resources considered necessary at no extra cost to BHEL.
- 1.11.3 Progress review meetings will be held at site during which actual progress during the week vis-a-vis scheduled program shall be discussed for actions to be taken for achieving targets. Contractor shall also present the program for subsequent week. The contractor shall constantly update / revise his work program to meet the overall requirement. All quality problems shall also be discussed during above review meetings. Necessary preventive and corrective action shall be discussed and decided upon in such review meetings and shall be implemented by the contractor in time bound manner so as to eliminate the cause of non conformities.
- 1.11.4 Tenderers have to furnish a list of Tools and Plants including cranes, Tractor / Trailers etc., which they propose to deploy for this work.
- 1.11.5 The contractor shall submit daily, weekly and monthly progress reports, manpower reports, materials reports, consumables (gases / electrodes) report, cranes availability report and other reports as per Performa considered necessary by the Engineer. The periodicity of the reports will be decided by BHEL Engineer at site.
- 1.11.6 The contractor shall submit weekly / fortnightly / monthly statement report regarding consumption of all consumables for cost analysis purposes.
- 1.11.7 The contractor shall submit a report of any damage, shortage, discrepancy etc., every week detailing in this regard.
- 1.11.8 The manpower reports shall clearly indicate the manpower deployed, category wise specifying also the activities in which they are engaged.
- 1.11.9 Monthly Plan and review will be done as per the Format provided in Form-14 (Any revision in the format during the contract will also be applicable).
- 1.11.10 The contractor shall submit any other details like Site organization chart, Progress photographs, Safety implementation report, pending materials and any other documents/reports required from BHEL for the activities planned during the subsequent month, etc. as sought by BHEL Engineer.

VOLUME-IA PART-I CHAPTER – XII

MATERIAL HANDLING, TRANSPORTATION AND SITE STORAGE

The scope of the work will comprise of but not limited to the following:

(All the works mentioned here shall be carried out within the accepted rate unless otherwise specified.)

- 1.12.1** Loading of material at BHEL / Customer stores and storage yard, transport to site, unloading at site / working area of equipment placement on respective foundation / location, fabrication yard, pre-assembly bay or at working area are in the scope of work of contractor. Contractors Quoted / Accepted rate shall be inclusive of the same. Required cranes, tractors, trailer or trucks / slings / tools and tackles / labour including operators Fuel lubricants etc for loading & unloading of materials will be in the scope of contractor.
- 1.12.2** The storage yard is located in more than one location within the Main Plant Boundary.
- 1.12.3** Required cranes for loading & unloading of materials, trailer shall be in the scope of contractor. The contractor shall provide any fixtures, concrete blocks & wooden sleepers, sandbags which are required for temporary supporting of the components at site.
- 1.12.4** Contractor shall plan and transport equipments, components from storage yard to erection site and erect them in such a manner and sequence that material accumulation at site does not lead to congestion at site of work.
- 1.12.5** The equipments / materials from the storage yard shall be moved in sequence to the actual site of erection / location at the appropriate time as per the direction of BHEL Engineer so as to avoid damage / loss of such equipment at site.
- 1.12.6** Contractor shall take delivery of the components and equipment's from the storage area after getting approval of BHEL Engineer on standard indent forms specified by BHEL. Complete and detailed account of the equipment's erected as well as progress shall be submitted to the engineer as directed.
- 1.12.7** Sometimes it may become necessary for the contractor to handle certain un required components in order to take out the required materials. The contractor has to take this contingency also into account. No extra payment is payable for such contingencies.
- 1.12.8** Materials shall be stacked neatly, preserved and stored in the contractor's shed / work area in an orderly manner. In case it is necessary to shift and re-stack the materials kept at work area / site to enable other agencies to carry out their work, same shall be done by the contractor at no extra cost.
- 1.12.9** The contractor shall take all such measures as may be reasonably necessary to ensure that its arrangements and those of its sub-contractors with respect to the transport of Goods, Materials and

Labour to the site do not interfere with local traffic in the vicinity of the site and where such interference is unavoidable shall make such special arrangements as may be reasonably required to minimize the effect of such interference.

VOLUME - IA PART- I CHAPTER - XIII

HOUSE KEEPING

1.13.1 MAINTENANCE OF CLEAN SITE CONDITIONS AND HOUSEKEEPING

1.13.1.1 CONSTRUCTION MATERIALS AND DEBRIS

During the execution of work the Contractor shall keep the entire site in neat and tidy conditions always by proper housekeeping and stacking of construction materials at site and by removing all debris and waste material regularly, on day to day basis if necessary.

Contractor shall arrange suitable portable metallic storage bins to store construction materials at site. No material shall be allowed to be spread at site directly on roads / floors. All the garbage and waste material shall be disposed off regularly at the designated area as specified by the Engineer.

Accumulation and piling up of construction materials /debris/ tool boxes will not be permitted except only at the locations approved for this purpose. Material required for use for next 3 days only shall be stacked in the building keeping a clear passage for movement of personnel.

1.13.1.2 CONTRACTOR'S CONSTRUCTION SITE OFFICE

Contractor's site office within the construction area for his engineers and labour shall be established using the standard Porta Cabins or containers and no site office shall be allowed inside the building. No make shift structures are permitted. The facilities to be built by the contractor shall be aesthetically pleasing and shall match with the general surrounding of KKNPP site.

1.13.1.3 OTHER REQUIREMENTS

It is also essential that contractor keeps all his moving machinery viz. vehicles etc. in neat and clean condition during entry & exit to/ from plant site and to achieve this contractor shall keep suitable arrangement for washing at his own cost.

The service lines viz. water, air, power cable, welding lead etc. shall not run on the floor but shall be routed by providing hangers on the walls and ceiling.

Smoking, chewing of tobacco/Pan etc is not permitted in the Project premises; hence these shall not be brought into the project site. Identity card/Entry pass of any person found indulging

in any such activities will be confiscated and will be removed from site without any explanations.

1.13.1.4 TOILET FACILITY AT WORK SITE

Contractor shall establish toilet facility comprising of urinals and IWCs outside the construction site near rest room at site and labour camp along with water supply arrangements, disposal of waste, lighting, ventilation, washing facility, drainage arrangement, cleaning facility, etc., and shall maintain them in clean condition at all times by deploying suitable persons.

In addition, Contractor shall establish mobile toilet facility comprising of urinals and IWCs within the nuclear island along with provisions for water supply, lighting, ventilation, washing facility, cleaning facility, etc., and shall maintain them in clean condition at all times by deploying suitable persons. The numbers and the location of these toilet blocks shall be decided with the consent of Engineer. These mobile toilet blocks shall be shifted as and when required as the work progresses. As guidance contractor may adopt the design of public toilet facilities provided by M/s.Sulabh International.

For disposal of the sewage, contractor shall make his own arrangement to connect / dispose the sewage to the STP established by NPCIL at plant site/ labour camp.

Workers are not permitted to take their lunch in work spot and other erection area of plant. They shall use the covered lunch shed provided by BHEL

Note: BHEL Provide Lunch shed for workers for taking lunch inside the plant area at free of cost. However, agency, workers and all concerned are to co- operate with BHEL for Maintaining the shed in clean condition

1.13.1.5 USE OF STORAGE AREAS AND LAND

Warehouse, shed, workshop and office facilities as required by the Contractor shall be provided by him at his own expenses. Prior approval of the Engineer shall be obtained in respect of location layout and details of these buildings. After the work is completed, these temporary facilities shall be removed by the Contractor at his own expense to the satisfaction of the Engineer.

1.13.2 HOUSEKEEPING ORGANIZATION OF THE CONTRACTOR

With reference to deployment of housekeeping supervisor, the following minimum requirement shall be fulfilled:

Sr. No.	Manpower per Shift	Housekeeping In charge	No. of Supervisors to be appointed	No. of workmen to be appointed
1	Up to 100	0	01	one sweeper per 200 Sq Mtrs of allotted area
2	100 to 500	01	02	
3	Above 500		1 for every addl. 500 workers in addition to number mentioned against Sr. No. 2	

1.13.3 QUALIFICATION OF HOUSEKEEPING SUPERVISOR SHALL BE AS FOLLOWS:

- Housekeeping In charge:
Any Degree / Diploma in engineering with two years project/ Industrial experience
- Housekeeping Supervisor:
+2 with one-year Project/ Industrial experience or Any diploma

1.13.4 TRAINING REQUIREMENTS

- Along with the induction safety training, the workmen should undergo housekeeping training along with safety training.
- Housekeeping workers shall undergo training in usage of housekeeping equipments and tools such as vacuum cleaners.
- The typical syllabus for the training is as follows
 - Aims and Objectives of housekeeping.
 - DOs and DON'Ts on construction housekeeping activities.
 - Films on construction housekeeping and feedback.

1.13.5 REQUIREMENTS AND SPECIFICATION OF TOOLS

- a) Contractor shall submit a list of housekeeping tools that shall be used during the course of the work, to BHEL before the commencement of work.
- b) Contractors must maintain adequate stock of housekeeping tools (HKT) and as given below conforming to relevant Indian standards (or relevant international standards), required to be used during execution of the work.
- c) These tools and appliances must be inspected quarterly by housekeeping supervisor of Contractor and records of such inspection shall be maintained.

Sl. No.	Description	Minimum Qty. required/available at any given time (in nos) for one major building.
1	Industrial vacuum cleaner (with wet mopping facility)	1
2	Cob webs remover	2
3	Brooms	8
4	CS / Plastic Dustbin	8
5	Trolley	2
6	Ladders (3mtrs)	2
7	Waste carrying baskets	4
8	Ladders (6mtrs)	1
9	V type ladders	1
10	Cleaning brushes	10
11	Caution board (wet cleaning and cleaning in progress)	16
12	Wet and dry-cleaning duster/cloths	4

Additional quantity of above equipment and any other item required for works shall be arranged by Contractor without any extra cost. Different major buildings shall be equipped with above tools and for smaller building and structures tools form a pool shall be used.

1.13.6 HOUSE KEEPING WORK PRACTICES:

Housekeeping is very essential to provide safe working area for construction personnel and for movement of the machineries. In order to achieve this objective; a two-part housekeeping policy is adopted. As first part Contractor has to maintain certain housekeeping practices for his own works. In addition to this, for up keeping of overall plant area and areas where multiple agencies work simultaneously, different package Contractors shall be responsible for maintaining general housekeeping in the allocated specific area to them.

1.13.7 HOUSEKEEPING OF OWN WORKS:

- a) The Contractor shall at all time keep his work spot, site office, workshops and surroundings clean and tidy from rubbish, scrap, surplus materials and unwanted tools and equipment.
- b) Welding and other electrical cables shall be so routed to allow safe traffic by all concerned. Cables shall not be spread on floor; it shall be properly supported / clamped along the wall.
- c) No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or the public. The Engineer-In-Charge may require the Contractor to remove any materials which are considered to be of danger or cause inconvenience to the public. In case Contractor fails to comply with the instruction of Engineer-In-Charge, BHEL/NPCIL can deploy/arrange resources and recover the expenses incurred from the dues payable to contractor. Recoveries shall be actual expenses incurred plus 5% overheads or as defined in TCC.
- d) The Contractor shall on day to day basis remove from the work place all unwanted scaffoldings, surplus materials, rubbish, etc.
- e) The Engineer-In-Charge has the right to stop work if the Contractor fails to improve upon the housekeeping after having been notified.
- f) Contractor shall keep supervisor and supporting staff exclusively for housekeeping of own works.
- g) Contractor shall submit the minimum manpower deployment schedule on monthly basis based on the approved housekeeping plan/ schedule for the approval of the ENC.

1.13.8 HOUSEKEEPING OF THE ASSIGNED AREA / BUILDING:

From the time of release of area/fronts Contractor is responsible for maintaining and up keeping of the all the areas/ SSC under this contract. He shall ensure his sub-contractors maintain

proper housekeeping. While handing over the area from the civil Contractor, it shall be ensured that civil works have been substantially completed. This point of time onwards till all works of the Contractor in the building is completed, notwithstanding the fact that other Contractors are also working in the same area; it shall be the responsibility of the Contractor to maintain general cleanliness in the area assigned to him. In order to maintain general cleanliness in the area, the Contractor may take the help / assistance from the agencies working in the same area and he shall also extend all cooperation to other Contractors for such works. However, overall responsibility of housekeeping of the assigned area shall lie with the Contractor.

1.13.9 GENERAL DESCRIPTION OF WORK

SL NO	OPERATION	MINIMUM FREQUENCY OF OPERATION
1	Cleaning and Sweeping of construction area, all floors, staircase, platform, and wiping of handrails, equipment, JBs, pipes and etc	Daily
2	Wet mopping of floors	Weekly
3	Vacuum cleaning of floors	Monthly or as and when required
4	Debris removal from dust bin, baskets placed in the respective building.	weekly or as and when required

1.13.10 SCOPE FOR EXECUTION OF HOUSEKEEPING WORK:

- a) Cleaning and sweeping of construction area, storage area, floors, staircase, platform, anything and everything up to ceiling height and ceiling, as per the frequency indicated in the table.
- b) Removal of cobwebs, putting the collected debris other than structural materials in the dustbin kept at the specified location on every day basis for the different areas as per agreed schedule. Disposal of collected structural materials within the plant premises on regular intervals.
- c) Cutting of bushes and up keeping of open storage areas
- d) Lifting, carrying and disposal of all generated debris such as structural pieces, cable pieces, cable trays, ducts, wooden pieces, packing materials, piping material etc. and all other generated scrap from allotted building within the plant premises on regular intervals.

- e) Disposal of debris from dust bins/baskets placed in the respective building within the plant premises on once in a week basis or as and when required.
- f) The Contractor shall arrange his own equipment's and tools required for this work like trolleys, ladders, buckets, dust bins, brooms, industrial vacuum cleaner, brushes, wiping cloths or any other material required for the cleaning.
- g) The storage and security of his materials and equipment shall be the sole responsibility of the Contractor and shall have no right to claim for any loss/theft or damage of the same.
- h) The exclusive work force shall be deputed for the this work and work force deployed for this general housekeeping shall not be diverted for any other job or for his own house keeping jobs.
- i) All deployed work force shall be provided with dress (with proper code), safety and cleaning gears and in no case work should stop for want of gears.

1.13.11 PROVIDING WORK FORCE / STAFF:

The Contractor shall deploy adequate manpower at his own account & responsibility. At the time of allotment of the area for up keeping, the name of contractor's officials in charge for housekeeping, herein after referred as "Housekeeping in charge" (HIC) of the area shall be conveyed by the Contractor to the ENC. These HIC shall report the daily performance to the ENC or his authorised representative.

1.13.12 REPORTING:

- a) The Housekeeping Supervisor(s) should report daily to the AIC (Area in charge) & take day-to-day instructions.
- b) The Contractor shall make sure that Housekeeping Supervisor(s) is necessarily available during working hours for receiving & implementing the Instructions of the AIC.
- c) It shall be the responsibility of the Contractor to get the attendance of the housekeeping staff verified by AIC.
- d) The weekly / fortnightly / monthly jobs should be planned by Housekeeping Supervisor(s) in consultation with AIC in such a manner that these are spread over the entire week and done during office hours.
- e) However, certain jobs will necessarily be carried out during Sundays, for which instructions should be taken by the Housekeeping Supervisor(s) from AIC.
- f) Proper registers/records of the jobs carried out on daily, weekly, fortnightly and monthly basis will be maintained by the Housekeeping Supervisor(s) and

- g) will be countersigned by the AIC on daily basis and finally at the end of each month by ENC. Approval of ENC shall be obtained for the report formats.
- h) Housekeeping Supervisor shall remain in his area most of the time and shall have information about agencies working/ material stacked in his area. Suitable control system may be devised for the same.
- i) The Contractor shall be equipped to handle the special/emergency services even at short notice.
- j) All equipment deployed shall be of quality standard.
- k) Housekeeping Supervisor shall not allow those materials which affect the up keeping and fire hazards to building. Ex: wooden planks, drums, and scaffolding materials which are not painted.

1.13.13 SANITATION / TOILET FACILITY AT WORK SITE

Contractor shall establish toilet facility comprising of urinals and IWCs within the construction site along with water supply arrangements, disposal of waste, lighting, ventilation, washing facility, drainage arrangement, cleaning facility, etc., and shall maintain them in clean condition at all times by deploying suitable persons.

The numbers and the location of these toilet blocks shall be decided with the consent of Engineer and in line with GCC guidelines. As guidance, contractor may adopt the design of public toilet facilities provided by M/s. Sulabh International. For disposal of the sewage, NPCIL STP may be used.

1.13.14 DISPOSAL OF WASTE AND DEBRIS

During the execution of work, the Contractor shall keep the entire site in neat and tidy conditions always by proper housekeeping and stacking of construction materials at site and by removing all debris and waste material regularly, on day to day basis if necessary.

Contractor shall arrange suitable portable metallic storage bins to store construction materials at site. No material shall be allowed to be spread at site directly on roads / floors. All the garbage and waste material shall be disposed off regularly at the designated area as specified by the Engineer.

The curing water shall be constantly removed from various areas / floors by adopting temporary dewatering scheme in the buildings and maintain the site in hygienic condition.

All soil, filth or other matter of an offensive nature taken out of any trench, sewer, drain, cesspool or other place shall not be deposited on the surface, but shall at once be carried away by contractor, from the site of work for suitable and proper disposal.

VOLUME - IA PART – I CHAPTER – XIV

TENTATIVE WEIGHT SCHEDULE FOR INSULATION WORKS - UNIT 3

(BHEL FREE ISSUE MATERIAL - FIM)

TENTATIVE WEIGHT SCHEDULE FOR INSULATION WORKS OF UNIT 3			
Area	Item Description	UOM	Approx Weight in MT
Piping	Mineral Wool Mattress	MT	330
	GI Metal Cladding sheet	MT	240
	Ancillary Items (Glass cloth, Glass thread, binding wire, Lacing wire, MS flats, Al bands, Aluminium foil etc.)	MT	55
	Insulation cord	MT	45
Turbine & Equipments	Ceramic wool, Cement	MT	75
TOTAL		MT	745

Note:

1. The weight details mentioned above are approximate and liable to vary as per design consideration.
2. There may be variation or addition of description, weights etc., and any additional scope of work supplied under the above package shall be erected by the contractor and payment will be made as per the quoted/accepted rate in the respective category.

Annexure-1

Checklist No. QA.PC.WD011/1-R-1

CHECKLIST FOR EVALUATION OF SUBCONTRACTORS*[To be filled and submitted by the contractor]*

Contractor:	BHEL	W.O.Number	400442
Package:	TSS Package		
Item:	Insulation Works Package Unit 3	BOQ/WD No	Schedule J

PART 1: SUBCONTRACTOR DETAILS			
Registered Company Name:			
Registered Address:			
Phone:		E-Mail:	
Fax:		Website:	
Details of 'scope of work to be subcontracted':			
Insulation Works Package Unit 3			
Number of years in business:			
Employee Strength:			
(Please attach the Organization Chart of the Company)			
Key persons to be contacted:			
Top management:			
Quality Assurance:			
Marketing:			
Does the Subcontractor have several plants/branches?			Yes/No
If Yes, please provide details:			
Company Name:	Location:	Field of Activity:	

PART 2: CONTRACTS MANAGEMENT SYSTEM				
Part 2	Contracts Management	Yes	No	Comments
2.1	Do you have a procedure on Contract review processes?			
	• Are interface mechanisms (point of contacts for each discipline) between contractor and subcontractor are clear?			
	• Are the QA requirements clearly understood?			
	• Whether NPCIL jobs executed earlier?			
2.2	Recognition details if any (code stamps like U1, U2 or certification like ISO etc. verify the records)			
2.3	Is the Company a Limited Liability, Partnership, Sole Trader, Public ltd., Other? Please specify:			
2.4	What was the company's turnover for last 3 years?			
	What is the combined value of orders received over the last 3 years?			
2.5	Floor space availability for present activities			
	Level of House Keeping			
	General delivery Schedule			
2.6	Major clients preferably Govt/PSU for whom you have executed similar works in last 3 years(List can be attached)			
	Company Name	Contract Details with schedule		Address

PART 3: QUALITY MANAGEMENT SYSTEM				
Part 3	Quality Management System	Yes	No	Comments
3.0	Do you have valid ISO: 9001 certification?			Enclose copy
3.1	Do you have a Quality Manual?			
3.2	Do you have an internal and external audit programme in place?			
3.3	Do you have a staff training programme in place?			
3.4	Purchasing Process: <ul style="list-style-type: none"> Do you have a controlled list of approved suppliers? Are your suppliers assessed and monitored? Are order quality requirements clearly defined? 			
3.5	Inspection Process: <ul style="list-style-type: none"> Are there documented procedures for the inspection and testing of items? Are there documented procedures for inward, in-process and final inspection? Are incoming items and raw material inspected upon receipt? Is acceptance/rejection criteria defined? Are rejected items identified and segregated? Are process cards used for monitoring product inspection and test activities at each stage? Are QA stamps/stickers used and controlled? 			
3.6	Are QA records pertaining to item maintained?			
3.7	Are monitoring and measuring devices controlled, calibrated and records available?			
3.8	Records of NDE qualification of QC personnel available?			

3.9	Do you have full/partial identification and traceability of item? Please specify: [full traceability required for QA1,QA2 and QA3 category items]		
3.10	Product Handling Process:		
	• Do you have a procedure on handling and storage of items?		
	• Are shelf life items controlled and monitored?		
3.11	Do you have a procedure for controlling customer property?		
3.12	Do you have a procedure to confirm customer documents are of latest revision before being issued for use?		
3.13	Do you have a procedure for controlling deviations to customer specification?		
3.14	Control of records (process cards, test results, etc.). How long do you retain quality records?		
3.15	Is non-conforming item clearly identified?		
3.16	Is there a documented NC control procedure?		
3.17	Do you have a documented customer complaint procedure?		
3.18	Are there documented procedures for corrective actions?		
3.19	Would you permit access to NPCIL personnel for QS/audit of your Quality Management System and processes as per approved QPs, without additional charges?		

Specific to item to be supplied	
Understanding of scope of work	
Availability and understanding of related standards.	
Capacity of the Subcontractor to inspect/test the work/item	
Understanding of special Examination/testing (<i>e.g Ultrasonic Examination/Helium Leak testing etc. as applicable</i>)	
Availability of special facilities required for the item	
Availability of trained personnel specific to item to be supplied	
Availability of inspection/test facilities	
Availability of QP and procedures	
Independence of Head of QA/QC group	
Availability of test reports for the item/items for the past 1 year	

Submitted by (Subcontractor)	Signature,(with name, designation and date)
Assessed and forwarded to NPCIL (Contractor: Head QA & PE)	Signature,(with name, designation and date)

VOLUME-IA PART – I CHAPTER-VIII TAXES AND DUTIES

1.15.1 All taxes and duty other than GST & Cess and BOCW Cess

The contractor shall pay all (**except the specific exclusion viz GST & Cess and BOCW Cess, both of which are dealt separately**) taxes, fees, license charges, deposits, duties, tools, royalty/ seigniorage, commissions, Stamp Duties, or other charges / levies, which may be levied on the input goods (including construction material viz. sand, coarse aggregates, moorum, borrowed earth, etc.) & services consumed and output goods & services delivered in course of his operations in executing the contract **and the same shall not be reimbursed by BHEL**. In case BHEL is forced to pay any of such taxes, BHEL shall have the right to recover the same from his bills or otherwise as deemed fit.

1.15.2 Goods and service Tax (GST) -

For GST Registered bidder:

- 1.15.2.1 The successful bidder shall furnish proof of GST registration under GST Law, covering the supply and services under this contract. Registration should also bear endorsement for the premises from where the billing shall be done by the successful bidder on BHEL for this project/ work. The bidder to specify in their offer the category of registration under GST i.e. Regular dealer or composite dealer.
- 1.15.2.2 Bidder's price/rates shall be exclusive of GST & GST Compensation Cess (herein after termed as GST).
- 1.15.2.3 Vendor / Contractor require to ensure that all Input Tax benefits as per existing laws have been considered.
- 1.15.2.4 Price quoted by the composite dealer shall be considered as inclusive of GST. In the event of any change in the status of vendor / Contractor from composite to regular dealer after the submission of the bid but before completion of supply of services or goods, Contract value shall be amended to remove the embedded GST and any ITC benefit arising due to change of status, which shall be passed on to BHEL. GST paid on the amended contract value shall be reimbursed at actuals against the Tax invoice if BHEL is able to take input tax credit. However, no reimbursement of GST shall be made if BHEL is not able to take input tax credit. The decision of BHEL in this regard will be final and binding on the vendor/contractor.

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1.15.2.5 It is the responsibility of the vendor / contractor to adhere to all the provisions of E- Invoicing under GST Act (if applicable). As per the E-Invoicing provisions vendor / Contractor has to generate IRN and QR Code from the E-Invoicing system and the same need to be printed in the invoice submitted to their customer. Invoices that do not comply to the above requirements, will not be accepted by BHEL. If the successful Bidder is not falling under the preview of E-Invoicing, then he has to submit a declaration in that respect along with relevant financial statements. However, applicability of E-invoicing, shall be verified from the E-Invoicing portal on submission of vendor / Contractor GSTN. BHEL shall reimburse GST only if all the provisions of E-invoicing are complied with.

1.15.2.6 It is the responsibility of the vendor/ Contractor to issue the Tax Invoice strictly as per the format prescribed under the GST Act within the prescribed time period in order to enable BHEL to avail input tax credit within the due date. Invoices shall be submitted on time to the concerned BHEL Engineer In Charge. Tax invoice should also contain below details

- a. Contractor Name and Contact details.
- b. GST No of Contractor
- c. PAN No of Contractor
- d. Document Type: Tax Invoice/ Debit Note/ Credit Note
- e. Category: B2B / B2C (B2B is only applicable w.r.t BHEL)
- f. Customer Name and Contact details / Bill To Details (as mentioned below)
- g. Unique Tax Invoice Number
- h. Invoice Date
- i. IRN No, QR Code, Acknowledgment No and Acknowledgment Date generated from E-Invoice Portal as per E-invoicing provisions under GST Act (If applicable)
- j. Place of Supply (as mentioned below)
- k. Description of service provided
- l. 8 Digit SAC code
- m. GST Rate
- n. Gross value of Invoice
- o. Taxable Value
- p. Tax / GST Amount
- q. Total Invoice value including GST.

Above are inclusive and not exhaustive list of requirements.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

1.15.2.7 Bidder should mention the “Bill To “and “Place of supply” as below in the Tax Invoice

Bill To: Location of BHEL Site office

-----,

State: -----
GSTN of BHEL: -----

Place of Supply: Location of BHEL Site office

-----,

State: -----
GSTN of BHEL: -----

(Above details will be given later, contractors may contact BHEL, PSSR before billing)

1.15.2.8 In case of supply of goods contract, the successful bidder must promptly provide details of the dispatched items on the same day they are removed for shipment to the BHEL site. This intimation must include all relevant information and documents about the goods and a scanned copy of the tax invoice. If any financial liabilities arise for BHEL due to non-compliance with GST laws resulting from the bidder's delay in providing this information, the bidder will be held liable, unless the delay is directly attributable to BHEL.

1.15.2.9 BHEL will reimburse the GST amount claimed by the Vendor/Contractor against a tax invoice along with the amount due to the contractor in the RAB. However, If the Vendor/Contractor fails to fulfill the GST compliance requirements detailed below for any preceding invoice, BHEL reserves the right to recover an amount equivalent to the reimbursed GST from the subsequent bills as a measure against statutory non-compliance. Additionally, an amount equivalent to the GST claimed in subsequent bills will be withheld until statutory compliance for the prior invoice is ensured.

In the case of one-time vendors/contractors or the Vendor/Contractor's final bill, BHEL will withhold an amount equivalent to the GST claimed from the same bill towards pending statutory compliance. This withheld amount will only be released once the following GST compliance requirements are fully satisfied.

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GST Compliance Requirements:

- a. Vendor / Contractor must provide the original copy of Tax invoice /debit note as per the prescribed format under the GST act within the prescribed time period in order to enable BHEL to avail input tax credit within the due date.
- b. The details of the invoice or debit note referred to in clause (a) must be furnished/filed by the Vendor/ Contractor in the statement of outward supplies (presently in GSTR1 or IFF) and such details should get reflected in the BHEL GST login (both in GSTR 2A and GSTR 2B) in the manner specified under GST Act.
- c. Details of vendor/contractor invoice reflected in BHEL GST login should match with the details in the tax invoice submitted by the vendor/contractor, including the invoice number, invoice date, GSTIN, and place of supply. Additionally, the status of GSTR-1 and GSTR-3B filings must be "Yes."
- d. The tax charged in the invoice /debit note referred to in clause (a) must be paid to the Government by the Vendor/Contractor, either in cash or through the utilization of input tax credit.

1.15.2.10 In case, any GST credit is delayed/denied to BHEL or BHEL has to incur any liability (like interest / penalty) due to non/delayed receipt of goods or submission of tax invoice after the expiry of timeline prescribed in the relevant GST Act for availing ITC, or any other reasons not attributable to BHEL, Then the same shall be recovered from the vendor/contractor along with interest levied/ leviable on BHEL.

1.15.2.11 GST shall be levied on recoveries, wherever applicable and same shall be recovered from payments. BHEL shall issue / raise Tax invoice on contractor/vendors for such recoveries.

1.15.2.12 E-way bills / Transit passes / Road Permits, if required for materials / T&P etc., bought into the project site is to be arranged by the Vendor / Contractor themselves. BHEL shall not issue or raise any Road Permit/ E- Way Bill for this purpose. Any claim or demand raised by the GST department for non-generation / non-submission of E-way bill shall be to the contractor/ vendor account

1.15.2.13 BHEL shall not reimburse any expenditure incurred by the contractor towards demand, additional liability or interest / penalty etc., raised by the GST

TECHNICAL CONDITIONS OF CONTRACT (TCC)

department due to issues such as wrong rates / wrong classification of services or goods.

1.15.2.14 Where GST is payable by BHEL under reverse charge basis, any demand raised or any interest or penalty levied / leviable by the GST department due to non-submission or delayed submission of invoice by the contractor or for any other reason not attributable to BHEL, the same shall be recovered from the vendor/contractor.

1.15.2.15 Tax Deduction at Source (TDS) as per Sec 51 of the CGST Act shall be deducted (if applicable). GST TDS certificate in Form GSTR -7A shall be issued to be contractor. However, GST TDS certificate can be generated only if the contractor accepts the TDS details uploaded by BHEL and files his return. If any specific exemption from GST TDS is applicable to any contractor/vendor, then a declaration to that effect along with relevant documents as may be required by BHEL, substantiating such exemption in line with GST law provisions or notification, shall be submitted by the vendor/contractor.

For GST Unregistered bidder:

1.15.2.16 In case, bidder is not required to register under Goods and service Tax (GST) & Cess, the same is to be specified in the offer.

1.15.2.17 Successful bidder to furnish a Self-declaration that registration under GST is not required or not applicable as per the provisions of GST Law along with relevant document and provisions in the GST law.

1.15.2.18 In case BHEL has to incur any liability (like interest / penalty etc.) due to non-compliance of GST law in respect of the invoice submitted by the contractor, for the reasons attributable to the contractor, the same shall be recovered from the contractor.

1.15.2.19 TDS under GST (as & when applicable) shall be deducted at prevailing rates on gross invoice value.

1.15.2.20 If RCM is made applicable at a later date, GST will be paid by BHEL to the department at applicable rate treating the quoted the price as inclusive of GST if BHEL is not able to take Input tax credit.

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1.15.2.21 In the event of any change in the status of bidder from unregistered to registered under the GST law after the submission of bid but before the completion of supply of services or goods, the same need to be intimated and all the clauses applicable for Registered bidder need to be followed. The vendor/ contractor is required to pass on the ITC benefit arising due to change of status, to BHEL. Contract value shall be amended accordingly. GST paid on the amended contract value shall be reimbursed at actuals against the Tax invoice only if BHEL is able to take input tax credit.

1.15.3 Statutory Variations

1.15.3.1 BHEL shall pay statutory variation only for GST, and no other variations shall be payable

1.15.3.2 In general, Statutory variation for GST is payable to the Vendor/ Contractor during the contract period including extension thereof. Beyond the contract period, BHEL will reimburse the actual applicable tax only if BHEL is able to take the input tax credit. However, the decision of BHEL in this regard will be final and binding on the vendor/contractor

1.15.4 New Taxes/Levies-

In case Government imposes any new levy / tax after submission of bid during the tenure of the contract, BHEL shall reimburse the same at actual on submission of documentary proof of payment subject to the satisfaction of BHEL that such new levy / tax is applicable to this contract. However, Contractor/ Vendor shall obtain prior consent from BHEL before depositing new taxes and duties.

Any benefits arise out of new tax levies and/or abolition of existing taxes must be passed on to BHEL.

The decision of BHEL in this regard will be final and binding on the vendor/contractor.

1.15.5 Direct Tax

1.15.5.1 Vendor/ Contractor is required to update himself on its own and comply with provisions of Indian Income Tax Act as notified from time to time. Purchaser shall not be liable towards liability of income tax accruing to the vendor/contractor of whatever nature including variations thereof, arising out of this Order/ Contract, as well as tax liability of the vendor/ Contractor and his personnel

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10.15.5.2 Deductions of Tax at source as per Income Tax Act, at the prevailing rates shall be effected by the Purchaser before release of payment, as a statutory obligation, if applicable. TDS certificate will be issued by the Purchaser as per the statutory provisions. The Vendor/Contractor has to mention their Permanent Account Number (PAN) and GSTIN in all invoices.

1.15.6 BOCW Act & BOCW Welfare Cess Act

1.15.6.1 Contractor's price/rates shall be exclusive of BOCW Cess .

1.15.6.2 The Contractor should Register their Establishment under BOCW Act 1996 read with rules 1998 by submitting Form I (Application for Registration of Establishment) and Form IV (Notice Of Commencement / Completion of Building other Construction Work) to the respective Labour Authorities i.e.,

- a. Assistant Labour Commissioner (Central) in respect of the project premises which is under the purview of Central Govt.–NTPC, NTPL etc.
- b. Appropriate State authorities in respect of the project premises which is under the purview of State Govt.

1.15.6.3 The Contractor should comply with the provisions of BOCW Welfare Cess Act 1996 in respect of the work awarded to them by BHEL.

1.15.6.4 The contractor should ensure compliance regarding Registration of Building Workers as Beneficiaries, Hours of work, welfare measures and other conditions of service with particular reference to Safety and Health measures like Safety Officers, safety committee, issue of Personal protective equipments, canteen, rest room, drinking water, Toilets, ambulance, first aid centre etc.

1.15.6.5 The contractor irrespective of their nature of work and manpower (Civil, Mechanical, Electrical works etc) should register their establishment under BOCW Act 1996 and comply with BOCW Welfare Cess Act 1996.

1.15.6.6 Contractor shall make remittance of the BOCW Cess as per the Act in consultation with BHEL as per the rates in force (presently 1%). BOCW remittance should be made only after obtaining prior consent from BHEL. BHEL shall reimburse the same upon production of documentary evidence. However, BHEL shall not reimburse the fee paid towards the registration of establishment, fees paid towards registration of Beneficiaries and Contribution of Beneficiaries remitted.

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- 1.15.6.7** Non-compliance to Provisions of the BOCW Act & BOCW Welfare Cess Act is not acceptable. In case of any non-compliance, BHEL reserves the right to withhold any sum as it deems fit. Only upon total compliance with the BOCW Act and the discharge of total payment of Cess (in consultation with BHEL) under the BOCW Cess Act by the Contractor, BHEL shall consider refund of the amounts.

VOLUME 1A PART-1 CHAPTER XVI

GENERAL

The scope of the work will comprise of but not limited to the following:

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.16.1 Successful Bidder is requested to furnish the following at PSSR-HQ Chennai immediately after release of Letter of Intent (LOI)

- i) Security Deposit
- ii) Unqualified Acceptance for LOI, Detailed LOI / Work Order.
- iii) Rs.160/- Stamp Paper for preparation of Contract Agreement.

1.16.2 Successful Bidder is requested to furnish the proof of documents for the following at the respective PSSR- Site

- i) PF Regn No.
- ii) Labour License No.
- iii) Workmen Insurance Policy No.

1.16.3 In addition to the clause 2.8 of General Conditions of Contract (Volume-1C of Book-II) the contractor shall comply with the following.

1.16.4 PROVIDENT FUND

1.16.4.1 The contractor is required to extend the benefit of Provident Fund to the labour employed by you in connection with this contract as per the Employees Provident Fund and Miscellaneous Provisions Act 1952. For due implementation of the same, you are hereby required to get yourself registered with the Provident Fund authorities for the purpose of reconciliation of PF dues and furnish to us the code number allotted to you by the Provident Fund authorities within one month from the date of issue of the letter of intent. In case you are exempted from such remittance an attested copy of authority for such exemption is to be furnished. Please note that in the event of your failure to comply with the provisions of said Act, if recoveries therefor are enforced

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from payments due to us by the customer or paid to statutory authorities by us, such amount will be recovered from payments due to you.

- 1.16.4.2 The final bill amount would be released only on production of clearance certificate from PF / ESI and labour authorities as applicable.

1.16.5 OTHER STATUTORY REQUIREMENTS

- 1.16.5.1 The Contractor shall submit a copy of Labour License obtained from the Licensing Officer (Form VI) u/r25 read with u/s 12 of Contract Labour (R&A) Act 1970 & rules and Valid WC Insurance copy or ESI Code (if applicable) and PF code no. along with the first running bill.

- 1.16.5.2 The contractor shall submit monthly running bills along with the copies of monthly wages (of the preceding month) u/r78(1)(a)(1) of Contract Labour Rules, copies of monthly return of PF contribution with remittance Challans under Employees Provident Fund Act 1952 and copy of renewed WC Insurance policy or copies of monthly return of ESI contribution with Challans under ESI Act 1948 (if applicable) in respect of the workmen engaged by them.

- 1.16.5.3 The Contractor should ensure compliance of Sec 21 of Contract Labour (R&A) Act 1970 regarding responsibility for payment of Wages. In case of “Non-compliance of Sec 21 or non-payment of wages” to the workmen before the expiry of wage period by the contractor, BHEL will reserve its right to pay the workmen under the orders of Appropriate authority at the risk and cost of the Contractor.

- 1.16.5.4 The Contractor shall submit copies of Final Settlement statement of disbursal of retrenchment benefits on retrenchment of each workmen under ID Act 1948, copies of Form 6-A (Annual Return of PF Contribution) along with copies of PF Contribution Card of each member under PF Act and copies of monthly return on ESI Contribution – Form 6 under ESI Act 1948 (if applicable) to BHEL along with the Final Bill.

- 1.16.5.5 In case of any dispute pending before the appropriate authority under ID Act 1948, WC Act 1923 or ESI Act 1948 and PF Act 1952, BHEL reserve the right to hold such amounts from the final bills of the

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Contractor which will be released on submission of proof of settlement of issues from the appropriate authority under the act.

- 1.16.5.6 In case of any dispute prolonged / pending before the authority for the reasons not attributable to the contractor, BHEL reserves the right to release the final bill of the contractor on submission of Indemnity bond by the contractor indemnifying BHEL against any claims that may arise at a later date without prejudice to the rights of BHEL.

1.16.6 DEPLOYMENT OF SKILLED / SEMI-SKILLED TRADESMEN

The following clause is applicable in case the contract value / contract price is Rs. Five crores and above.

The contractor shall, at all stages of work deploy skilled / semi-skilled tradesmen who are qualified and possess certificate in particular trade from CPWD Training Institute / Industrial Training Institute / National Institute of Construction Management and Research (NICMAR), National Academy of Construction, CIDC or any similar reputed and recognized Institute managed / certified by State / Central Government. The number of such qualified tradesmen shall not be less than 20% of total skilled / semi-skilled workers required in each trade at any stage of work. The contractor shall submit number of man days required in respect of each trade, its scheduling and the list of qualified tradesmen along with requisite certificate from recognized Institute to Engineer-in-Charge for approval. Notwithstanding such approval, if the tradesmen are found to have inadequate skill to execute the work of respective trade, the contractor shall substitute such tradesmen within two days of written notice from Engineer-in-Charge. Failure on the part of contractor to obtain approval of Engineer-in-Charge or failure to deploy qualified tradesmen will attract a compensation to be paid by contractor at the rate of Rs. 160 per such tradesman per day. Decision of Engineer-in-Charge as to whether particular tradesman possesses requisite skill and amount of compensation in case of default shall be final and binding.

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1.10.7 Site Visit by the Bidder

1.16.7.1 The bidder shall, prior to submitting his tender for the work, visit, examine and acquire full knowledge & information and necessary conditions prevailing at the site and its surroundings of the plant premises together with all statutory, obligatory, mandatory requirements of various authorities about the site of works at his own expense, and obtain and ascertain for himself on his own responsibility that may be for preparing his tender and entering into a contract, and take the same into account in the quoted contract price for the work.

1.16.7.2 The bidder shall satisfy themselves about the following factors:

- i). Site conditions including access to the site, existing and required roads and other means of transport/communication for use by him in connection with the work including diverting and re-routing of services.
- ii). Requirement and availability of land and other facilities of his enabling works, establishment of his nursery, office, stores etc.
- iii). Ground conditions including those bearing upon transportation, disposal, handling and storage of materials required for the work or obtained there-from.
- iv). Source and extent of availability of suitable materials, including water etc., and labour (skilled and unskilled) required for work, and laws and regulations governing their use and employment.
- v). Geological, meteorological, topographical and other general features of the site and its surroundings as are pertaining to and needed for the performance of the work.
- vi). The limit and extent of surface and subsurface water to be encountered during the performance of the work, and the requirement of drainage and pumping.
- vii). The type of equipment and facilities needed, for and in the performance of the work;
- viii). The extent of lead and lift required for the work in complete form over the entire duration of the contract, and
- ix). All other information pertaining to and needed for the work including information on the following:-
a) Instances

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which may influence or affect the work or the cost thereof under this contract.

1.16.7.3 The bidder should note that information, if any, in regard to the local conditions, as contained in these tender documents, has been given to tenderer merely for guidance and is not warranted to be complete.

1.16.7.4 A bidder shall be deemed to have full knowledge of the site, whether he inspects it or not, and no extra charges consequent on any misunderstanding or otherwise shall be allowed.

1.16.7.5 The bidder and any of his personnel or agents will be granted permission by the Site-In-Charge or his authorized nominee, on receipt of formal application in respect thereof a week in advance of the proposed date of inspection of site, to enter upon his premises and lands for purpose of such inspection, but only on the express condition that the tenderer (and his personnel and agents) will relieve and indemnify the Employer (and his personnel and agents) from and against all liability in respect thereof and will be responsible for personal injury (whether fatal or otherwise), loss of or damage to property and any other loss, damage, costs and expenses however caused which, but for the exercise of such permission, would not have arisen.

1.16.8 The work covered under this specification is of highly sophisticated nature, requiring the best quality workmanship, engineering and construction management. The contractor must have adequate quantity of tools, construction aids, equipments etc., in his possession. He must also have on his rolls adequately trained, qualified and experienced supervisory staff and skilled personnel.

1.16.9 It is not the intent to specify herein all details of all material. Any item related this work not covered by this but necessary to complete the system will be deemed to have been included in the scope of the work.

1.16.10 All the necessary certificates and licenses required to carry out this scope of work are to be arranged by the contractor then and there at no extra cost.

1.16.11 Site testing wherever required shall be carried out for all items / materials installed by the contractor to ensure proper installation and

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functioning in accordance with drawings, specifications and manufacturer's recommendations.

- 1.16.12 The contractor shall carry out additional tests, if any, which the Engineer feels necessary because of site conditions and also to meet system specification.
- 1.16.13 The work shall be executed under the usual conditions without affecting power plant construction / operation and in conjunction with other operations and contracting agencies at site. The contractor and his personnel shall co- operate with the personnel of other agencies, co-ordinate his work with others and proceed in a manner that shall not delay or hinder the progress of work as a whole.
- 1.16.14 All the work shall be carried out as per instructions of BHEL engineer. BHEL engineer's decision regarding the correctness of the work and method of working shall be final and binding on the contractor.
- 1.16.15 Wherever Construction sequences are furnished by BHEL, the contractor shall follow the same sequence. Contractor shall execute the supply and works as per sequence prescribed by BHEL at site engineer. No claims for extra payment from the contractor will be entertained on the grounds of deviation from the methods of execution of similar job in any other site or for any reasons whatsoever.
- 1.16.16 If required by BHEL, the contractor shall change the sequence of his operation so that work on priority sectors can be completed within the projects schedule. The contractor shall afford maximum assistance to BHEL in this connection without causing delay to agreed completion date.
- 1.16.17 Contractor shall, transport all materials to site and unload at site / working area for inspection and checking. All material handling equipment required shall be arranged by the contractor.
- 1.16.18 Contractor shall retain all T&P / Testing instrument / Material handling equipment's etc. at site as per advice of BHEL engineer and same shall be taken out from site only after getting the clearances from engineer in charge.
- 1.16.19 The contractor at his cost shall arrange necessary security measures for adequate protection of his machinery, equipment, tools, materials etc. BHEL shall not be responsible for any loss or damage to

TECHNICAL CONDITIONS OF CONTRACT (TCC)

the contractor's construction equipment and materials. The contractor may consult the Engineer-in-Charge on the arrangements made for general site security for protection of his machinery equipment tools etc.

1.16.20 The Contractor may have to execute work in such a place and condition where other agencies also will be under such circumstances. However, completion time for construction, agreed will be subject to the condition that contractor's work is not hampered by the agencies.

1.16.21 Contractor has to work in close co-ordination with other agency at site. BHEL engineer will co-ordinate area clearance. In a project of such magnitude, it is possible that the area clearance may be less / more at a particular given time. Activities and Construction program have to be planned in such a way that the milestones are achieved as per schedule/ plans. Contractor shall arrange & augment the resources accordingly.

1.16.22 The contractor must obtain the signature and permission of the security personnel of the customer / BHEL for bringing any of their materials inside the site premises. Without the Entry Gate Pass these materials will not be allowed to be taken outside. Surplus materials including steel item brought at site by the contractors with proper documentation and Gate pass, shall be allowed to taken out of the project premises after completion of relevant works, on certification by BHEL in charge.

1.16.23 Contractor shall remove all scrap materials periodically generated from his working area and collect the same at one place earmarked for the same. Load of scraps is to be shifted to a place earmarked by BHEL. Failure to collect the scrap is likely to lead to accidents and as such BHEL reserves the right to collect and remove the scrap at contractor's risk and cost if there is any failure on the part of contractor in this respect.

1.16.24 The contractor shall ensure that his premises are always kept clean and tidy to the extent possible. Any untidiness noted on the part of the contractor shall be brought to the attention of the contractor's site representative who shall take immediate action to clean the surroundings to the satisfaction of the Engineer-in-Charge.

TENDER SPECIFICATION No: BHEL PSSR SCT 2184

TECHNICAL CONDITIONS OF CONTRACT (TCC)

- 1.16.25 The contractor is strictly prohibited from using BHEL's regular components like angles, channels, beams, plates, pipe / tubes, and handrails etc. for any temporary supporting or scaffolding works. Contractor shall arrange himself all such materials. In case of such misuse of BHEL materials, a sum as determined by BHEL engineer will be recovered from the contractor's bill. The decision of BHEL engineer is final and binding on the contractor.
- 1.16.26 No member of the already erected structure / buildings, other component and auxiliaries should be removed / modified without specific approval of BHEL engineer.
- 1.16.27 Contractors shall ensure that all their Staff / Employees are exposed to periodical training programme conducted by qualified agencies/ personnel on latest ISO 9001 Standards.
- 1.16.28 Sometimes, it may be required to re-schedule the activities to enable other agencies to commence/ continue the work so as to keep the overall project schedule.
- 1.16.29 The terminal points decided by BHEL are final and binding on the contractor for deciding the scope of work and effecting the payment for the work done up to the terminals.
- 1.16.30 Crane operators deployed by the contractor shall be tested by BHEL before he is allowed to operate the cranes.
- 1.16.31 On Completion of work, all the temporary buildings, structures, pipe lines, cable etc. shall be dismantled and leveled and debris shall be removed as per instruction of BHEL by the contractor at his cost. In the event of his failure to do so, the expenditure towards clearance of the same will be recovered from the contractor. The decision of BHEL Engineer in this regard is final.
- 1.16.32 It is the responsibility of the contractor to do the checking, testing etc. if necessary, repeatedly to satisfy BHEL Engineer with all the necessary tools and tackles, manpower etc. without any extra cost. The testing will be completed only when jointly certified so, by the BHEL Engineer.
- 1.16.33 If any item not covered but requires being executed, same shall be carried out by the contractor. Equivalent or proportional unit rate shall be considered wherever possible from the BOQ. The rates quoted

TECHNICAL CONDITIONS OF CONTRACT (TCC)

by the contractor shall be uniform as far as possible for similar items appearing in rate schedule.

1.16.34 The contractor's work shall not hinder other work, either underground or over ground, such as electrical, phone lines, water or sewage lines, etc. In areas of overlap, the contractor shall work in coordination with other related contractors. Any damage by the landscape contractor's team to such utilities will be penalized and contractor shall be responsible for cost for such damages.

1.16.35 The contractor will be responsible for the safe custody and proper accounting of all materials in connection with the work. If the contractor has drawn materials in excess of design requirements, recoveries will be effected for such excess draws at the rate prescribed by manufacturing units.

1.16.36 Contractor has to clear the front, expeditiously and promptly as instructed by BHEL Engineer for other agencies, like Boiler, piping, Turbine, Generator erection, Cabling, instrumentation, insulation etc., to commence their work from / on the equipments coming under this scope.

1.16.37 For the purpose of planning, contractor shall furnish the estimated requirement of power (month wise) for execution of work in terms of maximum KW demand.

1.16.38 RECORDS TO BE MAINTAINED AT SITE:

Record of Quantity of FREE/Chargeable items issued by BHEL must be maintained during contract execution. Also reconciliation statement to be prepared at regular intervals.

The under mentioned Records/ Log-books/ Registers applicable to be maintained.

- (i) Hindrance Register
- (ii) Site Order Book.
- (iii) Test Check of measurements.
- (iv) Steel & Cement Supply and Consumption Daily Register
- (v) Records of Test reports of Field tests.
- (vi) Records of manufacture's test certificates.

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- (vii) Records of disposal of scraps generated during and after the work completion.

1.16.39 SITE INSPECTION

1.16.39.1 The Owner or his authorized agents may inspect various stages of work during the currency of the contract awarded to him. The contractor shall make necessary arrangements for such inspection and carry out the rectification pointed out by the Owner or his authorized agents without any extra cost to the Owner or his authorized agents. No cost whatsoever such duplication of inspection of work be entertained.

1.16.39.2 BHEL / Owner will have full power and authority to inspect the works at any time, either on the site or at the contractor's premises. The contractor shall arrange every facility and assistance to carry out such inspection. On no account will the contractor be allowed to proceed with work of any type unless such work has been inspected and entries are made in the site inspection register by Owner / BHEL.

1.16.39.3 The contractor shall maintain at site a joint protocol for recording actual measurement of work carried out at site, inspection and witnessing of various tests conducted by the contractor.

1.16.39.4 Field Quality Assurance (FQA) Formats: -

It is the responsibility of the contractor to collect and fill up the relevant FQA log sheets of BHEL and present the same to BHEL after carrying out the necessary checks as per the log sheets and obtaining the signature of BHEL and Owner as token of their acceptance. Payment to the contractor will be inked with the submission of these FQA log sheets.

1.16.39.5 Site testing wherever required shall be carried out for all items / materials installed by the contractor to ensure proper installation and functioning in accordance with drawings, specifications and manufacturer's recommendations.

1.16.39.6 Contractor shall, transport all materials to site and unload at site / working area for inspection and checking. All material handling equipment required shall be arranged by the contractor

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VOLUME-IA PART-II CHAPTER-I

CORRECTIONS / REVISIONS IN SPECIAL CONDITIONS OF CONTRACT, GENERAL CONDITIONS OF CONTRACT AND FORMS & PROCEDURES

Sl. No.: 01

Following Clauses in General Conditions of Contract (GCC) are modified/ revised/ added:

S.No	GCC Clause Reference	Modification / Revision / Addition in GCC Clause
1.	GCC Clause 1.9.1, Sl. No. (ii)	The following mode of deposit, Sl. No. (e) is added: e) Insurance Surety Bonds
2.	GCC Clause 1.10.3, Sl. No. (vi)	The following Clause, Sl. No. (vi) is deleted: Security deposit can also be recovered at the rate of 10% of the gross amount progressively from each of the running bills of the contractor till the total amount of the required security deposit is collected. However, in such cases at least 50% of the required Security Deposit, including the EMD, should be deposited in any form as prescribed before start of the work and the balance 50% may be recovered from the running bills as described above
3.	GCC Clause 1.10.3, Sl.No.(vii)	The following mode of deposit, Sl. No. (vii) is added: e) Insurance Surety Bonds
4.	Note mentioned under the GCC Clause 1.10.3	Note mentioned under GCC Clause 1.10.3 is revised as below: Note: (1) BHEL will not be liable or responsible in any manner for the collection of interest or renewal of the documents or in any other matter connected therewith. (2) In case of delay in submission of security deposit, enhanced security deposit which would include interest (Repo rate +4%) for the delayed period, shall be submitted by the bidder.
5.	GCC Clause 1.10.8	GCC Clause 1.10.8 is revised as below: Bidder agrees to submit security deposit required for execution of the contract within the time period mentioned. In case of delay in submission of security deposit, enhanced security deposit which would include interest (Repo rate+4%) for the delayed period, shall be submitted by the bidder. Further, if security deposit is not submitted till such time the first bill becomes due, the amount of security deposit due shall be recovered as per terms defined in NIT / contract, from the bills along with due interest
6.	GCC Clause 2.22.1	GCC Clause 2.22.1 is revised as: Retention Amount shall be 5% of the Contract Value and shall be furnished through BG in line with clause 1.12 of GCC before payment of first RA Bill. The validity of the said BG shall be initially for the contract period & shall be extended, if so required, up to

TECHNICAL CONDITIONS OF CONTRACT (TCC)

S.No	GCC Clause Reference	Modification / Revision / Addition in GCC Clause
		<p>acceptance of final bill. In case of increase in contract value, additional BG for 5% of differential amount shall be submitted by Contractor before payment of next RA Bill due.</p> <p>Retention Amount can also be recovered at the rate of 10% of the gross amount progressively from each of the running bills of the contractor till the total amount of the required retention amount is collected.</p> <p>In case, contractor opts cash deduction from RA bills in the beginning & subsequently offers to submit BG later on, then refund of deducted retention amount may be permitted against submission of BG for 5% of the Contract Value.</p>
7.	New Clause for "Breach of Contract, Remedies and Termination" is added in place of existing clause of Risk & Cost (i.e. 2.7.2.1 to 2.7.3)	<p>1.Clause 2.7.2 and 2.7.3 are revised as:</p> <p>2.</p> <p>3.2.7.2 Breach of Contract, Remedies and Termination</p> <p>2.7.2.1 BHEL shall terminate the contract after due notice of a period of 14 days in any of the following cases, which if not rectified/ improved within the time period mentioned in the notice, then, 'Breach of Contract' will be considered to have been established:</p> <ul style="list-style-type: none"> i). Contractor's poor progress of the work vis-à-vis execution timeline as stipulated in the Contract, backlog attributable to contractor including unexecuted portion of work does not appear to be executable within balance available period considering its performance of execution. ii). Withdrawal from or abandonment of the work by contractor before completion of the work as per contract. iii). Non-completion of work by the Contractor within scheduled completion period as per Contract or as extended from time to time, for the reasons attributable to the contractor. iv). Repeated failure of contractor in deploying the required resources, to comply the statutory requirements etc. even after given by BHEL is writing. v). Strike or Lockout declared is not settled within a period of one month. vi). Termination of Contract on account of any other reason (s) attributable to Contractor. vii). Assignment, transfer, subletting of Contract without BHEL's written permission. viii). Non-compliance to any contractual condition or any other default attributable to Contractor. <p>2.7.2.2 Remedies in case of Breach of Contract is established</p> <p>In case 'Breach of Contract' is established, Security Deposit and Retention Amount shall be encashed/ forfeited. This is without prejudice to BHEL's right to levy of liquidated damages, debarment</p>

TECHNICAL CONDITIONS OF CONTRACT (TCC)

S.No	GCC Clause Reference	Modification / Revision / Addition in GCC Clause
		<p>etc. which shall be applied as per the provisions of the contract. Sequence of recovery to be made in case of breach of contract is established, is as below:</p> <ol style="list-style-type: none"> a) In case the value of Security Deposit & Retention Amount, available for the Contract, is less than 10% of the Contract Value, the balance amount shall be recovered from dues available in the form of Bills payable to contractor, BGs against the same contract etc. b) Demand notice for deposit of balance recovery amount shall be sent to contractor, if funds are insufficient to effect complete recovery against dues indicated in (a) above. c) If contractor fails to deposit the balance amount to be recovered within the period as prescribed in demand notice, following action shall be taken for balance recovery: <ol style="list-style-type: none"> i) Dues payable to contractor against other contracts in the same Region shall be considered for recovery. ii) If recovery cannot be made out of dues payable to the contractor as above, balance amount to be recovered, shall be informed to other Regions/Units for making recovery from the Unpaid Bills/Running Bills/SD/BGs/Final Bills of contractor. iii) In-case recoveries are not possible with any of the above available options, Legal action shall be initiated for recovery against contractor. <p>Note:</p> <ol style="list-style-type: none"> 1) In addition to above, levy of liquidated damages, debarment, termination, short-closure etc. shall be applied as per provisions of the contract. 2) If tendering is done for the balance work, the defaulted contractor (including all the members/partners in case of JV/ partnership firm) shall not be eligible for either executing the balance work or to participate in the tender(s) for executing the balance work. <p>2.7.3 In case Contractor fails to deploy the resources as per requirement informed by BHEL in writing to expedite the work, BHEL can deploy own/hired/otherwise arranged resources and recover the expenses incurred from the dues payable to contractor. Recoveries shall be actual expenses incurred plus 5% overheads or as defined in TCC.</p>
8.	GCC Clause 2.7.7	<p>GCC Clause 2.7.7 is revised as:</p> <p>BHEL may permit or direct contractor to demobilize and remobilize at a future date as intimated by BHEL in case of following situations for reasons other than Force majeure conditions and not attributable to contractor:</p> <ol style="list-style-type: none"> i) suspension of work(s) at a Project either by BHEL or Customer,

TECHNICAL CONDITIONS OF CONTRACT (TCC)

S.No	GCC Clause Reference	Modification / Revision / Addition in GCC Clause
		<p>or</p> <p>ii) where work comes to a complete halt or reaches a stage wherein worthwhile works cannot be executed and there is no possibility of commencement of work for a period of not less than three months</p> <p>4.</p> <p>In such cases, charges towards demobilization and remobilization shall be as decided by BHEL after successful remobilization by contractor at site, and decision of BHEL shall be final and binding on the contractor. After remobilization, all conditions as per contract shall become applicable. In case Contractor does not remobilize with adequate resources or does not start the work within the period as intimated, then BHEL reserves the right to terminate the contract and effect remedies under Clause 2.7.2.2. Duration of the contract/time extension shall be revised suitably. In case of any conflict, BHEL decision in this regard shall be final and binding on the contractor.</p>
9.	GCC Clause 2.11.3	<p>GCC Clause 2.11.3 is revised as:</p> <p>However, if any 'Time extension' is granted to the contractor to facilitate continuation of work and completion of contract, due to backlog attributable to the contractor alone, then it shall be without prejudice to the rights of BHEL to impose penalty/LD for the delays attributable to the contractor, in addition to any other actions BHEL may wish to take under clause 2.7.2 of GCC i.e. "Breach of Contract, Remedies and Termination".</p>
10.	GCC Clause 2.19.1	<p>GCC Clause 2.19.1 is revised as:</p> <p>The contractor will be fully responsible for all disputes and other issues connected with his labour. In the event of the contractor's labour resorting to strike or the Contractor resorting to lockout and if the strike or lockout declared is not settled within a period of one month, it may be considered as 'Breach of Contract' under Clause 2.7 and the remedies under Clause 2.7.2.2 may be executed, at the discretion of BHEL.</p>
11.	GCC Clause 2.24.1	<p>GCC Clause 2.24.1 is revised as:</p> <p>Even though the work will be carried out under the supervision of BHEL Engineers the Contractor will be responsible for the quality of the workmanship and shall guarantee the work done for a period of Twelve months from the date of commencement of guarantee period as defined in Technical Conditions of Contract, for good workmanship and shall rectify free of cost all defects due to faulty erection detected during the guarantee period. In the event of the Contractor failing to repair the defective works within the time specified by the Engineer, BHEL may proceed to undertake the repairs of such defective works, by itself, without prejudice to any other rights and recover the cost incurred for the same along with 5% overheads from the Security Deposit.</p>

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Sl. No.: 02

In addition to The EARNEST MONEY DEPOSIT (EMD) clause 1.9 and The SECURITY DEPOSIT (SD) clause 1.10 published in General Conditions of Contract (Volume I Book II) following is added for FDR

1. FDR should be Lien marked in favour of M/s BHEL.
2. Bank issuing FDR should agree to the following conditions and submit duly signed letter addressed to BHEL, confirming the following points:
 - a) There is no Lock in Period for Encashment of the Said FDR
 - b) The amount under the Said FDR would be paid to BHEL-PSSR on Demand, at any point of Time before, or upon Maturity, without any reference to the (Contractor Name).
 - c) Encashment whether premature or otherwise would not require any clearance from any other authority /Person.
 - d) FDR will be auto renewed for such period/s initially mentioned in the FDR and the intimation of Such renewal shall be sent to BHEL, PSSR and (Contractor), immediately after the renewal.
 - e) FDR will not be closed, Encashed, Changed or Discharged without the Written permission/Confirmation from M/s BHEL PSSR.
 - f) Bank to acknowledge and agree that the Lien created on the FDR shall be in Force until M/s BHEL PSSR, gives a Discharge Letter in this regard.

Sl. No.: 03

Detailed Instruction for EMD / Security deposits through SBI e-collect:

Step 1: Vendors may visit SBI collect website, the URL of which is <https://www.onlinesbi.sbi/sbicollect> where they get the home page with various categories of institutions.

Step 2: Select PSU - Public Sector Undertakings – leading to a page with list of PSUs

Step 3: Type BHEL and search, they get to see all BHEL divisions wherein they shall select BHEL PSSR Chennai. The screen shot of the same is given below.

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Payment Progress

Select Payee

Category: PSU-Public Sector Undertaking

bhel

Filter by State: -- Select --

Name of PSU-Public Sector Undertaking	State
BHEL BAP RANIPET	Tamil Nadu
BHEL PSSR CHENNAI	Tamil Nadu

Showing 1 to 2 of 2 entries (filtered from 113 total entries)

Back

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Step 4: Select EMD receipts. Having selected the Payee in the Payment Progress, it will lead to the payment details – a drop down list of values. From that list, vendors shall select EMD receipts. Upon clicking the entry EMD receipts, a form will open asking for the remitters details and the details of the tender.

Step 5: Confirm details and pay

Fill in all the details correctly, verify the details, and complete the payment as it is leading to the payment gateway.

Step 6: Take a printout on completing the payment and enclose the copy of the same along with the bid submission. Store the copy of receipt for future reference.

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Sl. No.: 04

VOID

Sl. no 05.

VOID

Following Clauses are modified in the Special Conditions of Contract (SCC)

Sl. No.: 06

Clause No. 10.5 on RA Bill Payments, in Special Conditions of Contract (SCC), Volume- IB, Book- II, is revised as under:

"The payment for running bills will normally be released within 30 days of submission of running bill complete in all respects with all documents. It is the responsibility of the contractor to make his own arrangements for making timely payments towards labour wages, statutory payments, outstanding dues etc., and other dues in the meanwhile."

VOLUME-IA PART – II

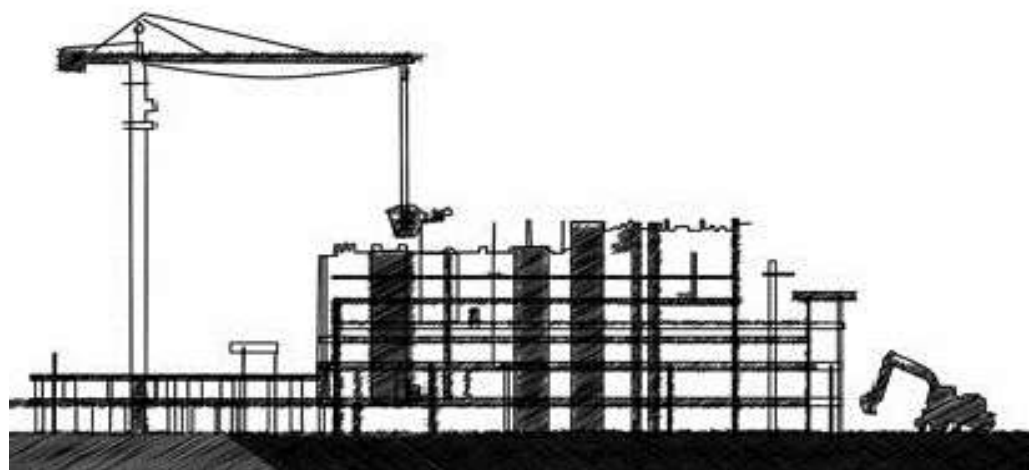
Next chapters are as below

Chapter - 2	HSE Plan for Site Operations by Subcontractor	131 pages
Chapter - 3	Hire Charges	13 pages



HSEP14

Health, Safety & Environment Plan for Site Operations by Subcontractors



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SECTION A

CRITICAL RESOURCES FOR HSE IMPLEMENTATION

1. SHARING OF OPERATING COSTS OF FACILITIES

TABLE A.1

SN	FACILITY
1	Ambulance with 24 hr. First Aid Trained Driver (Specs in Annexure A)
2	Operation of Medical center, Nurses, Medical Consumables etc. (Specs in Annexure A)
3	Training Center Consumables
4	Water sprinkling for dust suppression
	(Others:)

Note:

- Responsibility of operation of above facilities shall rest with BHEL
- Operating cost of the above shall be deducted from subcontractors on 'proportional to contract' value basis. Sample deduction table enclosed as Annexure A.1
- "Contract value" defined above & subsequently in the document shall be considered as "Awarded contract value".
- No overhead cost/ enabling cost of BHEL shall be levied on the contractors for common facilities.
- These running costs shall be recovered from all the available subcontractors at site for the complete operational duration of the site
- No overheads shall be charged on shared operating costs

2. RESOURCES TO BE PROVIDED SOLELY BY THE SUBCONTRACTOR

TABLE A.2

SN	ITEM	SPECIFICATIONS
1.	HSE DISPLAYS, Posters and signage	Annexure B
2.	HSE Tools/ Equipment/ Devices	Annexure C
3.	Rest Sheds for Workers	Annexure D
4.	Labor Colony	Annexure E
5.	Toilets (Latrines & Urinals) - in Site and Labor Colony	Annexure F
6.	Fire Extinguishers	Annexure G

Note:

In case subcontractor fails to provide the required resources, same will be procured and deployed by BHEL with applicable overhead on total procurement cost

3. ESTABLISHMENT OF COMMON FACILITIES

In green field projects BHEL shall arrange and provide the following facilities which shall be used by all subcontractors for their employees and workers. These shall be

- Medical Centre
- Safety park with facilities of audio-visual training & vertigo test center.
- No cost shall be deducted from the subcontractors for the structure part only.
- The running cost with basic inputs already mentioned at Point 1 above shall be shared by all contractors.
- The sub-contractors shall be required to ensure participation in trainings, medical checkup and vertigo test as per the guidelines laid in this document and required as per statutory HSE requirements.

- vi. However, in projects where in these facilities are not provided by BHEL, subcontractors shall ensure the training, medical/ vertigo test of all workers at site in consultation and guidance of BHEL HSE team at site in line with provisions of this document.
- vii. The overall onus of compliance to HSE practices pertaining to training, medical checkup including vertigo test shall lie on the subcontractor only.

4. CRITICAL REQUIREMENTS W.R.T. EQUIPMENT & PPES

- i. Conventional Hydra crane with carriage in front shall not be permitted. Pick & carry tyre mounted Front Cabin mobile crane (FX or TRX/ NextGen series of 'ESCORT' or equivalent make) shall only be permitted.
- ii. Any Heavy equipment (cranes, winch machines, etc.) shall be deployed only after pre-safety Inspection by safety dept. Valid AMCs/ Fitness/ other statutory clearances as per local rules shall be required to be submitted before mobilizing the equipment at site.
- iii. All other Hand tools and power tools should not be older than 5 years.
- iv. For Chimney passenger lift, winch to have double drum rope for passenger and double safety devices must be used. Winch should not more than 3 years old and winch rope must be inspected with valid certificate from competent authority within 6 months and should meet the IS standard 9507 provision of OLR and push back button arrangement or dead man switch.
- v. Gate pass for all the lifting T&Ps and construction machinery/ equipment shall be made after obtaining written acceptance (Pre-entry Safety Clearance) from BHEL Site Safety Department after physical verification and checking all requisite documents/ compliance to Safety norms
- vi. All motor vehicles should have valid registration certificate, insurance, Pollution under control (PUC) and fitness certificate as per Motor Vehicle Act 2020. The certificates should be pasted in the glass from inside.
- vii. PPEs shall be from reputed manufactures viz. 3M, Udyogi, Karam, Frontier, Freedom, Honeywell, Liberty, Bata, Nomex, Acme, Unicare, Life Gear or equivalent. In case Subcontractor recommends any other name the same can be approved at site level by the Construction manager & Site HSE
- viii. For height work, where fall could result in death or disability, a secondary means of fall protection (Safety Net, Retractable Fall Arrestor etc.) shall be mandatorily provided by the subcontractor, failing which, a penalty of INR 10000 per case will be imposed. In addition, there should be constant supervision for such critical height work. Any non-erection activities at height eg. Housekeeping etc. shall also fall under the category of height work
- ix. **Scaffold Tagging**

Scaffolds being erected, modified or dismantled must be tagged as suitable for use. Tagging shall be done with standard tag holder. Scaffolding tag should be certified by scaffolding inspector having valid certificate.

- **GREEN** scaffold tag- shall be fixed when scaffold is complete and safe for use, signed and dated by the scaffolding competent person daily.
- **RED** scaffold tag – to be fixed if scaffold is in some way defective and cannot be used or is still under erection.
- **YELLOW** scaffold tag – to be fixed if scaffold is in under construction/ maintenance.



FIG. A.4.1 SAMPLE SCAFFOLD TAGS AND TAG HOLDER

x. **T&P Color Coding:**

- a. Inspections and tests shall be documented by means of color coding which shall verify that inspections or testing are current and that all receptacles, portable Power tools, Lifting Tools & Tackles have been inspected and tested as required. The color codes used on the project shall be:

GREEN	BLUE	YELLOW	PURPLE
January	April	July	October
February	May	August	November
March	June	September	December

TABLE. A.4.2: T&P COLOR CODES

- b. The cycle of colors shall be Quarterly as a minimum or as decided by BHEL. The color code tape / Sticker shall be clearly visible to designate the period for which the inspections and tests were conducted.
- c. Following the initial inspection, the equipment must be color-coded quarterly as per color-coding instructions that will be issued by the subcontractor.
- d. Fire extinguisher with the current month color-coding inspection sticker must be provided and secured in the platform.
- e. All slings shall be regularly inspected in accordance with the requirement of the project for frequent and periodic inspections and discard immediately if they fail to meet the minimum requirements of the project.
- f. The Subcontractor's HSE Officer shall ensure that all PPE is inspected prior to its issue. He is to ensure all subcontractor personnel are using safe and proper PPE equipment. Regular

inspections on the PPE shall be carried out and personnel not adhering to those inspections shall be removed immediately from the site.

- g. A Ten (10) day interval period shall be given into each monthly color code change. During this Ten (10) day period either color shall be acceptable.

xi. **T&P Tagging:**

All deployed Wire Rope Slings, Chain Pulley Blocks, Hooks, slings etc. shall be Tagged using aluminum or any other metal tag with punching.

5. HSE PERSONNEL TO BE PROVIDED SOLELY BY THE SUBCONTRACTOR

5.1. NUMBERS OF HSE PERSONNEL (APPLICABLE FOR EACH WORK SHIFT)

Number of HSE Officers and Supervisors shall be in proportion to number of workers as per Table A.6 below

TABLE A.5

No. of Workers	No. of HSE Supervisors	No. of HSE Officers
Up to 100	1	1
101 to 250	2	1
251 to 500	4	1
501 to 1000	6	2
1000 to 2000	6+ One additional supervisor up to every additional 250 workers	3
2000-3000	10+ One additional supervisor up to every additional 250 workers	4
3000-4000	14+ One additional supervisor up to every additional 250 workers	5

5.1.1. DEPLOYMENT PLAN

- Above requirement is for every shift for each unit.
- The dynamic deployment plan of Safety manpower at various locations containing names, areas, time periods, shifts etc. shall be submitted to BHEL for approval by subcontractor
- BHEL may modify the deployment plan based on nature and volume of jobs, Risks and hazards associated etc.
- For less than 20 workers HSE Officer is not mandatory. In case the number of workers exceed 20 for 3 consecutive months, HSE Officer is to be engaged. The HSE Officer shall be deployed for a minimum period of 6 months even if the number of workers fall below 20 in any month subsequent to deployment. If within that 6-month period, the number of workers is more than 20 for at least 3 months, the deployment duration of HSE Officer will extend further 6 months after completion of previous 6-month period.
- For Site Material Management/ Handling (Loading/ Unloading) contracts, 1 no. HSE Officer shall be required irrespective of the total manpower deployed.
- HSE Officers/Supervisors of all the vendors may be required to report directly to BHEL HSE Officer at site & shall comprise as a total team for handling all HSE issues. However, each safety officer/ agency shall be individually responsible for the safe execution of work in their respective areas.

5.2. QUALIFICATION & EXPERIENCE REQUIREMENTS OF HSE PERSONNEL

5.2.1. HSE OFFICER

First HSE Officer to be mandatorily as per Option I as under and shall be designated Senior HSE Officer. In case of non-availability of HSE Officers with Option I configuration, the subsequent HSE Officers can be as per Option II below with recorded reasons and approval of Site Construction Manager of BHEL. All these deviations should be reported to Region HSE and PSHQ HSE.

A. Option I

- i. possesses a recognized degree in any branch of engineering or technology or architecture and had a practical experience of working in a building or other construction work in a supervisory capacity for a period of not less than two years or possesses a recognized diploma in any branch of engineering or technology and has had practical experience of building or other construction work in a supervisory capacity for a period of not less than five years;
- ii. possesses a recognized degree or diploma in industrial safety with at least one paper in construction safety (as an elective subject/ part thereof);
- iii. has adequate knowledge of the language spoken by majority of building workers from the construction site in which he is to be appointed.

B. Option II:

Graduation Degree in Science with Physics & Chemistry and degree or diploma in Industrial Safety (All Degrees/ Diploma from any Indian institutes recognized by AICTE or State Council of Technical Education of any Indian State) with practical experience of working in a building, plant or other construction works (as HSE Officer, in line with Indian Factories Act, 1958 or BOCW Act, 1996) for a period of not less than five years

Note:

- i. HSE Officer as per Option II shall be valid only on availability of Senior HSE Officer as per Option I at site.
- ii. In case of resignation of the Senior HSE Officer, the same has to be replaced within 15 days else all subsequent HSE Officers as per Option II (in case of multiple HSE Officers with a single agency) shall not be considered as valid.
- iii. The penalty shall be deducted considering non-availability of any HSE Officer at site.

5.2.2. HSE SUPERVISOR: EITHER OF X OR Y BELOW

X. Recognized Degree in any branch of Engineering OR Diploma in any branch of engineering with at least one-year construction experience

OR

Y. A recognized graduation Degree in Science (with Physics & Chemistry) or a recognized diploma in Engg. or Tech.

Additional requirements for option (Y) above

- i. Trained in fire-fighting as well as in safety / occupational health related subjects, with:
- ii. Minimum Two years of practical experience in construction work environment or in the field of safety and

Note:

- i. Option a above is by default, b is under special approval from Site HSE & Construction manager
- ii. In both cases the candidate should possess requisite skills to deal with construction & fire safety related day-to-day issues.

5.3. HSE IN-CHARGE

In case there is more than one HSE Officer with any subcontractor, one of them, who is senior most by experience & meets qualification as per option 1 as mentioned in clause 2.1 A above (in HSE discipline), may be designated as HSE In-charge who will be the nodal point of contact on HSE matters.

5.4. SUPPORTING STAFF TO HSE TEAM

- i. Supporting Staff shall include scaffolders, scaffolding inspectors, riggers, skilled and unskilled manpower
- ii. Subcontractor shall provide adequate number of workers as and when required, in order to attend and comply to Safety observations raised by BHEL/ Customer.

5.5. AVAILABILITY AND PENALTY FOR NON-DEPLOYMENT

- i. The subcontractor shall submit the certificates of qualification & experience of HSE manpower before deployment for BHEL to assess suitability as per requirement detailed in this document
- ii. In case of rejection, subcontractor shall arrange additional candidates and submit resume to BHEL. Penalties will be applicable during the period of non-deployment in such cases as well.
- iii. Subcontractor shall ensure physical availability of safety personnel at the place of specific work locations.
- iv. The Subcontractor shall deploy the HSE Officers as per the site's requirement. Non-deployment shall lead to stoppage of the work and final decision shall rest with Site HSE & Construction manager.
- v. The Subcontractor shall prepare an organization chart identifying the areas of operations, responsibilities and reporting structure of all safety personnel for each shift and submit the same to BHEL.
- vi. The subcontractor shall deploy sufficient HSE Officers, supervisors, as per numbers & qualifications mandated in this Section since mobilization of first batch of manpower and add more in proportion to the added strength in work force. Any delay in deployment will attract a penalty at following rates:

Non-deployment of HSE Officer –	Rs. 75,000 per man-month
Non-deployment of HSE Supervisor –	Rs. 50,000 per man-month

- vii. Penalty shall be collected for the period of non-availability of safety personnel after allowing a grace period of 15 days for finding a replacement. The same shall be deducted on pro-rata basis till the required manpower is deployed.
- viii. In case of abnormal delay & frequent rejections of candidates proposed by the subcontractor, BHEL shall exercise the right to deploy the safety manpower & deduct the amount from subcontractor's running bill with applicable overheads. In such cases also, the provision of logistics, transportation, food and other logistical support to the HSE personnel shall be in the scope of subcontractor in addition to the salary. After deployment of manpower by BHEL, the penalty for non-deployment specified above shall not be applicable.

6. COMPETENCY OF OPERATORS/ DRIVERS OF CRANE, WINCH, LIFTING/ CONSTRUCTION EQUIPMENT ETC.

- i. The Operators/ Drivers of crane, winch, construction/ lifting equipment etc. shall be experienced and have valid driving license for the class of vehicle / machinery as applicable (like Crane/ Forklift/ Rig, Construction equipment driving license etc.).
- ii. Minimum HMV driving license is required for all heavy equipment/ heavy vehicle (trailer/ Hyva /dumper /TM) operators at site.
- iii. The subcontractor shall certify competence of these persons in writing as and when they are posted at site.
- iv. Crane, Winch, Construction & lifting equipment operator should have certificate on subject course or experience certificate in employer letterhead.
- v. Where state is providing license for operating crane, tractor and other construction vehicles, same to be ensured.

Note: In case the statutory requirements i.e. State or Central Acts and / or Rules as applicable like the Building and Other Construction Workers' Regulation of Employment and Conditions of Service- Act,1996 or State Rules (wherever notified), the Factories Act, 1948 or Rules (wherever notified), etc. are more stringent than above, the same shall be followed.

- 7. In case of any stringent requirement of BHEL's customer over and above the specifications mentioned in current document, the same shall also be required to be complied at site by subcontractor.

8. REFERENCES

The Safety Rules for Construction & Erection as outlined hereunder, while setting out a broad parameter of safety norms, are not exhaustive. The subcontractor and his agencies are advised to refer to the following statutory provisions as amended from time to time for details and strict compliance therewith.

8.1.FOR GREENFIELD PROJECTS

- a) Building and Other Construction Workers (regulation of employment and conditions of service) Act, 1996 (briefly referred to as BOCW Act),
- b) Building and other construction workers (regulation of employment and conditions of service) Central Rules, 1998 (briefly referred to as BOCW Rules) as adopted by the various State Governments,

8.2. FOR EXPANSION, MODIFICATION, ALTERATION AND, OR CONSTRUCTION ACTIVITY WITHIN AN EXISTING PLANT OPERATING AS PER APPROVED SITE PLAN UNDER THE FACTORIES ACT

- a) Factories Act, 1948,
- b) Factories Rules, as adopted by the various State Governments
- c) BOCW Act
- d) BOCW Rules
- e) In case a new act/ statutory guideline/ modification/ consolidation of acts is implemented the same shall be required to be adhered by the subcontractor.
- f) The latest amendment of the above-mentioned acts/ rules shall be followed at site.

9. BHEL POWER SECTOR HSE MANAGEMENT SYSTEM

The Systems and procedures of BHEL Power Sector HSE Management System shall be implemented by the subcontractor, including:

- HSE PROCEDURE FOR REGISTER OF OHS HAZARDS AND RISKS
- HSE PROCEDURE FOR REGISTER OF ENVIRONMENTAL ASPECTS AND IMPACTS
- HSE PROCEDURE FOR REGISTER OF REGULATIONS
- HSE PROCEDURE FOR TRAINING AND AWARENESS
- HSE PROCEDURE FOR EMERGENCY PREPAREDNESS AND RESPONSE PLAN
- HSE PROCEDURE FOR PERMIT TO WORK
- HSE INSPECTION AND OTHER FORMATS

Note:

- i. BHEL reserves the right to revise/ update these systems and procedure as per requirement to address any changing HSE needs
- ii. BHEL will provide hard / soft copies of applicable HSE Procedures, Work Permits, Operational Control Procedures, Inspection/ Other Formats etc. that are necessary for ensuring safe work to the successful bidder at Site. It is the responsibility of the subcontractor to ensure availability of these documents before commencing work at site.
- iii. The subcontractor can get soft copies of these documents from respective Region SCT/ HSE for reference. The signed hard copies of the same shall not be required to be submitted along with tender document
- iv. Subcontractor shall use the Digital (Web & App-Based) HSE management Software Systems provided by BHEL whenever provided. In case not provided, hard copy systems will continue to be used. All information technology resources (Computers, mobile phones, mobile data, internet access etc.) for the use of such systems shall be ensured by the subcontractor.

10. CLEARANCE OF MONTHLY RUNNING BILLS SUBJECT TO SAFETY COMPLIANCE

- The monthly running Bills of the subcontractor shall be released subject to compliance to HSE requirements as per checklist in Annexure H
- BHEL site HSE Head and Package In-charge shall be authorized to issue the clearance
- Site Construction Manager of BHEL shall be the final authority on the matter.

11. HSE PERFORMANCE EVALUATION

- Subcontractor shall be assessed on monthly basis for HSE Compliance by BHEL Safety In-charge at site.
- The HSE evaluation shall be based on HSE Performance Evaluation System of BHEL covering the contractual, statutory and regulatory requirements of HSE.
- BHEL shall reserve the right to use these performance scores for evaluating bidder's capacity for future tenders
- If safety record of the subcontractor in execution of the awarded job is to the satisfaction of safety department of BHEL, issue of an appropriate certificate to recognize the safety performance of the subcontractor may be considered by BHEL after completion of the job, provided the execution performance is satisfactory.

12. HSE PENALTIES

- Nonconformity of safety rules and safety appliances will be viewed seriously and BHEL has right to impose fines on the subcontractor for every instance of violation noticed.
- As per contractual provision HSE penalties shall be imposed on subcontractors for non-compliance on HSE requirement as per following format.
- Following are the applicable penalties for various Safety violations:

Sub: MEMO for Penalty for non-compliances in Safety

Following lapse (tick marked) was observed and penalty (in Rs.) is imposed as stated at the bottom of this memo. It is requested that such occurrences be please avoided in future.

S. No	Nature of Non - Compliance	Penalty (in INR)	Remarks
A. System Violations			
1	Working without valid Work Permit/ HIRA/ Method Statement / JSA	2000	Per case
2	Controls as per Work Permit/ HIRA/MS/JSA not ensured	2000	Per case
3	Reported Safety Violations Not Closed within Stipulated Time	1000-10000	Per case
4	Absence of required Subcontractor Officials (Site Head, HS Head) in Safety Reviews/Meetings	5000	Per case
5	Not providing required PPEs (Safety Harness, Lifeline, Safety Net, Fall arrestor, Safety Helmet, Gloves, Shoes etc.) for the work by subcontractor	2000	Per case
B. Competency/ Training/ Induction Violations			

1	Incompetent personnel deployed for specialized jobs like height work, hot work, rigging, vehicle operation etc. (without valid license/ certificate etc.)	3000	Per case
2	Work without induction training & medical check	2000	Per case
3	Height Work without Vertigo Test and height work training	2000	Per case
C. PPE Violations – Height Work			
1	Not wearing/ hooking Double Lanyard Safety Harness while working at height (> 1.2 meters) or not anchoring to lifeline	1000	Per case
2	Not Providing Lifeline for height work	3000	
3	Unsafe platforms – without Top, Mid Rails and Toe-Guards for Height Work	3000	
4	Not providing secondary means of fall protection for height work (Safety Nets, Retractable Fall Arrestors etc.)	3000	Per case
D. PPE Violations – General			
1	Not wearing safety helmet	1000	Per case
2	Wearing of helmets without chin straps	1000	Per case
3	Not Wearing safety shoes	500	Per case
4	Not wearing gloves	500	Per case
6	Not using grinding goggles/ face shield during grinding/ cutting	2000	Per case
E. Electrical Safety Violations			
1	Broken/ exposed wires/ cables	2000	Per case per day
2	Electrical plug not used for connection/ hand machines	1000	Per case per day
3	Not using proper ELCBs for electrical equipment	2000	Per case per day
4	Improper earthing of welding & Other electrical machines (Lack of double earthing, improper/ untested earth pit etc.)	2000	Per case per day
5	Not using 24 V supply for lighting in confined spaces	2000	Per case
6	Cables haphazard/ blocking way/ not organized properly	1000	Per case per day
F. Lifting & Rigging Violations			
1	Using Sling/ Chain Pulley Block and other Small T&Ps without proper, traceable Tag and Test Certificate	2000	Per T&P per day
2	Using damaged slings or not slinging properly	2000	Per T&P per day
3	Use of lifting equipment without having valid Test certificate	5000	Per equipment per seven days
4	Lifting hooks used without latches	2000	Per hook per day
5	Not effectively barricading area below lifting activity	5000	Per case
6	Using untrained/ unqualified rigger	5000	Per case
G. Housekeeping			
1	Non-removal of scrap from platforms	5000	Per Event Per location per 7 days
2	Not conducting scheduled housekeeping drives	5000	Per drive
H. Hot Work Safety Violations			
1	Gas cutting without flash back arrestor at both ends	5000	Per machine per incidence
2	Gas cutting at height without fire blanket	2000	Per event

3	Not keeping gas cylinders vertically	2000	Per event
4	Lifting cylinders without cage or rolling of cylinders	2000	Per incidence
5	Leakage in gas cylinder	2000	Per incidence
I. Vehicle Safety/ Operation			
1	Not having valid driving license for the type of vehicle/ T&P	2000	Per driver per incidence
2	Two-wheeler entry in construction area	2000	Per vehicle
3	Using Hydra for material movement at site in unsafe manner	2000	Per case
4	Using Two Hydra in Tandem for material movement without proper precautions as per OCP	2000	Per case
5	Vehicles, Hydras, Cranes, Dumpers and Earth Movers not having automatic back horns linked to gear	2000	Per Equipment per day
6	Not providing proper hard barricades around excavations/ unpermitted areas	5000	Per location per day
7	Not using guide rope while transporting material using Hydra or Cranes	2000	Per event
8	Over speeding	5000	Per case
9	Using Conventional Hydra crane	50000	Per day /crane
J. Accidents/ Incidents/ Near Misses			
1	Non-reporting of Near Miss/ Incident	20000	Per case
2	Major Accident – Worker unable to resume work within 48 hrs	100000	Per incident
3	Fatal Accident	500000	Per incident
K. Miscellaneous			
1.	Not providing the facility (drinking water, rest shed, labor colony etc. as per the specifications/ requirement)	5000	Per month per violation
2.	Not nominating the required number of workers for training as per plan	5000	Per incidence
3.	Lack of proper arrangement for disposal of sewage/ waste water/ effluents etc.	10000	Per incidence

Details (if any) related to non- compliance (Name of persons, Nature of deficiency, etc.):

Penalty Amount:

1. Rate as per above chart
2. No. of Persons/ machine/ event/ labor
3. No. of times the same error is repeated: Repetition factor
4. Total Penalty= 1. X 2. X 3. =

Witnessed by:

(Sub- Subcontractor representative)
representative)

(BHEL

Signature

Name

- Distribution: 1 Copy: to Sub- subcontractor Site In-charge,
1 Copy to Site Construction Manager (BHEL)
1 Copy to Site Finance

Note:

- i. In case the amount of penalty imposed by BHEL's Client on BHEL for Safety violation/ incident due to or in the area of the subcontractor is more than those indicated above, same shall be imposed back-to-back on the subcontractor. However, in case such an amount is less than the specified above, penalty amount indicated above shall be imposed on the subcontractor.
- ii. For same violation only one penalty (higher of the two mentioned below) shall be applicable
 - a. Penalty imposed by BHEL's Customer over BHEL.
 - b. Penalty as indicated in current document.
- iii. For repeated violation for the same equipment/ location, the penalty would be double of the previous penalty. Date of "Repeated violation" will be counted from subsequent days.
- iv. For repeated fatal incident in the same Unit incremental penalty shall be imposed: The subcontractor will pay 2 times the previously paid penalty in case there is repeated major/ fatal incident under the same subcontractor for the same package in the same unit.
- v. Any other non-conformity noticed not listed above will also be fined as deemed fit by BHEL. The decision of BHEL engineer is final on the above.
- vi. If principal customer/statutory and regulatory bodies impose some penalty on HSE due to the non-compliance of the subcontractor the same shall be passed on to them.
- vii. The penalty amount shall be recovered by BHEL Finance department from subcontractors from the RA/Final bill.

13. PUNITIVE ACTIONS FOR "CRITICAL SAFETY VIOLATIONS":**"Critical Safety Violations" include:**

- i. Not wearing required PPEs when provided and not following safe work procedure
- ii. Taking unnecessary risks especially in height work, hot work, radiation work, lifting activity
- iii. Coming to work under influence of sedatives like alcohol, drugs etc.
- iv. Coming to work without ID Card/ Gate Pass (if provided)
- v. Intimidating/ threatening at work
- vi. Using cell phones during height work, hot work, lifting activity, driving.

In case any worker carries out any of the critical safety violations as above, BHEL reserves the right to enforce punitive action in following manner:

First Offence:	1 Punch on Gate Pass/ Induction Card/ ID Card etc. and 1-hour HSE Training. With one day off from duty
Second Offence:	2 Punches and 2-hours HSE Training with one day off from duty

Third Offence:	3 Punches and the worker will be dismissed. Gate pass to be confiscated
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In case any employee of subcontractor carries out any of the critical safety violations as above, subcontractor Site In-charge shall issue warning letter to concerned employee with copy to BHEL

Note:

- i. For above violations, guilt of the worker/ employee has to be established through appropriate evidences and records maintained.
- ii. If worker/ employee has not been given the required PPEs and safety equipment by the agency and/or not facilitated by the agency to follow safety rules, he/ she will not be considered liable but the agency will be penalized as per penalty provision in this document. In such cases, the subcontractor shall not pass the penalty over to the worker/ employee through wage deduction etc.
- iii. These critical safety violations and their consequences shall be shared with all workers and employees during induction and other training programs/ meetings, toolbox talks etc.
- iv. Gate Pass shall have provision of Tagging as indicated above
- v. The appellate authority (only for final dismissal) in this case shall be the BHEL Site In-charge whose decision shall be final on the matter and binding on all parties.

14. LEGAL IMPLICATIONS

Any legal Costs incurred by BHEL, on account of accidents taking place in the activities of the subcontractor, shall be debited to the subcontractor on actual cost basis.

For any accident occurring at site to any worker/ employee of the subcontractor leading to legal implications to BHEL Employee/ Management shall be safeguarded by BHEL legal department. All legal expenses incurred by BHEL on this account shall be recovered from the subcontractor. The accident also includes fire, loss of property or life at site.

15. HSE REVIEW MEETING

- i. Subcontractor Site In-charge and HSE In-charge shall attend the HSE Review Meeting as and when called by BHEL.

The indicative agenda points are given below:

- a) Implementation of earlier MOM points
- b) Compliance Status of HSE Observations
- c) Incidents & Near Misses, their Root Causes and Actions Taken
- d) HSE performance review
- e) HSE inspection findings
- f) HSE audit and CAPA
- g) HSE training
- h) Health check-up camp
- i) HSE planning for the erection and commissioning and installation activities in the coming month

- j) HSE reward and promotional activities
- ii. MOM on the discussion along with HSE observations will be circulated to the subcontractor for action.
- iii. The subcontractor shall close the observations to the satisfaction of BHEL within stipulated time frame

16. OTHER REQUIREMENTS

- i. If the subcontractor fails to improve the standards of safety in its operation to the satisfaction of BHEL after being given reasonable opportunity to do so and/or if the subcontractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instruction regarding safety issued by BHEL, BHEL shall have the right to take corrective steps and the cost shall be debited to the subcontractor with applicable overheads.
- ii. If the subcontractor succeeds in carrying out its job in time without any fatal or disabling injury incident and without any damage to property BHEL may, at its sole discretion, favorably consider to reward the subcontractor suitably for the performance.
- iii. In case of any damage to property due to lapses by the subcontractor, BHEL shall have the right to recover the cost of such damages from the subcontractor after holding an appropriate enquiry.
- iv. The subcontractor shall take all measures at the sites of the work to protect all persons from incidents and shall be bound to bear the expenses of defense of every suit, action or other proceeding of law that may be brought by any persons for injury sustained or death owing to neglect of the above precautions and to pay any such persons such compensation or which may with the consent of the subcontractor be paid to compromise any claim by any such person, should such claim proceeding be filed against BHEL, the subcontractor hereby agrees to indemnify BHEL against the same.
- v. The subcontractor shall not employ men below the age of 18 years and women on the work of painting with products containing lead in any form. Wherever men above the age of 18 are employed on the work of lead painting, overalls shall be supplied by the subcontractor to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of work.
- vi. The subcontractor shall notify BHEL of his intention to bring to site any equipment or material which may create hazard.
- vii. BHEL shall have the right to prescribe the conditions under which such equipment or materials may be handled and the subcontractor shall adhere to such instructions.
- viii. BHEL may prohibit the use of any construction machinery, which according to the organization is unsafe. No claim for compensation due to such prohibition will be entertained by BHEL.

17. MEMORANDUM OF UNDERSTANDING:

After award of work, subcontractors are required to enter into a memorandum of understanding as given below:

Memorandum of Understanding

BHEL, Power Sector Region is committed to Health, Safety and Environment Policy (HSE Policy).

M/s.....do hereby also commit to comply with the same HSE Policy while executing the Contract Number _____

M/s.....have gone through and understood all the HSE requirements of the contract including HSE manpower, tools & equipment, systems & procedures, and agree to fulfill the same as a minimum. Any additional resources and support required for ensuring fulfillment of HSE Objectives shall be provided by subcontractor at no extra cost.

M/s..... agree that in case they fail to comply to the HSE requirements as stipulated in the contract, BHEL shall have the right to implement the same and the cost shall be recovered from the subcontractor with applicable overheads.

M/s..... shall ensure that safe work practices as per the HSE plan. Spirit and content therein shall be imbibed in all workers and supervisors for compliance.

In addition to this, M/s.....shall comply to all applicable statutory and regulatory requirements which are in force in the place of project and any special requirement specified in the contract document of the principal customer.

M/s.....shall co-operate in HSE audits/inspections conducted by BHEL /customer/ third party and ensure to close any non-conformity observed/reported within prescribed time limit.

M/s..... agree that the subcontractor shall seek HSE clearance as per BHEL format before each RA bill as mentioned in clause no. 9. The penalty amounts for not providing Safety manpower and various Safety violations have also been reviewed and agreed.

M/s..... agree to share the HSE Costs (running costs) of common facilities created by BHEL on proportional to contract value basis as calculated at Site by BHEL.

Signed by authorized representative of M/s -----

Name :

Place & Date:

SECTION B

OPERATIONAL REQUIREMENTS

1. PURPOSE:

- 1.1. The purpose of this HSE Plan is to provide for the systematic identification, evaluation, prevention and control of general workplace hazards, specific job hazards, potential hazards and environmental impacts that may arise from foreseeable conditions during installation and servicing of industrial projects and power plants.
- 1.2. This document shall be followed by BHEL's subcontractors at all installation and servicing sites. In case customer specific documents are to be implemented, this document will be followed in conjunction with customer specific documents in complementary manner.
- 1.3. Although every effort has been made to make the procedures and guidelines in line with statutory requirements, in case of any discrepancy wherein the relevant statutory guidelines supersedes this document, the same shall be followed.
- 1.4. In case there's any specific HSE requirement from BHEL's Client, not explicitly indicated in this document the same shall be required to be fulfilled as per the decision of BHEL Site construction manager.

2. SCOPE:

The document is applicable to BHEL's Subcontractors at all installation / servicing activities of BHEL Power Sector as per the relevant contractual obligations

3. OBJECTIVES AND TARGETS:

- i. To achieve "Zero Incident at Site"
- ii. 100% compliance to all legal/statutory requirements related to EHS.
- iii. 100% Health, Safety and Environmental Induction training attendance for all workers.
- iv. 100% High Risk activities to be carried out only after approved Method Statement, HIRA / Aspect-Impact / JSA / OCP and Permit to Work are implemented.
- v. 100% PPEs compliance in high and medium risk activities.
- vi. 100% incident reporting, recording and reviewing for corrective actions.
- vii. Regular Safety Reviews to assess HSE program compliance and closure of any recognized gaps to improve safety management and incident prevention
- viii. Prevent injury and ill health of all workers at site ('Workers' refers to all personnel including managerial, supervisory, professional, technical, clerical and other workers including contract laborers)
- ix. Prevent pollution to environment
- x. Ensure the Health and Safety of all persons at work site is not adversely affected by the work.
- xi. Ensure protection of environment of the work site.
- xii. Comply at all times with the relevant statutory and contractual HSE requirements.
- xiii. Provide trained, experienced and competent personnel. Ensure medically fit personnel only are engaged at work.
- xiv. Provide and maintain plant, places and systems of work that are safe and without risk to health and the environment.

- xv. Provide all personnel with adequate information, instruction, training and supervision on the safety aspect of their work.
- xvi. Effectively control, co-ordinate and monitor the activities of all personnel on the Project sites including subcontractors in respects of HSE.
- xvii. Establish effective communication on HSE matters with all relevant parties involved in the Project works.
- xviii. Ensure that all work planning considers all persons that may be affected by the work.
- xix. Ensure fitness testing of all T&Ps/Lifting appliances like cranes, chain pulley blocks etc. are to be certified by competent person.
- xx. Ensure timely provision of resources to facilitate effective implementation of HSE requirements.
- xxi. Ensure continual improvements in HSE performance.
- xxii. Ensure conservation of resources and reduction of wastage.
- xxiii. Capture the data of all incidents including near misses, process deviation etc. Investigate and analyze the same to find out the root cause.
- xxiv. Ensure timely implementation of correction, corrective action and preventive action.
The subcontractor shall also comply with HSE Targets stipulated by BHEL from time to time.

4. BHEL HEALTH, SAFETY & ENVIRONMENT POLICY:

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

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

Chairman & Managing Director/ BHEL

5. ILLUSTRATIVE RESPONSIBILITIES OF SUBCONTRACTOR EMPLOYEES

5.1 HSE - A LINE RESPONSIBILITY

- i. HSE is a "Line Responsibility".
- ii. The term "Line" includes management, Executives, Supervisors, Foremen, and Workers who are part of the workforce. Line is to be fully involved in HSE Planning & Implementation with the aid and advice of HSE organization.
- iii. "Line", having control of resources and manpower is responsible for overall implementation of HSE Systems and closure of HSE observations.

5.2 SITE IN -CHARGE:

- i. Shall sign Memorandum of Understanding (MoU)
- ii. Shall ensure availability of all necessary resources required for implementation of HSE at Site
- iii. Shall engage qualified HSE Officer(s) and supervisors (s)
- iv. Shall adhere to the rules and regulations mentioned in this code, practice very strictly in area of work in consultation with concerned engineer and the safety coordinator.
- v. Shall screen all workmen for health and competence requirement before engaging for the job and periodically thereafter as required.
- vi. Shall not engage any employee below 18 years.
- vii. Shall arrange for all necessary PPEs like safety helmets, belts, full body harness, shoes, face shield, hand gloves etc. before starting the job.
- viii. Shall ensure that all T&Ps engaged are tested for fitness and have valid certificates from competent person.
- ix. Shall ensure closure of all HSE non-conformities reported by BHEL or observed during internal inspection by providing appropriate resources in a timely manner.
- x. Shall ensure the implementation of provisions of applicable acts and rules pertaining to HSE.
- xi. Shall ensure availability of updated (Hazard Identification and Risk Assessment) Register for the area of activity
- xii. Shall ensure availability of Method Statements & Job Safety Analysis for all hazardous activities
- xiii. Shall ensure necessary controls to minimize risk in all applicable hazardous activities including Height Work, Hot Work, Lifting & Rigging, Confined Space, Maintenance, excavation, Radiography, Loading/ Unloading, Drilling/ Blasting etc.
- xiv. Shall ensure implementation of HSE requirements mentioned in this document and as specified in the BHEL HSE management System including training, inspection, awareness, reporting etc.
- xv. Shall ensure that person working above 2.0 meter should use Safety Harness tied to a life line/stable structure.
- xvi. Shall ensure a secondary means of fall protection (Safety Net, Retractable Fall Arrestor etc.) for preventing fall from height
- xvii. Shall ensure that materials are not thrown from height. Cautions to be exercised to prevent fall of material from height.

- xviii. Shall report all incidents (Fatal/Major/Minor/Near Miss) to the Site engineer /HSE officer of BHEL.
- xix. Shall ensure that Horseplay is strictly forbidden.
- xx. Shall ensure that adequate illumination is arranged during night work.
- xxi. Shall ensure that all personnel working under subcontractor are working safely and do not create any Hazard to self and to others.
- xxii. Shall ensure display of adequate signage/posters on HSE.
- xxiii. Shall ensure that mobile phone is not used by workers while working.
- xxiv. Shall ensure conductance of HSE audit, mock drill, medical camps, induction training and training on HSE at site.
- xxv. Shall ensure full co-operation during HSE audits.
- xxvi. Shall ensure submission of look-ahead plan for procurement of HSE equipment's and PPEs as per work schedule.
- xxvii. Shall ensure good housekeeping.
- xxviii. Shall ensure adequate valid fire extinguishers are provided at the work site.
- xxix. Shall ensure availability of sufficient number of toilets (preferably bio-toilets) /restrooms and adequate drinking water at work site and labor colony.
- xxx. Shall ensure adequate emergency preparedness.
- xxxi. Shall be member of site HSE committee and attend all meetings of the committee
- xxxii. Power source for hand lamps shall be maximum of 24 v.
- xxxiii. Temporary fencing should be done for open edges if Hand – railings and Toe-guards are not available
- xxxiv. To record all incidents including near miss and report to BHEL and to ensure analysis & corrective actions for the same
- xxxv. Shall conduct weekly Safety Walks in the work area and record the findings.
- xxxvi. Construction of Canteen at Site, Office Infrastructure: Printer, PC, Fire Extinguishers etc.
- xxxvii. Shall analysis HSE Performance regularly in work area and take steps to improve the same
- xxxviii. Shall ensure stoppage of work in case of unacceptable Safety hazards

5.3 HSE OFFICER:

- i. Carry out safety inspection of Work Area, Work Method, Men, Machine & Material, P&M and other tools and tackles.
- ii. Facilitate inclusion of safety elements into Work Method Statement and creation of Job Safety Analysis (JSA)
- iii. (HSE Head) To prepare deployment plan of HSE personnel for all shifts, so as to ensure constant supervision of all areas. The plan to be submitted to BHEL
- iv. Highlight the requirements of safety through Tool-box / other meetings.
- v. Help concerned HOS to prepare Job Specific instructions/ JSA for critical jobs.
- vi. Conduct investigation of all incident/dangerous occurrences & recommend appropriate safety measures.
- vii. Advice & co-ordinate for implementation of HSE Systems & Procedures.
- viii. To stop work in case of any critical safety violation until the violation is cleared
- ix. Convene HSE meeting & minute the proceeding for circulation & follow-up action.

- x. Plan procurement of PPE & Safety devices and inspect their healthiness.
- xi. Report to BHEL on all matters pertaining to status of safety and promotional program at site level.
- xii. Facilitate administration of First Aid
- xiii. Facilitate screening of workmen and safety induction.
- xiv. Conduct fire Drill and facilitate emergency preparedness
- xv. Design campaigns, competitions & other special emphasis programs to promote safety in the workplace.
- xvi. Apprise BHEL on safety related problems.
- xvii. Notify site personnel non-conformance to safety norms observed during site visits / site inspections.
- xviii. Recommend to Site In charge, immediate discontinuance of work until rectification, of such situations warranting immediate action in view of imminent danger to life or property or environment.
- xix. To decline acceptance of such PPE / safety equipment that do not conform to specified requirements.
- xx. Encourage raising Near Miss Report on safety along with, improvement initiatives on safety.
- xxi. Shall work as interface between various agencies such customer, package-in-charges, subcontractors on HSE matters.

5.4 HSE SUPERVISOR:

- i. All requirements as per 5.1
- ii. To monitor allotted area for Safety violations, take required action and inform the concerned Safety Supervisor / Officer
- iii. To assist HSE Officer

5.5 PACKAGE IN-CHARGES, ENGINEERS & ALL EMPLOYEES:

- i. To be aware of, get involved in and ensure implementation of all HSE related Systems and Procedures including but not limited to:
 - a. BHEL HSE Management System including HSE Procedures and OCPs, HIRA, JSA etc.
 - b. Work Permit System
 - c. Emergency Preparedness Response Plans
 - d. Contractual HSE requirements
 - e. Legal Requirements
 - f. Penalty System
 - g. Training requirements
- ii. To ensure that the persons engaged in respective area follow the safety rules like using appropriate PPEs.
- iii. To develop Method Statements and ensure availability of Job Safety Analysis for all activities in scope
- iv. To ensure that the reported HSE non-conformities in the work area are resolved immediately before resuming work
- v. To record all incidents including near miss and report to BHEL.

- vi. To adopt safe working practices at all times and act as role model for Safety
- vii. To take immediate corrective action actions in case any non-conformity is observed on product / process / system with respect to Occupational Health, Safety and Environment.
- viii. In case any particular activity / work has extremely high consequential risk or high environmental impact, same shall be brought to the notice of BHEL Package In-charge before starting the work.
- ix. To interfere/ stop work as & when identified unsafe.
- x. To maintain & promote improved level of house-keeping all the time at site.
- xi. To support/co-operate with audit team members as & when safety audits are carried out.
- xii. To involve in investigation, if any incident occurs in his work area.
- xiii. To participate in safety promotional programs
- xiv. To attend the safety committee meeting, if member/invitee
- xv. To ensure that only fit T&Ps and qualified persons are engaged for all activities.
- xvi. Shall ensure that person working above 2.0 meter should use Safety Harness tied to a life line/stable structure.
- xvii. Shall ensure that materials are not thrown from height. Cautions to be exercised to prevent fall of material from height.
- xviii. Shall ensure that all T&Ps engaged are tested for fitness and have valid certificates from competent authorities.

6. HSE PLANNING BY SUBCONTRACTOR:

6.1 HAZARD ANALYSIS & RISK ASSESSMENT (HIRA), METHOD STATEMENT (MS) & JOB SAFETY ANALYSIS (JSA):

- i. Subcontractor shall identify all OHS Hazards and Risks applicable to all activities in scope and plan & implement the required control measures. HIRA Register shall be maintained.
- ii. Subcontractor shall develop Method Statements & Job Safety Analysis documents for all hazardous activities in scope and ensure the required control measures. Job Safety Analysis is to be attached along with any Work Permit request

6.2 REGISTER OF REGULATIONS:

Subcontractor shall prepare a register of applicable rules and regulations in the scope and plan to ensure compliance.

HIRA Register, Method Statements, Job Safety Analysis and Register of Regulations are dynamic documents and shall be revised (as applicable):

- i. At fixed frequency of 3 months
- ii. Addition/ deletion/ modification of a process/ activity
- iii. After an accident/ incident
- iv. After any change in applicable rules/ regulations/ laws.

6.3 MONTHLY HSE PLAN COVERING THE FOLLOWING AS A MINIMUM SHALL BE PREPARED AND SUBMITTED TO BHEL FOR APPROVAL:

- i. HSE Trainings covering all activities/ hazards/ workers
- ii. HSE Inspection Plan covering all areas/ activities/ equipment/ hazards
- iii. HSE Activities: Safety walks, Awards, housekeeping, reviews etc.

Note: Online/ App-based system shall be used for HSE Planning and Implementation/ Update whenever provided by BHEL otherwise Hard-copy based system shall continue

6.4 MONTHLY HSE PLANNING & REVIEW OF HSE ACTIVITIES ALONG WITH BHEL:

Monthly planning and review of HSE activities shall be carried out by subcontractor as per provided **format** jointly along with BHEL

7. MOBILIZATION OF MACHINERY/EQUIPMENT/TOOLS BY SUBCONTRACTOR:

- i. Subcontractor shall notify the engineer, of his intention to bring on to site any equipment or any container, with liquid or gaseous fuel or other substance which may create a hazard. The Engineer shall have the right to prescribe the condition under which such equipment or container may be handled and used during the performance of the works and the subcontractor shall strictly adhere to such instructions. The Engineer shall have the right to inspect any construction tool and to forbid its use, if in his opinion it is unsafe. No claim due to such prohibition will be entertained.
- ii. As a measure to ensure that machinery, equipment and tools being mobilized to the construction site are fit for purpose and are maintained in safe operating condition and complies with legislative and owner requirement, inspection shall be arranged by in-house competent authority for acceptance as applicable. Inspection by Third Party competent person shall be arranged:
 - a. Before first time use at site
 - b. After carrying out any modification
 - c. After repairs subsequent to involvement in any accident/ incident
- iii. As a further measure to ensure that machinery, equipment and tools being mobilized to the construction site are fit for purpose and are maintained in safe operating condition and comply with legislative and owner requirement, inspection as per provided format shall be arranged by in-house expert / competent authority (preferable) for acceptance. The equipment considered for this purpose shall include all those in the T&P list in the tender document.

8. MOBILIZATION OF MANPOWER BY SUBCONTRACTOR:

- i. As a measure to ensure that manpower being mobilized to the construction site is fit and competent for safe working, screening arrangement shall be made by the sub-subcontractor to ensure competency and fitness through following measures:
 - a) **Medical Checkup:** Examination of medical fitness shall be conducted through qualified medical professional for all workers to be deployed as per provided **format**. For height workers, vertigo (height phobia) test to be carried out as qualification criteria as per Annexure K and recorded in provided **format**.

- b) **Induction Training:** Induction training of all workers to be ensured as per **provided procedure and format**. Training evaluation to be carried out and training to be repeated if not passed
- c) Only on successfully meeting above criteria, permanent gate passes to be issued
- ii. The subcontractor shall arrange induction and regular health check of their employees as per schedule VII of BOCW rules by a registered medical practitioner.
- iii. The subcontractor shall take special care of the employees affected with occupational diseases under rule 230 and schedule II of BOCW Rules. The employees not meeting the fitness requirement should not be engaged for such job.
- iv. Ensure that the regulatory requirements of excessive weight limit (to carry/lift/ move weights beyond prescribed limits) for male and female workers are complied with.
- v. Appropriate accommodation to be arranged for all workmen in hygienic condition.
- vi. Cost of contractual, statutory and regulatory requirements like Training, medical checks, PPEs etc. shall not be transferred to the workers and such activities shall be considered as part of the job.

9. PROVISION OF PERSONAL PROTECTIVE EQUIPMENT (PPEs):

- i. Personnel Protective Equipment (PPEs), shall be provided by the subcontractor to all workers as per requirement of the job.
- ii. The choice of PPEs to ensure multiple (at least more than 1) means of protection against any hazard. All applicable safety precautions for a job shall be ensured notwithstanding the duration or perceived importance of the task.
- iii. The applicability of PPEs shall be as per the concept of Hierarchy of controls, i.e.:
- iv. Elimination->Substitution->EngineeringControls->AdministrativeControls-PPEs
- v. Relying solely on PPEs without ensuring necessary controls to be strictly avoided.
- vi. The following matrix recommends usage of minimum PPEs against the respective job.

Activity	Type of Protection						Remarks, if any
	Hand	Eye	Ear	Body	Respiratory	Others	
Gas Welding & Cutting	LG	WG	-	LA	*SCBA/ OLBA	-	* for confined space
Electric Arc Welding	LG	HMWS	-	LA	*SCBA/ OLBA	-	* for confined space
Rigging	CG	SG	-				--
Working at Height	-	SG	-	DLCBH	-	*FAS	* for vertical columns
Grinding & Chipping	CG	FS / SG	-	LA	-	-	--
Working in High Noise	-	-	EP / EM	-	-	-	--
Handling of Cement Concrete	RG	SG	-	-	DM	-	

Blasting	CG	SG	EP*	-	-	-	* at noise area
Excavation	CG	SG	-	-	DM	-	*Gum boot in place of Safety shoe for foot
Chemical Handling	PVCG	CSG	-	PVCA	-	-	*Full body rubber suit with hood
Electrical and C&I	ERG*	SG	-	-	-	-	*For high voltages
Sand/shot blasting	CG	-	EP/EM	CA	SAMH	-	

ABBREVIATIONS: FS: Face Shield, CSG: Chemical splash goggles, HMWS: Helmet mounted welder's shield, GB: gum boot, DLFBH: Double lanyard full body harness, SG: Safety goggles, DM: Dust mask, SAMH L Supplied air mask/hood, EP/EM: Ear plug/Ear Muff, CG: Cotton hand gloves, LG: Leather hand gloves, LA: Leather apron, RG: Rubber gloves, PVCG: PVC Gloves, PVCA: PVC Apron, SCBA: Self-contained breathing apparatus, WG: Welding goggles, ERG: Electrical Rubber Gloves. OLBA: Online breathing apparatus

The list is not exhaustive. Additional PPEs to ensure Safe Work may need to be deployed as per the requirement of the task at no additional cost.

- vii. The PPEs shall conform to the relevant standards as below (illustrative list) and bear ISI mark.

RELEVANT IS-CODES FOR PERSONAL PROTECTION

PPEs	IS Codes
Industrial Safety Helmets.	IS: 2925 – 1984
Rubber gloves for electrical purposes.	IS: 4770 – 1968
Industrial Safety Gloves (Leather & Cotton Gloves).	IS: 6994 – 1973 (Part-I)
Leather safety boots and shoes.	IS: 1989 – 1986 (Part-I-II)
Industrial and Safety rubber knee boots.	IS: 5557 – 1969
Code of practice for selections care and repair of Safety footwear.	IS: 6519 – 1971
Leather Safety footwear having direct molding sole.	IS: 11226 – 1985
Eye protectors.	IS: 5983 – 1978
Ear protectors.	IS: 9167 – 1979
Eye & Face protection during welding	IS: 1179-1967
Industrial Safety Belts and Harness	IS: 3521 – 1983
Guide for selection of industrial Safety equipment for body protection	IS: 8519 -1977
Respiratory Protective Devices	IS: 9473-2002, 14166-1994, 14746-1999

- viii. Where workers are employed in sewers and manholes, which are in use, the subcontractor shall ensure that the manhole covers are opened and ventilated at least for an hour before the workers are allowed to get into manhole, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent incident to the public

- ix. All the personnel and visitors shall mandatorily use safety helmet (with company logo), safety shoe and reflective vests, in addition to any other PPEs as deemed appropriate for the area of work/ visit.
- x. Following Color scheme for Helmets shall be followed:
 - a. Workmen: Yellow
 - b. Safety staff: Green or white with green band
 - c. Electrician: Red
 - d. Others including visitors: White
 - e. For height workers, special marking on helmets besides indication on Gate Pass/ ID Card
- xi. The subcontractor shall maintain register for issue and receipt of PPEs.
- xii. All the PPEs shall be checked for quality before issue and the same shall be periodically re-checked. The users shall be advised to check the PPEs themselves for any defect before putting on. The defective ones shall be replaced.
- xiii. The Helmets shall have logo or name (abbreviation of agency name permitted) affixed or printed on the front.
- xiv. The body harnesses shall be serial numbered.

10. ARRANGEMENT OF INFRASTRUCTURE:

10.1 DRINKING WATER:

- i. Drinking water shall be provided and maintained at suitable places at different elevations such that minimum quantity of 5 liters is available for each worker during the day.
- ii. Drinking water tank shall be so installed so as to be available within 200 meters of each working area
- iii. Container should be labeled as “Drinking Water” in languages understood by the workers
- iv. Cleaning of the container shall be ensured at least once in a week. Mild cleaning detergents as used for cleaning vessels shall be applied and scrubbers (3M or equivalent) shall be used for removing scales and deposits on the inside surface. The tank shall be thoroughly cleaned with potable water only before it is refilled (also applicable to labor colony).
- v. Suitability of water source for drinking to be tested as per IS10500 at least once in six months.

10.2 WASHING FACILITIES:

- i. In every workplace, adequate and suitable facilities for washing shall be provided and maintained.
- ii. Separate and adequate cleaning facilities shall be provided for the use of male and female workers. Such facilities shall be conveniently accessible and shall be kept in clean and hygienic condition and dully illuminated for night use.
- iii. Water suitable for washing and not for drinking shall be clearly indicated as “Not for Drinking” in language understood by workers.
- iv. Overalls shall be supplied by the subcontractor to the workmen and adequate facilities shall be provided to enable the painters and other workers to wash during the cessation of work.

10.3 LATRINES AND URINALS:

- i. Latrines and urinals shall be provided in every work place as indicated in Section A
- ii. Urinals shall also be provided at different elevations.
- iii. They shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times, by appointing designated person.
- iv. Separate facilities shall be provided for the use of male and female worker if any.

10.4 PROVISION OF REST SHEDS FOR WORKERS DURING REST PERIOD:

Proper Rest Shed (s) with shelter shall be provided for rest during break so as to accommodate all workers as indicated in Section A

10.5 MEDICAL FACILITIES:

10.5.1 GENERAL

- i. Provision of Medical Center, Ambulance etc. shall be as per Section A of this document
- ii. Medical waste shall be disposed as per prevailing legislation (Bio-Medical Waste – Management and Handling Rules, 1998)
- iii. Every injury shall be treated, recorded and reported.
- iv. All First Aid injuries shall be recorded as per provided Format
- v. List of qualified first aiders and their contact numbers to be displayed at conspicuous places.

10.5.2 FIRST AIDER/ FIRST AID BOX

- i. The first aider along with facilities should be available at a point nearest to the work location wherein majority of the workers are working.
- ii. The subcontractor shall provide necessary first aid facilities as per schedule III of BOCW. At every work place first aid facilities shall be provided and maintained.
- iii. The first aid box shall be kept by first aider who shall always be readily available during the working hours of the work place. His name and contact no to be displayed on the box.
- iv. The first aid boxes should be placed at various elevations so as to make them available within the reach and at the quickest possible time.
- v. The first aid box shall be distinctly marked with a Green Cross on white background.
- vi. Details of contents of first aid box is given in Annexure J
- vii. A slip of contents shall be pasted on the First Aid Box with following details
- viii. Monthly inspection of First Aid Box shall be carried out by the owner as per provided format
- ix. The subcontractor should conduct periodical first –aid classes to keep his supervisor and Engineers properly trained for attending to any emergency.

10.5.3 HEALTH CHECK UP

The persons engaged at the site shall undergo health check-up as per provided format before induction. In addition, the persons engaged in the following works shall undergo health check-up at least once in a year:

- i. Height workers
- ii. Drivers/crane operators/riggers
- iii. Confined space workers
- iv. Shot/sand blaster
- v. Welding and NDE personnel

10.5.4 HEIGHT PHOBIA/ VERTIGO TEST:

- i. The persons engaged in working at heights (above 2 meters) to be assessed for Vertigo and associated conditions and recorded as per provided format. Suggested Vertigo Test Procedure is given in Annexure K
- ii. Such workers are to be allowed only on successful completion of test, otherwise shall be allocated ground-based jobs.
- iii. IDs / Height passes shall be issued to such workers, besides special markings on helmets for easy identification.

10.5.5 PROVISION OF CANTEEN FACILITY:

- i. Canteen facilities shall be provided for the workmen of the project inside the project site where worker strength is 250 or more.
- ii. Proper cleaning and hygienic condition shall be maintained.
- iii. Proper care should be taken to prevent biological contamination.
- iv. Adequate drinking water should be available at canteen.
- v. Fire extinguisher shall be provided inside canteen.
- vi. Regular health check-up and medication to the canteen workers shall be ensured as per applicable regulations.
- vii. Canteen waste to be disposed of in hygienic manner

10.6 PROVISION OF ACCOMMODATION/LABOR COLONY FOR WORKFORCE:

- i. Proper accommodation for workforce to be provided in line with minimum requirements indicated in Section A
- ii. Labor colony shall be inspected each week by HSE Officer and report submitted to BHEL as per provided format

10.7 PEST CONTROL:

Regular pest control should be carried out at all offices, mainly laboratories, canteen, labor colony and stores.

10.8 SCRAPYARD:

- i. In consultation with customer, scrapyard shall be developed to store metal scrap, wooden scrap, waste, hazardous waste.
- ii. Scrap/Waste shall be segregated as Bio-degradable and non-bio-degradable and stored separately.

10.9 ILLUMINATION:

- i. The subcontractor shall arrange at his cost adequate lighting facilities e.g. flood lighting, hand lamps, area lighting etc. at various levels for safe and proper working operations at dark places and during night hours at the work spot as well as at the pre-assembly area.
- ii. Lamp (hand held) shall not be powered by mains supply but either by 24V or dry cells.
- iii. Lamps shall be protected by suitable guards where necessary to prevent danger, in case of breakage of lamp.
- iv. Emergency lighting provision for night work shall be made to minimize danger in case of main supply failure.
- v. Adequate and suitable light shall be provided at all work places & their approaches including passage ways as per IS: 3646 (Part-II).

SUITABLE ILLUMINATION LEVELS FOR VARIOUS AREAS SHALL BE DECIDED BASED ON BROAD GUIDELINES INDICATED BELOW:

S. No.	Location	Lux Level (lumens/sqm)
A. Construction Site		
1	Outdoor areas like store yards, entrance and exit roads	20
2	Platforms	50
3	Entrances, corridors and stairs	100
4	General illumination of work area	150
5	Rough work like fabrication, assembly of major items	150
6	Medium work like assembly of small machined parts	300
7	Fine work like precision assembly, precision measurements etc.	700
8	Sheet metal works	200
9	Electrical and instrument labs	450
B. Office		
1	Outdoor area like entrance and exit roads	20
2	Entrance halls	150
3	Corridors and lift cars	70
4	Lift landing	150
5	Stairs	100
6	Office rooms, conference rooms, library reading tables	300
7	Drawing table	450
8	Manual telephone exchange	200

- vi. Illuminations shall be inspected on weekly basis as per provided **format** using a calibrated lux meter.

11. HSE TRAINING & AWARENESS:

11.1 TRAINING PLAN:

- i. All training programs to be carried out in a planned manner. Monthly/ Annual Training Calendar to be submitted to BHEL for approval and shall cover HSE Training requirements of all activities, workers, hazards applicable to the area(s) of work.
- ii. Subcontractor shall nominate workers as per the schedule of specific training plan, failing which, penalty shall be imposed.
- iii. Training records of all workers along with attendance, signatures, faculty details etc. shall be maintained in soft/ hard copy as per provided **formats**.
- iv. Each labor should undergo at least 0.5% of total man-hours worked in HSE training.

11.2 HSE INDUCTION TRAINING

- i. All persons entering into project site shall be given HSE induction training by the HSE officer of BHEL /subcontractor before being assigned to work.
- ii. The induction training shall be imparted through audio-visual medium (Classroom specialized training), and shall be minimum of 1 Complete Day.
- iii. Evaluation to be carried out after training and training shall be repeated in case of failure.
- iv. Safety Induction Card shall be printed by Subcontractor and provided to all trained workers. A Safety induction book shall also be printed and issued to each worker after induction training (Format for the same may be provided by BHEL).
- v. Induction training subjects shall include but not limited to:
 - a. Briefing of the Project details.
 - b. Safety objectives and targets.
 - c. Site HSE rules.
 - d. Critical Safety Violations and consequences
 - e. Site HSE hazards and aspects.
 - f. First aid facility.
 - g. Emergency Contact No.
 - h. Incident & Near Miss reporting.
 - i. Fire prevention and emergency response.
 - j. Rules to be followed in the labor colony (if applicable)
 - k. Accident case studies
- vi. General:
 - a. Proper safety wear & gear must be issued to all the workers being registered for the induction (i.e., Shoes/Helmets/Goggles/Leg guard/Apron etc.)
 - b. They must arrive fully dressed in safety wear & gear to attend the induction.
 - c. Any one failing to conform to this safety wear& gear requirement shall not qualify to attend.

- d. On completing attending subcontractor's in-house HSE induction, each employee shall sign an induction training form to declare that he had understood the content and shall abide to follow and comply with safe work practices.
- e. They may only then be qualified to be issued with a personal I.D. card, for access to the work site subject to clearing the medical fitness test.

SAFETY INDUCTED	
Name :	
Date :	
Sign By Trainer :	

ABOVE STICKER SHALL BE PASTED ON HELMET OF WORKERS AFTER SAFETY INDUCTION TRAINING

11.3 JOB-SPECIFIC SKILL BASED HSE TRAINING

The contracting agency shall also impart job specific skill-based safety training to all its employees (Minimum one day) on various related safety topics using internal/external safety professionals/consultants as per the matrix given below. Record of such trainings and attendance particulars shall be maintained in a register for ready reference to statutory authorities/engineer-in charge as per provided format.

TRAINING MATRIX

Name of topic	Executives	Supervisors	Skilled Workmen	Other Workers
Safety Induction	Y	Y	Y	Y
Accident_ Causes, factors, cost	Y	Y	Y	-
Industrial hazards & Accident Prevention	Y	Y	Y	-
Investigating, reporting, records	Y	Y	-	-
Personal Protective Equipment	-	Y	Y	Y
Construction Safety & Role of Supervisory personnel	-	Y	-	-
Permit to Work (PTW)	-	Y	Y	y
Statutory Provisions (BOCW Act/Rules, Factories Act 1948 etc.)	Y	Y	y	y
Material handling	-	y	Y	Y
Emergency Management	Y	Y	Y	-
Electrical Safety	-	Y	Y	-
Fire safety	Y	Y	Y	Y
First Aid & CPR (cardio pulmonary resuscitation)	-	Y	Y	Y (Selected)
Safety in Welding & Cutting	-	-	Y	-
Safety Audit	Y	Y	-	-
Safety in Lifting Tools & Tackles	-	Y	Y	y

Safety in Working at height	-	Y	Y	Y
Safety in Confined space work	-	Y	Y	Y
Defensive Driving	-	Y*	Y*	Y*

*for construction vehicle operators, helpers & crane operators

Y=YES

Note:

- Subcontractor shall prepare a training plan/ matrix covering all hazards and implement the same after approval of BHEL.
- It is to be ensured that every worker undergoes Job-Specific training once every 3 months.
- Records of training programmes along with attendance shall be maintained by the subcontractor
- Each worker to be issued a Card indicating the types of trainings undergone.

11.4 HSE TOOL-BOX TALK:

- HSE tool Box talk shall be conducted by frontline foreman/supervisor of subcontractor to specific work groups prior to the start of work and shall be randomly attended by subcontractor engineers/ officials. The agenda shall consist of the following:
 - Details of the job being intended for immediate execution.
 - The relevant hazards and risks involved in executing the job and their control and mitigating measures.
 - Specific site condition to be considered while executing the job like high temperature, humidity, unfavorable weather etc.
 - Recent non-compliances observed.
 - Appreciation of good work done by any person.
 - Any doubt clearing session at the end.
- Tool box talk to be conducted before start of work in every shift.
- During toolbox talk, visual check-up of workers regarding health, any signs of fatigue, intoxication etc. shall be conducted and any suspected workers to be acted upon.
- Record of Tool box talk shall be maintained as per provided **format**

11.5 TRAINING ON HEIGHT WORK:

- Training on height work shall be imparted to all workers working at height by in-house/external faculty at least once every 3 months.
- For Height Workers Separate pass shall be provided by the subcontractor.
- The training shall be of minimum 2-hour duration, through audio-visual medium and followed by evaluation. In case of poor scoring, training shall be repeated.
- The training shall include following topics:
 - Proper use of PPEs – safety harness, lanyard, fall arrester, retractable fall arrester, life line, safety nets etc.
 - Provision of secondary means of fall protection

- c. Safe climbing through monkey ladders.
- d. Inspection of PPEs.
- e. Medical fitness requirements.
- f. Mock drill on rescue at height.
- g. Dos & Don'ts during height work.
- h. Accident case Studies

11.6 RE-INDUCTION TRAINING

The induction training shall be repeated for every worker after at least 1 year and shall be a pre-requisite for renewal of Gate Pass/ ID card.

11.7 PENALTY TRAINING

The personnel involved in Safety Violations/ Incidents shall mandatorily undertake penalty training pertaining to the violation/ incident. Penalty training shall be at least half-day duration.

11.8 HSE PROMOTION-SIGNAGE, POSTERS, COMPETITION, AWARDS ETC.:

- i. HSE Displays shall be installed as indicated in Section A
- ii. Contracting agencies shall arrange for display of safety hoardings depicting suitable safety cartoons/messages/ cautionary notices at appropriate places of project site to remind the workers to perform their duties safely.
- iii. Apart from safety hoardings, each agency should maintain a safety bulletin board at all their work locations. Such safety bulletin boards should depict the activities being planned for the day, good practices, permit details etc.
- iv. Safety suggestion boxes shall be kept at each subcontractor's office at site for obtaining safety suggestions from the workers. Best suggestions should be implemented and may be rewarded suitably to encourage the workers for safety.
- v. Safety awareness campaigns, competitions, plays, movie shows, songs etc. to be organized for workers at Site and Labor colony from time to time to enhance Safety Awareness

11.9 HSE REWARDS & INCENTIVE SCHEME

Subcontractor shall implement a reward & incentive scheme for workers & supervisors displaying adherence to safety principles. Such workers shall be felicitated in a monthly function, attended by Subcontractor top management and BHEL representatives. Suitable gift shall be given to such workers for encouragement.

11.10 HSE AWARENESS PROGRAM FOR OFFICIALS:

Subcontractor shall arrange monthly HSE awareness program on different topics including medical awareness for all engineers/ supervisors / officials working at site. This program can be part of progress/ safety review meetings.

12. HSE COMMUNICATION AND PARTICIPATION:

12.1 HSE INCIDENT REPORTING, INVESTIGATION & CORRECTIVE ACTION:

- i. All incidents (near misses, property damage, first-aid cases, minor, major and fatal incidents) shall be reported to BHEL as they happen immediately through SMS and Hard/Soft copy as per provided format
- ii. All incidents including near miss, minor, major and fatal incidents shall be recorded
- iii. All incidents shall be investigated for Root Causes and corrective actions ensured to prevent recurrence shall be implemented.
- iv. Work shall be put on hold in the area till corrective actions are verified by BHEL
- v. The Root Cause Analyses and Corrective actions taken shall be recorded

12.2 HSE EVENT REPORTING:

- i. Important HSE events like HSE training, Medical camp etc. organized at site shall be reported to BHEL site management in detail with photographs for publication in different in-house magazines
- ii. Celebration of important days like National Safety Day, World Environment Day etc. shall also be reported as mentioned above.

12.3 MONTHLY HSE REPORTING:

- i. All routine and non-routine HSE activities shall be reported to BHEL on monthly basis by the subcontractor as per provided format. The reporting medium can be hard/soft as per BHEL requirement.
- ii. The period of reporting shall be 25th of the preceding month to 24th of the present month and shall be submitted by the end of the calendar month.
- iii. Report shall include good quality images of HSE Activities

12.4 DAILY HSE ACTIVITY REPORTING:

Daily HSE activities shall be reported by subcontractor to BHEL as per provided format

12.5 HSE SUGGESTIONS:

All workers and employees shall be encouraged to provide suggestions for improvement in Health, Safety & Environment performance at site. The suggestions shall be recorded in a "Suggestions Register" as per provided format. Suggestions found suitable for implementation shall be implemented and recognition / reward to be given to the submitter.

Suggestion Register to be placed at Site and Labor Colony and shall be reviewed on periodic basis

12.6 CLIENT COMMUNICATION:

All HSE related communication from BHEL, customer / external statutory and regulatory agencies to be handled on priority. Same to be recorded and issues to be resolved in expeditious manner

13. SAFETY DURING WORK EXECUTION:

Safety during work execution shall be ensured by following appropriate Safety Rules, providing adequate resources, deploying competent and trained manpower, regular training & inspection and non-conformity resolution. Main aspects are indicated as under:

13.1 OPERATIONAL CONTROL PROCEDURES:

In order to reduce the risk associated with hazardous activities, applicable OCPs (Operational control procedures) will be followed by subcontractor as per BHEL instructions, outcomes of Hazard Analysis & other requirements. This will be done as part of normal scope of work. Illustrative list of reference OCPs is given below.

TABLE 13.1 ILLUSTRATIVE LIST OF REFERENCE OCPs

No.	Topic	No.	Topic	No.	Topic
0	General Safety	22	Steam blowing	44	Material preservation
1	Handling of chemicals	23	Working in confined area	45	Electro-resistance heating
2	Electrical safety	24	Operation of passenger lift, material hoists & cages	46	Blasting
3	Energy conservation	25	Vehicle/ Crane maintenance	47	Transformer charging
4	Welding and gas cutting operation	26	Radiography	48	Handling of battery system
5	Fire safety	27	Waste disposal	49	DG set
6	Use of hand tools	28	Handling & storage of mineral wool	50	Sanitary maintenance
7	First aid	29	Working at night	51	Piling rig operation
8	Food safety at canteen	30	Computer operation	52	Passivation
9	Use of cranes	31	Storage in open yard	53	EDTA Cleaning
10	Storage and handling of gas cylinders	32	Drilling, reaming and grinding(machining)	54	Chemical cleaning of Pre boiler system
11	Manual arc welding	33	Stress relieving	55	Boiler Light up
12	Use of helmets	34	Hydraulic test	56	Rolling and Synchronization
13	Good house keeping	35	Trial run of rotary equipment	57	Loading of Unit

14	Safe excavation	36	Batching	58	Air compressor
15	Working at height	37	Cable laying/tray work	59	Hydra Operation
16	Filling of hydrogen in cylinder	38	Spray insulation	60	Duct Pre-assembly
17	Illumination	39	Compressor operation	61	Resumption of construction activities after lockdown and prevention of coronavirus infection during site operations
18	Handling and erection of heavy metals	40	Gas distribution test		
19	Acid cleaning	41	Cleaning of Hot well / Deaerator		
20	Oil flushing	42	Electrical maintenance	61A	Prevention of Covid-19 infection in labour colony
21	Alkali boil out	43	O&M of control of AC plant & system	62	Truss/ Structure fit-up and alignment

- The reference OCPs shall be suitably modified by subcontractor as per specific requirements to control the hazards.
- In case any other OCP is found to be applicable during the execution of work at site, then subcontractor will prepare and follow those as well.

13.2 WORK PERMIT SYSTEM:

- The following activities shall be carried out by the subcontractor strictly after obtaining Permit to Work from BHEL
 - Height working
 - Hot working
 - Confined space Work
 - Excavation more than 2-meter depth
 - Radiography
 - Heavy / Complex / Critical Lifting Activity
 - Night / Holiday Work
 - Material Loading / Unloading
 - Grating, Safety Net, Safety Facility Removal
 - Live Electrical Maintenance etc. - Lockout / Tagout
 - Beam / truss/ duct/ structure alignment
- The Work Permit Formats shall be provided by BHEL at Site. It is the responsibility of the subcontractor to ensure their availability
- The above list is not exhaustive. BHEL reserves right to introduce additional Permits or modify requirements for usage of existing Permits. The conditions for using the Permit are specified in the Format (General Requirements).
- Where customer is having separate Work Permit System the same shall be followed in conjunction / merged to ensure all activities and checks are covered in all systems.
- Details of working Group to be attached along with work permit request.

- vi. All the Permits along with JSA/HIRA must be initiated by Agency Execution Team
- vii. Permit applicant shall apply for work permit of particular work activity at particular location before starting of the work with Job Hazard Analysis.
- viii. All Permit signatories (including subcontractor's package in-charge and HSE Officer) shall physically visit the work area and check that all the safety control measures necessary for the activity are in place. Only then the permit shall be issued.
- ix. Signatory shall physically visit the area of work and ensure all required safeguards before signing the Permit
- x. Signatory shall periodically visit the area to confirm the availability of required safeguards throughout the currency of the permit
- xi. In case any Permit requirement is not available, work will be stopped till it is made available
- xii. Permit holder shall implement and maintain all control measures during the period of permit. The permit will be closed after completion of the work.
- xiii. Online Work Permit System shall be used whenever provided by BHEL, otherwise hard copy shall be used

13.3 ACTIVITY-SPECIFIC PRECAUTIONS/ CONTROLS

Detailed HSE precautions for various activities undertaken at Site by the subcontractors are specified in **Annexure I**. Same are to be ensured by the Sub-subcontractor while carrying out respective activities at Site

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3.1	Excavation	8
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14. ENVIRONMENTAL CONTROL & SOCIAL RESPONSIBILITY

- i. Environment protection has always been given prime importance by BHEL. Environmental damage is a major concern of the principal subcontractor and every effort shall be made, to have effective control measures in place to avoid pollution of Air, Water and Land and associated life. Banned substances like asbestos and Chlorofluorocarbons such as carbon tetrachloride and trichloroethylene shall not be used. Waste disposal shall be done in accordance with the guidelines laid down in the project specification.
- ii. Any chemical including solvents and paints, required for construction shall be stored in designated bonded areas around the site as per Material Safety Data Sheet (MSDS).
- iii. In the event of any spillage, the principle is to recover as much material as possible before it enters drainage system and to take all possible action to prevent spilled materials from running off the site. The subcontractor shall use appropriate MSDS for clean-up technique
- iv. All subcontractors shall be responsible for the cleanliness of their own areas
- v. Regular dust suppression using sprinklers shall be carried out in respective area
- vi. The subcontractors shall ensure that noise levels generated by plant or machinery are as low as reasonably practicable. Where the subcontractor anticipates the generation of excessive noise levels from his operations the subcontractor shall inform to Construction Manager of BHEL accordingly so that reasonable & practicable precautions can be taken to protect other persons who may be affected.
- vii. It is imperative on the part of the subcontractor to join and effectively contribute in joint measures such as tree plantation, environment protection, contributing towards social upliftment, conversion of packing woods to school furniture, enhancing good relation with local populace etc.
- viii. The subcontractor shall carry out periodic air and water quality check and illumination level checking in his area of work place and take suitable control measure.

15. HOUSEKEEPING

- i. Keeping the work area and access roads clean/ free from debris, removed scaffoldings, scraps, insulation/sheeting wastage /cut pieces, temporary structures, packing woods etc. will be in the scope of the subcontractor. Such cleanings have to be done by subcontractor within quoted rate, on daily basis.
- ii. If such activity is not carried out by subcontractor / BHEL is not satisfied, then BHEL may get it done by other agency and actual cost along with BHEL overheads will be deducted from subcontractor's bill. Such decisions of BHEL shall be binding on the subcontractor
- iii. Dedicated Housekeeping gangs shall be deployed, who shall be provided all required PPEs and safety training
- iv. Mass housekeeping shall be carried out for half a day in a week
- v. Proper housekeeping to be maintained at work place and the following are to be taken care of on daily basis.
- vi. All surplus earth and debris are removed/disposed off from the working areas to identified locations.
- vii. Unused/Surplus cables, steel items and steel scrap lying scattered at different places/elevation within the working areas are removed to identified locations.
- viii. All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from workplace to identified locations.
- ix. Sufficient waste bins shall be provided at different work places for easy collection of scrap/waste. Scrap chute shall be installed to remove scrap from high locations.
- x. Access and egress (stair case, gangways, ladders etc.) path should be free from all scrap and other hindrances.
- xi. Workmen shall be educated through tool box talk about the importance of housekeeping and encourage not to litter.
- xii. Labor camp area shall be kept clear and materials like pipes, steel, sand, concrete, chips and bricks, etc. shall not be allowed in the camp to obstruct free movement of men and machineries.
- xiii. Fabricated steel structures, pipes & piping materials shall be stacked properly.
- xiv. No parking of trucks/trolleys, cranes and trailers etc. shall be allowed in the camp, which may obstruct the traffic movement as well as below LT/HT power line.
- xv. Utmost care shall be taken to ensure over all cleanliness and proper upkeep of the working areas.

16. WASTE MANAGEMENT

- i. Take suitable measures for waste management and environment related laws/legislation as a part of normal construction activities. Compliance with the legal requirements on storage/ disposal of paint drums (including the empty ones), Lubricant containers, Chemical Containers, and transportation and storage of hazardous chemicals will be strictly maintained.
- ii. Details of E-Waste, Hazardous Waste, biomedical waste etc. and their disposal plan, shall be submitted to BHEL every 6 months as per provided **formats**.

16.1 BINS AT WORK PLACE

- i. Sufficient rubbish bins shall be provided close to workplaces.
- ii. Bins should be painted yellow and numbered.
- iii. Sufficient nos. of drip trays shall be provided to collect oil and grease.
- iv. Sufficient qty. of broomsticks with handle shall be provided.
- v. Adequate strength of employees should be deployed to ensure daily monitoring and service for waste management.

16.2 STORAGE AND COLLECTION

- i. Different types of rubbish/waste should be collected and stored separately.
- ii. Paper, oily rags, smoking material, flammable, metal pieces should be collected in separate bins with close fitting lids.
- iii. Rubbish should not be left or allowed to accumulate on construction and other work places.
- iv. Do not burn construction rubbish near working site.

16.3 SEGREGATION

- i. Earmark the scrap area for different types of waste.
- ii. Store wastes away from building.
- iii. Oil spill absorbed by non-combustible absorbent should be kept in separate bin.
- iv. Clinical and first aid waste stored and incinerated separately.

16.4 DISPOSAL

- i. Sufficient containers and scrap disposal area should be allocated.
- ii. All scrap bin and containers should be conveniently located.
- iii. Provide self-closing containers for flammable/spontaneously combustible material.
- iv. Keep drainage channels free from choking.
- v. Make schedule for collection and disposal of waste.

16.5 WARNING AND SIGNS

- i. Appropriate sign to be displayed at scrap storage area
- ii. No toxic, corrosive or flammable substance to be discarded into public sewage system.
- iii. Waste disposal shall be in accordance with best practice.
- iv. Comply with all the requirements of Pollution Control Board (PCB) for storage and disposal of hazardous waste.

17. TRAFFIC MANAGEMENT SYSTEM

17.1 SAFE WORKPLACE TRANSPORT SYSTEM

- i. Traffic routes in a work place shall be suitable for the persons or vehicles using them. This shall be sufficient in number and of sufficient size. This shall reflect the suitability of traffic routes for vehicles and pedestrians.

- ii. Where vehicles and pedestrians use the same traffic routes there shall be sufficient space between them. Where necessary all traffic routes must be suitably indicated. Pedestrians or vehicles must be able to use traffic routes without endangering those at work. There must be sufficient separation of traffic routes from doors, gates and pedestrian traffic routes.
- iii. For internal traffic, lines marked on roads / access routes and between buildings shall clearly indicate where vehicles are to pass.
- iv. Temporary obstacles shall be brought to the attention of drivers by warning signs or hazard cones.
- v. Speed limits shall be clearly displayed for each kind of vehicle.
- vi. Speed ramps preceded by a warning signs or marker are necessary.
- vii. The traffic route should be wide enough to allow vehicles to pass and re-pass oncoming or parked traffic and it may be advisable to introduce on-way system or parking restrictions.
- viii. Safest route shall be provided between places where vehicles have to call or deliver.
- ix. Avoid vulnerable areas/items such as fuel or chemicals tanks or pipes, open or unprotected edges and structures likely to collapse
- x. Safe areas shall be provided for loading and unloading.
- xi. Avoid sharp or blind bends. If this is not possible hazards should be indicated e.g. blind corner.
- xii. Ensure road crossings are minimum and clearly signed.
- xiii. Entrance and gateways shall be wide enough to accommodate a second vehicle without causing obstruction.
- xiv. Set sensible speed limits which are clearly sign posted.
- xv. Where necessary ramps should be used to retard speed. This shall be preceded by a warning sign or mark on the road.
- xvi. Forklift trucks shall not pass over road hump unless of a type capable of doing so.
- xvii. Overhead electric cable, pipes containing flammable hazardous chemical shall be shielded by using goal posts height gauge posts or barriers.
- xviii. Road traffic signs shall be provided on prominent locations for prevention of incidents and hazards and for quick guidance and warning to employees and public. Safety signs shall be displayed as per the project working requirement and guideline of the state in which project is done. Vehicles hired or used shall not be parked within the 15m radius of any working area. Any vehicle, that is required to be at the immediate/near the vicinity, shall be approved by the person in-charge of the site.

17.2 TRAFFIC ROUTE FOR PEDESTRIANS

- i. Where traffic routes are used by both pedestrians and vehicles road shall be wide enough to allow vehicles and pedestrians safely.
- ii. Separate routes shall be provided for pedestrians to keep them away from vehicles. Provide suitable barriers/guard at entrances/exit and the corners or buildings.
- iii. Where pedestrian and vehicle routes cross, appropriate crossing shall be provided.

- iv. Where crowd is likely to use roadway e.g. at the end of shift, stop vehicles from using them at such times.
- v. Provide high visibility clothing for people permitted in delivery area.

17.3 WORK VEHICLE

Work vehicle shall be as safe stable efficient and roadworthy as private vehicles on public roads. Site management shall ensure that drivers are suitably trained. All vehicle e.g. heavy motor vehicle forklift trucks dump trucks mobile cranes shall ensure that the work equipment conforms to the following:

- i. A high level of stability.
- ii. A safe means of access/egress.
- iii. Suitable and effective service and parking brakes.
- iv. Windscreens with wipers and external mirrors giving optimum all round visibility.
- v. Provision of horn, vehicle lights, reflectors, reversing lights, reversing alarms.
- vi. Provision of seat belts.
- vii. Guards on dangerous parts.
- viii. Driver protection - to prevent injury from overturning and from falling objects/materials.
- ix. Driver protection from adverse weather.
- x. No vehicle shall be parked below HT/LT power lines.
- xi. Valid Pollution Under Control certification for all vehicles
- xii. Wheel stopper shall be use during the parking of vehicle
- xiii. Helper to be deployed in each vehicle as per site requirement.

17.4 DAILY CHECK BY DRIVER

1. There should also be daily safety checks containing below mentioned points by the driver before the vehicle is used.

Brakes	Mirrors	Warning signals
Tires	Windscreen waters	Specific safety systems i.e. controls & interlocks
Steering	Wipers	

2. Management should ensure that drivers carry out these checks.

17.5 TRANSPORTATION OF PERSONNEL AND MATERIALS BY VEHICLES

- i. All drivers shall hold a valid driving License for the class of vehicle to be driven and be registered as an authorized BHEL driver with the Administration Department.
- ii. Securing of the load shall be by established and approved methods, i.e. chains with patented tightening equipment for steel/heavy loads. Sharp corners on loads shall be avoided when employing ropes for securing.
- iii. All overhangs shall be made clearly visible and restricted to acceptable limits
- iv. Load shall be checked before moving off and after traveling a suitable distance.
- v. On no account is construction site to be blocked by parked vehicles Drivers of vehicles shall only stop or park in the areas designate by the stringing foreman.

- vi. Warning signs shall be displayed during transportation of material.
- vii. All vehicles used by BHEL shall be in worthy condition and in conformance to the Land Transport requirement.
- viii. Wheel stopper shall be use during the parking of vehicle
- ix. Helper to be deployed in each vehicle as per site requirement.

17.6 MAINTENANCE

All Vehicles used for transportation of man and material shall undergo scheduled inspections on frequent intervals to secure safe operation. Such inspections shall be conducted in particular for steering, brakes, lights, horn, doors etc. Site management shall ensure that work equipment is maintained in an efficient, working order and in good repair. Inspections and services carried out at regular intervals of time and or mileage. No maintenance shall be carried below HT/LT power lines.


18. EMERGENCY PREPAREDNESS AND RESPONSE

- i. Emergency preparedness and response capability of site shall be developed as per Emergency Preparedness and Response plan issued by BHEL
- ii. Availability of adequate number of first aiders and fire warden shall be ensured with BHEL and its subcontractors
- iii. All the subcontractor's supervisory personnel and sufficient number of workers shall be trained for fire protection systems. Enough number of such trained personnel must be available during the tenure of contract. Subcontractor should nominate his supervisor to coordinate and implement the safety measures.
- iv. Assembly point shall be earmarked and access to the same from different location shall be shown
- v. Fire exit shall be identified and pathway shall be clear for emergency escape.
- vi. Appropriate type and number of fire extinguisher shall be deployed as per Fire extinguisher deployment plan and validity shall be ensured periodically through inspection
- vii. Adequate number of first aid boxes shall be strategically placed at different work places to cater emergency need. Holder of the first aid box shall be identified on the box itself who will have the responsibility to maintain the same.
- viii. First aid center shall be developed at site with trained medical personnel and ambulance
- ix. Emergency contact numbers (format given in EPRP) of the site shall be displayed at prominent locations.
- x. Tie up with fire brigade shall be done in case customer is not having fire station.
- xi. Tie up with hospital shall be done in case customer is not having hospital.
- xii. Disaster Management group shall be formed at site
- xiii. Mock drill shall be arranged at regular intervals. Monthly report of the above to be given to BHEL HSE Officer as per prescribed BHEL formats
- xiv. Mock drill shall be conducted on different emergencies periodically to find out gaps in emergency preparedness and taking necessary corrective action

19. HSE INSPECTION

Inspection on HSE for different activities being carried out at site shall be done to ensure compliance to HSE requirements. The subcontractor shall maintain and ensure necessary safety measures as required for inspection and tests HV test, Pneumatic test, Hydraulic test, Spring test, Bend test as applicable, to enable inspection agency for performing Inspection. If any test equipment is found not complying with proper safety requirements then the Inspection Agency may withhold inspection, till such time the desired safety requirements are met.

Online/ App-based HSE Inspection system shall be used for inspection whenever provided by BHEL otherwise Hard-copy based system shall continue

 <input type="checkbox"/> OK	<input type="checkbox"/> NOT OK
Contractor Name:	
Equipment Identification No :	
Inspection Date :	
Next Inspection Date :	
Inspected By :	

Every Inspected Equipment shall display above sticker

19.1 INSPECTION PLAN

Subcontractor shall prepare an inspection plan covering all areas/ activities/ equipment/ hazards and implement the same after getting approval of BHEL. Responsibility to ensure coverage of all areas/ activities rests with the subcontractor.

All Inspections shall be witnessed by BHEL – only then they shall be considered as valid

19.2 INSPECTION REPORTS

Monthly inspection reports as per plan shall be submitted to BHEL HSE Head

19.3 NON-CONFORMANCES

Any non-conformances identified during inspection observed shall be addressed on priority.

The responsibility of resolution shall rest with the Subcontractor Site In-charge

In case immediate closure of non-conformities is not possible:

- work to be halted in the area
- non-conformance to be generated and submitted to responsible person and BHEL
- non-conformance to be resolved through responsible agency / person

Only after closure of non-conformances, work to be allowed to resume

19.4 DAILY HSE CHECKS

Both the Site Supervisors and HSE Officer of Subcontractor are to conduct daily site Safety inspection around work activities and premises to ensure that work methods and the sites

are maintained to an acceptable standard. The following are to form the common subjects of a daily safety inspection:

- i. Personal Safety wears & gear compliance.
- ii. Complying with site safety rules and permit-to-work (PTW).
- iii. Positions and postures of workers.
- iv. Use of tools and equipment etc. by the workers.

The inspection should be carried out just when work starts in beginning of the day, during peak activities period of the day and just before the day's work ends.

19.5 INDICATIVE LIST OF INSPECTIONS AND PERIODICITIES

Indicative list & periodicity of Inspections is given as under. It is the responsibility of the subcontractor to develop an inspection plan covering all areas & activities in the scope.

SL. No.	Format Name	Frequency of check (if applicable)
01	Inspection of First Aid Box	Weekly
02	Inspection of PPE	Weekly
03	Inspection of T&Ps	Monthly
04	Inspection of Cranes	Monthly
05	Inspection of Winches	Monthly
06	Inspection on Height Working	Weekly
07	Inspection on Welding & Gas Cutting	Monthly
08	Inspection on Electrical Installation	Monthly
09	Inspection on Elevator	Weekly
10	Inspection of Excavation	Weekly
11	Inspection of Labor Colony	Monthly
12	Inspection of Illumination Levels	Weekly

The checklists shall be provided by BHEL at Site. It is the responsibility of the subcontractor to ensure their availability before start of work

19.5.1 INSPECTION OF PPE

- i. PPEs shall be inspected by HSE officer at random once in a week as per provided **format** for its compliance to standard and compliance to use and any adverse observation shall be recorded in the PPE register.
- ii. The applicable PPEs for carrying out particular activities are listed below.

19.5.2 INSPECTION OF TOOLS & PLANTS (T&Ps)

- i. A master list of T&Ps shall be maintained by each subcontractor in provided **format**.
- ii. All T&Ps being used at site shall be inspected by HSE officer once in a month as per provided **format** for its healthiness and maintenance.
- iii. The T&Ps which require third party inspection shall be checked for its validity during inspection. The third-party test certificate should be accompanied with a copy of the concerned competent person's valid qualification record.

- iv. BHEL shall be given advance intimation of Third-Party Inspection. BHEL shall associate with Inspection as per discretion.
- v. The validity of T&P shall be monitored as per provided **format**

19.5.3 INSPECTION OF CRANES AND WINCHES

- i. Cranes and winches shall be inspected by the operator through a daily checklist for its safe condition (as provided by the equipment manufacturer) before first use of the day.
- ii. Cranes and Winches shall be inspected by HSE officer once in a month as per provided **format** for healthiness, maintenance and validity of third-party inspection.
- iii. The date of third-party inspection and next due date shall be painted on cranes and winches.
- iv. The operators/drivers shall be authorized by sub-subcontractor based on their competency and experience and shall carry the I-card.
- v. The operator should be above 18 years of age and should be in possession of driving license of HMV man & goods), vision test certificate and should have minimum qualification so that he can read the instructions and check list.

19.5.4 INSPECTION OF HEIGHT WORKING

- i. Any activity carried out at more than 2 m height is classified as height work.
- ii. Inspection of height working shall be conducted daily by Supervisors before start of work to ensure safe working condition including provision of
 - a. Fall arrestor
 - b. Lifelines – connected to rigid & independent structure
 - c. Safety nets deployed below all height work activities
 - d. Fencing and barricading
 - e. Warning signage
 - f. Covering of opening
 - g. Proper scaffolding with access and egress.
 - h. Illumination
- iii. For full duration of height work, constant supervision to be maintained by dedicated HSE personnel
- iv. Inspection on height working shall be conducted once in a week by HSE officer as per provided **format**.
- v. Medical fitness of height worker shall be ensured.
- vi. Height working shall not be allowed during adverse weather.

19.5.5 INSPECTION OF WELDING AND GAS CUTTING OPERATION

- i. Supervisor shall ensure that no flammable items are available in near vicinity during welding and gas cutting activity.
- ii. Gas cylinders shall be kept upright.
- iii. Use of Flash back arrestor shall be ensured at both ends.

- iv. Inspection during welding and gas cutting operations shall be carried out by HSE officer once a month as per provided **format**.
- v. Use of fire blanket to be ensured to avoid falling of splatters during welding or gas cutting operation at height.
- vi. Availability of fire extinguisher at vicinity shall be ensured.

19.5.6 INSPECTION OF ELECTRICAL INSTALLATION / APPLIANCES

- i. Ensure proper earthing in electrical installation
- ii. Use ELCB at electrical booth
- iii. Electrical installation shall be properly covered at top where required
- iv. Use appropriate PPEs while working
- v. Use portable electrical light < 24 V in confined space and potentially wet area.
- vi. Inspection shall be carried out as per provided **format**.

19.5.7 INSPECTION OF ELEVATOR

- i. Elevators shall be inspected by concerned supervisors once in a week as per provided **format**
- ii. All elevators shall be inspected by competent person and validity shall be ensured.
- iii. The date of third-party inspection and next due date shall be painted on elevator.

19.5.8 INSPECTION OF EXCAVATION

Excavation activities shall be inspected as per provided **format**

19.5.9 INTERNAL/ EXTERNAL HSE AUDITS/INSPECTIONS

- i. All non-conformities and observations on HSE identified during internal or external HSE audit shall be disposed of by site in a time bound manner and reported back the implementation status.
- ii. Corrective action and Preventive action on HSE issues raised by certification body issued by BHEL shall be implemented by site and reported to Site management.

20. TERMS AND DEFINITIONS:

1. Incident

Work- related or natural event(s) in which an injury, or ill health (regardless of severity), damage to property or fatality occurred, or could have occurred.

2. Near Miss:

An incident where no ill health, injury, damage or other loss occurs, but it had a potential to cause, is referred to as "Near-Miss".

3. Man-Hours Worked:

The total number of man hours worked by all employees including subcontractors working in the premises. It includes managerial, supervisory, professional, technical, clerical and other workers including contract labors. Man-hours worked shall be calculated from the payroll or time clock recorded including overtime. When this is not feasible, the same shall be estimated by multiplying the total man-days worked for the

period covered by the number of hours worked per day. The total number of workdays for a period is the sum of the number of men at work on each day of period. If the daily hours vary from department to department separate estimate shall be made for each department and the result added together.

4. First Aid Cases:

First aids are not essentially all reportable cases, where the injured person is given medical treatment and discharged immediately for reporting on duty, without counting any lost time.

5. Lost Time Injury:

Any work injury which renders the injured person unable to perform his regular job or an alternative restricted work assignment on the next scheduled work day after the day on which the injury occurred.

6. Medical Cases:

Medical cases come under non-reportable cases, where owing to illness or other reason the employee was absent from work and seeks Medical treatment.

7. Type of Incidents & Their Reporting:

The three categories of Incident are as follows:

8. Non-Reportable Cases:

An incident, where the injured person is given medical help and discharged for work without counting any lost time.

9. Reportable Cases:

In this case the injured person is disable for 48 hours or more and is not able to perform his duty.

10. Injury Cases:

These are covered under the heading of non-reportable cases. In these cases, the incident caused injury to the person, but he still continues his duty.

11. Total Reportable Frequency Rate

Frequency rate is the number of Reportable Lost Time Injury (LTI) per one Million Man hours worked. Mathematically, the formula read as:

$$\text{Number of Reportable LTI} \times 1,000,000 / \text{Total Man Hours Worked}$$

12. Severity Rate:

Severity rate is the Number of days lost due to Lost Time Injury (LTI) per one Million Man hours worked. Mathematically, the formula reads as:

$$\text{Days lost due to LTI} \times 1,000,000 / \text{Total Man Hours Worked}$$

13. Incidence Rate:

Incidence Rate is the Number of LTI per one thousand manpower deployed. Mathematically, the formula reads as:

$$\text{Number of LTI} \times 1000 / \text{Average number of manpower deployed}$$

14. HIRA:

Hazard Identification and Risk Assessment (HIRA) is a process of identifying Hazards in work area and then assessing them properly

15. Method Statement:

A method statement is prepared by the Execution/ Engineering Department detailing the steps, equipment, competencies and safety precautions required for carrying out any activity

16. Job Safety Analysis:

A job safety analysis (JSA) is a procedure which helps integrate accepted safety and health principles and practices into a particular task or job operation. In a JSA, each basic step of the job is to identify potential hazards and to recommend the safest way to do the job. Other terms used to describe this procedure are job hazard analysis (JHA) and job hazard breakdown.

17. Safety Walk:

It's conducted periodically by an official - it's a walk through a portion or whole of a site as a HSE officer who notes down HSE observations, speak to concerned workmen and supervisor on observation, get the same corrected with personal follow up- this sends out a strong message on Management's commitment to safety.

18. Heavy & Complex Lifting:

A heavy and complex lifting activity includes:

1. Lifting above 20 Tons
2. Tandem Lifting using multiple cranes
Total load exceeding 75% of capacity of crane. Depending up the condition of cranes, hydra cranes, winch machines & other lifting accessories
3. Lift of unusual difficulty or geometry or rigging
4. Lift over operating units
5. Any other lift as decided by site HSE / Erection

19. Safety Committee:

As per the BOCW, Safety Committee shall be constituted if there are more than five hundred or more construction workers are employed at any site. As per the Factories Act, 1948 it is for 250 workers. It shall be represented by equal number of representatives of employer and construction workers.

20. Night Work:

Work conducted after sunset when only a fraction of total manpower is available





ANNEXURES



ANNEXURE A

Medical Centre & Ambulance

A. Medical Centre

1. Paramedical staff
 - a. When < 500 workers, 1 Trained Male Nurse (round the clock deployment)
 - b. When >=500 workers*:
 - i. Registered Medical Practitioner (Qualified MBBS) to be deployed for at least 8 hours in a day, 5 days per week
 - ii. 2 Trained Male Nurses (round the clock deployment)
 2. All articles as per Schedule IV of BOCW Central Rules, 1998 to be made available in the Medical Centre (given under for convenience)
 3. Basic Facilities/ Requirements to be provided as per location eg. Refrigerator, Air Conditioner, Anti Venom Serums etc.
 4. Tie-ups with speciality hospitals to be ensured for referring serious patients
- * In case the number of workers is envisaged to exceed 500, a medical practitioner is to be engaged.

SCHEDULE IV (BOCW CENTRAL RULES, 1998) ARTICLES FOR AMBULANCE ROOM [SEE RULE 226 (C)]

- i. A glazed sink with hot and cold water always available.
- ii. A table with a smooth top at least 180 cm x 105 cm.
- iii. Means for sterilising instruments.
- iv. A couch.
- v. Two stretchers.
- vi. Two buckets or containers with close fitting lids.
- vii. Two rubber hot water bags
- viii. A kettle and spirit stove or other suitable means of boiling water.
- ix. Twelve plain wooden splints 900 cm x 100 cm x 6 cm.
- x. Twelve plain wooden splints 350 cm x 75 cm x 6 cm.
- xi. Six plain wooden splints 250 cm x 50 cm x 12 cm.
- xii. Six woollen blankets.
- xiii. Three pairs of artery forceps.
- xiv. One bottle of spiritus annemias arematations (120 ml).
- xv. Smelling salt (60 gm).
- xvi. Two medium size sponges.
- xvii. Six hand towels.
- xviii. Four kidney trays.
- xix. Four cakes of toilet, preferably antiseptic soap.
- xx. Two glass tumblers and two wine glasses.
- xxi. Two clinical thermometers.
- xxii. Two tea spoons.
- xxiii. Two graduated (120 ml) measuring glasses.
- xxiv. Two minimum measuring glasses.
- xxv. One wash bottle (1000 cc) for washing eyes.
- xxvi. one bottle (one litre) carbolic lotion 1 to 20.
- xxvii. Three chairs.
- xxviii. One screen.
- xxix. One electric hand torch.
- xxx. Four first-aid boxes or cupboards stocked to the standards prescribed in
- xxxi. An adequate supply of tetanus toxoid.
- xxxii. Injections—morphia, pethidine, atrophine, adrenaline, coramine, novocaine (6 each).
- xxxiii. Cramine liquid (60 ml).
- xxxiv. Tablets—antihistaminic antispasmodic (25 each).
- xxxv. Syringes with needles—2 cc, 5 cc, 10 cc and 500 cc.

- xxxvi. Three surgical scissors.
- xxxvii. Two needle holders, big and small.
- xxxviii. Suturing needles and materials.
- xxxix. Three dissecting forceps
 - xl. Three dressing forceps
 - xli. Three scalpels.
 - xlii. One stethoscope and a B. P. apparatus.
- xliii. Rubber bandage—pressure bandage.
- xliv. Oxygen cylinder with necessary attachments.
- xlv. Atropine eye ointments.
- xlvi. I. V. Fluids and sets 10 nos.
- xlvii. Suitable, foot operated, covered, refuse containers.
- xlvi. Adequate number of sterilised, paired, latex hand gloves.

B. Ambulance

1. When number of workers is <500:
If the distance to a major hospital capable of handling critical injuries expected at Site is ≤ 50 KM from Site, then 1 BLS (Basic Life Support)/ Type B Ambulance otherwise ALS* (Advanced Life Support)/ Type D Ambulance
2. If no. of workers increases to >2000 workers one additional BLS Ambulance to be deployed
3. Minimum Articles as per Schedule V of BOCW Central Rules to be ensured in each Ambulance. (given under for convenience)

*Final call to be taken at Site in consultation with all the contractors

SCHEDULE V (BOCW CENTRAL RULES, 1998) CONTENTS OF AMBULANCE VAN OR CARRIAGE [SEE RULE 227]

The Ambulance Van shall have equipment prescribed as under:

- a) General—a portable stretcher with folding and adjusting devices with the Head of the stretcher capable of being tilted upward. Fixed suction unit with equipment. Fixed oxygen supply with equipment. Pillow with case, sheets, blankets, towels, emergency bag, bed pan, urinal glass.
- b) Safety Equipment—Flaros with life of three thousand minutes, floor lights, flash lights, fire extinguishers (dry power type), insulated guntlets.
- c) Emergency Care Equipment—
 - i. **Resuscitation**—Portable suction unit, portable oxygen unit, bag valve mask, hand operated artificial ventilation unit, airways, mouth gag tracheostomy adapters, short spine board, I.V. FLUIDS with administration unit, B. P. manometer cuff stethoscope.
 - ii. **Immobilisation**—Long and short padded boards, wire ladder splints, triangular bandage—long and short spine boards.
 - iii. **Dressing**—Gauze pads—100 m x 100 mm universal dressing 250 x 1000 mm, roll of aluminium foils—soft roller bandages 150 mm x 5 mm yards adhesive tape in 75 mm roll safety pins, bandage sheets, burn sheets.
 - iv. **Poisoning**—Syrup of Ipecac, activated charcoal pre packeted dose, snake bit kit, drinking water.
 - v. **Emergency Medicines**—As per requirement (under the advice of construction Medical Officer).



ANNEXURE A.1

Sample calculation for deduction of operational cost of facilities

Annexure A.1**Cost Calculation Methodology of Operation of Facilities (Data is indicative only)**

(Period of 48 months is considered - shall be on actual basis)

A. Project Info:

Total time of Project	48 months
Project cost	1000 Crore
No. of packages	10 (A1-A10)

B. Item-wise Calculation:

Item	Nos.	Rate	Unit	Amount
Ambulance with Driver	2		Monthly/Unit	170000
Nurse/First aider	2 X 2 shifts	15000	Per month	30000
Training center one time cost	1	100000	Once	100000
Medical center one time cost	1	200000	Once	200000
Medicines at medical center	1	10000	Monthly	10000
Dust suppression water tank	2	2000	Monthly	4000
Doctor	1	70000	Monthly	70000
Cleaning staff	1	12000	Monthly	12000
Recurring monthly expenditure				296000
Total one-time expenditure				300000

C. Package-wise Deduction Plan for a period of 48 months

Period (In Months)	6	36	6
	For 1-6 months	For 7-42 months	For 43-48 months
Cost to be incurred from contractors	7%	81%	12%
	1.17% per month	2.25% per month	2.00% per month

D. Calculation For One-Time Running Cost

Packages/ Contracts	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10				
Contract Values (in Thousands)	100000	250000	2000000	200000	500000	1500000	1000000	1000000	250000	200000	7000000			
Share of common facilities one time running cost (in Thousands)	4	11	86	9	21	64	43	43	11	9	Individual Pkg value X Total one time running cost / All Pkg award values			
Timeline of work	1-6	1-8	2-48	6-36	7-15	10-48	6-48	7-40	40-48	41-48				
Month Count of work	6	8	47	31	9	39	43	34	9	8				
Deduction per month (in Thousands)	1	1	2	0	2	2	1	1	1	1	Total of One time Running cost (in thousands)	% deduction share of one time running cost per month	Nos. of active packages in month	
Month No.														
1	1	1									2	1%	2	
2	1	1	2								4	1%	3	
3	1	1	2								4	1%	3	
4	1	1	2								4	1%	3	
5	1	1	2								4	1%	3	
6	1	1	2	0			1				5	2%	5	
7		1	2	0	2		1	1			8	3%	6	
8		1	2	0	2		1	1			8	3%	6	
9			2	0	2		1	1			7	2%	5	
10			2	0	2	2	1	1			8	3%	6	
11			2	0	2	2	1	1			8	3%	6	
12			2	0	2	2	1	1			8	3%	6	
13			2	0	2	2	1	1			8	3%	6	
14			2	0	2	2	1	1			8	3%	6	
15			2	0	2	2	1	1			8	3%	6	
16			2	0		2	1	1			6	2%	5	
17			2	0		2	1	1			6	2%	5	
18			2	0		2	1	1			6	2%	5	
19			2	0		2	1	1			6	2%	5	
20			2	0		2	1	1			6	2%	5	
21			2	0		2	1	1			6	2%	5	
22			2	0		2	1	1			6	2%	5	
23			2	0		2	1	1			6	2%	5	
24			2	0		2	1	1			6	2%	5	
25			2	0		2	1	1			6	2%	5	
26			2	0		2	1	1			6	2%	5	
27			2	0		2	1	1			6	2%	5	
28			2	0		2	1	1			6	2%	5	
29			2	0		2	1	1			6	2%	5	
30			2	0		2	1	1			6	2%	5	
31			2	0		2	1	1			6	2%	5	
32			2	0		2	1	1			6	2%	5	
33			2	0		2	1	1			6	2%	5	
34			2	0		2	1	1			6	2%	5	
35			2	0		2	1	1			6	2%	5	
36			2	0		2	1	1			6	2%	5	
37			2			2	1	1			6	2%	4	
38			2			2	1	1			6	2%	4	
39			2			2	1	1			6	2%	4	
40			2			2	1	1	1		7	2%	5	
41			2			2	1		1	1	7	2%	5	
42			2			2	1		1	1	7	2%	5	
43			2			2	1		1	1	7	2%	5	
44			2			2	1		1	1	7	2%	5	
45			2			2	1		1	1	7	2%	5	
46			2			2	1		1	1	7	2%	5	
47			2			2	1		1	1	7	2%	5	
48			2			2	1		1	1	7	2%	5	
Total	4	11	86	9	21	64	43	43	11	9	300	100%		

D. Calculation For Recurring Running Cost

Packages/ Contracts	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10		
Contract Values (in Thousands)	100000	250000	2000000	200000	500000	1500000	1000000	1000000	250000	200000	7000000	
Timeline of work	1-6	1-8	2-48	6-36	7-15	10-48	6-48	7-40	40-48	41-48	Total of Recurring cost (in thousands)	Nos. of active packages in month
Month No.	6	8	47	31	9	39	43	34	9	8		
1	85	211									296	2
2	13	31	252								296	3
3	13	31	252								296	3
4	13	31	252								296	3
5	13	31	252								296	3
6	8	21	167	17			83				296	5
7		15	120	12	30		60	60			296	6
8		15	120	12	30		60	60			296	6
9			126	13	31		63	63			296	5
10			95	10	24	72	48	48			296	6
11			95	10	24	72	48	48			296	6
12			95	10	24	72	48	48			296	6
13			95	10	24	72	48	48			296	6
14			95	10	24	72	48	48			296	6
15			95	10	24	72	48	48			296	6
16			104	10		78	52	52			296	5
17			104	10		78	52	52			296	5
18			104	10		78	52	52			296	5
19			104	10		78	52	52			296	5
20			104	10		78	52	52			296	5
21			104	10		78	52	52			296	5
22			104	10		78	52	52			296	5
23			104	10		78	52	52			296	5
24			104	10		78	52	52			296	5
25			104	10		78	52	52			296	5
26			104	10		78	52	52			296	5
27			104	10		78	52	52			296	5
28			104	10		78	52	52			296	5
29			104	10		78	52	52			296	5
30			104	10		78	52	52			296	5
31			104	10		78	52	52			296	5
32			104	10		78	52	52			296	5
33			104	10		78	52	52			296	5
34			104	10		78	52	52			296	5
35			104	10		78	52	52			296	5
36			104	10		78	52	52			296	5
37			108			81	54	54			296	4
38			108			81	54	54			296	4
39			108			81	54	54			296	4
40			103			77	51	51	13		296	5
41			120			90	60		15	12	296	5
42			120			90	60		15	12	296	5
43			120			90	60		15	12	296	5
44			120			90	60		15	12	296	5
45			120			90	60		15	12	296	5
46			120			90	60		15	12	296	5
47			120			90	60		15	12	296	5
48			120			90	60		15	12	296	5
Total	143	388	5676	329	235	3102	2334	1772	132	96	14208	



ANNEXURE B

HSE Displays

A. Types of Displays**1. Based on Content**

SN	Type
1.	HSE Hazards & Precautions Height Work, Housekeeping, Fire Safety, PPEs, Hot Work, Lifting & Rigging Activity, Site-specific Hazards – eg. for Refineries, Nuclear plants etc.; COVID Precautions; Environment Protection etc.
2.	Other Displays, Signage etc. HSE Policy, ISO Certificate, Safety Statistics, Assembly Area Location/ Route, Emergency Contact Numbers, Site Safety Rules & Regulations, Speed Limit, Work in Progress, Lock-Out Tag-Out (LOTO) Boards etc.

2. Based on Mounting

[Type 1]	[Type 2]	[Type 3]
Flex Sign Boards of Wooden Frame – directly mounted on Structures (walls, stairs, railings etc.)	Flex Sign Boards with Wooden Frame – mounted on metallic/ wooden legs – preferably double-sided	Coloured weather-proof Paintings on Walls (after due concurrence of BHEL/ Customer – Type 1 in case of no concurrence/ space)

B. General Requirements:

- Displays should be weather-proof as per installation location, i.e. rain-proof, wind-proof and sun-proof.
- Installation location and size to ensure visibility for the intended viewers (workers and moving personnel)
- Displays to have at least 50% graphical elements preferably (as applicable). Language should be understandable by majority of the workers
- Displays to be relevant to the hazards in the area
- Proper installation to ensure boards don't obstruct activities and should not be prone to fall so as to pose danger
- In case of multiple elevations (eg. Boiler, Power-house etc.), each elevation to have displays for applicable hazards including Height-Work, Housekeeping
- For temporary work locations, posters/ boards may be erected and shifted after task is over
- Minimum size of displays should be A1 unless otherwise specified
- In case of damage, displays shall be reviewed and repaired/ replaced
- In areas where night work is envisaged, fluorescent displays shall be installed and these should comprise of at least 20-30% of total displays
- Total Number of displays to be not less than 1 per 10 workers and are to be dynamically updated based on number of workers

C. Area-wise Displays

Below is list of Area-wise displays that are to be installed at Sites (Numbers, locations may be adjusted for specific requirements)

SN	Area	Suggested Subjects	Minimum Size	Minimum Quantity	Locations
1	Walls/ Foundations/ Cement Structures etc. belonging to the package area	Safety Hazards Prevention and other HSE Awareness content	[Type 3]	As per BHEL assessment from time to time	
2	Site Interior Roads belonging to the package area	At least every 20 meters: 1. Speed Limit Indication, Safe Driving board 2. Boards for hazard awareness	1.As needed [Type 2] 2. A1 or equivalent each [Type 2]	As indicated	Sides of Roads; Height to ensure good visibility
3	Specific Package Areas	A. Common At entry to respective Package/ Work Area, each contractor to put up daily updated board with following for each shift: 1. Scope of work and start date 2. Emergency Contact Numbers 3. Emergency Assembly Location, Escape Plan 4. Locations and supervisors of various gangs in the area, 5. Current Work permit Details 6. Safety Supervisor Location assignments - Names, Mobile Nos., Assigned Locations 7. Details (Name, Contact No. etc.) of Package In-charge - Contractor & BHEL 8. Details (Name, Contact No. etc.) of Safety In-charge - Contractor & BHEL 9. LTI Free Man-days & details of last LTI also to be indicated In addition, Area-Specific Displays as indicated in Table 1	A0 [Type 2]	1 per Package Area	Entry/ Ground Level

Table 1
(Area/ Package-wise HSE Display Plan – As applicable)

Prepared By (Subcontractor)				
S. No.	Area	Suggested Minimum No. of Displays & Types	Type	Numbers Installed
1	Boiler	3 per working elevation	[Type 1]	
2	Powerhouse	5 per elevation	[Type 1]	
3	ESP	5 Per Pass	[Type 1]	
4	Buildings	5 per elevation	[Type 1]	
5	Cooling Tower (NDCT/ IDCT/ ACC)	20 per Structure	[Type 1]	
6	Chimney	20 per Structure	[Type 1]	
7	Fabrication Yard	10 per Yard	[Type 2]	
8	Batching Plant	5 per Plant	[Type 1]	
9	Material Storage Yard – Open	20 per Yard	[Type 2]	
10	Material Storage Shed – Semi-Closed/ Closed	10 per Shed	[Type 1]	
11	Electrical Booths	2 per booth + Line diagram, Emergency contact details	[Type 1]	
12	Medical & First Aid Centre	2 per Centre	[Type 1]	
13	Rest Shed	2 per Shed	[Type 1]	
14	Canteen	2 per Canteen	[Type 1]	
15	Drinking Water Area	1 Per Outlet	[Type 1]	
16	Washing Water Area	1 Per Outlet	[Type 1]	
17	Training Centre	10 per room	[Type 1/2]	
18	Assembly Area	5	[Type 1/2]	
19	Stairs	1 per landing elevation	[Type 1]	
20	Cylinder Storage Area	5 + Signage: Type of Gas, Empty, Filled etc.	[Type 1/2]	
21	Labor Colony	Electrical Safety with Distribution Plan/ Line Diagram - 1 COVID Precautions Posters – 5 Safety Awareness Posters – 10 Hygiene awareness posters - 2	[Type 1]	
22	Others	As per requirement	[Type 1/2]	

Date:

Sign (Contractor)

Sign (BHEL)



ANNEXURE C

HSE Tools/ Equipment/ Devices

Following equipment conforming to relevant IS/ISO/BS Codes/ Standards in indicated quantities shall be ensured by subcontractor. This list is tentative, not exhaustive. Quantity and date/ period of deployment shall be as per site requirement.

A. HSE Tools/ Equipment/ Devices

SN	Item
1	Lifelines
2	Retractable Fall Arrestors
3	Safety Nets (10m X 5m) fire proof double mesh
4	Sky Climbers
5	Fire Blanket
6	Honey Bee Removal Suit & Kit
7	Scaffolding Pipes
8	Flashback Arrestors
9	Barricading Tape
10	Binoculars
11	Walkie-Talkies
12	LOTO kit
13	24-Volt light
14	Sand Buckets
15	Hard barricading Pipes
16	Standby Fire kits
17	Hand-held Megaphone
18	Small Public Address System
19	Foldable Stretcher
20	Height Rescue Kit (Non-Motorized)
	(Others:)

B. Test & Measurement Devices

SN	Device
1	ELCB Tester
2	Multi meter (Light cables)
3	Earth Resistance Meter
4	Lux Meter
5	Sound Meter
6	Anemometer
7	Breath Analyzer (Alcohol)
8	Multi-gas dozi-meter/ detector
9	Gas leakage detector / alarm
10	Gas monitor (confined space)
11	Radiation meter & Badges
12	Blood Pressure Monitor
13	Fire detectors
14	Hand held signaling light
	(Others:)



ANNEXURE D

Rest Sheds

1. Determining the Number, Sizes and Locations of Rest Shelters

i. **Numbers:**

The number of rest shelters shall be determined based on maximum number of workers at any one time (across all shifts). Formula is:

W_{max} = Maximum number of workers at any time in the Site

Space per worker = 1.1 sq meter

Total space required, T_{space} = $W_{max} \times 1.1$

Based on total space requirement calculated above, the number of rest sheds can be decided according to availability of locations and concentration of workers – so as to ensure the required space.

ii. **Locations:**

The rest sheds should be so located so as to minimize the distance to be travelled by the workers from their locations of work considering all the practical constraints

iii. **Other:**

The Rest shelter should be fenced so that it cannot be used as parking area.

2. Design & Construction of Rest Sheds

a. **Permanent/ Long duration Rest Sheds**

- i. For locations where, permanent rest sheds can be constructed without possibility of removal for relatively long period of time, a semi-closed shed can be constructed covered with tin roof and supported with well-grouted beams. The floor of the shed to be preferably cemented/ solidified.
- ii. Adequate structural requirements suitable to the local weather (wind/ rain etc.) to be ensured.
- iii. The design of the rest shed to be approved by Civil Engineering Department of BHEL Site before commencing work

b. **Temporary/ Movable/ Portable Rest Sheds**

- i. For locations where, permanent rest sheds cannot be constructed either due to non-availability of permanent location or other reasons, temporary rest shed shall be constructed.
- ii. Temporary rest sheds shall comprise of Tent arrangement carried out by professional agencies

3. Amenities in Rest Sheds

a. **Essential Amenities**

Following amenities shall be essentially ensured in a rest shed:

- i. Hygienic environment with regular cleaning and housekeeping (with records)
- ii. Adequate illumination
- iii. Adequate ventilation/ heating as per weather conditions
- iv. Clean Drinking water source
- v. Hand Washing area
- vi. Toilets & Urinals
- vii. Benches/ mats for sitting/ lying
- viii. Any other essential requirement deemed necessary by the Site
- ix. Dust bins of sufficient quantity/ size that are vacated each day/ as per requirement

b. **Additional/ Optional Amenities**

Following amenities are optional but are recommended to enhance the level of satisfaction of work force:

- i. Hot/ Cold drinks (Tea, Coffee, Glucose etc.) as per requirement
- ii. Snacks
- iii. Fans/ Coolers/ Heating arrangements as per requirement and weather conditions
- iv. A nice, welcoming interior design, music etc.
- v. Water cooler

4. Health & Safety Requirements of Rest Sheds

Use of asbestos in construction is banned and shall not be used.

In addition, following essential Safety features shall be ensured in Rest sheds:

- i. Availability of Fire extinguishers (preferably CO2 type)
- ii. Display of Safety Posters
- iii. Pest/ reptile protection
- iv. Mosquito prevention measures

5. Note:

Any suitable closed spaces/ newly constructed buildings etc. available at project may also be used for the purpose of rest shed with due concurrence of BHEL



ANNEXURE E

Labor Colony

1. These Guidelines suggest minimum requirements. However, additional requirements based on feasibility and circumstances, while adhering to directions of GOI/District Administration/Local Authority guidelines to be considered
2. Norms for social distancing, training/ awareness, face masks, disinfection, sanitization, gate entry, quarantine, medical, action in case of suspect cases of COVID and other communicable diseases etc. to be followed as per Govt. and BHEL guidelines issued from time to time
3. Labor colony to be developed as close to the Site as possible to avoid lengthy commute
4. A "Suggestion Register" shall be made available at the labor colony for residents. The feedback shall be reviewed on weekly basis and acted upon by concerned Contractor. Same shall be reviewed periodically by authorized BHEL Site Official.
5. **Canteens, Latrines & Urinals, Washing Facilities, Creches, Residential Accommodation and other infrastructure/ facilities:**
Numbers/ Quantities and Features of these facilities shall be in line with the following as applicable:
 - a. BOCW Act & State Rules
 - b. The Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act & State Rules
 - c. Factories Act & State Rules
 - d. Other Relevant Acts & Rules
6. **Cleanliness & Hygiene/ Housekeeping:**
 - a. Regular cleaning of the labor colony to be ensured.
 - b. Daily cleaning of Sanitary facilities.
 - c. Proper drainage system to prevent water-logging
 - d. Regular fogging to prevent spread of mosquitoes
 - e. Prevention of foul smell through necessary interventions
 - f. Dust suppression as per requirement
 - g. Cutting of Grass at regular intervals and other necessary measures to prevent pests & reptiles
 - h. Stray animals to be banned from labor colony.
 - i. Outside every common facility, eg. Toilet, washroom, food hall/ canteen etc., provision of washbasin with flowing water and soap (preferably liquid soap) to be ensured
7. **Power Supply Layout:**
Electrical supply Layout of Labor Colony shall have the provision of Safety devices like MCBs, ELCBs etc. and to be clearly displayed
8. **Washing & Drinking Water Availability**
 - a. Adequate water to be provided in line with: "Estimation of Water Requirements for Drinking and Domestic Use (Source: National Building Code 2016, BIS)"
 - b. Drinking water tank to be cleaned every week and sticker for the same pasted on the tank
 - c. Drinking water source should be tested as per IS 10500
9. **Waste Disposal:** Separate bins for dry, wet and biomedical waste to be installed. These bins to be evacuated regularly
10. **Training & Awareness/ Displays**
 - a. **HSE Awareness Displays:** Posters/ banners/ boards to be displayed in labor colony. Subjects of displays shall be precautions for applicable hazards at work site.
 - b. **Emergency Contact Numbers** including that of Doctor, Hospital, Labor Colony Supervisor, HSE Officials to be displayed prominently

11. Doctor Visits:

Regular and need-based visits by Doctors to be ensured through tie-ups etc.

12. Inspection & Review: Regular inspection of labor accommodation to be carried out by the Contractor as per prescribed format. Last inspection date, inspector and next due date to be prominently indicated near main gate**13.** Provision of a Fair Price shop in the premises to be ensured as per requirement**14.** Adequate arrangements to be ensured in case of children/ families



ANNEXURE F

Toilets

Toilets (Latrines and urinals shall be ensured at Site and Labor Colony in accordance with the Inter-State Migrant Workmen Act, 1979 as given below:

LATRINES	URINALS
<p>1. Latrines shall be provided in every establishment on the following scale, namely: -</p> <p>a. Where females are employed, there shall be at least one latrine for every 25 females;</p> <p>b. Where males are employed, there shall be at least one latrine for every 25 males:</p> <p>Provided that where the number of males or females exceeds 190, it shall be sufficient if there is one latrine for 25 males or females, as the case may be, up to the first 100, and one for every 30 thereafter</p> <p>2. Every latrine shall be under cover and so partitioned off as to secure privacy, and shall have a proper door and fastenings.</p>	<p>1. There shall be at least one urinal for male workers up to fifty and one for female up to fifty employed at a time:</p> <p>Provided that where the number of male or female workmen, as the case may be, exceeds 500 it shall be sufficient if there is one urinal for every fifty females up to the first 500 and one for every 100 or part thereof thereafter.</p> <p>2. The urinals shall be designed and located so as to ensure privacy.</p>

Important:

- Where workers of both sexes are employed there shall be displayed outside each block of latrine and urinal a notice in the language understood by the majority of the workers '**For Men Only**', or '**For Women Only**', as the case may be.
- The notice shall also bear the figure of a man or of a woman, as the case may be.
- The latrines and urinals shall be conveniently situated and accessible to workers at all times at the establishment.
- The latrines and urinals shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times.
- Latrines and urinals other than those connected with a flush sewage system shall comply with the requirements of the public health authorities.
- Water shall be provided by the means of tap or otherwise so as to be conveniently accessible in or near the latrines and urinals.
- At Site, on ground, **Modular Bio-toilets** as per industry standard specifications and regular professional cleaning shall be ensured. The toilets should be sufficient in number and easily accessible to workers from every work area
- At Site, in various elevations, suitable urinals with proper drainage to be ensured at each elevation in line with IS 2064 (1993). Same to be cleaned regularly



ANNEXURE G

Fire Extinguishers

SN	Type of Fire Risk (Class of Fire)	Extinguishing Medium & Relevant INDIAN STANDARD	Scale of Equipment (Minimum recommended)
1.	CLASS 'A' Fires involving ordinary combustible materials like wood, paper, textiles, rubber etc. (Ordinary hazard or low fire load)	WATER Soda acid type, water type (gas pressure) and water type (constant air pressure) IS: 934 -1976; IS: 940 -1976; IS: 6234 -1971	For every 600 square meter floor area or part, one 9-litre capacity. Minimum 4 numbers per floor or room; should not be required to travel more than 15 meter to reach any extinguisher.
2.	CLASS 'A' (Extra hazard & high fire load)	-do	-do – (Also, consult local fire authority).
3.	CLASS 'A' (Special hazards)	-do	-do – Extra provision For every 100 square meter floor area or part, one 4.5 Kg. CO ₂ ; minimum 2 numbers per room; should not be required to travel more than 10 meter to reach any extinguisher.
4.	CLASS 'B' (Fires in flammable liquids like oils, solvents, petroleum, products, varnishes, paints, etc. where blanketing effect is essential) (Storage and handling in small quantities)	FOAM / CARBON DIOXIDE / DRY CHEMICAL POWDER IS: 933 -1976; IS: 2878 1976; IS: 2171 1976; IS: 4308 -1982	For every 50 square meter floor area or part, 2 numbers 9 -liters foam or 5 kg dry powder; should not be required to travel more than 10 m in the area of storage to reach any extinguisher.
5.	CLASS 'B' (Bulk storage other than in tank form))	-do -	-do- (but minimum 3 numbers per room)
6.	CLASS 'C' (Fires involving gaseous substances under pressure where it is necessary to dilute the burning gas at a very fast rate with an inert gas or powder) (storage and handling of gas cylinders)	CARBON DIOXIDE / DRY CHEM. POWDER. The best way to extinguish such fire is by stopping the flow of fuel gas to the fire. Container is kept cool with water spray. IS: 2878 1976; IS: 2171 -1976; IS: 4308 -1982	For every 100 square meter floor area or part; 2 numbers, 10 kg powder extinguisher or 6 kg CO ₂ ; minimum 3 nos. per room; should not be required to travel more than 10 meter to reach any extinguisher.
7.	CLASS 'D' Fires involving metals like magnesium, aluminum, zinc, potassium etc. where the burning metal is reactive to water and which require special extinguishing media or technique	SPECIAL DRY POWDER IS: 2171 -1976 IS: 4861 -1968	For every 50 square meter floor area or part, 2 nos. 5 kg special dry powder; minimum 3 nos. per room; should not be required to travel more than 10 meter to reach any extinguisher.
8.	MIXED OCCUPANCY (electrical); Generators; Transformers; etc.	CARBON DIOXIDE DRY POWDER, IS: 2878 1976; IS: 2171 -1976	For every 100 square meter floor area or part one 10 kg CO ₂ . Minimum 2 numbers for every location should not be required to travel more than 10 meter to reach an extinguisher.

Note: Due to peculiarities of the power plant construction sites, there would be locations in the construction areas of Boiler, Turbine, Generator, Transformer, etc. where different types of fire risk (classes of fire) may co-exist. Special care shall be taken while selecting and installing portable fire extinguishers for such locations so that all types of fire risk that may co-exist, are adequately covered. Similar special care shall be taken for storage areas.

a. All Electrical welding booths shall be equipped with appropriate Fire Extinguisher

- b. Appropriate Fire Extinguishers shall be made within easy reach of all welding operations
- c. Fire extinguishers shall be regularly tested and last checked date to be indicated on each. Master list shall be prepared with location and details
- d. Providing appropriate fire-fighting equipment at designated work place and nominate a fire officer/warden adequately trained for his job.
- e. Subcontractor shall provide enough fire protecting equipment of the types and numbers at his office, stores, temporary structure in labour colony etc. Such fire protection equipment shall be easy and kept open at all times.
- f. The fire extinguishers shall be properly refilled and kept ready which should be certified at periodic intervals. The date of changing should be marked on the Cylinders.
- g. All other fire safety measures as laid down in the “codes for fire safety at construction site” issued by safety coordinator of BHEL shall be followed.
- h. Non-compliance of the above requirement under fire protection shall in no way relieve the subcontractor of any of his responsibility and liabilities to fire incident occurring either to his materials or equipment or those of others.
- i. Emergency contacts nos. must be displayed at prominent locations
- j. Tarpaulin being inflammable should not be used (instead, only non-infusible covering materials shall be used) as protective cover while preheating, welding, stress relieving etc. at site.



ANNEXURE H

HSE Compliance Certificate

Bill Ref no: _____ Date: _____

NAME OF THE AGENCY: _____ Work-Area/Package: _____

Sl. No.	Description	Remarks
1	<u>HOUSE KEEPING:</u>	
1.1	All working areas at site (specific to the agency) are free from garbage's, scraps & any other undesired non-plant materials. There is no encroachment in safe passage of man, material & T&P to carry out activities safely	
1.2	All the plant materials under the custody of the agency are stacked & stored properly.	
2	<u>GENERAL ILLUMINATION:</u>	
2.1	ALL the working areas at site & office of the agency including passages are having proper & sufficient illumination.	
3	<u>STATUTORY & REGULATORY REQUIREMENT:</u>	
3.1	Sufficient water for drinking & other purposes and sanitation in work area and labour colony are available.	
3.2	Periodical Medical check-up of workers & staff done regularly & report submitted to BHEL	
3.3	Regular EYE testing is done for Crane operators/Welders and data's are available with agency	
3.4	All the T&P, Cranes etc used by the agency are having proper T.Cs & Fitness certificate available from competent authority.	
4	<u>SAFETY COMPLIANCE:</u>	
4.1	Number of Tool box meetings between Safety officers, erection staff & workers of the agency held in this month with location mentioned	
4.2	All precautions & Safety measures including PPE compliances are taken before working at HEIGHT	
4.3	Permit for working at Height is taken & complied accordingly	
4.4	ELCB is used in Construction Power Supply source by the agency & Proper Distribution board and electrical cabling has been used by the agency and regularly checked by electrician & safety officer of the agency	
4.5	Unsafe areas barricaded properly & unsafe opening closed properly	
4.6	Proper Platforms & Hand-rails used In areas earmarked earlier	
4.7	Proper safety signage's, Slogans & Emergency contact phone numbers including FIRE contact nos. are made available by the agency in locations mentioned	
5	Whether any penalty imposed by BHEL towards non-compliance of above points.	

<u>VENDOR'S SIGNATURE</u>	
Erection Engineer	
HSE Officer	
Site-in-Charge	

<u>BHEL'S SIGNATURE</u>	
Erection Engineer	
HSE Officer	
Package-in-Charge	



ANNEXURE I

Activity-Specific Safety Precautions/ Controls

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General

The philosophy of hierarchy of controls as below shall be followed



Fig. 1.1

It shall be ensured that there are multiple protections against any accident/ incident. For example, for height work there shall be safe platforms and walkways, Safety Nets and Lifelines for hooking double lanyard Safety harness by workers.

Monitoring and modifying worker behavior shall be part of ensuring safety. All personnel should be competent and trained for the job

Brief Safety guidelines for various hazardous activities are indicated below, besides the mandatory requirements based on Hazard Identification studies, HSE Procedures, Operational Control Procedures, Work Permits, applicable Indian Standard Codes and other provisions detailed in this document. Constant supervision at all times to be maintained by Execution & Safety Team to ensure implementation of these provisions.

1. WORK AT HEIGHT:

- a. All work at height above 2 meter above ground level without complete platforms, handrails and other related fall protection shall require a work permit in the prescribed form. This shall require approval by the competent authority. The HSE officer of sub-contractors shall follow the checklist religiously by physically verifying the condition of the work area before recommending for approval.
- b. Prior to the start of work at elevation, the HSE Officer involved with the work must meet the work supervisor to review the scope of work, and must review all the possible fall hazards and effective safety responses. The evaluation / analysis must be documented and kept on file and on site by the HSE Officer.
- c. Whenever a fall hazard or other exposure exists for working at heights more than 2.0m/6ft, the nature and scope of work will be evaluated for conditions and environmental factors before selecting the appropriate fall protection system (active, passive or a combination of measures, as appropriate).
- d. All Engineering and Administrative Controls including barricading, safe platform, Safety Nets etc. shall be made available at work location. Under no circumstances, there shall be total reliance on PPEs only
- e. **Safety Nets**
 - i. Contractor shall maintain sufficient stock of Safety Nets for deployment
 - ii. Safety Nets as per IS: 11057:1984 should be used extensively for prevention / arrest men and materials falling from height.
 - iii. The safety nets shall be fire resistant, duly tested and shall be of ISI marked.

- iv. Safety Nets shall be deployed below all platforms where height work is envisaged. Duration of work, delay shall be no excuses for non-installation of Safety Net
- f. Reaching beyond barricaded area without lifeline support, moving with support of bracings, walking on beams without support, jumping from one level to another, throwing objects and taking shortcut must be discouraged.
- g. Monkey Ladder shall be fitted with cages. Rope ladder should be discouraged.
- h. In case of pipe-rack, persons should not walk on pipes and walk on platforms only.
- i. In case of roof work, walking ladder/ platform should be provided along with lifeline and/ or fall arrestor.
- j. For chimney or structure painting, both hanging platform and men should be anchored separately to a firm structure along with separate fall arrestor.
- k. The procedures for the safety response to identified fall hazards developed and rescue plans must be reviewed with all individuals exposed to the hazards.
- l. The HSE Officer must establish an inspection process of fall protection systems. Some equipment requires documented inspections by its manufacture on a regular schedule. Such equipment must have evidence of the inspection and re-certification process on it. This information must be reviewed before the equipment is actually used. Individuals must visually inspect the fall protection equipment before each use. Failure to complete this inspection process could result in serious injury or death.
- m. Immediately remove from service any fall protection equipment that is identified as defective, damaged, or has been subjected to an impact. Damaged fall protective equipment must be destroyed to prevent re-use and not be discarded into trash containers, as the worn or damaged equipment could be unintentionally re-used.
- n. Aerial lifting devices, excluding scissor lifts require the use of full body harnesses and lanyards in any elevated position.
- o. Where Height related works are applicable then rescue team (consist of 5- 10 person) shall be identified and trained for potential rescue.

1.1 Personnel fall protection system must include:

a. Safety Harness

All height workers must use Full Body Safety harness with double lanyards with shock absorber (only). The primary lanyard is never unhooked until the secondary lanyard is secure. The design of the working platform should be such that under no circumstances, worker should have both lanyards unhooked while at height.

b. Lanyard

- i. The type of work and the environment conditions determine lanyard and lifeline selection. If welding, chemical cleaning that may damage lanyards, connectors or lifelines, sandblasting, etc., either protect the components or use more appropriate type of system.
- ii. Lanyards and lifelines must incorporate, or be used with, an appropriate deceleration (shock absorbing) device. Deceleration devices include rope grabs, rip-stitch lanyards, specially woven lanyards, tearing, or deforming lanyards, automatic self-retracting lifelines and lanyards which dissipate or limit the energy imposed on the employee during fall arrest.
- iii. Once in use, the system's effectiveness is to be monitored. In some cases, a program for cleaning and maintaining the system may be necessary. Lanyard and lifelines must use locking snap hooks only and under

no circumstances must two lanyard snap hooks be connected.

c. Lifeline

All lifelines in general are to be made of min 12mm dia. steel rope (plastic coated) and tied to columns with 3 clamps at each end. Wherever columns are not available to tie the lifelines, the vertical posts as per the design below are to be provided after carrying out drop load test initially. A load of 240kg to be dropped off the mid-point of lifeline in this test.

d. Lifeline Post

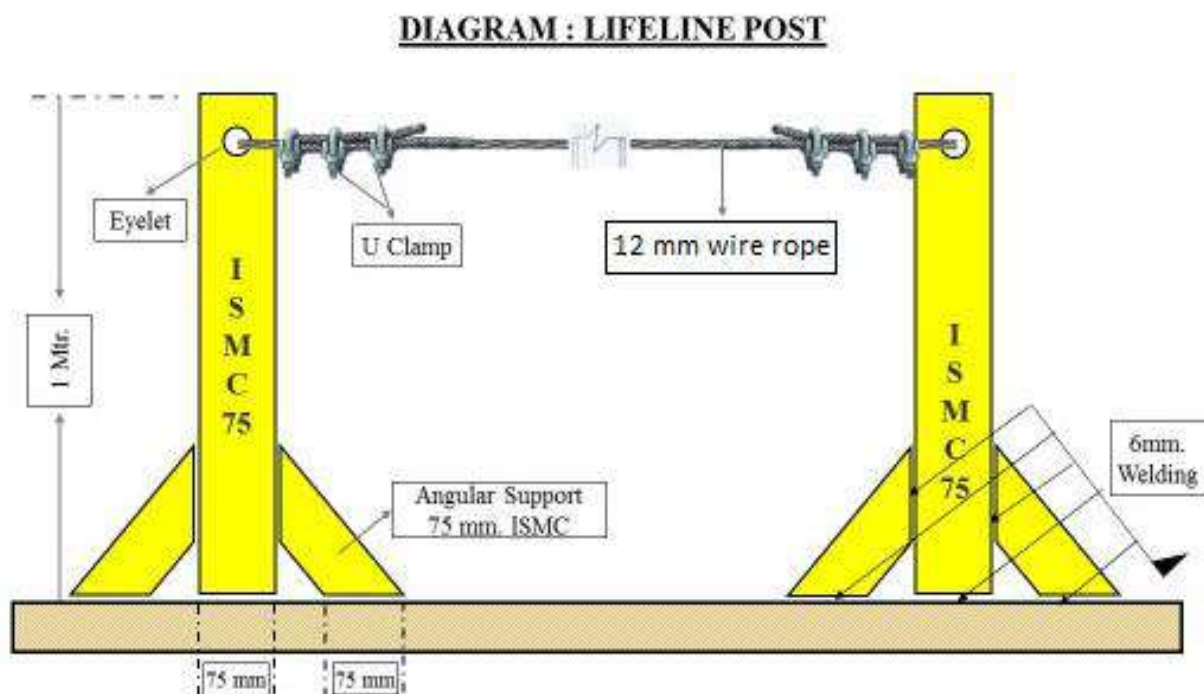


Fig. 2.1 Lifeline Post

- i. The support at vertical post shall be fixed at end-to-end (welded/ bolted). The maximum length of one end to another end shall be 6 meters
- ii. If the length of a lifeline is more than 6 meters, then intermediate vertical post(s) are to be used. Such intermediate post(s) will act as supports and the lifeline rope should simply pass through the eyelets (holes) of such supports without being anchored
- iii. The lifeline need not be wrapped / clamped to any intermediate post
- iv. Such intermediate posts must be used at an interval of every 6 meters
- v. The post(s) in which the original lifeline is to be installed should be capable of sustaining a tensile stress of 2268 Kgs.
- vi. In a horizontal lifeline installation, maximum allowable sagging is 500-600 mm
- vii. For a single spun lifeline, no more than 3(Three Nos.) persons are allowed to work; for more than two workers, another lifeline should be installed
- viii. Horizontal lifeline should be so installed that it does not impede safe movement of workers
- ix. All the installation work must be carried out by competent person with adequate knowledge

1.2 Working Platform

- a. Working platforms, gangways and stairways shall be so constructed that they do not sag unduly or unequally and if the height of the platform gangways provided is more than 3.6 m above ground level or

floor level, they shall be closely boarded and shall have adequate width, which shall not be less than 750 mm and be suitably fenced.

b. Precautions against the fall of Materials, Persons and Collapse of Structures:

- i. Every opening in the floor or a building or in a working platform shall be suitably barricaded to prevent the fall of persons by providing suitable fencing or railing whose minimum height shall be 90 cm.
- ii. Adequate precautions should be taken such as the provision of fencing, or barriers to protect any person who might be injured by the fall of materials, or tools or equipment being raised or lowered. Hard barricading shall be made at such places made of scaffolding pipe & clamps covered with reflective net. Cradle may be used for lifting materials - however this shall be made of MS angles and flats only and duly certified by the HSE officer. Operators may also use designed containers for lifting small tools.
- iii. Guardrails (including scaffolding) erected over/adjacent working areas must have the guardrails screened (opening < 0.5), to prevent material from falling outside the platform/decking.
- iv. Guardrails must be able to withstand a 200-pound force exerted in any one direction.
- v. Where necessary to prevent danger, guys, stays or supports should be used or other effective precautions should be taken to prevent the collapse of structures or parts of structures that are being erected, maintained, repaired, dismantled or demolished.
- vi. All openings through which workers are liable to fall should be kept effectively covered or fenced and indicated in the most appropriate manner.
- vii. Guardrails and toe-board/barricades and sound platform conforming to IS: 4912-1978 and other Indian laws and regulations as depicted below should be provided.

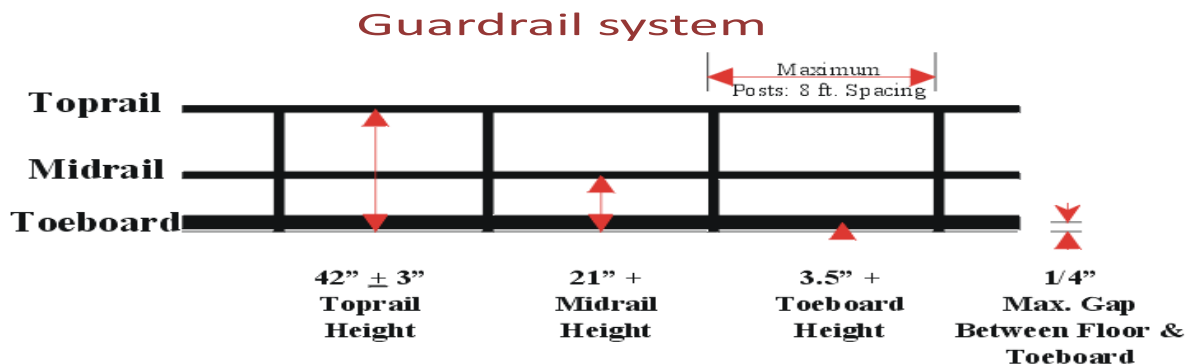


Fig. 2.2 Guard Rail System

- viii. Guardrails shall be provided to protect workers from falling from elevated work places. The rails are generally made of MS pipes of suitable dia. Rebar shall not be used for any handrails, ladder or cover purpose. Wherever the guard-rails and toe-boards cannot be provided:
 - a. adequate safety nets or safety sheets shall be erected and maintained; or
 - b. adequate safety harnesses shall be provided and used and / or
 - c. adequate fall arrestor shall be provided and used.

As mentioned under PPE clause, all these PPEs shall be defect free and regularly inspected for any defect. The full body safety harness shall have double lanyard only with max 1.8m length.

- ix. The monkey ladders shall have sufficient fall arrestors. Adequate lifelines of 8mm steel wire rope shall be provided across the work area.
- x. The HSE officer shall recommend appropriate PPEs after analyzing hazards and risks involved.

1.3 Scaffolding

All scaffolds shall be conformant to the relevant standards including IS 3696 and IS 4014 as applicable. A sketch of the scaffolds proposed to be used shall be prepared and approval of the BHEL Engineer obtained prior to construction / use. Only cup lock type scaffoldings will be allowed in site. Where cup lock type scaffolding arrangement is not feasible by the virtue of the location, in that case only pipe and clamp type scaffolding will be allowed.

- a. The scaffolding work must be carried out by a competent person, who shall train the scaffold users on safety aspects
- b. All scaffolds shall be erected / dismantled by scaffolding crew under direct supervision of competent scaffolding supervisors.
- c. All scaffolds shall be capable of supporting 4 times maximum intended load and erected on sound, rigid footing, capable of carrying the maximum intended load without settling or displacement. Bamboo scaffolding is not permitted for use on site.
- d. Each employee on the scaffold shall use an approved safety harness attached to an independent lifeline. The lifeline is to be securely attached to substantial members of the structure (not the scaffold itself) or to securely rigged lines, which shall safely suspend a worker in event of a fall.
- e. Guard rails and toe boards shall be installed on all open sides and ends of platforms more than (2) meters above ground or floor
- f. Scaffold planks must be at least 5 cm x 25 cm (2" x 10") full thickness lumber scaffold grade or better.
- g. Scaffold planks shall not span distances greater than 2.5 meters (8 feet).
- h. Scaffold planks shall extend over end supports not less than 6 inches nor more than 12 inches and be secured to the scaffold. Scaffolding and accessories with defective parts shall be immediately repaired or replaced.
- i. All scaffolding must be a minimum of two planks wide. No one may work from a single plank.
- j. Scaffold planks must be inspected before use. Planks that have been damaged must be removed from the site.
- k. Access ladders must be provided for each scaffold. Climbing the end frames is prohibited unless the design incorporates an approved ladder.
- l. Adequate mudsills or other rigid footing capable of withstanding the maximum intended load must be provided.
- m. Scaffolds more the 6 meters (20 feet) in height must be tied to the building or structure at intervals which do not exceed 4 meters (13 feet) vertically and 6 meters (20 feet) horizontally.
- n. Do not overload scaffolds. Material should be brought up as needed. Scaffolding must not be loaded in excess of its rated capacity.
- o. Barrels, boxes, kegs, blocks or similar unstable object must never be used as work platforms or to support scaffold.
- p. Where persons must work under or pass under a scaffold then a 18 gauge wire mesh screen must be installed between the toe board and guard rail.
- q. Employees exposed to overhead hazards while working on a scaffold will be protected by 5 cm (2") thick planks.
- r. Wooden/bamboo ladders shall not be allowed at any cost. Ladder's rungs shall be fitted /welded

properly. Before every use the rungs should be checked for safe use.

- s. Wooden scaffolds shall not be used in areas where fire / fire products are expected
- t. Ropes made of jute / Plastic and other fire prone material shall not be used to tie up scaffolding components together
- u. The platform should have permanent hand rail and mid rail with Toe board without fail.
- v. All platforms are to be tightly planked for the full width of the scaffold, except as may be necessary for entrance openings. Platforms shall be secured in place.
- w. On suspension scaffolds designed for a working load of 500 pounds, no more than two workers are permitted to work on the scaffold simultaneously. On suspension scaffolds with a working load of 750 pounds, no more than three workers are permitted on the scaffold simultaneously.

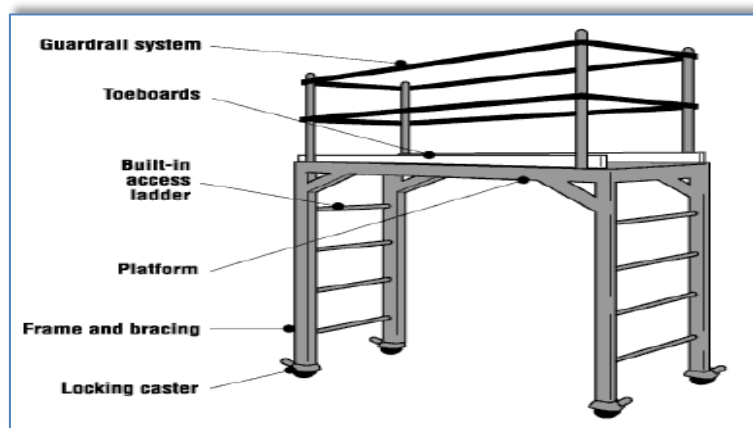
x. Requirements for different types of Scaffolds:

A. Suspended Scaffold

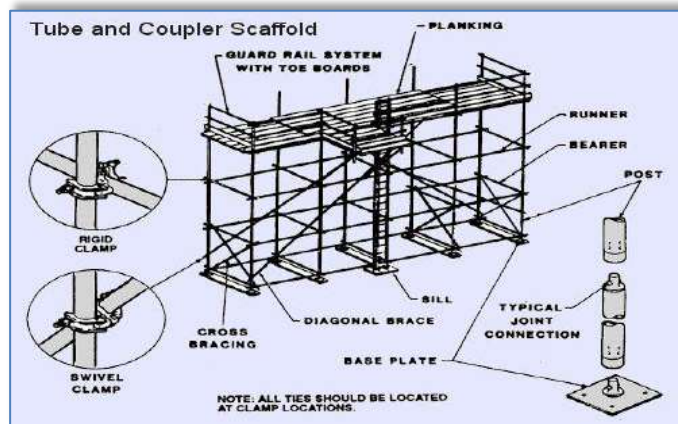
- i. Suspended scaffolds are platforms suspended by ropes, or other non-rigid means, from an overhead structure.
- ii. Requirements for use are to be preapproved by HSE Head, under a specific Permit to Work.

B. Rolling Scaffolds

- i. The height of rolling scaffolds shall not exceed three times the minimum base dimension.
- ii. The minimum base dimension of rolling scaffold will be 1.25 meters (4 feet).
- iii. Adequate help must be provided when moving a rolling scaffold.
- iv. Secure or remove all loose materials, equipment and tools before moving a rolling scaffold.
- v. No one is permitted to ride a rolling scaffold when it is being moved. Castor brakes must be locked-on when the scaffold is not being moved.



Rolling Scaffold



Tube & Coupler Scaffold

Fig. 2.3 Types of Scaffolds

1.4 Ladder Safety

A sketch of the ladders proposed to be used shall be prepared and approval of the BHEL Engineer obtained prior to construction / use

a. Safe Use of Ladders:

- i. Fall protection is required when working on a ladder above 2 meters and when climbing above nearby guardrails.

- ii. Ladders must be inspected prior to use and by a competent person quarterly, with documentation.
- iii. Use portable ladders for height up to 4 M only
- iv. Provide fixed ladders for height above 4 M
- v. Place the ladder at an angle of 75 degrees (approx.) from the horizontal (1:4)
- vi. Extend ladder at least 1 M above the top landing
- vii. Secure top and bottom of the ladder firmly to prevent displacement- anti skid lining at the bottom
- viii. Ensure that the width of the ladder is not less than 300 mm and distance between rungs is not more than 300 mm
- ix. Provide landings of minimum size 600 x 600 mm at intervals not more than 6 M for fixed ladders. Check the ladders daily for any defects
- x. Ensure that the areas around base and top of the ladder are clear. Getting on and off the ladder is more hazardous than using it. Use a mudsill if the ladder is to rest on soft, loose or rough soil
- xi. Do not use ladders of conducting material near power lines, and only use ladders near power line or other energize system with exposed parts if they are confirmed locked-out and de-energized.
- xii. Stand no higher than the fourth rung from the top for carrying out any job standing on a ladder.
- xiii. Never reach out from a ladder to perform work where your belt buckle protrudes past the ladder rung.
- xiv. Always face the ladder while climbing up or down
- xv. Maintain three-point contact while climbing up or down a ladder i.e. two hands and one foot or two feet and one hand on the ladder at all the times.
- xvi. Avoid climbing up or down a ladder while carrying anything in hands. Lift tools, equipment and materials with a rope.
- xvii. Work from portable and extension ladders near guardrail where fall expose exists over the guardrail regardless of height, and above 2.0 mtr. heights from the working/walking surface will require the use of personal fall arrest equipment

2. EXCAVATION & CIVIL WORKS

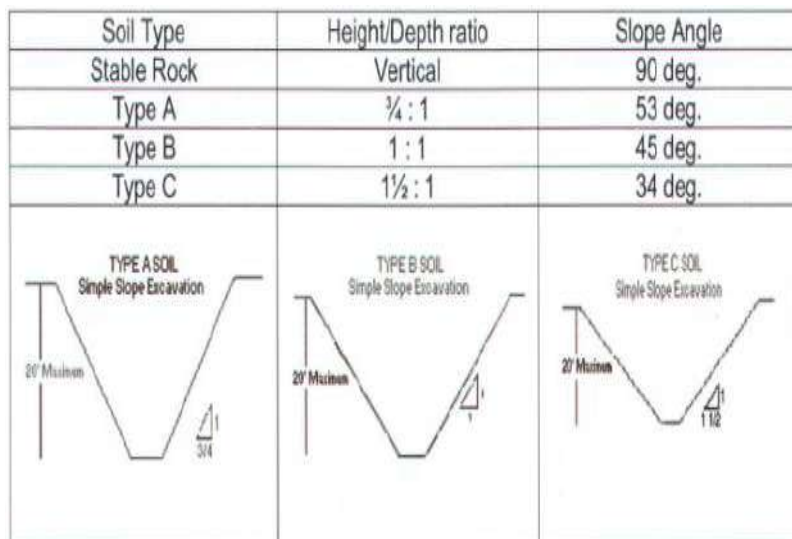
All safety precautions shall be taken for foundation and other excavation marks as per IS-3764.

2.1 Excavation

The following safety measures are to be ensured before and during excavation:

- a. All Excavation activities more than with depth of 1.22 meter or more shall require and Excavation Work Permit
- b. Check for underground utilities like electrical / telephone cables, sewage, water lines and proper care has to be exercised to protect and prevent damage to it.
- c. Electrical cables and service lines to be identified using cable detector/locator device before carrying out the excavation work
- d. Proper and adequate slope is maintained while excavating
- e. Adequate shoring or sheeting is done wherever require to prevent soil sliding
- f. Safe access through ladder or steps for exit & entry to excavation
- g. No material /excavated soil is kept within one meter from the edge
- h. Safe way is planned and provided for movement of HEM /transport equipment near excavation
- i. Safety helmet and shoes/gum boots are provided and worn by the workmen at excavation works

- j. Dewatering arrangement is made where water seepage is prevailed.
- k. Stop blocks are provided to avoid vehicles reversing into the excavated trenches
- l. Danger signs /Caution boards are displayed at work spot
- m. Hard Barricading is provided at excavated pits. It should be made of scaffolding pipe and clamp with reflective nets.
- n. All Excavated area of depth 3mtr or more is to be hard barricaded with pipe.



Determining Soil Type		
Type	Description	Examples
A	Cohesive soils with an unconfined compressive strength of 1.5 tons per square foot or greater.	Clay, silty clay, sandy clay, clay loam and in some cases: silty clay loam and sandy clay loam.
B	Cohesive soils with unconfined compressive strength greater than 0.5 tsf but less than 1.5 tsf.	Angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases silty clay loam and sandy clay loam.
C	Cohesive soils with unconfined compressive strength greater than 0.5 tsf or less.	Granular soils such as gravel, sand and loamy sand; submerged soil or soil from which water is freely seeping; submerged rock that is not stable.

Fig. 3.1 Excavation Reference

2.2 Piling

Ensure the following precautionary measures before starting piling works:

- a. Inspection of piling equipment by responsible person for its condition before initiating piling operation.
- b. Checklist and OCP for piling to be prepared using manufacturer's instructions and used
- c. Testing and its certification wire rope, slings, D-shackles, chain pulley blocks using in the process of piling work by competent person
- d. Adequate support and secured foundation of the piling equipment to avoid toppling
- e. Hoses should be lashed and adequately secured
- f. Proper work platform is to be provided on piling frame
- g. Safe work procedures and close supervision to prevent unsafe acts of operators/any unsafe conditions that may arise
- h. Only experienced and trained operators are engaged for the piling operation
- i. Provision of Personal Protective Equipment (PPE) like safety shoes/gumshoes/safety helmet/safety belt etc. and its use by their workmen.
- j. Special care and precautions If work is near electrical live cables/ electrical equipment
- k. Cordoning of work area to prevent un authorized entry
- l. Guarding of revolving parts
- m. Specific measures to prevent over turning of pile driver/missing of hammer/ hammer movement out of range

2.3 Batching Plant Operation

Following Safety considerations for batching plant are to be ensured:

- 1. Modern type batching plant should be used in which all the moving parts are protected and emergency

and safety features are incorporated.

2. Installation of external Electric moto-vibrators in the feeding hopper of all batching plants to reduce human intervention.
3. Installation of safety devices like pull-chord on both the sides of conveyor for stopping the conveyor in emergency
4. Workers carrying cement / sand to be given appropriate PPEs like respiratory masks & gloves.
5. Conveyor belt/rotating parts must be guarded properly.
6. Safety awareness shall be inculcated in workmen about the risk involved in rotating parts.
7. The agency shall ensure to erect the batching plant as per drawing including installation of all safety devices as provided by manufacturer and witnessed by BHEL Engineer in charge before starting of machine in future.
8. Safety audit to also focus on Batching plant.
9. The site shall impose penalty on the agency who has violated the safety norms as per contract.

2.4 Mobile Plant

Mobile plant includes tractors, trailers, dumpers, excavators, bulldozers, road rollers etc. for earthmoving purpose and concrete mixers, concrete transit mixtures, concrete pumps etc for concreting purpose. Due to the very nature of their function and movement in difficult terrains, congested areas, working in tandem with manual work and other operations the danger is inherent.

Automatic reverse camera with reverse horn connected with reverse gear is compulsory for all moving machineries.

Following Safety measures to be ensured for Mobile Plant:

- a. Where movement around site is involved, routes should be planned, obstruction free and well maintained
- b. Observe specified speed limits
- c. Operating personnel should be aware of associated risks and its preventive measures
- d. Only experienced, trained and authorized persons with valid license (wherever applicable) should operate the mobile equipment/vehicles
- e. Provide and use Warning lights and reverse horn for cautioning the people around
- f. Operation should be on level and stable ground with adequate working clearance.
- g. Loading of out riggers/stabilizers should be well within safe ground bearing capacity
- h. No person should be on equipment or vehicle during loading and unloading of material
- i. Operators should be protected by warning barriers or switching off power when working in close proximity of overhead power lines
- j. The equipment /vehicles should be well maintained and provided with effective brake system and other safety devices (wherever require)
- k. Rotating parts of equipment should be adequately guarded
- l. Provide necessary personal protective appliances and ensure its use by the operating personnel Ensure effective measures at source to control harmful emissions, dust, fumes contaminating atmosphere and cause health hazards to the operators and people in the vicinity.
- m. No overloading/over stressing of vehicles/plant is allowed
- n. Hoses, pipes, receivers, gauges and valves involved in carrying out hydraulic fluid/ compressed air should be checked for leaks and tested prior to operation.

- o. Adequate safe clearance for swing and movement is to be judged during operation of Concrete mixer
- p. Setting of machines on firm and level ground with wheel locked to prevent movement of machine
- q. Proper instructions and Special precautions are to be ensured to prevent entry in to the danger zone of projectile of bucket while dropping bucket
- r. Operator leaving work spot should ensure that the equipment/vehicle is kept in neutral position and place on firm and level ground.
- s. The hand brake should be kept in position and block road wheels as additional safety measure
- t. Blades/buckets should be kept low while moving
- u. The dozer blades should not be used as brakes except in emergency
- v. The ground should be examined for its bearing capacity and general safety especially when operating road roller at the edges of slopes, embankments.
- w. The roller should not be moved downhill with the engine out of gear
- x. If operating near excavations the following precautionary measures are to be ensured
- y. Barricading, edge protection to prevent fall of persons/vehicles over running while reversing etc.
- z. Suitable support system and adequate allowance to avoid the danger of side collapsing
- aa. Experienced signaler /attendant should be always accompanied with operator/driver for proper direction /signal and also to caution others in the working Zone during operation of mobile plant

2.5 Concrete Vibrators

- a. Revolving parts/belt drives should be adequately guarded and Vibrating unit shall be completely enclosed and have suitable overload relays and effectively earthed
- b. Ensure sufficient length of cable to the Vibrator.
- c. Ensure electric starters and other accessories are firmly fixed adequately supported
- d. Ensure locking of needle load while inserting needle in to the vibrator,
- e. Ensure periodical lubrication and maintenance

2.6 Concrete Mixers

- a. Setting of machines on firm and level ground with wheel locked to prevent movement of machine
- b. Proper instructions and Special precautions are to be ensured to prevent entry in to the danger zone of projectile of bucket while dropping bucket

3. WELDING & GAS CUTTING SAFETY (HOT WORK)

- a. All Hot Work shall require a Hot Work Permit
- b. Inbuilt Voltage Reduction Device (VRD) equipped arc welding machine will only be allowed for work.
- c. There shall be flash-back arrestors conforming to IS-11006 at both cylinder and burner ends. Damaged tube and regulators must be immediately replaced.
- d. All safety precautions shall be taken for welding and cutting operations as per IS-818.
- e. When possible, items to be welded, cut, heated, etc. shall be moved to a safe location free of combustible or flammable material. If this is not possible, then all combustibles/ flammables that can be removed from the area shall be removed within a 35-foot circumference and a positive means of confining arcs and sparks generated by the process shall be ensured and additional person(s) shall be stationed as fire-watch for the area(s) still exposed, along with obtaining the Hot Work Permit as applicable.
- f. Appropriate fire-fighting equipment is to be available in close proximity of any welding and gas cutting operations at all times suitable for the type of Fire.

- g. Drums, tanks, and similar containers that have contained flammable or toxic material shall not be welded, cut, or heated until they have been made safe by water filling, thorough cleansing or similar accepted practices. The container shall also be ventilated during the welding, cutting, or heating process.
- h. Proper ventilation is required for any welding or torch operations performed in a confined space.
- i. Any welding or gas cutting operations performed on metals of toxic compounds or coating such as zinc, stainless steel, lead, cadmium, chromium, and beryllium shall be properly ventilated and/or proper respiratory protection shall be worn by any person that could be exposed to fumes, vapors, and gasses created by the welding and gas cutting processes.
- j. Wherever it is practical, all arc welding operations shall be shielded to prevent direct light rays or sparks from contacting persons in the vicinity or from reaching areas normally used to travel through or into the vicinity. Where this is not practical, persons who shall be in the area are to use proper eye and skin protection. Other persons who are not participating in the welding or gas cutting operations are not to be allowed into the hazard zone.
- k. Welders and other employees who are exposed to arc welding radiation shall wear suitable clothing and protective apparel to prevent burns and other types of ultraviolet radiation damage to the skin.
- l. Arc welding machines shall be shut down when being moved or when they are not in continuous use. Electrode holders left unattended shall have electrodes removed and shall not be left where they might contact employees or conducting objects.
- m. Arc welding power supply cable shall be of proper rating and material, e.g. copper.
- n. Welders shall guard against allowing materials adjacent to or behind them to reflect radiation back toward them or towards others in the area. Reflected radiation can cause skin burns and eye flash burns.
- o. Valve caps shall be in place when cylinders are not in use. Valve caps shall never be used for lifting the cylinder vertically.
- p. Torches shall only be lit by approved strikers; never with matches, cigarette lighters, or hot-work.
- q. **Splatter / Slag Collector:**

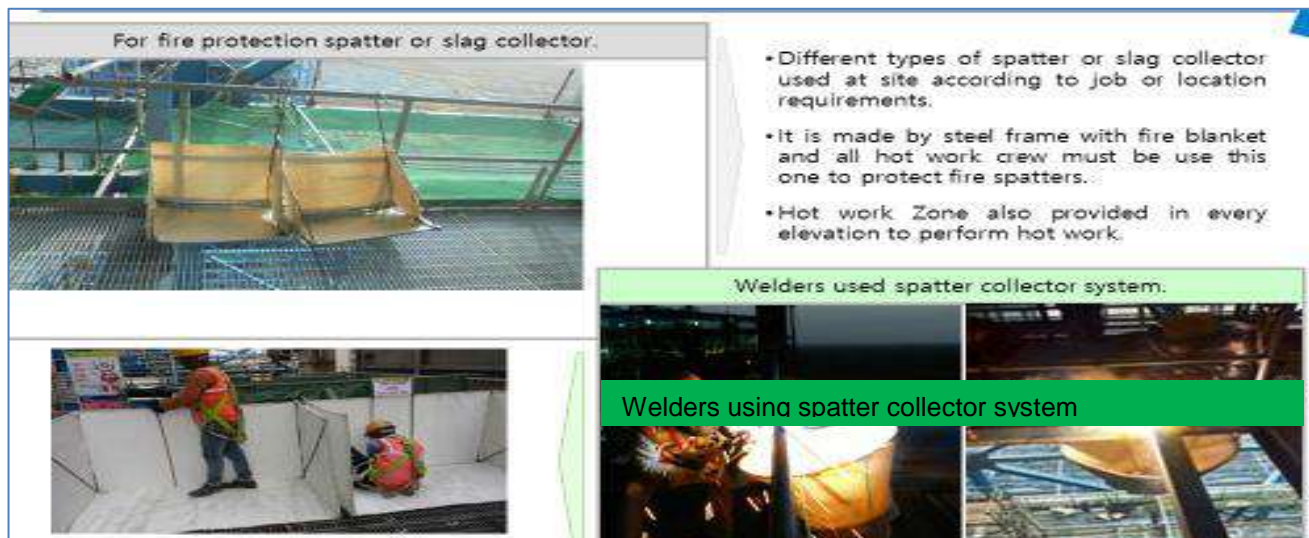


Fig. 4.1 Splatter / Slag Collector

While carrying out job at height, the sparks or molten slag shall be prevented from falling down by putting a fire-resistant (non-asbestos) sheet or patter/ slag collector or even MS Sheet. The passage of falling sparks

or molten slag shall be barricaded till ground floor and any cable/ tubes/ any other objects interfering in the passages shall either be removed or covered with Fire-resistant sheet or MS Sheet.

r. COMPRESSED GAS

- i. All cylinder valves shall be closed when any work is finished and when any Cylinders are empty or being moved. Valve protection caps shall be placed and secured properly before gas cylinders are transported, moved or stored.
- ii. Compressed gas cylinders shall be secured in an upright position with chain or appropriate means during storage & use. However, a trolley shall be used for transportation.
- iii. Compressed gas cylinders shall always be secured from tipping or falling, whether in use, in storage or in transit. The cylinders shall always be secured upright, except during times when actually being hoisted or carried.
- iv. When cylinders are transported by powered vehicle they shall be secured in a vertical position.
- v. Regulators shall be removed when cylinders are not in use or are in transit, unless the cylinder is firmly secured on a special carrier designed for this purpose.
- vi. Gas cylinders are not allowed to be used in man-basket when occupied.
- vii. Cylinders containing oxygen or fuel gasses shall not be taken into confined spaces.
- viii. Oxygen cylinders shall be stored a minimum of 6 meters from fuel gas cylinders or shall have an approved firewall between them.
- ix. All cylinders shall be kept at a safe distance from welding or cutting operations or shielded from arc/sparks / slag.
- x. All cylinders shall be placed where they cannot become part of the electrical circuit.
- xi. Oxygen and acetylene shall not be stored together. Oxygen must be separated from acetylene (or ANY fuel gas) or combustible material by at least 20ft or a barrier with a 30-minute fire resistance rating.
- xii. All Cylinders should be stored upright in a designated area with labels for the type of gas. All applicable precautions to be ensured during storage
- xiii. Oxygen and fuel gas regulators, hoses and associated equipment shall not be altered and shall be in proper working order while in use.
- xiv. Compressed air can be extremely dangerous if allowed to penetrate the skin. As such, the use of compressed air to clean off yourself or other workers shall be strictly prohibited.
- xv. All gas cylinders shall be stored in upright position. Suitable trolley shall be used for cylinder movement, the design of which shall be submitted to BHEL Engineer for approval.
- xvi. No of cylinders shall not exceed the specified quantity as per OCP
- xvii. Cylinders shall be moved by tilting and rolling them on their bottom edges. They shall not be intentionally dragged, struck or permitted to strike each other violently.
- xviii. All cylinder should be kept only in cylinder trolley.
- xix. Cylinder shall be transported in upright vertical position by suitable mean.

4. LIFTING & RIGGING SAFETY

- a. All Heavy / Complex Lifting operations as defined in Clause 6.12 shall require a Lifting Work Permit. A written rigging procedure and plan must be prepared for all individual heavy/ complex lifting operations.

- b. All the cranes and lifting tools & tackles shall be inspected on daily / weekly basis as well as monthly by expert as per applicable formats.
- c. In addition, inspection / certification as mandated by law shall be carried out wherein these shall be tested and certificates of fitness shall be obtained from 3rd party State Govt. approved competent agency before deploying at site and later periodically. BHEL shall be given advance intimation of any such inspections
- d. The last date of Third-Party Inspection and the next Due date shall be conspicuously displayed on all cranes. A copy of certificate shall be pasted on operator's cabin of all the lifting equipment.
- e. Specifically designed heavy steel plates lifting clamps shall be used for lifting heavy metal sheets. Manmade lifting clamp chapa shall not be used for lifting/shifting of plates.
- f. Following requirements shall be mandatorily followed, wherever applicable:
 - i. The manufacturer's instruction for maintenance shall also be followed. All safety measures shall be followed.
 - ii. All tools tackles, lifting appliances; material-handling equipment etc. used by the subcontractor shall be of safe design and construction.
 - iii. The operators, slingers and signalers shall be qualified as per IS 13367 (part-1):2003 "Safe use of cranes- code of practices".
 - iv. There shall be a person responsible for co-ordination among cranes where multiple cranes are used, and lifting over load chart of the crane to be avoided.
 - v. Mobile phone should be banned for crane operator and lifting operation. Only walkie talkie shall be allowed in rigging/Lifting purpose.
- g. Lifts/Movements between 5 Tons and 20 Tons:
 - i. Shall include a rigging plan, detailing schematic representation of the handling/lifting operations that must be included on the Method Statement.
 - ii. When performing similar lifts of identical items, only one rigging plan need be prepared, provided each of the lifts can be performed in accordance with the rigging plan.
- h. Lifts/Movements Less Than 5 Tons:
 - i. An equipment rigging plan is not required for lifts less than 5 tons, safety measures are covered in the JSA. This could change as per BHEL requirement

i. Personnel Lifts (Man-Basket / Jhoola):

The design of personnel man basket shall be submitted to BHEL Engineer for approval before use. Relevant permit (Height work & others as applicable) shall be completed prior to lifting any people, along with a rigging plan.

- i. A separate Lifeline / fall arrestor anchored to a fixed structure outside of Jhoola shall be provided for the workers inside the basket. All occupants of the basket shall have Safety Harnesses equipped with rope grabs, which are to be hooked to the vertical lifeline.
- ii. Man-basket shall be used where access through ladders or scaffolding is not feasible.
- iii. Man-baskets shall be designed and engineered by a manufacturer (job made man-baskets are not allowed, unless designed and tested by a certified engineer), and built robust with MS Angles and flats or plates or channels only.
- iv. Guard rails top and mid, must be in place and screened-in to avoid material from falling out of

basket. The factor of safety shall be 200%.

- v. It shall have a door with double latches and shall open inside. Anchor points shall be identified within the man-basket.
- vi. The man-basket shall be thoroughly inspected and load tested and a trial run performed without personnel before being put to job.
- vii. It shall be treated as a lifting tool (T&P Item) and shall undergo same certification cycle and inspection as other lifting equipment.
- viii. An additional sling of required lifting capacity shall be fixed the man-basket main lifting point and attached to the crane above the ball or block.
- ix. While lifting man-basket, the crane shall maintain a uniform speed of lift without any swing.
- x. Once man-basket reaches the destination, the lift brakes shall be locked as long as the basket
 - a. remains at that point. The same care shall be taken in its descent.
- xi. As for hanging man-basket, the same shall be hung off a rigid structure with help U-shaped handle welded to man-basket. This shall be tested once in a year by a competent person.
- xii. Use of Rebar steel for making and monkey-ladder must be avoided.

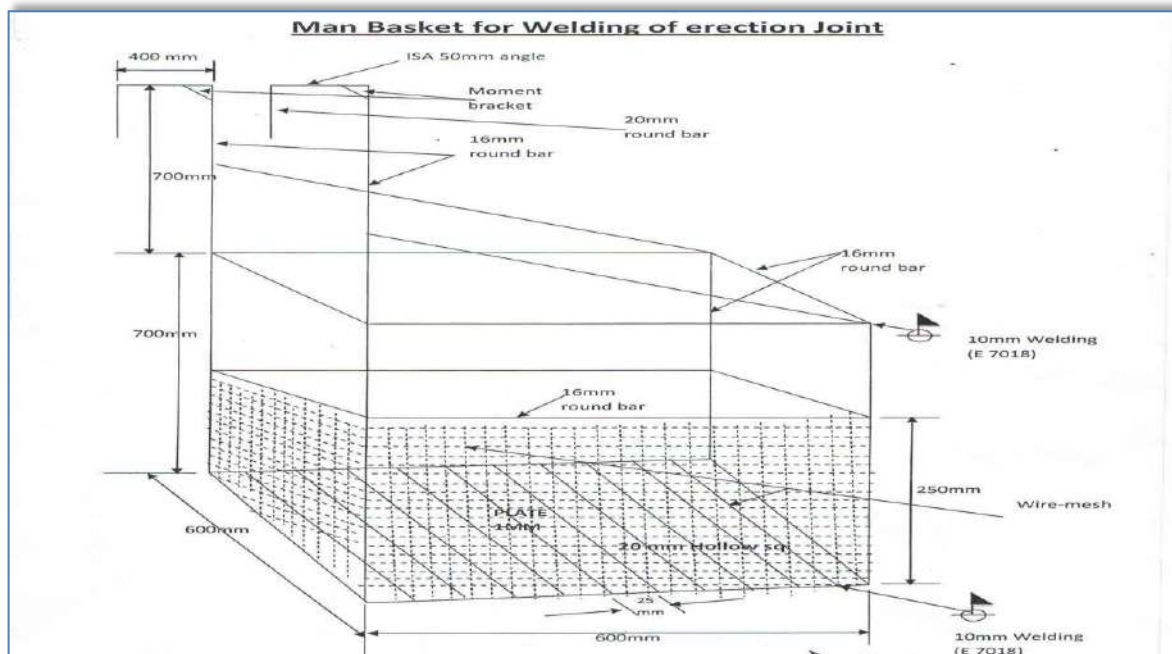


Fig. 5.1 Man Basket for Welding Erection Joint

4.1 Cranes & Hoisting Equipment:

This section provides the guidelines to ensure proper rigging and lifting activities are accomplished safely and in accordance with applicable specifications, codes, and regulations.

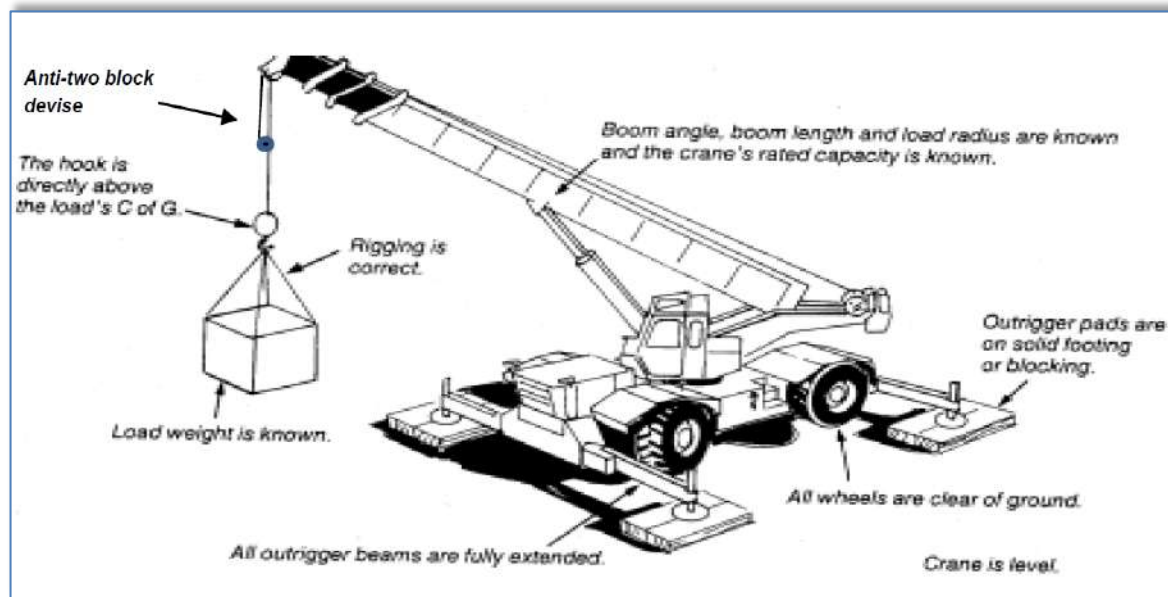


Fig. 5.2 Proper Crane Setup

- a. On every crane or piece of hoisting equipment notices of all rated load capacities, recommended operating speeds, and any hazard warnings or special instructions shall be conspicuously posted. All instructions and warning shall be visible from the equipment operator's station.
- b. Cranes shall have an Anti-Two-block safety device installed
- c. All mobile cranes shall have overload and backup alarms, load angle indicators and limit switches
- d. All areas within swing radius of cranes that are potentially accessible by pedestrian, vehicular, or equipment movement shall be barricaded to prevent anyone or any vehicle or equipment from being struck by the crane or hoisting equipment, or its load(s).
- e. No part of the lifting equipment or its load shall be within the distance as specified in the Indian Electricity Act from an energized power line
- f. Cranes shall have annual certified third-party inspection and be inspected before use by the operator. Any defects shall be corrected before use. Logs of crane inspection shall be kept with the crane.
- g. Make certain that the rigging personnel, material, and equipment have the necessary capabilities for the job and are in safe condition.
- h. Communicate with person(s) directly responsible for accomplishing the work and / or work area to establish requirements/responsibilities and make certain that all preparatory work is complete.
- i. Mats/Pads must be used on all lifting equipment, equipped with out riggers.
- j. Pick and carry must have the load secured to the rig in front.
- k. Only BHEL Approved Plate Lifting Spreader Beam configuration shall be used (Sample in Fig. 11.3.5.3)
- l. Crane operators must follow the following:
 - i. Pass an annual Operator's Physical examination
 - ii. Carry a valid training certification card at all time while operating issued by the Govt. or other recognized institute.

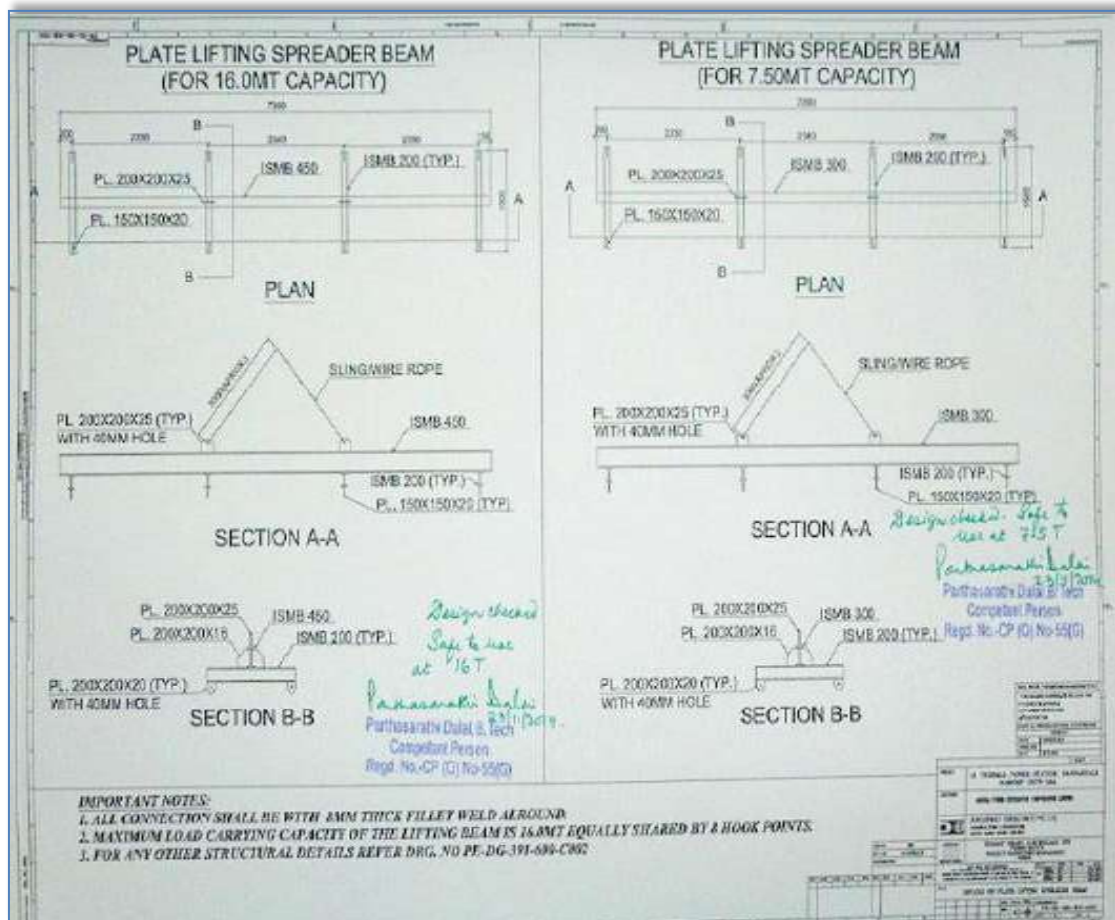


Fig. 5.3 Typical Plate Lifting Spreader Beam Configuration for 7.5 MT and 15 MT Loads

m. Safe Rigging Practices

- Review the planned operation and requirements with the operator and rigging crew.
- Ensure a pre-lift meeting is conducted with crane operator, tagline operator, signal personnel, and Safety Manager.
- Designate a qualified person from the rigging crew to observe clearance of the equipment and give timely warning for all operations where it is difficult for the operator to maintain the desired clearance by visual means.
- Clear the lift area of all unnecessary personnel.
- Hydras shall only be allowed for loading & unloading works & shall not be allowed to move with load

n. Rules for Safe Rigging

- Use loops, thimbles and corner pads to prevent damage to slings when used around corners or on cutting edges.
- Never allow wire rope to lie on the ground for any length of time or on rusty steel or near solvents, chemicals or corrosive substances.
- Slings must not be pulled from between or under loads with load resting on the sling.
- Keep all rope away from flame cutting or welding operations.
- Never use rope as sling material.
- Never wrap a wire rope completely around a hook.

- vii. Do not bend wire rope near any attached fitting.
- viii. The sling must be selected to suite the most heavily loaded leg rather than the total weight when using multi-legged sling to lift loads in which one end is heavier than the other.
- ix. When using 3 and 4-legged sling configurations, any two legs must be capable of supporting the entire load.
- x. Where possible, wire rope choker hitches must include a shackle with the eye around the shackle pin to prevent breaking wires of the choke. The choker hitch must be “snugged down” prior to lifting, not after tension is applied.
- xi. Unless authorized by the hook manufacturer when more than two rope eyes are placed over a hook, install a shackle, pin resting in the hook, and place the rope eyes in the bowl of the shackle.
- xii. Properly rig all loads to prevent dislodgment of any part.
- xiii. Use guide ropes or tag lines to prevent the rotation or uncontrolled motion of the load when necessary.
- xiv. Loads must be safely landed and properly blocked before being unhooked and unslung. Tag lines must not be used in situations that jeopardize the safety of the lift.
- xv. Lifting beams must be plainly marked with their weight and designed working load and must only be used in the manner for which they were designed.
- xvi. The hoist rope or chain must never be wrapped around the load. The load must be attached to the hook by slings or other rigging devices that are adequate for the load being lifted.
- xvii. Multiple part lines must not be twisted around each other.
- xviii. The hook must be brought over the center of gravity of load before the lift is started.
- xix. If there has been a slack rope condition, determine that the rope is properly seated on the drum and in the sheaves prior to lifting.
- xx. Keep hands away from pinch points as the slack is being taken up.
- xxi. Leather gloves are recommended when handling wire rope.
- xxii. Avoid impact loading caused by sudden jerking when lifting or lowering. Lift the load gradually until the slack is eliminated.
- xxiii. Never ride on a load that is suspended.
- xxiv. Avoid allowing the load to be carried over the heads of any personnel.
- xxv. Never work under a suspended load until the load has been adequately supported from the floor and all conditions have been approved by the supervisor in charge of the operation.
- xxvi. Never leave a load suspended unless emergency evacuation is required.
- xxvii. Never make temporary repairs to sling.
- xxviii. The capacity of a sling is determined by its angle, construction, type of hitch and size.
- xxix. Never lift loads with one leg of a multi-leg sling until the unused legs are made secure.
- xxx. Never point load a hook unless it is especially designed and rated for such use.
- xxxi. Make certain that the load is broken free before lifting and that all legs are taking the load.
- xxxii. When using two or more slings on a load make certain all slings are made from the same materials.
- xxxiii. Lower the loads on to adequate blocking to prevent damage to the slings.
- xxxiv. Materials and equipment being hoisted must be loaded and secured to prevent any movement which could create a hazard in transit.

- xxxv. The weight of the hook, load block and any material handling devices must be included when determining crane capacity.
- xxxvi. Calculated weights cannot exceed load chart without written approval.
- xxxvii. Personnel must be completely clear of loads being picked up or set down by crane. Tag lines will be used to control the loads. Loads must not be touched by hand while placing/ moving.

o. Slings

The following are rules for safe use of synthetic slings:

- i. Synthetic slings must be marked to show the rated capacity for each type of hitch and type of web material.
- ii. Nylon web slings must not be used where fumes, vapors, sprays or mists or liquids of acids or phenolic are present. Web slings with aluminum fittings must apply in this category.
- iii. **Synthetic web slings must be removed from service and destroyed if any of the following conditions are present:**
 - a. Acid or caustic burns
 - b. Melting or charring of any part of the sling surface
 - c. Snags, punctures, tears or cuts
 - d. Broken stitches
 - e. Distortion of fittings
 - f. Synthetic web slings of polyester or nylon must not be used at or come in contact with temperatures in excess of 82°C
 - g. Polypropylene web slings must not be used at or come in contact with temperatures in excess of 93°C
 - h. Insulated hooks must be tested yearly to ensure insulation integrity to at least manufacturer's specifications.

p. Wire Rope Slings must be removed from service and destroyed if any of the following conditions are present:

- i. In (10) randomly distributed wires broken in one (1) rope lay, or five (5) broken wires in one (1) strand in one (1) rope lay.
- ii. Wear or scraping of one-third the original diameter of outside wires.
- iii. Kinking, crushing, bird caging or any other damage resulting in distortion of the wire rope structure such as:
- iv. Evidence of heat damage.
- v. End attachments that are cracked, deformed worn.
- vi. Corrosion of the rope or end attachments.

q. Metal mesh slings must be immediately removed from service if any of the following conditions are present:

- i. A broken weld or broken brazed joint along the sling edge.
- ii. Reduction in wire diameter of 25 percent due to abrasion or 15 percent due to corrosion.
- iii. Lack of flexibility due to distortion or corrosion.

r. Requirements of Plate Clamps:

- i. The rated load of the plate clamp must be marked on the main structure.

- ii. Care must be taken to make certain the load is correctly distributed for the plate clamp being used.
- iii. Do not allow load or plate clamp to come into contact with any obstruction.
- iv. The plate clamp must not be used for side pulls or sliding the load.
- v. When lifting stainless steel or special alloys, ensure plate clamp is designed for use on the specific metal.

s. Signaling Practices:

- The "slinger" is responsible for attaching and detaching the load to and from the crane. He shall:
 - have received appropriate training on general safe lifting operations;
 - be capable of selecting lifting gears suitable for the loads;
 - liaise with the operator and direct the movement of the crane safely.
- The "signaller" is responsible for relaying the signal from the slinger to the crane operator. He shall:
 - have received appropriate training on general safe lifting operations;
 - be able to direct the movement of the crane and loads.

Suggested hand signals



Note: During the lifting operation, either the slinger or signaller shall communicate with the operator. Other communication methods (e.g., wireless walkie-talkies, telephones, etc.) may also be used.

Fig. 5.4 Recommended Signaling Practices

5. DEMOLITION WORK

Before any demolition work is commenced and also during the process of the work the following shall be ensured, besides using the Work Permit:

- a. All roads and open areas adjacent to the work site shall either be closed, suitably protected or restricted for movement
- b. No electric cable or apparatus which is liable to be a source of danger nor a cable or an apparatus used by the operator shall remain electrically charged.

- c. All practical steps shall be taken to prevent danger to persons employed from the risks of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render them unsafe.

6. T&PS GENERAL

- a. All T&Ps/ MMEs should be of reputed brand/appropriate quality & must have valid test /calibration certificates bearing endorsement from competent authority of BHEL.
- b. Subcontractor to also submit monthly reports of T&Ps deployed and validity test certificates to BHEL safety Officer as per the format/procedure of BHEL.
- c. Tagging and punching in all lifting tool is compulsory with SWL, sr. no. and due date.
- d. All T&Ps shall be inspected by authorized Third Party agency as per applicable frequency. BHEL shall be kept informed of any such scheduled inspection
- e. All T&Ps shall be internally inspected in each quarter and colour coded.

7. CHEMICAL HANDLING

- a. Displaying safe handling procedures & MSDS for all chemicals such as lube oil, acid, alkali, sealing compounds etc. at work place.
- b. Where it is necessary to provide and/or store petroleum products or petroleum mixture & explosives, the subcontractor shall be responsible for carrying out such provision / storage in accordance with the rules & regulations laid down in the relevant petroleum act, explosive act and petroleum and carbide of calcium manual, published by the chief inspector of explosives of India. All such storage shall have prior approval if necessary from the chief inspector of explosives or any other statutory authority. The subcontractor shall be responsible for obtaining the same.
- c. The used containers of chemicals shall be segregated and disposed of suitably
- d. In case the used containers need to be re-used, all traces of the chemical to be removed by thorough cleaning with detergents etc. under trained supervision

8. ELECTRICAL SAFETY

- a. Only electricians licensed by appropriate statutory authority shall be employed by the subcontractor to carry out all types of electrical works. The subcontractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installations.
- b. No PDB or any other distribution board shall be more than 03 (three) years of purchase. Only modern PDB with industrial sockets as shown in layout below to be allowed to use at site.
- c. Power supply to all equipment at site to be routed through MCBs of appropriate rating. A 'Power Supply Distribution Plan' shall be prepared and submitted to BHEL Engineer for approval
- d. All power supplies through cables shall be underground or overhead with height > 3mtrs.
- e. All power distribution boxes shall be locked and the key controlled by site management of concerned subcontractor.
- f. All individual equipment & tools at site shall be powered through Earth Leakage Circuit Breakers of 30 mA sensitivity.
- g. These MCBs and ELCBs shall be regularly tested as per Clause 14
- h. All fuses and fuse wires shall be of standard size and rating.
- i. All electrical appliances used in the work shall be in good working condition and shall be properly double earthed other than armour earthing.

- j. All extension boards shall have separate switches for all sockets / connections.
- k. All portable electric tools used by the subcontractor shall have safe plugging system (industrial top & socket) to source of power and be appropriately earthed.
- l. Providing adequate no. of 24 V sources and ensure that no hand lamps are operating at voltage level above 24 Volts especially in confined spaces like inside water boxes, turbine casings, condensers etc.
- m. Electrical appliance shall have proper earthing and for appliances equal to & more than 415V shall have two separate earthing (as per IS-3043-1987)

n. Portable Electric Lights

- i. Portable electric lights used in wet or potentially wet locations must be either low voltage type (24 volts or less) or protected by a GFI (ground fault interrupter).
- ii. They must be visually checked before each use and periodically while in use to assure their original integrity is maintained.
- iii. Cords with cuts, breaks, deep abrasions, etc. shall be taken out of service immediately.
- iv. Repairs to extension cords shall only be performed by qualified/ licensed electricians.
- v. Must not be allowed to lie in wet or potentially wet areas.

o. Underground Cables:

- i. Every electric line or cable of unknown origin that is discovered or exposed during a digging, drilling, probing, or similar operation is to be considered as energized and life threatening.
- ii. The senior company employee on the site will ensure that all necessary safety precautions are taken in order to isolate the line from all workers and the public.
- iii. Such precautions may include halting the operation if appropriate.
- iv. The senior company employee on the site is to then contact the proper authorities to have the line identified and either confirmed to be abandoned and/or made safe for continuing the work.
- v. Any and all underground lines that are discovered or become severed must be considered energized on both sides, and be treated accordingly.
- p. Details of earth resource and their test date to be given to BHEL safety officer as per the prescribed formats of BHEL
- q. The subcontractor shall use only properly insulated and armoured cables and conform to the requirement of Indian Electricity Act and Rules for all wiring, electrical applications at site.
- r. BHEL reserves the right to replace any unsafe electrical installations, wiring, cabling etc. at the risk & cost of the subcontractor.
- s. No maintenance work shall be carried out on live equipment
- t. Adequate precautions shall be taken to prevent danger for electrical equipment. No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or the public
- u. The subcontractor shall carefully follow the safety requirement of BHEL/ the purchaser with the regard to voltages used in critical areas.
- v. Wiring and Branch Circuits Must be protected by a proper amperage over-current device such as a HRC fuse or circuit breaker. Such installations must be located so as to prevent physical damage to the wire conductors & panels.

- w. The sub-contractor shall supply modern power distribution board of different combination (1-phase & 3-phase). All the distribution of power should be through modern PDB. Equipment drawing is mentioned below.

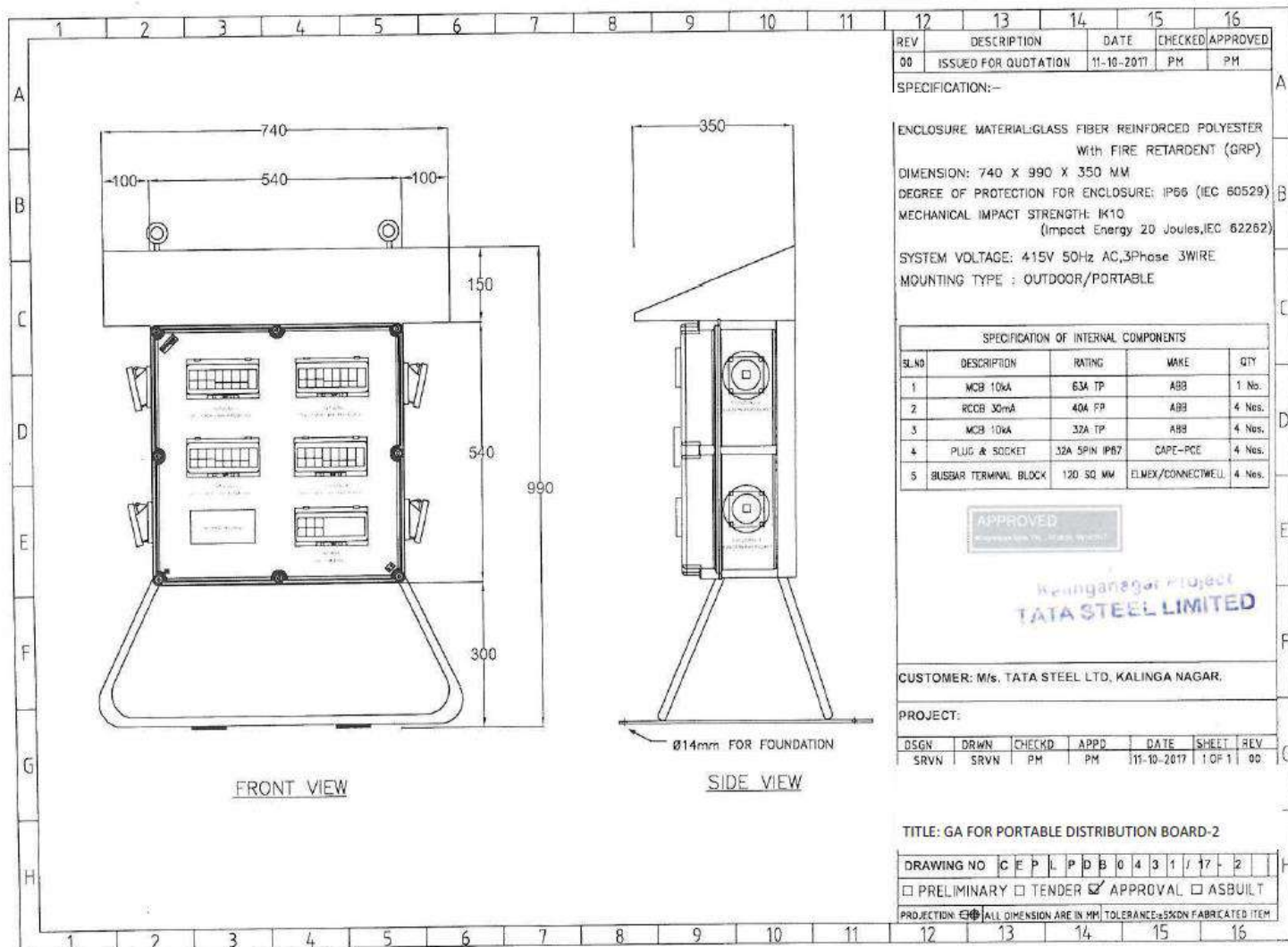


Fig. 9.1 Layout of a modern Power Distribution Board

x. General Electrical Safety

- In general, equipment or machinery being moved or transported must maintain minimum clearances of 25 ft. to all power lines.
- TAG IN/ TAG OUT must be in force in Switch Room and all Distribution Boxes for live power line. The authorized person's name and contact no shall be displayed
- Ensure "double insulated" three - core cables and three pin connectors are used and are properly ground "all insulated" types, all electrical tools and appliances must be manufactured for industrial use.
- All connections shall be electrically and mechanically sound and properly insulated. Taped joints are not permitted. Connections to socket outlets must be made with proper plugs (industrial top and socket).
- Splices in electrical cords are not permitted. Repairs must be made at the socket connection and retain the same mechanical and dielectric condition of the original connection.

- vi. Damaged or defective electric tools, equipment and extension cords, etc. must not be used and shall be tagged out of service, removed from the work area and taken back to stores.
- vii. Only licensed electricians are authorized to repair and work on electrical equipment. Tampering with electric tools or equipment by others could result in termination.
- viii. Temporary electric cabling should be elevated 2.2 meters above the floor/ground or covered for protection. It must be kept clear of walkways and other locations where it may be exposed to damage or create a tripping hazard.
- ix. Energized wiring in junction boxes, circuit breaker panels and similar places must be covered and locked at all times.
- x. Areas with live high voltage wires or terminals must be barricaded against entry and warning signs posted Danger – High Voltage and Authorized Personnel Only.
- xi. Personnel should never work on energized equipment, de-energizing (lockout/tag out) the equipment is always the first requirement.
- xii. The lockout and tag out procedure will be used when testing or working on, or around, energized installation.
- xiii. Working around energized equipment should never be done alone. A second electrician must always be available for assistance.
- xiv. If lockout/tag out of the work is infeasible (must be demonstrated), work on energized electrical circuits must be approved by the Site In-charge. All safety precautions necessary must be taken, PPE use must be evaluated per the exposure and used, i.e high/low voltage gloves, insulated shoes, overcoats/aprons, face shields, and other protective equipment like insulated tools, blankets, mats, etc. must be used.
- xv. The welding machines earth leads shall be properly fixed without loose contacts. The earth cable only has to be used. No steel members shall be used as earth leads.
- xvi. Electrical crews must be qualified for the equipment and tools they work on, including being trained in Cardio-Pulmonary Resuscitation (CPR) methods and First Aid for rendering help in the event of electric shock.

y. Qualified Persons for Electrical Works

(One who is trained and wiremen licensed to Govt. of Respective State and familiar with the construction, operation and safety hazards of the equipment upon which they are permitted to work.)

- i. Qualified persons are intended to be only those who are well acquainted/experienced with and thoroughly conversant in the electric equipment and electrical hazards involved with work being performed.
- ii. Only qualified persons may be permitted to work on or near exposed energized parts. Such persons are required to have been trained in three specific areas:
- iii. Qualified persons must be capable of working safely on energized circuits;
- iv. Must be familiar with the proper use of special precautionary techniques and procedures bases on equipment and exposure; and
- v. Must be familiar with required personal protective equipment, insulating and shielding materials, and insulated tools.

- vi. Qualified persons are expected to be able to evaluate unknown situations and adjust their activities in such a way that only safe work practices are used. Such behavior is the responsibility of the qualified person.
- vii. It is possible and likely for an individual to be 'qualified' with regard to certain equipment in the work place, and unqualified on other equipment they must know their limitation and stop work if not qualified on what equipment they were to work on.
- viii. An employee who is undergoing on-the-job training, who, in the course of such training, has demonstrated an ability to perform duties safely at his or her level of training, and who is under the direct supervision of a qualified person is considered to be a qualified person for the performance of those duties. The process must be documented as proof.

z. Mandatory PPEs of electrical work on LV & HV

- i. HV arc flash suit with protective hood (for protection of face and head) as specified for hazard risk category-4 in NFPA-70E or similar IS specification for working on HT switch gear (for all voltage >690 V) to the concerned licensed electrician or competent person.
- ii. LV arc flash jacket/FR as specified for hazard risk category-4 in NFPA-70E or similar IS specification having ATPV rating of 8.5 to 9 cal/cm² for working on LV (>260V and ≤690V) to the concerned licensed electrician or competent person.



- iii. The LV arc flash jacket as shown above shall be worn continuously while working on LV (>260V and ≤690V). The color specification of LV arc flash jacket should be blue.
- iv. Electrical hand gloves should have following specification: Flame resistance, arc flash and cut protection of voltage rating (>260V and ≤690V).
- v. Electrical safety over shoe of relevant IS make for foot protection of licensed electrician or competent person while working in HV & LV line or equipment.

9. USE OF HAND TOOLS AND POWER-OPERATED TOOLS

a. General Provisions

- i. All hands and power tools and similar equipment, shall be maintained in safe condition.
- ii. When power operated tools are designed to accommodate guards, they shall be equipped
- iii. with such guards, when in use;
- iv. Belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, chains and other reciprocating, rotating or moving parts of the equipment shall be similarly guarded;
- v. Personnel using hand and power tools and exposed to the hazard of falling, flying, abrasive, and splashing objects, or exposed to harmful dusts, fumes, mists, vapors, or gases shall be provided with the particular personal protective equipment necessary to protect them from the hazards;

- vi. All hand-held powered platen sanders, grinders, grinders with wheels of 5 cm or less, routers, planers, laminate trimmers, nibblers, shears, scroll saws and jigsaws with blade shanks of 0.5 cm wide or less shall be equipped with only a positive on-off control.
- vii. All hand-held powered drills, tappers, fastener drivers, horizontal, vertical or angle grinders with wheels greater than 5 cm in diameter, disc sanders, belt sanders, reciprocating saws, saber saws and other operating powered tools shall be equipped with a momentary contact on control provided that turnoff can be accomplished by a single motion of the same finger or fingers that turn it on.

b. Hand Tools

- i. The subcontractor shall not issue or permit the use of unsafe hand tools;
- ii. Wrenches including adjustable pipe end and socket wrenches shall not be used when saws are sprung to the point that slippage occurs;
- iii. Impact tools such as drift pins, wedges and chisels shall be kept free of mushroomed heads;
- iv. The wooden handles of tools shall be kept free of splinters or cracks and shall be kept tight on the tools.

c. Power Operated Tools

- i. Electric power operated tools shall be either of the approved double-insulated type or shall be grounded;
- ii. The use of electric cords for hoisting or lowering loads shall not be permitted;
- iii. Pneumatic power tools shall be secured to the hose or whip by some positive means to prevent the tool from becoming incidentally disconnected;
- iv. Safety clips or retainers shall be securely installed or maintained on pneumatic impact (percussion) tools to prevent attachments from being incidentally expelled;
- v. All pneumatically riveting machine staplers and other similar equipment provided with automatic fastener feed, which operate at more than 7 kg/cm² pressure at the tool a safety device on the muzzle to prevent the tool from ejecting the fasteners unless the muzzle is in contact with the work surface;
- vi. Compressed air shall not be used for cleaning purposes except when the pressure is reduced to less than 2 kg/cm² and that too with effective chip guarding. The 2 kg/cm² pressure requirement does not apply to concrete form, mill scale and similar cleaning purposes;
- vii. The manufacturer's safe operating for hoses, pipes, valves, filters and other fittings shall not be exceeded;
- viii. Only personnel who has been trained in the operation of the particular tool shall be allowed to operate power-actuated tools;
- ix. The tool shall be tested each day before loading to see that the safety devices are in proper working condition. The method of testing shall be accordance with the manufacturer's recommended procedure;
- x. Any tool found not in proper working order, or that which develops a defect during use, shall be immediately removed from service and not used until properly repaired;
- xi. Tools shall not be loaded until just prior to the intended firing time. Neither loaded nor empty tools are to be pointed at any other person. Hands shall be kept clear of the open barrel end;
- xii. Loaded tools shall not be left unattended;
- xiii. Fasteners shall not be driven into very hard or brittle materials including, but not limited to, cast iron, glazed tiles, surface hardened steel, glass block, live rock, face brick or hollow tiles;

- xiv. Driving into materials that can be easily penetrated shall be avoided unless backed by a
- xv. substance that will prevent the pin or fastener from passing completely through and creating a flying missile hazard on the other side;
- xvi. No fastener shall be driven into a palled area caused by an unsatisfactory fastening;
- xvii. Only non-sparking tools shall be used in an explosive or flammable atmosphere;
- xviii. All tools shall be used with the correct shield, guard or attachment as recommended by the manufacturer.

d. Abrasive Wheels and Tools

- i. All grinding wheel must be ISO certified only.
- ii. All grinding machines shall be supplied with sufficient power to maintain the spindle speed at safe levels under all conditions of normal operation;
- iii. Grinding machines shall be equipped with suitable safety guards;
- iv. The maximum angular exposure of the grinding wheel periphery and sides shall not be more than 900, except that when the work requires contact with the wheel below the horizontal plane of the spindle, the angular exposure shall not exceed 1200. In either case, the exposure shall begin not more than 8.650 above the horizontal plane of the spindle. Safety guards shall be strong enough to withstand the bursting of the wheel;
- v. Floor and bench-mounted grinders shall be work-rests, which shall be rigidly supported and readily adjustable. Such work-rests shall be kept at a distance not to exceed 5 mm from the surface of the wheel;
- vi. Cup type wheels used for external grinding shall be protected by either revolving cup guard or a band type guard;
- vii. When safety guards are required, they shall be mounted as to maintain proper alignment with the wheel and the guard and the guard and its fastening shall be adequate strength to retain the fragments of the wheel in case of incidental breakage. The maximum angular exposure of the grinding wheel periphery and sides shall not exceed 1800;
- viii. Portable abrasive wheel used for internal grinding shall be provided with suitable safety flanges;
- ix. When safety flanges are required, they shall be used only with wheels designed to fit the flanges. Only safety flanges, of a type and design and properly assembled so as to ensure that the pieces of the wheel will be retained in case of incidental breakage, shall be used;
- x. All abrasive wheels shall be closely inspected and ring tested before mounting to ensure that they are free from cracks or defects;
- xi. Grinding wheels shall fit freely on the spindle and shall not be forced on. The spindle nut shall be tightened only enough to hold the wheel in place;
- xii. All employees using abrasive wheels shall be protected by suitable eye protection equipment.

e. Wood Working Tools

- i. All fixed power-driven woodworking tools shall be provided with a disconnect switch that can either be locked or tagged in the off-position;
- ii. The operating speed shall be attached or otherwise permanently marked on all circular saws over 0.5 m in diameter or operating at over 3000 peripheral rpm. Any saw so marked shall not be operated at a speed other than that marked on the blade. When a marked saw is re-tensioned for a different speed,

- the marking shall be corrected to show the new speed;
- iii. Automatic feeding devices shall be installed on machines wherever the nature of the work will permit. Feeder attachments shall have the feed rolls or other moving parts covered or guarded so as to protect the operator from hazardous points;
- iv. All portable power-driven circular saws shall be equipped with guards above and below the base plate or shoe. The upper guard shall cover the saw to the depth of the teeth, except for the minimum arc required to permit the base to be tilted for bevel cuts. The lower guard shall cover the saw to the depth of the teeth, except for the minimum arc required to allow proper retraction and contact with the work. When the tool is withdrawn from the work, the lower guard shall automatically and instantly return to the covering position.

10. START UP, COMMISSIONING AND TESTING:

There are various activities involved prior to commissioning- the major ones are -Hydraulic Test, Steam Blowing, Transformers Charging, Boiler Light Up, Rolling and Synchronisation and Full loading of unit.

- a. These activities shall be personally supervised by the site executive along with the commissioning engineer.
- b. Appropriate Work Permits shall be taken as applicable
- c. The readiness of upstream and downstream system shall be ensured before taking up.
- d. These shall be handled strictly by the authorized persons only and the team shall be suitably briefed about the activity including hazards & risks involved and control plan by the concerned executive-in-charge before start.
- e. Entry of persons to the area of activity shall be suitably restricted and the emergency functions like Ambulance, first aid center and Fire station shall be intimated about the plan well in advance.
- f. Tag-in/ Tag-out shall be in place while charging transformer and whenever necessary.
- g. Electricians with valid wiremen license only shall be permitted to work on power lines.
- h. The area and the passage shall be adequately illuminated.

11. FIRE SAFETY

- a. The Fire Prevention, Protection and Preparedness Program is an integral part of the overall HSE Program. Effort and consideration must be given to safety, life and potential for delays in construction schedules and plant startup, as well as protection of property on a given project. The purpose of which is to prevent
 - i. Inception of fire
 - ii. Loss of life or personal injury
 - iii. Loss of Property
 - iv. Interruption of operations
- b. Site-in-charge / Safety Officer will make periodical review of the site Fire Protection, Prevention Preparedness Programme, Site conditions and available fire protection equipment. It is very imperative that the Sub-contractors along with BHEL to establish good contact with Local fire station for availability of Fire tender in case of emergencies, in addition to their own fire equipment.
- c. Fire Protection, Prevention and Preparedness Inspections - The Contractor /Sub-Contractor will be required to make frequent fire prevention inspections of his work site and operating facilities. Deficiencies will be corrected at once.
- d. Area where Hot work activities are carried out (Gas cutting / Welding/ any other spark producing work)

above a working spot, a GI / fire-resistant non-asbestos sheet or suitable material shall be placed to prevent the fall of hot sparks. A bucket of water shall be kept nearby while doing hot work

- e. Hot work shall be preferably carried out in a designated area with a standing Hot Work Permit, to be renewed monthly. The designated area shall have fire extinguishers.
- f. Any hot work outside designated area shall require a Hot Work permit and fire watch. No flammable material shall be stored within 35 feet from any fire load.

12. PAINTING:

- a. Requirements provide a detailed procedure to be implemented by all concerned employees and sub-contractors involved in painting activities.
- b. Significant Environmental Hazards:
 - i. Chemical hazard due to inhalation of lead fumes (lead containing paint)
 - ii. Chemical hazard due to inhalation of VOC's from painting operations
 - iii. VOC's from painting and coating operation
 - iv. Disposal of paints and coats drums
- c. Control Procedure for Painting:
 - i. Chemical products used in painting and coating operation shall have proper MSDS sheet in place. Whenever any doubt arises with respect to handling and safety point of view it should be accessed to all concerned.
 - ii. Toxic substances and hazards relate the toxic chemicals shall be identified.
 - iii. Proper PPE shall be used including plastic gloves appropriate overall etc.,
 - iv. Arrangement for cleaning of spillage shall be ensured
- d. Only trained workers shall be allowed and proper training should be imparted to the works.
- e. Exposure limits of the toxic substances shall be checked before starting the work and nobody shall be allowed to carry the work beyond the permissible limit.
- f. Ventilation or exhaust facility shall be provided at place where painting and coating operations are carried out.
- g. Overalls shall be supplied by the contractors/subcontractors to the workmen and adequate facilities shall be provided to enable the painters to wash at the cessation of work.
- h. Smoking, open flames or sources of ignition shall not be allowed in places where paints and other flammable substances are stored.
- i. A caution board in national /regional language "**smoking strictly prohibited**" shall be displayed in the vicinity.
- j. Suitable fire extinguishers/sand buckets shall be kept available at places where flammable paints are stored, handled or used.
- k. In case of indoor painting or painting in confined spaces, exhaust ventilating shall be provided. If adequate ventilation is not provided a proper respirator shall be provided and used by persons who are trained and fit tested.
- l. The VOC's from painting and coating operations shall not exceed the permissible level of CPCB/ SPCB norms. The paints and coats must be selected as per the guidelines.
- m. Workers shall thoroughly wash their hands and feet before leaving the work.

13. “HAZARDOUS ENERGY” CONTROL PROCEDURE/ LOCKOUT/TAGOUT (LOTO)

Hazardous Energy Control Procedures, known as "Lockout/Tagout (LOTO)" refers to specific practices and procedures to safeguard employees from the unexpected energization or startup of machinery and equipment, or the release of hazardous energy during service or maintenance activities.

Contractors must develop and submit a written LOTO program. This requires that a designated qualified individual turns off and disconnects the machinery or equipment from its energy source(s) before performing service or maintenance and that the authorized employee(s) either lock and tag the energy- isolating device(s) to prevent the release of hazardous energy and test the machine or equipment to verify that the energy has been isolated effectively.

a. Minimum Requirements:

The following are minimum requirements that must be included in the Contractor's LOTO program:

- i. Inspection of equipment by a trained individual who is thoroughly familiar with the equipment operation and associated hazards.
- ii. Identification and labeling of lockout devices. Purchase of locks, tags, and blocks. Development of a standard written operating procedure, permitted through a controlling authority that is followed by all workers.

b. General Requirements

The following steps must be taken to protect workers that install or service equipment and systems:

Follow the hazardous energy procedures and statutory regulations. Follow the manufacturer's service/repair instructions. Identify and label all sources of hazardous energy. Before beginning work, accomplish the following:

- i. De-energize all sources of hazardous energy:
- ii. Disconnect or shut down engines or motors.
- iii. De-energize electrical circuits.
- iv. Block fluid (gas or liquid) flow in hydraulic or pneumatic systems.
- v. Block or secure machine parts against motion.
- vi. Block or dissipate stored energy.
- vii. Discharge capacitors.
- viii. Release or block springs that are under compression or tension.
- ix. Vent fluids from pressure vessels, tanks, or accumulators—but never vent toxic, flammable, or explosive substances directly into the atmosphere.
- c. Lockout and tag out all forms of hazardous energy including electrical breaker panels, control valves, etc. Make sure that only one key exists for each of your assigned locks and that access to the key is controlled. Verify by test and/or observation that all energy sources are de- energized.
- d. After completion of the work, accomplish the following:
 - i. Inspect repair work before removing the lock and activating the equipment.
 - ii. Make sure that only the worker that installed the lock removes his/her assigned lock.
 - iii. Make sure that all workers are clear of danger points before re-energizing the system.

e. LOTO Procedure**PURPOSE AND SUMMARY**

This procedure provides the requirements and responsibilities of Hazardous Energy Control and the process for Lockout / Tag out (LOTO) of energy isolating devices (valves, circuit breakers, disconnect, etc.). Its use

shall ensure that machinery, equipment, or systems are isolated from all potentially hazardous energy to prevent unexpected energization, startup, or release of stored energy which may cause personnel injury or property damage.

This procedure applies to all BHEL personnel and subcontractors working on the WBPDC (1X660MW) STAGE-III projects where equipment must be taken out of service for the performance of work activities such as installation, maintenance, repair, construction, or equipment removal. The procedure may also be used to isolate equipment of which the energization or operation may present danger to personnel or property. Lockout / tag out are not required for electrical equipment that can be unplugged from the source and the person performing the work has control of the plug.

This procedure shall be applied to prevent injury or damage caused by the unexpected release of active or stored energy. Hazardous energy sources could be in the form of the following:

- Electrical
- Hydraulic
- Chemical
- Thermal
- Mechanical
- Pneumatic

Preplanning of work activities includes the identification of all potential hazardous energy sources so that they may be properly controlled and isolated, locked, and tagged out.

Prior to initiating work activities on or around locked out / tagged out equipment, the equipment must be tested and tried by or in the presence of the person(s) performing the work activities.

RESPONSIBILITIES

- The Engineers in Charge is responsible for implementing and enforcing this procedure and approving lockouts /tag outs that impact the operation of the project.
- The Engineer in Charges responsible for authorizing Lockout /Tag out Requests.
- The Lockout / Tag out Coordinator is responsible for maintaining the Lockout / Tag out Log. Each shift should have a designated Lockout / Tag out Coordinator.
- The Isolator is responsible for determining the proper isolation devices and device positions required to isolate all potential energy sources so that the work stated on the Lockout /Tag out Request Permit may be safely performed. The Isolator must be familiar with the equipment and energy type(s) that require isolation. For this reason, in some cases the Isolator may be more than one person (i.e. Engineer, System Operator and/or Electrician). The Isolator shall position the specified device points, and apply locks and tags, and sign the tags and the LOTO Permit isolation point blocks.
- The Safety Manager is responsible for conducting an annual audit that is documented to ensure all procedures and requirements are current and being followed as written.

DEFINITIONS

Affected Employee: -

An employee whose job requires him/her to operate or use machinery or equipment on which servicing or maintenance is being performed under a lock out/tag out procedure or whose job requires him/her to work in an area in which servicing or maintenance is being performed under a lockout/tag out procedure

Authorized Employee: -

An employee who implements a lockout/tag out procedure on machinery, equipment, or systems in order that servicing or maintenance may be performed. Often an authorized employee and an affected employee may be the same person.

Danger “Do Not Operate” Tag

A tag used to identify energy isolation devices and specify the required position of the device. The tag should be affixed to the isolation device such that it is in plain view of anyone attempting to operate the device. The tags shall be sequentially numbered and shall specify the lockout/ tag out request number. The tag shall also state the purpose, and the expected duration of the lockout /tag out

Isolation Device

A device that is designed and intended to prevent the passage of energy. These devices, usually located at the energy source, are typically valves, circuit breakers, etc. Isolation devices should have a means of being locked in position

Lockout Device

A device that uses a positive physical means such as a lock, either key or combination type to maintain an energy isolation device in the safe position and prevent the inadvertent energization of machinery, equipment, or systems. Device locks should serve no other purpose other than hazardous energy control isolation

Lockout Tag out Request Permit

A pre-numbered form used to request that machinery, equipment or systems be taken out of service. A Lockout/Tagout Request Permit may be initiated by any one requiring energy isolation for work activities or for taking faulty equipment out of service

Lockout / Tag out Request Log

A record of all Lockout /Tag out Request Permits shall be maintained by the Lockout /Tag out Coordinator.

PROCEDURE

1. REQUESTING A LOCKOUT / TAGOUT PERMIT

When machinery, equipment, or systems are partially or completely taken out of service for work activities or equipment protection, a lockout / tag out shall be requested. The requestor shall be familiar with scope of work required and shall provide a brief description of the work on the Lockout / Tag out Request Permit. The requestor shall also provide the proposed start time and estimated duration of lockout / tag out. If familiar with the machinery, equipment, or system to be taken out of service, the requestor may identify the devices that are required to be isolated. The LOTO Request Permit shall be forwarded to the Authorized Lockout / Tag out Coordinator for reviewed and signature, along with Permit to Work number to be entered on the LOTO Request Permit.

- a. The Lockout / Tag out Coordinator shall record the necessary information on the Lockout / Tag out Request Log and forward the request to the Engineer in Charge for approval.
- b. The Safety Manager or Engineer in Charge shall review the Lockout / Tagout Request Permit for impact on project operations. Project operations could be impacted by the equipment being taken out of service or by the required isolation to take the equipment out of service. If project operations are impacted by the Lockout / Tagout, the request shall be forwarded to the Engineer in Charge for approval.
- c. The Engineer in Charge shall provide the lockout / tag out isolation points necessary to perform the task stated on the request. The device identification, device location, device position, and locking mechanism

shall be entered into the appropriate blocks on the Lockout / Tag out Request Permit.

- d. The Engineer in Charge indicates approval of the Lockout / Tagout Request Permit by signing in the appropriate space on the request. If the Lockout /Tag out Request Permit is rejected, the Engineer in Charge shall return it to the requestor, via the Lockout / Tagout Coordinator with a written explanation of the rejection.
- e. Once approved, the Lockout / Tag out Request Permit shall be forwarded to the Lockout / Tag out Coordinator to assign tags and locks.
- f. The log shall show current status of all Lockout / Tag out Request Permits from submittal to approval, through lifting of locks and tags to final closeout. The log shall be maintained by the Lockout / Tag out Coordinator in their office.

2. PLACEMENT OF LOCKS AND TAGS

- a. The tags shall be filled out to match the information on the LOTO Request Permit. Appropriate locks for the types of isolation devices specified shall be collected and placed with the tags and the Lockout / Tag out Request Permit.
- b. The isolator(s) shall take the device locks, tags, and the Lockout / Tagout Request Permit to position the specified isolation devices, sign and hang the tags, and place the locks. If the isolator does not agree with or understand the Lockout / Tagout Request Permit, or has a problem performing the isolation, the problem should be brought to the attention of the Safety Representative or Area Supervisor immediately and the lockout / tag out should be postponed until the situation is resolved.
- c. Once the Isolator has placed all “locks” on isolation points, they will “test ”and “try” the machinery, equipment, or system to ensure all hazardous energy has been completely removed and the isolation is one totally accomplished, and has initialed and signed the Lockout /Tag out Request Permit indicating all isolation points have been confirmed. Examples of “lock”, “test” and “try”:
 - by checking that all locks on the LOTO Request Permit have been applied and are in the specified position open/closed, on/off, etc.; metering test of electrical circuits, opening of drain valves, checking pressure gauges or indicators; and try by pushing start buttons and on/off switches, etc.
 - Testing shall be performed by person(s) knowledgeable of the energy source(s) being isolated (e.g., an electrician should meter electrical circuits).
- d. A copy of the completed Lockout /Tag out Request Permit shall remain with the Work Package and used as part of the daily Pre-Job Briefings

3. WORKING UNDER A LOCKOUT / TAGOUT REQUEST

- a. Prior to starting the work activity, the person(s) performing the work shall review the Lockout / Tag out Request Permit and place the necessary tags and personal locks on the identified isolation devices. Personal locks may be placed only on devices that have already been locked and tagged in accordance with the Lockout / Tag out Request Permit.
 - All personal locks shall be accompanied by a tag that is signed and dated by the worker(s) and specifies the work activity being performed.
 - Personal locks should be of a different color than device locks for ready identification.
- b. Verification of the effectiveness of the isolation by the Isolator shall be performed for Worker’s working under the lockout / tag out, by demonstrating the checks on “lock”, “test” and “try”,
- c. When the work activity is finished, personal locks and tags shall be removed and the Safety Representative

shall be notified that the Lockout / Tagout is no longer required. If work under a lockout / tag out is to be delayed or interrupted for a period in excess of 24 hours, personal locks shall be removed until the work restarts. Personal locks shall be removed prior to the worker(s) leaving the project at the end of shift unless the key(s) are maintained at the project.

4. REMOVAL OF LOCKS AND TAGS

- a. When the lockout / tag out is no longer required, the Safety Representative or Area Supervisor shall obtain the Lockout / Tagout Request Permit from the work package for LOTO removal. Prior to removing locks or tags that may allow equipment to be energized, a check shall be made to verify that the equipment is free to safely operate (i.e., will not cause damage or injury). The locks and tags shall be removed and returned to the Lockout / Tagout Coordinator. Isolation devices may be repositioned at the discretion of the Engineer in Charge according to operational requirements. The Isolator shall complete the Lockout / Tagout Request Permit indicating each lock and tag has been removed and the Safety Representative or Area Supervisor forward to the Lockout / Tagout Coordinator.
- b. The Lockout / Tagout Coordinator shall discard the tags and maintain the completed Lockout / Tagout Request Permit for future reference.
- c. In the event that an employee leaves the job site without removing the personal lock I tag, the following measures shall be taken and documented. The measures listed below are a minimum set of guidelines and under all circumstances, refer to the site-specific safe work plan for detailed procedures:
 - Attempt calling / contacting the employee to return to the site for removal.
 - In the event an employee cannot be contacted, the Site Manager and Safety Manager shall sign an Emergency Lockout/Tagout Removal Form, which has been completed by the Area Supervisor.
 - Employee shall be notified upon returning to the site, prior to beginning any work.

5. INTERRUPTION OF A LOCKOUT / TAGOUT

Operational Emergency

The Engineer in Charge / Safety Manager /Area Supervisor may deem it necessary to temporarily remove the locks and tags from isolation devices, prior to the end of the work activity. The standard procedure for removal of locks and tags shall be followed. Extreme caution shall be taken by the Isolator removing the locks and tags to prevent personnel injury.

Testing

When the performance of a work activity requires the functional testing of a machine, component, or system, the locks and tags may be temporarily removed in accordance with the tag removal, to perform the test. As a result of the testing, if it is determined that the equipment needs further work, the locks and tags shall be positioned back on to the device. If it is not necessary to replace all the locks and tags, then the unnecessary locks and tags may be returned to the Lockout / Tagout Coordinator. The Engineer in Charge shall initial the Lockout / Tag out Request Permit in the removal block to indicate that these locks and tags have been removed. When testing has been satisfactorily completed, the locks and tags shall be removed.

ISOLATION DEVICES

- In most industrial applications, there are isolation devices that were not designed to accommodate a locking device. In these instances, an acceptable alternative that physically obstructs or prevents the use of the isolation device shall be found. Chains shall be placed on valves or electrical panels. Wires shall be determinate, pulled back, taped, and secured.

- If an isolation device does not accept a lock, a tag only is acceptable; however, all possible precautions shall be undertaken to provide a level of safety for the workers. The tag shall be readily visible to anyone attempting to operate the device.
- If more than one Lockout / Tagout Request Permit requires that a single isolation device be locked and tagged, a lock and tag for each request shall be placed. Each lock in itself prevents the inadvertent operation of the device.

GROUP / COMPLEX LOCKOUT

In a multiple lockout / tag out procedure, each person working on the machinery or equipment must place a lock or tag on the energy isolating device. If the energy isolating device will not accept multiple locks or tags, a hasp (a multiple lockout device, may be used. The locks or tags must be placed in such a way that energy cannot be restored to the machinery or equipment until every lock or tag is removed. As each employee involved no longer needs to maintain lockout / tag out protection that employee removes his - her lock and/or tag. The employee attaching the lock or tag is the only person authorized to remove the lock or tag.

6. TRAINING

The training must include recognition of hazardous energy source, type and magnitude of energy available, methods and means necessary for energy isolation and control. Each authorized employee shall receive adequate training. The training should address that all affected employees are instructed in the purpose and use of the energy control procedure. There should be training provisions included for any other employee whose work operations are or may be in an area where energy control procedures may be utilized. The employee training should also address when tag out systems are used including the limitations of a tag (tags are warning devices and do not provide physical restraint). The training should also include that a tag is not to be removed without authorization. The tag is never to be ignored or defeated in any way. Retraining is required when there is a change in job assignments, in machines, a change in the energy control procedures, or a new hazard is introduced. All training and I or retraining must be documented with employee's name and dates of training.

7. PROGRAM REVIEW

The lockout / tag out program must be reviewed at least annually. The review must ensure that procedures are being followed and that they are effective. A documented review of the inspection must include the date, the equipment, employees involved & the inspector. The inspector must be someone other than those actually using the lockout / tag out in progress.

ATTACHMENTS


#1. Danger (DO NOT OPERATE) Tags



#2. Device & Personal Locks and Multi Lock Hasp:



#3. Lockout / Tagout Request Permit

		LOCKOUT / TAGOUT REQUEST PERMIT			LOTO Request Permit No.: Work Permit No.:		
Equip. Out of Service:	LOTO Date Required by: ____/____/____	Estimated Duration:	LOTO Requested Date:				
Scope of Work:				LOTO Authorization Signed by: Date:			
				LOTO Removal Authorization Signed by: Date: Time:			
Tag No.	Device to be Tagged / Locked I.D. No.	Device Location	Device Position OPEN / CLOSE D -	Lock No.	Tag/Lock Placed by Print/Sign - Date/Time	Tag /Lock Removed by Print/Sign - Date/Time	
Comments Instructions: Attachment 3.Lockout / Tag out Request Permit:							

#4. Lockout / Tag out Request Log

LOTO Permit No.	Request or Name	Equipment & Location	Est. Work Completed Date	Approval Date	LOTO Placed Date	LOTO Removed Date	Comments

14. RISK ASSESSMENT

Risk and Hazard Analysis

In order to produce an overall Project EHS Plan, a project must be assessed for its risks. There are two components to the risk and hazard analysis. The procedure used to examine and plan for the identified risks and hazards is called a General Hazard and Risk Assessment.

JSA/HIRA review

Prior to commence the following activities Method statement and JSA/HIRA to be prepared by the concern engineer in coordination with EHS officer and submit to the client for review and approval. After getting approval the work will be started under PTW after clearance. For HIRA and criteria for the defining the high, medium & low risk the relevant annexure be referred. In case any deviations required in the approved method statement the concerned engineer/supervisor has to prepare additional HIRA/JSA to cover the new activities and associated risk. Following activities to be covered,

- Deep excavation (more than 5 feet)
- Significant concrete pouring (like heavy foundation, TG deck, Slab casting etc.)
- Confined entry
- Blasting
- Working on electrical/ energized equipment's
- Steel erection more than 5-Ton weight
- Working at height prior to completion of stairs/ladders/hand railing etc.

Definition:

HAZARD - Any potential or present danger to persons or property within the project site, e.g., oil on the floor is a hazard.

INCIDENT - An unintended happening that may result in injury, loss or damage, e.g., Slipping on the oil is an Incident.

INJURY – Physical harm, the result of an Incident, e.g., a sprained wrist from the fall would be an injury.

Hazard Analysis Document

- For high risk and dangerous work identified, the Applicant shall complete and submit a Hazard Analysis Document together with the PTW request. It will be a JSA (Job Safety Analysis) or Preliminary Hazard Analysis Checklist. And it shall be reviewed and approved by respective Construction and HSE Representatives.
- Issues such as work interface, coordination, drawings, toolbox meetings and work type/duration shall be detailed and included with supporting documentation for the Applicant's request for PTW.
- If applicable, Hazard Analysis Document shall be used as the foundation for development of Safe Work Method Statement. Each hazard identified shall be addressed in the Safe Work Method Statement and be submitted as part of the Applicant's submittal package.

Evaluation of Sub-contractor Risk Assessments includes

- Experience and expertise in performing similar type work.
- Duration of work performed
- Location of the work to be performed.

- Nature of the work to be performed.
- Potential for a subcontractor performing the work to expose themselves, other persons or employees, to hazards.
- Potential for exposure to work site hazards.

Review of Subcontractor specific issues

Preventive and protective measures must be introduced according to the following order of priority

- Eliminating the hazard by removing the activity from the work process. Examples include substitution with less hazardous chemicals, using different manufacturing processes, etc.
- Controlling the hazard at its source through use of engineering controls. Examples include local exhaust ventilation, isolation rooms, machine guarding, acoustic insulating, etc.
- Minimizing the hazard through design of safe work systems and administrative or institutional control measures. Examples include job rotation, training safe work procedures, lock-out and tag-out, workplace monitoring, limiting exposure or work duration, etc.
- Providing appropriate personal protective equipment (PPE) in conjunction with training, use, and maintenance of the PPE.

15. HSE PREPAREDNESS FOR ADVERSE CLIMATES AND WEATHER

All Preventive and Precautionary measures to ensure Health & Safety of workers in all possible adverse weather conditions based on the analysis of the local area conditions to be taken by the subcontractor

15.1 SUMMER

1. The Working Time and Lunch Hour will be as per instruction of Statutory Authorities (no work between 11am to 3:30pm). However, in case temp comes down due to rain/cloudy weather work will continue as per normal routine.
2. During long lunch break, worker will be allowed to go back home for rest. Those who will like to stay back will avail at the facility of rest shed or other designed area.
3. They will be allowed to take small break during work as per their need.
4. Water sprinkling will be done on roads to reduce dust concentration.
5. Workers will be provided with adequate cool drinking water and Butter milk/Lemon water etc.
6. Adequate ORS stock will be made available at the work location in the First-Aid Box for use as needed and at First-aid Centre for emergency need.
7. Fire prevention shall be on high alert, with removal of dry grass and bushes, etc, inside and outside the surrounding work areas. No smoking, and control of open flame/sparks shall be maintained and monitored.
8. Worker will be informed about the Do's and Don'ts to be followed during summer in the Pre Job Brief.

Dos & Don'ts

1. Drink plenty of cool water and other non-alcoholic fluid and keep body well hydrated.
2. Eat salt in food to replenish loss of salt through sweating.
3. Avoid over physical exercise.
4. Have adequate sleep at night.
5. Eat light and less spicy food
6. Avoid eating food which was cooked long time ago.

7. Nobody should use small water bodies such as pits, running rain water through crevices etc. for drinking and cleaning purpose as it may be unhygienic.

Emergency Handling

In case of emergency due to heat disorder:

1. Rescue the victim from workplace and place under shed.
2. If to be rescued from height, use stoke basket or rescue kit.
3. Inform Ambulance immediately.
4. If nearby any air conditioned room/shed is available, place him inside the room/shed.
5. Administer First aid by trained First aider for Heat Disorder
6. If conscious, give him ORS solution to drink.
7. If required send the victim hospital immediately.

15.2 MONSOON

A. Height Work & Structural Safety:

1. Ensure that all height work platforms are barricaded and avoid any highly hazardous
2. Height work.
3. Ensure that all personnel have good quality and intact safety shoes
4. Stop all dangerous height work during rain
5. Explain Do's and Don'ts to workers during Tool Box Meetings
6. Ensure that there are no weak structures, boards etc. that can fall during high winds
7. Do not allow any loose material (e.g. GI sheet, Ply board, empty cement bag, aluminium foil, foam sheets etc.) on roof sheds or top of structures.
8. Do not permit any one to ride up or come down scaffolds frame work during heavy wind or rain.
9. Provide "anchor" of adequate strength to scaffolds and other high-rise structures.
10. All rest sheds and GI sheds will be anchored into the round and wall and roof panels will be secured with J hook to prevent shed from blowing over or parts/pieces becoming airborne. Proper earthing per IS standard is also to be installed.
11. Do not go alone nor permit anyone to stay at tower-tops, roof-tops, high structures or on electrical poles during the course of stormy weather or heavy rain.

B. Electrical:

1. All electrical connections / loads have to be routed through ELCB / RCCB (residual current circuit breaker) whose rating should be 30mA.
2. RCCB operational checks need to be done DAILY / WEEKLY during monsoon season.
3. Avoid joints on power cables which need to be laid over-head or under-ground, better not to have any joint at all. In case joints become essential, such cables must be housed rigidly and insulation must be provided as per approved standard. The joint shall be suitable for outdoor use.
4. All electrical distribution board shall be properly covered at top and sides to protect from rain water. Extension boards shall be protected from rain water.
5. Ensure proper "earthing" for each and every electrical appliance.
6. Double earthing need to be provided for 3-phase power supply and for voltage more than 220V.

7. Provide lightening arrestors at the top of Boiler 3 and boiler 4 and rest sheds which are not covered by existing lightening arrestor of other installation.

C. Others:

1. Maintain smooth flow on open drains. i.e. no obstruction or blockade shall be made on storm water drains. If required, make temporary drains.
2. Arrange back-filling of excavated pits on war-footing basis.
3. Arrange bringing down booms of all cranes, hydra machines during stormy weather (wind speed 40-50 km/hr)
4. Confirm that all gantry cranes are effectively choked to prevent rolling and toppling.
5. Do not forget to deep ready a dew battery operated lights at site-offices during rainy season.
6. Avoid using wet damp clothes.
7. Hard Barricade excavated zone filled with water with scaffolding pipe & clamp with reflective net
8. Engage diesel operated water pump to dewater work area. For electrically operated water pump, the starter shall be protected from rain water. All rotating parts shall be guarded. Ensure availability of sufficient water pumps.

D. Health and hygiene:

1. Monsoon reduces the immunity of our body and makes us vulnerable to many diseases which are commonly associated with this season. It is time for us to keep our body challenging against disease by boosting our immunity and taking safety measures against these diseases.
2. The diseases associated with monsoon are Malaria, Jaundice, Gastro-intestinal infections, like typhoid, cholera etc. apart from these viral infections like cold and cough also make their presence felt. Majority of above said diseases are on account of:
3. Puddle of water formed due to rain become breeding grounds for mosquitoes which spread disease like, malaria and dengue fever. As a precautionary measure against mosquito-bite disease one can use mosquito net around the end which is better choice to mosquito repellents like mats and coils.
4. Pollution of drinking water during monsoon is very common. It is very necessary to drink clean and pure water when water-borne monsoon diseases like diarrhoea and gastro-intestinal infections threaten us.
5. Walking in dirty water during rainy season leads of numerous fungal infection which affect toes and nails. Diabetic patients have to take a special care about their feet. Keeping feet always dry and clean is very necessary. Avoid walking in dirty water. Keep shoes socks and raincoats dry and clean.

E. Workmen will be made aware of following Do's and Don'ts:

1. Do not sleep in daytime.
2. Avoid over physical exertion.
3. During lightning and thunder storm, do not take shelter under tree. Take shelter inside rest shed or store room.
4. Wash vegetables with clean water and steam them well to kill germs.
5. Avoid eating un-cooked foods and salads should be washed properly before consumption.
6. Drink plenty of water and keep body well-hydrated.
7. Always keep the surrounding area dry and clean. Don't allow to get water accumulated around.
8. Keep body warm as viruses attack immediately when body temperature goes down.

9. Do not enter air conditioned room with wet hair and damp cloths.
10. Dry your feet and webs with soft dry cloth whenever they are wet.
11. Eat light and less spicy food.
12. Avoid eating food which was cooked long time ago.
13. Eat salt in food to replenish loss of salt through sweating.

15.3 EMERGENCY WEATHER CONDITIONS

Cyclone/Severe thunder storm

In the event of Cyclone/Severe thunder storm, alert will be issued by subcontractor on notification received by Govt. authorities/Metrological departments Customer or BHEL.

The actions required during cyclone/rough weather:

1. Check and advice subcontractors to clean-up work area. Pick up all loose and unused material of respective supervisor's area.
2. Tie to secure all gas cylinders to avoid displacement and unsafe conditions which could be due to wind pressure.
3. Secure portable electricity generating sets and other equipment, pumps, hoses etc.
4. Make preparation for removal of water logging.
5. Take review of work activity and make preparation for removal of equipment and material from vulnerable areas.
6. Isolate/turn off all electrical power form the main panel/switches. Secure and anchor panels properly.
7. Recheck anchorage/tie of all temporary structures/sheds, tall objects, cranes, rigs, scaffolds etc. to avoid toppling due to wind force.
8. Cranes boom shall be secured, either locked or lowered the booms as reasonably and practicably possible and rigs to safe position for the safety point of view.
9. Group up all trash barrels, wooden pallets, forms; wooden decks etc. and anchor properly.
10. Welding machines, air compressors and such equipment are to be grouped together and secured to the stable objects. Welding leads, electrical cables, hoses are to be rolled up and secured properly.
11. Set on site vehicles on high ground in the site area with brakes set firmly.
12. Anchor all tanks, vessels, gas cylinders that may be moved by high wind and water.
13. Evacuate job site.

Personnel Evacuation:

1. Personnel Evacuation will be required if predicted wind speed and storm surge heights are beyond acceptable limits as per the instructions from Govt. Authorities/ Metrological departments or Customer.
2. Once the warning is received for personnel evacuation, an emergency response team shall be formed. The team will work with local authorities and other agencies formed/deployed to evacuate and transport all personnel involved in the project to the cyclone shelter.
3. Cyclone may be followed by the calm "EYE", be aware of it. If the wind suddenly drops, don't assume the cyclone is over. Violent wind may resume from the opposite side direction. Wait for the official "All clear Signal".

4. After the cyclone, do not go outside until officially communicated about safe situation outside. Use recommended routes for returning. Do not panic or rush while returning.
5. Checking of gas leaks and well-being of electrical appliances is essential before leaving the site.
6. Follow local communications for official warning and advice. The construction Manager shall also obtain updates from customer/metrological departments and communicate to the personnel on project site.

15.4 PREVENTION OF COVID-19 (COVID-19 HERE TO BE READ AS COVID-19 AND OTHER PANDEMICS/ COMMUNICABLE DISEASES) AT PROJECT SITE & LABOUR COLONY:

Resumption of Construction Activities after Lock Down and Prevention of Coronavirus Infection during Site Operations and OCP 61A: Prevention of COVID-19 Infection in Labor Colony will be strictly followed.

A. Preventive measures at project site:

- BHEL and Agencies shall nominate COVID Marshalls, who will be responsible for monitoring the COVID prevention measures and apprising management on the same.
- Mandatory health check-up for every worker/ official joining the site
- All activities to be carried out using least amount of paperwork and physical proximity as far as possible.
- **HSE Observer App** to be used to monitor HSE Activities and follow up with agencies for closure of non-conformities.

a. Strict Control at the Gate/ Banning Entry to Anyone Not Wearing Masks

- i. Security personnel at the gate may erect a barricade preferably approx. 10 meters from the gate and only allow personnel who are wearing proper masks inside.
- ii. Public address system may be used to warn any non-compliant visitors
- iii. Near entry gate, round markers at minimum 1-meter distance to be ensured so that distancing is ensured
- iv. A hand-wash or hand sanitiser facility is preferable at the gate to allow entry after hand wash or hand sanitisation. These are also to be provided at key locations to enable hand wash / hand sanitisation before starting work, before eating, etc.
- v. Gutkha, Paan, tobacco etc. to be banned from the site. Spitting to be strictly prohibited.

b. Screening at Gate with Contactless Thermometer & Action on Suspected Cases

- i. Security Personnel at the Gate to screen each person entering the premises using a non-contact infrared thermometer, which is duly serial numbered and calibrated.
 - ii. In case any site worker/ official is found to have fever more than 99 Degrees Fahrenheit or found coughing/ sneezing, he/she may be advised rest till recovery and entry to be permitted after obtaining clearance from medical officer/assistance/attendants.
- Parcel to be collected from gate by concerned person preferably with provision of Special Box
 - Any construction material received at site, unless properly sanitized, to be kept undisturbed for at least 3 days and to be used only after that period.
 - During Toolbox Talks, minimum 1-meter distance between any two workers to be ensured

c. During site execution activities:

For all site execution activities, social distancing is to be maintained. In case this is not possible due to nature of work, speciality of work, etc, ensure sensitisation of the labour/staff involved and use of appropriate PPEs, especially mandatory face mask. In any case, close working to be allowed only in special

circumstances and ensuring these activities are preferably time staggered to the extent possible

d. In office premises:

- i. Sharing of items like pens, water bottles etc. in office premises to be avoided
- ii. Doors preferably to be in open condition to avoid contact
- iii. All common touch points to be frequently disinfected in a day.

e. Regular disinfection of all Areas, Equipment and facilities

- i. A dedicated disinfectant gang to be identified for the task by each agency. The disinfectant gang to be provided full body suits for the task.
- ii. All areas (including office premises, site areas, chairs, tables, furniture etc.), tools & equipment to preferably be disinfected by dedicated gang every day before resumption of work.
- iv. Common touch points like handrails, lift buttons, door/window knobs or handles, vehicle door handles, taps, conference room & dining hall tables/chairs, common sofas/chairs, visitor sofa/chairs, files & folders, etc to preferably be disinfected regularly at frequent intervals every day.
- v. Pool vehicles, to be disinfected after every use. Social distancing to be maintained inside the common pool vehicles as per Govt./ statutory body guidelines.

f. Disinfecting the operator/driver touch points of Vehicles/cranes, T&Ps etc.

Disinfection to also be carried out for all Cranes, Vehicles, Equipment, consoles, T&Ps etc. which come into contact with operating personnel.

g. Posters on COVID-19

Sufficient Posters on COVID-19 to be ensured across the site in languages understood by most workers.

h. Brief guidelines for hand washing are as below:

- i. Soap to be provided at each wash basin and replenished regularly.
- ii. Washing with soap for at least 20 seconds is recommended.
- iii. As a general guideline, for every 100 workers, 1 wash-basin may be provided at site areas.
- iv. Close queue to be avoided near wash-basins and 1-meter distance to be maintained. Round markers at 1-meter distance can be ensured as guidance

Composition of Disinfectant:

- i. Readily available 1% hypochlorite solution or 4%
- ii. Liquid chlorine-1% solution
- lii. Surgical spirit-95% alcohol content
- iv. Hand sanitizer should have: Isopropyl alcohol-75%, Glycerol-1.45%, Hydrogen Peroxide-0.125%

B. Prevention of COVID-19 Infection in Labor Colony:

- Spacing of minimum 2 meters between living areas of workers inside a room may be maintained. Preferably, the living area of each worker may be partitioned using sheet of cloth, plastic etc.
- Rooms to be properly ventilated as far as possible
- Sanitation to be given prime importance and personal hygiene to be promoted
- Face masks shall be worn by everyone inside the colony premises
- Spitting of Pan. Gutkha etc. inside the colony and urinating etc. outside the toilets to be strictly avoided
- Regular visits by Doctors to the labor colony can be arranged on non-working day for check-up of all workers
- **Identification of "COVID Wardens" (CWs) by each agency for maintaining the following:**
 - i. Keeping an eye on the health of workers and report any suspected cases of fever, coughing etc. to the

management

- ii. Keeping an eye on the social distancing measures in the labor colony and report any non-conformances to the management.
- iii. Educate the workers about social distancing and COVID prevention measures.
- Training/ Awareness regarding COVID-19 to be provided to workers regularly.
- Workers to be instructed to maintain social distancing of minimum 1 m at all time
- **Posters on COVID-19:** Sufficient Posters on COVID-19 to be ensured across the labor colony in languages understood by most workers.
- All workers to be instructed to inform any suspected cases of illness (individual or others) to an emergency contact number of CW, the emergency contact numbers and CW contact numbers to be displayed at prominent locations
- **Inspection & Review**
 - i. Daily Inspection by concerned COVID Wardens and reporting to Agency
 - ii. Regular inspection by Agency & BHEL

15.5 Noise Mitigation

High noise is harmful to the human health and it can cause impairment if exposed for long duration at regular intervals, and also cause disruption in nearby communities.

- Noise monitoring shall be carried out in all construction locations periodically.
- Use of silent DG is allowed at site during construction.
- Low noise generation equipment's to be preferred.
- Work areas where noise levels exceed the 85db shall be posted as hearing protection required.
- Use of PPEs / ear plug/ear muff for personnel entering into high noise area.
- Activities generation High noise will be planned in day shift.

Noise Level Chart

Parameter	Night Noise level dBA	Daytime Noise Level dBA
At 1-meter from each piece of equipment	85	85
At Property boundary	70	70



ANNEXURE J

First-Aid Box

Details & Contents of First Aid Box as per Contract Labor (Regulation & Abolition Act), Central Rules, 1971

- (1) The first-aid box shall be distinctively marked with a Red Cross on a white background and shall contain the following items, namely:

(a) For establishments in which the number of contract labor employed does not exceed fifty, each first aid box shall contain the following equipment:

(i)	6 small sterilized dressings
(ii)	3 medium size sterilized dressings
(iii)	3 large size sterilized dressings
(iv)	6 pieces of sterilized eye pads in separate sealed packets.
(v)	6 roller bandages 10 cm wide.
(vi)	6 roller bandages 5 cm wide.
(vii)	One tourniquet
(viii)	A supply of suitable splints
(ix)	Three packets of safety pins.
(x)	Kidney tray.
(xi)	3 large sterilized burn dressings.
(xii)	1 (30ml) bottle containing a two percent alcoholic solution of iodine
(xiii)	1 (30 ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label
(xiv)	1 snake bite lancet
(xv)	1 (30gms) bottle of potassium permanganate crystals.
(xvi)	1 pair scissors
(xvii)	1 copy of the First-Aid leaflet issued by the Director General, Factory Advice Service and Labor Institutes, Government of India.
(xviii)	A bottle containing 100 tablets (each of 5 grains) of aspirin
(xix)	Ointment for burns
(xx)	A bottle of suitable surgical anti-septic solution

(b) For establishment in which the number of contract labor exceeds fifty each first-aid box shall contain the following equipment:

(i)	12 small sterilized dressings
(ii)	6 medium size sterilized dressings
(iii)	6 large size sterilized dressings.
(iv)	6 large size sterilized burn dressings
(v)	6 (15 grams) packets sterilized cotton wool
(vi)	12 pieces of sterilized eye pads in separate sealed packets.
(vii)	12 roller bandages 10 cm wide.
(viii)	12 roller bandages 5 cm wide.
(ix)	One tourniquet.
(x)	A supply of suitable splints.
(xi)	Three packets of safety pins.
(xii)	Kidney tray.
(xiii)	Sufficient number of eye washes bottles filled with distilled water or suitable liquid clearly indicated by a distinctive sign which shall be visible at all times.
(xiv)	4 per cent Xylocaine eye drops, and boric acid eye drops and soda by carbonate eye drops.
(xv)	1 (60ml) bottle containing a two percent alcoholic solution of iodine
(xvi)	One (two hundred ml) bottle of mercurochrome (2 per cent) solution in water.
(xvii)	1 (120ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label.
(xviii)	1 roll of adhesive plaster (6 cmX1 meter)
(xix)	2 rolls of adhesive plaster (2 cmX1 meter)
(xx)	A snake bite lancet.
(xxi)	1 (30 grams) bottle of potassium permanganate crystals.
(xxii)	1 pair scissors
(xxiii)	1 copy of the First-Aid leaflet issued by the Director-General, Factory Advice service and labor Institutes, Government of India.
(xxiv)	a bottle containing 100 tablets (each of 5 grains) of aspirin
(xxv)	Ointment for burns
(xxvi)	A bottle of a suitable surgical anti septic solution.

- (2) Adequate arrangement shall be made for immediate recoupment of the equipment when necessary.



ANNEXURE K

Vertigo Test

Vertigo Test Procedure/ Guidelines

This document specifies minimum requirements for vertigo test. These may be supplemented by any additional requirements deemed fit by the medical examiner/ HSE department)

Fear of height may be physiological or psychological. Therefore, to rule out any possibility of physiological factor, detailed medical check-up of workers is carried out before vertigo test. Medical check-up of workers includes the following:

history of past illnesses (like epilepsy, drug allergy, diabetics/ hypertension, unconsciousness etc.), general physical examination (like height, weight, BMI, build and nourishment etc.), measurement of pulse rate, Blood Pressure, respiratory rate.

After this check-up, those who are found suitable for height work by examining doctor, are allowed to undergo vertigo test.

During this health check-up, psychology of workers is also studied. If any worker finds it extremely difficult/ frightening to climb the monkey ladder & walk on the beam, during/after performing vertigo test or even before performing, then he is treated as disqualified.

As per standard, during vertigo test, worker is allowed to climb on a foundation through monkey ladder, walk on a beam, then steps down at the other end of beam, through monkey ladder. Height of the beam should be at least six feet from ground level. All necessary safety precautions are taken during this test. Worker has to wear full body harness with double lanyard. A horizontal lifeline is run parallel to the beam and worker has to put his lanyards into the lifeline. Additionally, a safety net is also put below the beam for rescue of the victim in case of a fall from beam.

Following activities are suggested to be carried out during testing:**1. Walking Bench Training:**

- a. Person should walk over the channel. He should maintain balance & walk without much problem.
- b. If the person has problem to balances himself on repeated chances, he may be having flat foot or some other problem. So, he may not be fit for height work.

2. Rope Climb Training:

Person should be able to climb the rope up to the top channel for ensuring that in case of fall, a person hanging on the safety harness, will be able to safely climb back to the platform within minimum time period before the safety harness start breaking down under the load.

3. Height Work Training:

Person should walk freely on the middle channel while holding the top channel with the help of safety harness.

4. Ladder for Vertical fall arrestor Training:

Vertical fall arrestor rope is fixed from top to bottom of the ladder. It will ensure:

- Usage of vertical fall arrestor.
- Usage of two lanyards of a safety harness.
- Ensure 3-point contact on the ladder while climb.

5. Chair for work at height Training:

- Climb though vertical ladder with two lanyard ropes.
- Hooking of two lanyard ropes to life line. With this safe arrangement, he can walk to chair.
- Sits in the chair safely, comes out & walks back to the vertical ladder & come down from vertical ladder. After completion of vertigo test, blood pressure of worker is again measured. If it is not within acceptable limits for any worker, concerned worker is denied height pass.

Only those who pass the above training are to be considered as fit for height work.

T&P HIRE CHARGES

Annexure

C1

DATE:31/08/2021

REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR
SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	USEFUL LIFE (IN YRS)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE)	Revised Rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (BEYOND USEFUL LIFE)
I.	CRANES :-			
1	Portal Gantry Crane 500T	15	24500.00	24500.00
2	100MT Crawler Crane ZOOMLION CRANE-QUY-100	10	11370.00	10940.00
3	Heavy Lift Crawler Crane 600MT Class DEMAG Model CC2800	15	56290.00	53560.00
4	PORTAL CRANE, 360T	15	14070.00	13390.00
5	600MT Class Crawler Crane- Manitowoc Model 18000-UPGRADED	15	55460.00	52770.00
6	600MT Class Crawler Crane- Liebherr Model LR1600-2 (Upgraded)	15	68610.00	65280.00
7	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER)	15	33510.00	31880.00
8	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER)	15	20940.00	19920.00
9	MANITOWOC M-250T TRUCK CRANE	15	30160.00	28690.00
10	270 MT Class Crawler Crane- Manitowoc Model 2250	15	31660.00	30130.00
11	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1	15	26390.00	25110.00
11.A	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED)	15	36110.00	34580.00
12	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2	15	15130.00	14390.00
12.A	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED)	15	18850.00	18050.00
13	LINKBELT LS- 248H CRAWLER CRANE (180T)	15	16750.00	15940.00
14	MANITOWAC MODEL 888 CRAWLER CRANE (200 MT)	15	21780.00	20720.00
15	CRAWLER CRANE SUMITOMO, 150T	15	10890.00	10360.00
16	All Terrain Crane, 150MT- Liebherr Model LTM1150	15	13400.00	12750.00
17	CRAWLER CRANE, 120 T Fushun Model QUY120	10	10830.00	10420.00
18.A	CRAWLER CRANE 135MT Kobelco Model CK1350- 1F	15	10720.00	10200.00
18.B	CRAWLER CRANE 135MT Kobelco Model CK1350	15	8880.00	8440.00
19	CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2	15	10050.00	9560.00
20	CRAWLER CRANE 100 T (KH 500)	15	10050.00	9560.00
21	Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B	10	5410.00	5210.00
22	ROUGH TERRAIN CRANE 75T (RT880)	12	6140.00	5880.00
23	CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280	12	5370.00	5150.00
24	Mobile Crane, 55MT (TIL)	12	4410.00	4230.00
25	CRAWLER CRANE, 25T -Tata Model TFC75	10	3030.00	2910.00
26	MOBILE CRANE, 20MT (TIL)	10	2270.00	2180.00
27	MOBILE CRANE, 20MT (ESCORTS)	10	2270.00	2180.00
28	MOBILE CRANE ESCORTS- 14MT	10	710.00	680.00
29	HYDAULIC PICK & CARRY CRANE, 8/9/10/11/12 MT	10	390.00	370.00

Annexure**C1**

DATE:31/08/2021

**REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR
SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS**

SL NO.	ITEM DESCRIPTION	USEFUL LIFE (IN YRS)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (BEYOND USEFUL LIFE)
30	FORK LIFT 5T	5	650.00	640.00
31	FORK LIFT 3T	5	540.00	530.00

**REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR
OUTSIDE AGENCIES**

SL NO.	ITEM DESCRIPTION	USEFUL LIFE (IN YRS)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/09/2019 to 31/8/2021 (BEYOND USEFUL LIFE)
I.	CRANES :-			
1	Portal Gantry Crane 500T	15	27230.00	27230.00
2	100MT Crawler Crane ZOOMLION CRANE-QUY-100	10	12630.00	12160.00
3	Heavy Lift Crawler Crane 600MT Class DEMAG Model CC2800	15	62550.00	59520.00
4	PORTAL CRANE, 360T	15	15630.00	14880.00
5	600MT Class Crawler Crane- Manitowoc Model 18000-UPGRADED	15	61620.00	58630.00
6	600MT Class Crawler Crane- Liebherr Model LR1600-2 (Upgraded version)	15	76230.00	72540.00
7	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER)	15	37230.00	35420.00
8	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER)	15	23270.00	22140.00
9	MANITOWOC M-250T TRUCK CRANE	15	33510.00	31880.00
10	270 MT Class Crawler Crane- Manitowoc Model 2250	15	35180.00	33480.00
11	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1	15	29320.00	27900.00
11.A	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED)	15	40120.00	38420.00
12	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2	15	16810.00	15990.00
12.A	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED)	15	20950.00	20060.00
13	LINKBELT LS- 248H CRAWLER CRANE (180T)	15	18610.00	17710.00
14	MANITOWAC MODEL 888 CRAWLER CRANE (200 MT)	15	24200.00	23020.00
15	CRAWLER CRANE SUMITOMO, 150T	15	12100.00	11510.00
16	All Terrain Crane, 150MT- Liebherr Model LTM1150	15	14890.00	14170.00
17	CRAWLER CRANE, 120 T Fushun Model QUY120	10	12030.00	11580.00
18.A	CRAWLER CRANE 135MT Kobelco Model CK1350- 1F	15	11910.00	11330.00
18.B	CRAWLER CRANE 135MT Kobelco Model CK1350	15	9860.00	9380.00
19	CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2	15	11170.00	10620.00
20	CRAWLER CRANE 100 T (KH 500)	15	11170.00	10620.00
21	Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B	10	6010.00	5790.00
22	ROUGH TERRAIN CRANE 75T (RT880)	12	6830.00	6540.00
23	CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280	12	5970.00	5720.00
24	Mobile Crane, 55MT (TIL)	12	4900.00	4700.00
25	CRAWLER CRANE, 25T -Tata Model TFC75	10	3370.00	3240.00
26	MOBILE CRANE, 20MT (TIL)	10	2520.00	2430.00
27	MOBILE CRANE, 20MT (ESCORTS)	10	2520.00	2430.00
28	MOBILE CRANE ESCORTS- 14MT	10	790.00	760.00
29	HYDAULIC PICK & CARRY CRANE, 8/9/10/11/12 MT	10	430.00	410.00

REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR
OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	USEFUL LIFE (IN YRS)	Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE)	Revised rates (Rs./Hour) valid from 01/09/2019 to 31/8/2021 (BEYOND USEFUL LIFE)
30	FORK LIFT 5T	5	720.00	710.00
31	FORK LIFT 3T	5	600.00	590.00

**RATES FOR INTER REGIONAL HIRE CHARGES FOR CRANES OF CAPACITY
75 TON OR MORE FOR PERIOD 01-09-2021 TO 31-08-2023**

Dt : 31/08/2021

SL NO.	ITEM DESCRIPTION	Rates (Rs./MONTH) valid from 01/09/2021 to 31/8/2023
I .	CRANES : -	
1	Portal Gantry Crane 500T	1243192
2	100MT Crawler Crane ZOOMLION CRANE-QUY-100	631183
3	Heavy Lift Crawler Crane 600MT Class DEMAG Model CC2800	2717358
4	PORTAL CRANE, 360T	679333
5	600MT Class Crawler Crane- Manitowoc Model 18000- UPGRADED	2676917
6	600MT Class Crawler Crane- Liebherr Model LR1600-2 (Ungraded version)	3311783
7	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER)	1617475
8	CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER)	1010917
9	MANITOWOC M-250T TRUCK CRANE	1455725
10	270 MT Class Crawler Crane- Manitowoc Model 2250	1528508
11	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1	1273758
11.A	300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED)	1754150
12	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2	730283
12.A	250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED)	915892
13	LINKBELT LS- 248H CRAWLER CRANE (180T)	808733
14	MANITOWAC MODEL 888 CRAWLER CRANE (200 MT)	1051358
15	CRAWLER CRANE SUMITOMO, 150T	525675
16	All Terrain Crane, 150MT- Liebherr Model LTM1150	646983
17	CRAWLER CRANE, 120 T Fushun Model QUY120	601125
18.A	CRAWLER CRANE 135MT Kobelco Model CK1350- 1F	517592
18.B	CRAWLER CRANE 135MT Kobelco Model CK1350	428625
19	CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2	485242
20	CRAWLER CRANE 100 T (KH 500)	485242
21	Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B	300558
22	ROUGH TERRAIN CRANE 75T (RT880)	321758
23	CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280	281533

**RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR
SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS**

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
I.	LIFTING EQUIPMENTS	
1	Strand Jack System for Boiler Drum Lifting	20930
2	MULTI SHEAVE PULLEY BLOCK 40/50T/60T	310
3	MULTI SHEAVE PULLEY BLOCK 100T	630
4	MULTI SHEAVE PULLEY BLOCK 150T	1260
5	ELCTRIC WINCH 5T	1270
6	ELCTRIC WINCH 10T	2360
7	ELECTRIC WINCH 15 T	2150
8	PASSENGER CUM GOODS HOIST 1T	2270
9	FURNACE MAINTENANCE PLATFORM	5040
10	Gang Operated Hydraulic Jack (Set of 4 Jacks - 175 MT each)	2100
II	WELDING & HEAT TREATMENT EQUIPMENT	
1	125KW, 3KHZ, AIR-COOLED INDUCTION HEATING EQUIPMENT	16380
2	75KW, 10 KHZ, COMPACT INDUCTION HEATING EQUIPMENT	8190
3	WELDING GENERATOR 320/300 A	300
4	WELDING RECTIFIER 400A/300A	300
5	WELDING RECTIFIER 600A	400
6	DIESEL WELDING GENERATOR 400A/300A	400
7	TRANSFORMER,600A	300
8	TRANSFORMER 300/400A	200
III	SERVICE PLANTS & ALLIED EQUIPT.	0
1	500KVA DIESEL GENERATOR	3800
2	TRANSFORMER OIL FILTERATION EQUIPMENT 6000LPH CAPACITY WITHOUT STORAGE TANK	6370
3	-DO- , WITH STORAGE TANK	7280
4	OIL FILTERATION M/C, 250/500 LPH (OTHER THAN SILICON OIL)	910
5	OIL FILTERATION M/C, 250GPH/1000LPH (OTHER THAN SILICON OIL)	1360
6	OIL FILTERATION M/C, 500GPH/2500LPH (OTHER THAN SILICON OIL)	1820
7	OIL FILTERATION M/C, 1000GPH/5000LPH (OTHER THAN SILICON OIL)	3640
8	Portable Lube Oil Purification Unit (Centrifuge M/c) Capacity: 750 LPH	1270
9	Low Vacuum de-hydration unit	630
10	DIESEL GENERATING SET,250 KVA	1770
11	DIESEL GENERATING SET,25 KVA	500

RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR
SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
12	VACUUM PUMP(ABSOLUTE V.C.)	540
13	ACID CIRCULATING PUMP WITH MOTOR 120M HEAD, 150T/HR	1090
14	ACID TRANSFER PUMP 20/50 T/HR	540
15	DEWATERING PUMP (Kirloskar make,11KW/15HP)	80
16	HP Air compressor (32 Kg/Sq. Cm, 150 CFM)	4240
17	AIR COMPRESSORS 250/300/330/360/350 CFM	2730
18	AIR COMPRESSORS 140/150/190/210 CFM	910
19	ACID CIRCULATING PUMP WITH MOTOR & STARTER, 200T/HR, 150M, 220 HP	1820
20	Industrial Blower 2000CFM	1270
21	Air Leak Test Blower (Flow: 40000 m ³ /Hr)	1160
22	Air Blower (Flow: 20000 m ³ /Hr)	940
IV	METAL FORMING /CUTTING EQUIPMENT	
1	TUBE EXPANDING M/C PNEUMATIC 60-100 MM	630
2	ELECTRO HYDRAULIC PIPE BENDING M/C 4"	1630
3	BOLTING MACHINE (ALCOA/AVLOCK/ HUCK)	1800
4	-do- Gun with nose Assembly only	540
V	TESTING/INSPECTION EQUIPMENT	
1	DATA LOGGER for PG TESTING	36980
2	MOTORISED HYDRAULIC TEST PUMP 250kg/cmsq	800
3	MOTORISED HYDRAULIC TEST PUMP 400-450kg/cmsq	1090
4	MOTORISED HYDRAULIC TEST PUMP 600 KG/CMSQ	1270
5	HYDRAULIC TEST PUMP 800 KG/CMSQ	1330
6	HYDRAULIC TEST PUMP 1000 KG/CMSQ	2230
7	BOLT STRETCHING DEVICE	910
8	BOROSCOPE/FIBROSCOPE FLEXIBLE TYPE (FLEXUX) IMPORTED	3640
9	ULTRASONIC FLAW DETECTOR	2730
10	MPI TEST KIT	360
11	GAS LEAK DETECTOR	270
12	VIBRATION/SOUND LEVEL METER IRD-306	360
13	VIBRATION/SOUND LEVEL METER IRD-308	360
14	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 350	1450
15	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 360	2540
16	SHOCK PULSE METER	630
17	HV.DC TEST KIT UPTO 50 KV	540
18	HV.DC TEST KIT ABOVE 50 KV	1000
19	HV.AC TEST KIT UPTO 50KV	810
20	HV.AC TEST KIT ABOVE 50KV	2910
21	MOTORISED MEGGER 2.5KV	400
22	MOTORISED MEGGAR 5KV	450
23	OSCILLOSCOPE-DUAL BEAM INDIGENOUS	450
24	OSCILLOSCOPE-DUAL BEAM IMPORTED	1090
25	WAVEFORM ANALYSER	910
26	OSCILLOGRAPH/UV RECORDER 24 CHANNEL	1630
27	OSCILLOGRAPH/UV RECORDER 12 CHANNEL	1090
28	OSCILLOGRAPH/UV RECORDER 6 CHANNEL	910

**RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR
SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS**

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
29	DIGITAL LOW RESISTANCE METER	630
30	DC POTENTIOMETER	180
31	PRECISION DEAD WEIGHT TESTER	1000
32	OPTICAL ALIGNMENT KIT	1360
33	BOROSCOPE/FIBROSCOPE(NON FLEXIBLE)	1200
34	VERNIER THEODOLITE,PRECISION	1200
35	VERNIER THEODOLITE,ORDINARY	200
36	ENGINEERS PRECISION LEVEL/DUMPY LEVEL	120
37	ISKAMATIC 'A'	3200
38	CALIBRATOR '03'	1000
39	48 POLE EXTENDER CARD	200
40	MULTIJET NPM	400
41	OSCILLOMETER	10190
42	VOC EQUIPMENT	1400
43	BINARY SIGNAL GENERATOR	290
44	ELECTRIC COUNTER	690
45	FREQUENCY GENERATOR	1000
46	DBF 3 VIBRATION RECORDER/ANALYSER	3270
47	L&T GOULD OSCILLOGRAPH 2-CHANNEL	490
48	L&T GOULD OSCILLOGRAPH 6-CHANNEL	1180
49	VIBROPORT 41/FFT ANALYSER	5460
50	ELCID kit	10010
51	UNIVERSAL CALIBRATION SYSTEM	2730
52	NATURAL FREQUENCY TESTER	2910
53	DIGITAL HARDNESS TESTER	360
54	ADRE 208 VIBRATION ANALYSER	7280
55	PCB DIAGNOSTIC REPAIR KIT	2000
56	SECONDARY INJECTION RELAY TEST KIT	5270
57	MICRO OHM METER	1450
58	DIGITAL MICRO OHM METER MEASURING RANGE: 200 $\mu\Omega$ TO 20K Ω	3230
59	PMI Machine OLYMPUS make	3350
60	Móbile Lighting Mast - 9 metres (4X400 W)	860
61	10KVA RESISTANCE BRAZING MACHINE	140
62	RECURRENT SURGE OSCILLOGRAPH (RSO) TEST KIT WITH PORTABLE HANDHELD OSCILLOSCOPE.	460
63	HYDROGEN GAS LEAK DETECTOR	50
64	STATOR WEDGE ANALYZER KIT WITH COMPLETE ACCESSORIES	4980
65	WEDGE DEFLECTION KIT	80
66	TILE PRESSING MACHINE FOR GAS TURBINE	270
67	INDUCTION BRAZING MACHINE	4870
68	MAGNETIC COHESIVE FORCE (MCF) EQUIPMENT	3640
69	ULTRASONIC FLOW METER	180
70	PORTABLE VIBRATION ANALYSER (MODEL 811T)	40
71	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -14KG/SQ CM. ; FLOW 60 M3/HR	470
72	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -30KG/SQ CM. ; FLOW 15 M3/HR	430

RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR
SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
73	HI SPEED MEMORY RECORDER, MAKE -YOKOGAWA, MODEL DL850E-Q-HE/B5/HD1	1810
74	TROLLEY MOUNTED HYDRAULIC JACK (100 MT)	1260
75	5KV Insulation Tester	450
76	4 Channel Digital Oscilloscope /Fast Recorder	1710
77	4 Channel Oscillographic Recorder	580
78	Sound Level Meter	230
79	Thermal Imaging Camera	770
80	Videoscope (Video Boroscope)	1510
81	DO (Dissolve Oxygen) Meter (0 to 1500 ppb)	1310
82	Conductivity Meter	80
83	Core Flux Test Kit	7280
84	Primary Current Injection Kit (2000A)	870
85	3 Phase Secondary Injection Kit (Relay Test)	3760
86	FRF Filtration Kit	1330
87	FFT Analyser	2290
88	Flue Gas Analyser	1030
89	Oil Test Kit (Mineral Oil)-Transformer	1010
90	Winding Resistance kit (R L C Load)	880
91	SFRA test Kit	1190
92	Tan Delta test Kit	4060
93	PF Meter	330
94	Ultrasonic Flow Meter	830
95	Oil Particle Counter	360
96	Plasma Cutting Machine (With complete accessories)	310
97	JCB make DG Set 80 KVA	670
98	Diesel Generating Set 82.5 KVA	610
99	Portable Jacking Oil Pump	1080
100	Alloy Analyser	1770

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
I.	LIFTING EQUIPMENTS	
1	Strand Jack System for Boiler Drum Lifting	23250
2	MULTI SHEAVE PULLEY BLOCK 40/50T/60T	350
3	MULTI SHEAVE PULLEY BLOCK 100T	700
4	MULTI SHEAVE PULLEY BLOCK 150T	1400
5	ELECTRIC WINCH 5T	1410
6	ELECTRIC WINCH 10T	2620
7	ELECTRIC WINCH 15 T	2390
8	PASSENGER CUM GOODS HOIST 1T	2520
9	FURNACE MAINTENANCE PLATFORM	5600
10	Gang Operated Hydraulic Jack (Set of 4 Jacks - 175 MT each)	2330
II	WELDING & HEAT TREATMENT EQUIPMENT	
1	125KW, 3KHZ, AIR-COOLED INDUCTION HEATING EQUIPMENT	18190
2	75KW, 10 KHZ, COMPACT INDUCTION HEATING EQUIPMENT	9090
3	WELDING GENERATOR 320/300 A	330
4	WELDING RECTIFIER 400A/300A	330
5	WELDING RECTIFIER 600A	440
6	DIESEL WELDING GENERATOR 400A/300A	440
7	TRANSFORMER, 600A	330
8	TRANSFORMER 300/400A	220
III	SERVICE PLANTS & ALLIED EQUIPT.	
1	500KVA DIESEL GENERATOR	4220
2	TRANSFORMER OIL FILTRATION EQUIPMENT 6000LPH CAPACITY WITHOUT STORAGE TANK	7070
3	-DO-, WITH STORAGE TANK	8080
4	OIL FILTRATION M/C, 250/500 LPH (OTHER THAN SILICON OIL)	1010
5	OIL FILTRATION M/C, 250GPH/1000LPH (OTHER THAN SILICON OIL)	1510
6	OIL FILTRATION M/C, 500GPH/2500LPH (OTHER THAN SILICON OIL)	2020
7	OIL FILTRATION M/C, 1000GPH/5000LPH (OTHER THAN SILICON OIL)	4040
8	Portable Lube Oil Purification Unit (Centrifuge M/c) Capacity: 750 LPH	1410
9	Low Vacuum de-hydration unit	700
10	DIESEL GENERATING SET, 250 KVA	1970
11	DIESEL GENERATING SET, 25 KVA	560
12	VACUUM PUMP (ABSOLUTE V.C.)	600
13	ACID CIRCULATING PUMP WITH MOTOR 120M HEAD, 150T/HR	1210
14	ACID TRANSFER PUMP 20/50 T/HR	600
15	DEWATERING PUMP (Kirloskar make, 11KW/15HP)	90
16	HP Air compressor (32 Kg/Sq. Cm, 150 CFM)	4710
17	AIR COMPRESSORS 250/300/330/360/350 CFM	3030
18	AIR COMPRESSORS 140/150/190/210 CFM	1010

RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
19	ACID CIRCULATING PUMP WITH MOTOR & STARTER, 200T/HR, 150M, 220 HP	2020
20	Industrial Blower 2000CFM	1410
21	Air Leak Test Blower (Flow: 40000 m³/Hr)	1290
22	Air Blower (Flow: 20000 m³/Hr)	1040
IV	METAL FORMING /CUTTING EQUIPMENT	
1	TUBE EXPANDING M/C PNEUMATIC 60-100 MM	700
2	ELECTRO HYDRAULIC PIPE BENDING M/C 4"	1810
3	BOLTING MACHINE (ALCOA/AVLOCK/ HUCK)	2000
4	-do- Gun with nose Assembly only	600
V	TESTING/INSPECTION EQUIPMENT	
1	DATA LOGGER for PG TESTING	41090
2	MOTORISED HYDRAULIC TEST PUMP 250kg/cmsq	880
3	MOTORISED HYDRAULIC TEST PUMP 400-450kg/cmsq	1210
4	MOTORISED HYDRAULIC TEST PUMP 600 KG/CMSQ	1410
5	HYDRAULIC TEST PUMP 800 KG/CMSQ	1480
6	HYDRAULIC TEST PUMP 1000 KG/CMSQ	2480
7	BOLT STRETCHING DEVICE	1010
8	BOROSCOPE/FIBROSCOPE FLEXIBLE TYPE (FLEXUX) IMPORTED	4040
9	ULTRASONIC FLAW DETECTOR	3030
10	MPI TEST KIT	400
11	GAS LEAK DETECTOR	300
12	VIBRATION/SOUND LEVEL METER IRD-306	400
13	VIBRATION/SOUND LEVEL METER IRD-308	400
14	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 350	1610
15	VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 360	2830
16	SHOCK PULSE METER	700
17	HV.DC TEST KIT UPTO 50 KV	600
18	HV.DC TEST KIT ABOVE 50 KV	1110
19	HV.AC TEST KIT UPTO 50KV	900
20	HV.AC TEST KIT ABOVE 50KV	3230
21	MOTORISED MEGGER 2.5KV	440
22	MOTORISED MEGGAR 5KV	500
23	OSCILLOSCOPE-DUAL BEAM INDIGENOUS	500
24	OSCILLOSCOPE-DUAL BEAM IMPORTED	1210
25	WAVEFORM ANALYSER	1010
26	OSCILLOGRAPH/UV RECORDER 24 CHANNEL	1810
27	OSCILLOGRAPH/UV RECORDER 12 CHANNEL	1210
28	OSCILLOGRAPH/UV RECORDER 6 CHANNEL	1010
29	DIGITAL LOW RESISTANCE METER	700
30	DC POTENTIOMETER	200
31	PRECISION DEAD WEIGHT TESTER	1110
32	OPTICAL ALIGNMENT KIT	1510
33	BOROSCOPE/FIBROSCOPE(NON FLEXIBLE)	1330
34	VERNIER THEODOLITE,PRECISION	1330
35	VERNIER THEODOLITE,ORDINARY	220

**RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS
ETC. FOR OUTSIDE AGENCIES**

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
36	ENGINEERS PRECISION LEVEL/DUMPY LEVEL	130
37	ISKAMATIC 'A'	3550
38	CALIBRATOR '03'	1110
39	48 POLE EXTENDER CARD	220
40	MULTIJET NPM	440
41	OSCILLOMETER	11320
42	VOC EQUIPMENT	1550
43	BINARY SIGNAL GENERATOR	320
44	ELECTRIC COUNTER	760
45	FREQUENCY GENERATOR	1110
46	DBF 3 VIBRATION RECORDER/ANALYSER	3630
47	L&T GOULD OSCILLOGRAPH 2-CHANNEL	540
48	L&T GOULD OSCILLOGRAPH 6-CHANNEL	1310
49	VIBROPORT 41/FFT ANALYSER	6060
50	ELCID kit	11120
51	UNIVERSAL CALIBRATION SYSTEM	3030
52	NATURAL FREQUENCY TESTER	3230
53	DIGITAL HARDNESS TESTER	400
54	ADRE 208 VIBRATION ANALYSER	8080
55	PCB DIAGNOSTIC REPAIR KIT	2220
56	SECONDARY INJECTION RELAY TEST KIT	5860
57	MICRO OHM METER	1610
58	DIGITAL MICRO OHM METER MEASURING RANGE: 200 $\mu\Omega$ TO 20K Ω	3590
59	PMI Machine OLYMPUS make	3730
60	Mobile Lighting Mast - 9 metres (4X400 W)	960
61	10KVA RESISTANCE BRAZING MACHINE	160
62	RECURRENT SURGE OSCILLOGRAPH (RSO) TEST KIT WITH PORTABLE HANDHELD OSCILLOSCOPE.	510
63	HYDROGEN GAS LEAK DETECTOR	60
64	STATOR WEDGE ANALYZER KIT WITH COMPLETE ACCESSORIES	5530
65	WEDGE DEFLECTION KIT	90
66	TILE PRESSING MACHINE FOR GAS TURBINE	300
67	INDUCTION BRAZING MACHINE	5410
68	MAGNETIC COHESIVE FORCE (MCF) EQUIPMENT	4040
69	ULTRASONIC FLOW METER	200
70	PORTABLE VIBRATION ANALYSER (MODEL 811T)	50
71	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -14KG/SQ CM. ; FLOW 60 M3/HR	520
72	CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -30KG/SQ CM. ; FLOW 15 M3/HR	480
73	HI SPEED MEMORY RECORDER, MAKE -YOKOGAWA, MODEL DL850E-Q-HE/B5/HD1	2010
74	TROLLEY MOUNTED HYDRAULIC JACK (100 MT)	1400
75	5KV Insulation Tester	500

**RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS
ETC. FOR OUTSIDE AGENCIES**

SL NO.	ITEM DESCRIPTION	Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023
76	4 Channel Digital Oscilloscope /Fast Recorder	1900
77	4 Channel Oscillographic Recorder	650
78	Sound Level Meter	260
79	Thermal Imaging Camera	860
80	Videoscope (Video Boroscope)	1680
81	DO (Dissolve Oxygen) Meter (0 to 1500 ppb)	1460
82	Conductivity Meter	90
83	Core Flux Test Kit	8090
84	Primary Current Injection Kit (2000A)	960
85	3 Phase Secondary Injection Kit (Relay Test)	4180
86	FRF Filtration Kit	1480
87	FFT Analyser	2550
88	Flue Gas Analyser	1140
89	Oil Test Kit (Mineral Oil)-Transformer	1120
90	Winding Resistance kit (R L C Load)	970
91	SFRA test Kit	1320
92	Tan Delta test Kit	4510
93	PF Meter	360
94	Ultrasonic Flow Meter	920
95	Oil Particle Counter	400
96	Plasma Cutting Machine (With complete accessories)	340
97	JCB make DG Set 80 KVA	740
98	Diesel Generating Set 82.5 KVA	680
99	Portable Jacking Oil Pump	1200
100	Alloy Analyser	1970