VOLUME – IA
Part I & II

TECHNICAL CONDITIONS OF CONTRACT (TCC)

BHARAT HEAVY ELECTRICALS LIMITED

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VOLUME-IA PART-I CHAPTER – II
SCOPE OF WORKS

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.)

1.2.1 BROAD SCOPE OF WORK

The scope of work covers "Erection, welding, NDE & testing of 1000 MWe Turbine, Generator, Condenser, Static, Rotary equipments, Auxiliary systems, cross over piping, Integral piping, Fabrication of structural steel, Pipe supports, Metal structures, Platforms, Final painting including handling of Materials at BHEL / Client's Stores / Storage Yard, Transportation to site for KKNPP-3 .

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

1.2.2 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, storage area (covered & open), outdoor shops, machine shop, electrode storage room with controlled atmosphere, dark room facility for Radiography testing, radiography source room, labour canteen, rest room.
4. Facilities like site office and field offices, sheds, closed and open workshops, 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. Assembly, erection, welding, inspection, NDE and hydro / Pneumatic /electrical testing of equipment such as Turbine, Generator, Main condensers, MSR, De- aerator, Feed pumps, Turbo drive, CEP's, CCW pumps, other seawater pumps and all the static and rotary equipments, cross over piping, integral piping, valve blocks, sheathing covers, deck floating, fire grid, instrumentation items issued as free issue materials by NPCIL including grouting, dry packing, concreting, arrangement of temporary structures & supports, and CEA clearance for generator.
6. Surface preparation by grit blasting or paint removal including supply of grit/ paint remover, supply and application of paint for pipe lines and metal structures.
7. Receipt of free issue materials from NPCIL/BHEL stores or at the delivery point, uncrate, inspection and preparation of incoming material inspection report (IMIR), reporting deficiency if any to NPCIL/BHEL, shifting from NPCIL's store to BHEL/contractors store, storage, preservation, material management, shifting from NPCIL/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 NPCIL's store.
8. For executing the work on free issue material from NPCIL, welding electrodes and filler wire will be issued as FIM by NPCIL and only supply of welding consumables like gases will be in the scope of contractor.
9. For executing the work on BHEL supplied structural steel work for making platforms and permanent supports, the supply of welding electrodes, filler wires, and welding consumables are in the scope of contractor,
10. Providing active support to BHEL for Preparation of work procedures and QAP.
11. Preparation and qualification of welding procedure and welders.
12. Preparation of reports for the works carried out and digitalization of RT films.

13. Preparation of CCC and material accounting and submission to NPCIL for acceptance.
14. Deployment of qualified manpower, supervisory staff and training & qualification of personnel and arrangement of Plant and Machinery, tools & tackles, scaffoldings, ladders, platforms etc.
15. Housekeeping, dewatering, preservation including supply of preservative consumables.
16. Preparation and submission of detailed work schedule to meet the specified targets using latest project management tools and facilities.
17. Wherever heavy duty crane is provided with operator by NPCIL, the contractor shall make arrangement for slinging , handling the loads erection and alignment by providing necessary tools and tackles such as wire rope, slings, D-shackles, etc. along with required manpower.

1.2.3 REFERENCE DRAWINGS, DOCUMENTS & SPECIFICATIONS:

1. The KKNPP-3&4 units are designed by Russian Federation. Accordingly assembly, fabrication, erection, inspection, testing activities of all the equipments, 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. Erection of equipments and piping 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. Working documents (set of drawings and documents) will generally contain necessary information for erection and testing of pipeline and equipment.
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 fabrication of relevant pipelines is started. The required dimensions of closing pieces of piping as indicated on the detailed drawings must be established by direct field measurements.
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.

1.2.4 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 NPCIL 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.

1.2.5 BUILDING AND SYSTEM DESCRIPTION:

1.2.5.1 Building description:

The erection of equipments & piping systems 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), other ancillary buildings within the plant site of KKNPP- 3&4.

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

1.2.5.2 System and equipment description:

The equipment & piping system covered under this tender document are related to TG & auxiliary and its associated systems. TG & auxiliary system mainly consists of Turbine and Auxiliary systems, Generator and Auxiliary systems, Steam Systems, Condensate Systems, Feed Water Systems, Oil and Gas systems and Supporting Systems.

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

1.2.6 RECEIPT OF MATERIAL, SHIFTING, STORAGE:

1.2.6.1 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 NPCIL during the contract period shall be treated as Free Issue Material (FIM). The WD's issued to the contractor contains the list of the items required for erection of piping & equipment. The contractor shall make note of such items and draw the items from NPCIL/BHEL 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 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. 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 NPCIL/BHEL stores once the materials is issued.

3. The Contractor shall draw the FIM from the NPCIL's stores located within the plant premises or in the vicinity of the plant premises. The contractor shall receive the FIM from the NPCIL at the delivery point (The delivery point can be a designated loading point at NPCIL stores or either at the contractor's stores or near and outside the respective building where the equipment is to be installed).The contractor may note that the EIC will decide the delivery point depending upon the practical feasibility of the access of tractor trailer carrying the cargo outside the nearest point of actual erection of the respective equipment, size of cargo and weight of the component.
4. The Contractor shall be responsible for shifting of all the items / general equipment / material, piping materials (except heavy, critical and ODC equipments which will be shifted by NPCIL) from the NPCIL's store / Contractor's store / shop to the place of work/ installation. In no case the equipment will be delivered by NPCIL at the actual place of erection.

   Note: Shifting of heavy, critical and ODC equipments from NPCIL stores to delivery point is in the scope of NPCIL. However, unloading of heavy, critical and ODC equipment's at the delivery point is in the scope of the contractor. Heavy duty crawler crane will be provided by NPCIL for unloading, required T & P's and assist crane are in the scope of contractor. All lifting tools and tackles should be load tested and due clearance to be obtained from BHEL/NPCIL safety before put in use.
5. After receiving the materials at the delivery point, 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 from the point of delivery 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 and equipment 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.

1.2.6.2 Storage of materials:

1. Attention is drawn to the fact that the environment at Kudankulam 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 sheds in his own arrangements to provide appropriate storage at site for all NPCIL 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. Valves shall be stored in specially designed stands to protect rubber parts/ machined surfaces. 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, such as pipes and fittings, 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 (such as cutting, washing, pickling) 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 BHEL & 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.

1.2.6.3 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 piping installation 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. Each piece of pipe, regardless of length, and each fittings or other component part, except minor fasteners, shall be clearly identified by legible marking on the part as per engineer's instruction.
5. All loose parts/ accessories such as gaskets, diaphragms, seals etc. of valves and other equipment shall be properly identified, stored and re-assembled by the contractor. The contractor will take adequate care to prevent damage to pipe penetrations during storage, handling and erection. The penetration shall be stored with their original shipping frame and protective arrangement and shall be brought to site as the last item, just prior to their incorporation in the system.

6. 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. When a part is cut to make more than one component the marking shall be transferred to all the pieces. When materials shall be marked by any method that will not result in any harmful contamination or sharp discontinuities and which will identify the material until the system is completely installed. Materials of 6 mm and greater in thickness may be marked by stamping. When stamping is used, it shall be done with round-nose continuous or round-nose interrupted dot low stress die stamps. Vibro etching is permitted on all thickness provided minimum wall thickness requirements are met and marking is acceptable to Engineer. Pipelines and sub-assemblies shall be identified in accordance with the code number assigned on the working drawings.

1.2.7 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&4. 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.

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

1.2.8 INTERFACING WITH OTHER AGENCIES AND TERMINAL POINTS:

1.2.8.1 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. The rate quoted by bidder shall include such combination of civil, mechanical, electrical and instrumentation work. 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 BHEL as well as supplied by NPCIL, the dimensional mismatches between the connecting components shall be suitably fabricated and joined by the contractor.

1.2.8.2 Terminal points:

1. 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. Alignment, fit-up and welding at all the terminal points and bolting in case of terminal flange joints with the other systems/agencies is included in Contractor's scope of work.
2. The piping connection to the various equipment's/embedded pipes and to terminal points of work done by other agencies is included in Contractor's scope of work. The Contractor shall also make suitable drawings required for such connections, if not already existing. Cutting/opening of blanks (as per Engineer's instructions) and edge preparation etc.
3. Service pipe lines supplying water, air, oil if any shall be terminated by other contractor one meter away from the wall either inside or outside of the building.

Contractor shall connect to these lines and erect lines inside the buildings as per the WD.

1.2.9 PREPARATION OF WORK PROCEDURES & DRAFTING ASSISTANCE

1. The contractor shall prepare and submit work procedures for fabrication, erection, inspection and testing all the equipment, piping, painting and structural works in his scope. 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. Contractor shall prepare Welding Procedure specification (WPS), Procedure Qualification Record (PQR), assembly, NDE, cleaning, etc.
3. 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.
4. Further, where complexity of the work or safety is involved, the contractor shall submit such work procedures when requested by BHEL/ NPCIL. Any other procedure deemed necessary for work shall be submitted to BHEL/ NPCIL for acceptance.
5. Contractor shall provide supervising/drafting assistance for various miscellaneous activities as instructed by BHEL Engineer for carrying out site dimensional measurements, as built checking, AutoCAD drafting etc.
6. Contractor has to provide dedicated engineer (1 no) with PC with AutoCAD software at BHEL site office to prepare work procedures, work instructions, JHA's, reports & protocols, as built drawings, other documentation works as instructed by BHEL Engineer. Computers shall have latest configuration of Windows 10 OS, 8 GB RAM.

Qualification and Experience required:

i. DME (Mechanical)
ii. Persons with 3 years' experience in any mechanical construction project will be preferred.
iii. Should be proficient in AutoCAD, 3D drafting and isometric drawings and MS office.

1.2.10 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, greasing, turning of motors, mounting of particular items on the equipment etc. is included in contractor's scope of work. Similarly for valves any instructions regarding welding in open, partially open or closed position or dismantling, storage and assembly, etc. shall be strictly adhered to and shall form part of contractor's scope of work. Adequate care shall be taken during welding of valves. For any equipment or 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 BHEL/NPCIL on account of delay by the contract or on account of supervision front, shall be deducted from the contractor.

1.2.11 GENERAL REQUIREMENTS IN ERECTION OF EQUIPMENT:

During equipment erection the contractor shall perform the following in general;

1. The general instructions and requirements for erection are detailed in WD or manufacturer's documents. Erection of equipments shall be done as

per the equipment installation drawings and specification, log sheet measurement and other details. The Contractor shall study related equipment layout, structural steel drawing, piping layout, foundation drawing and equipment drawing before starting any installation work.

2. The scope of work of equipment erection covers inspection of work front, cleaning, preparation of equipment foundation, shifting of equipments from NPCIL/BHEL stores / storage point, handling, rigging, assembly of component parts if any, erection at various elevations and locations on foundation or supporting structures etc., levelling, welding, cutting, grinding, drilling, fixing of foundation bolts, reaming of bolt holes, dowelling of pins including scrapping and blue matching, wherever required, supply of shims, packer plates, checking of wear ring clearance, bearing clearance etc. before coupling, alignment, torque tightening, greasing or filling with oil, checking for free rotation, coupling guard installation, lubrication, flushing, rectification of misalignment, grouting and dry packing, including assembly and fixing of other internal / external fittings/ piping and other components and completion of work in all respects as per drawings, documents and specifications. The nozzle opening of equipments shall be kept blanked till piping work is taken up. All the component parts of the equipments shall be shifted to the respective locations including the erection devices. Erection of electrical panels issued along with the equipment is part of scope of contractor.
3. All required manpower for the erection of equipments shall be provided by the contractor. Erection and alignment of all equipments shall be carried out by experienced fitters and technicians. Contractor shall deploy experienced erection supervisors and crews who have done similar type of jobs. Proper sequence for assembly and erection / installation shall be adhered to in accordance with drawings, catalogue and manufacturers instruction.
4. All necessary handling equipments, plant and machinery, tools & tackles and precision measuring instruments for carrying out the works as specified shall be provided by the Contractor. Contractor shall provide all tools and gauges for erection and alignment. Special tools, if any, received as part of equipments shall be used by the Contractor for erection purposes, which shall be returned in good condition after use. While handling, transporting or erecting the equipments, care shall be taken not to damage the nozzles,

instrument connections, structural clips, cranes, lifting tools & tackles, measuring tools, spanners kit, work bench tools, Torque wrench including scaffolding and working platforms, proper 24V lighting source at working spot etc.

5. The contractor shall support BHEL for preparing erection procedure and QAP for erection based on manufacturer manual and submit for approval of NPCIL before start of erection work.
6. Rigging procedures and erection schemes for all the heavy lifts shall be prepared by contractor and got approved by EIC before starting work. Approval by EIC shall not relieve contractor of his responsibilities. The details to be submitted will include the location of equipment from where it will be lifted, location of crane(s), details of crane(s) (like configuration, boom length, operating radius, boom point elevation, clearance underside the boom and the equipment, lifting capacity, counter weights to be deployed, holds on any neighbouring foundations, structures, equipments etc.), the load chart of the crane(s), design of the lifting tackles like spreader beam, D-shackles, wire rope slings etc. Contractor shall produce recent test certificates of the lifting tools and tackles including slings used for erection work. However, retesting shall be done by the Contractor, as and when required. Tested tools and tackles shall be punched for test loads and date of testing. Also the D-shackles, eye bolts and other tackles shall be inspected at regular intervals.
7. De-preservation shall be carried out by the contractor as part of scope of equipment erection and as per the manufacturer's recommendation. After shifting the equipment from the store to site the equipment shall be placed properly and safely. Steel structures/ wooden blocks used for the packing and transportation shall be removed carefully. Equipment Manufacturer's recommendations regarding de-preservation/ preservation during storage at site store and after erection at designated location shall be strictly followed by the contractor till the completion and handed over of the system to the NPCIL/BHEL.
8. All equipment shall be thoroughly cleaned, oiled and greased and offered for inspection to BHEL/NPCIL. Filling of lubricants and oils shall be as per manufacturer's recommendations. The required quantities of oils and lubricants shall be supplied by NPCIL.

9. The transportation locks provided on equipments shall be removed. The contractor shall prepare and submit documents like erection protocol, log sheets, measurement and test reports and any other report deemed necessary to BHEL/NPCIL. The contractor shall ensure thorough cleaning of external surface of equipments, its surroundings and its preservation till handing over.
10. Before starting the erection of equipments, the top surface of the foundations is to be cleared, chipped, roughened to obtain proper bond, while grouting. Also the sleeves are to be cleaned before erecting the equipments. Verticality of sleeve EP shall be checked. Line (orientation) and levels are to be marked on all the foundations to facilitate checking of alignment. Contractor shall also check the correct elevation and orientation of civil, structural foundations, before proceeding with the erection work. Discrepancy, if any, shall be brought to the notice of EIC. Necessary rectifications and chipping of foundations shall be carried out, by the contractor. Contractor shall be responsible for supply of packer plates (if required) and shall carry out levelling of equipment under the directions of EIC. For equipments to be installed on concrete foundations, the same shall be placed on the foundations together with the base plate and the bolts connecting the equipment to the base plate slackened. For equipments to be installed on metal structure foundations, the same shall be placed on the metal structure foundations and welded together with the base plate/frame. Equipment to be installed on steel structural frame shall be levelled by use of shims, packer plates and wedges. Prior to installation of equipment on foundations and grouting, the top of concrete foundation, and its pockets shall be thoroughly cleaned with air, water and dried. The base plate shall be levelled on concrete foundations by putting wedges between the base plate and concrete foundations along with packer plate and concrete grouting shall be performed. Equipments shall be placed level on the base plate and bolts connecting the equipment and base plate shall be tightened with shims. Position of anchor bolts shall be checked with the latest revision of manufacturers drawings /or other applicable drawings.
11. All items of equipment shall be properly oriented and the fabricated parts, connections should be installed as indicated on the drawings. Contractor shall also take care of the orientation of the nozzles and other connections of the equipments while erecting the same and ensure

compliance with the drawings and specifications supplied. Discrepancy, if any, in the number/orientation of the nozzles, welding alignment clamps etc. should be brought to the notice of the EIC before actual erection is started. Before taking up the equipment for erection, the contractor shall check the orientation of the nozzles, centre lines, elevations, length and position of anchor bolts spacing and size of bolt pockets on foundation, the diameter of anchor bolts & bolt holes in the equipment base plate with respect to applicable drawings and also with physical measurement of the equipment wherever required, and discrepancies if any shall be brought to the notice of EIC. Enlarging of the holes on the brackets/skids/skirts of the equipment during installation, if required, shall be carried out by the contractor at no extra cost to the corporation.

12. Normally, all concrete pedestals shall have pockets for installation of foundation bolts as required and provision for pouring of grout for grouting of base frames of equipments. However, where opening for introduction of grouting materials has not been provided, the contractor shall drill the required holes before installation of equipment. Location and dimensions of foundations shall be checked with respect to general layout plans, civil floor layouts and other drawings well in advance before starting of actual erection work. The size, number and locations of foundation bolt pocket or holding down bolt holes shall be checked in advance by the contractor and discrepancy if any, shall be brought to the notice of the EIC. Foreign materials if any, in the foundation bolt pocket, shall be completely removed by the contractor.
13. The rough foundation surface shall be chipped and the packer plates shall be placed and levelled. The contractor shall select and provide suitable size and number of packers / shims where ever required as part of scope of work. Flat packer plates / shims shall be provided on both the sides of each foundation bolt and placement of more than three layers of packers is not permissible and the layers of packer plates stacked shall be tack welded. For fine adjustment, shims shall be used. Steel packer plates shall be free from surface scales, unevenness, burrs etc. The leveling and centering should be done by using two taper packers which shall be ultimately fastened together by tack welding. Shims and packers shall be placed in such a fashion so as to enable concrete grout filling in the bolt hole without trouble. All equipment shall be properly levelled to ensure horizontality and verticality of the

equipment and reference pads/ marks provided in the equipments shall be used as a guide. The pumps shall be erected on foundation and leveled with shims and wedges with the help of precision levels and other instruments. The pump and the driver and reducing gear, if any, shall be then coupled and centering / alignment.

14. Horizontality of equipments shall be checked with master level, master level with micrometer, feeler gauge and straight edge. Blue matching shall be carried out wherever required at no extra cost by the contractor.
15. Verticality of the equipments shall be checked with plumb/ theodolite / total station/ other optical instruments. After erection the equipment shall be levelled and properly aligned with necessary shims and wedges supplied by Contractor at his own cost. After the levelling, alignment and verticality measurements etc. are checked and accepted by BHEL/NPCIL, contractor shall carry out grouting as per specifications. Final alignment for machinery shall be done after piping connections are made. Tolerances for alignment shall be as specified in the manufacturers documents.
16. Contractor should ensure that the piping and other connections does not induce any stress on the equipment nozzles. Care shall be taken to avoid undue strains or distortion of equipment due to uneven bearing on foundations. In order, to ensure that piping connections do not induce any undue stresses on the rotary equipments, the coupling alignment shall be checked by the contractor without piping connection and with piping connection. In case of change in alignment values, necessary corrections shall be performed on the piping, and realignment shall be done by the contractor to ensure no undue stresses are induced in the equipment. The coupling alignment values shall be maintained as specified in the manufacturer's instruction manual.
17. Initially centering/ leveling shall be done using proper instruments with necessary accuracy as per manufacturer recommendation on the pump base or nozzle. Grouting of foundation bolts to be done after temporary centering.
18. First centering shall be done after the anchor is fixed. Shaft centre deflection and inclination shall be measured at four points on the top, bottom, Left and right side by way of turning, the coupling in single or both with dial gauge or

clearance gauge etc. After the first centering is over the space between the base and foundation shall be grouted.

19. Second centering / final alignment shall be done after all piping connections are done. The alignment and tolerance for alignment shall be maintained as specified in the manufacturer's instruction manual. Shims and wedges where required will be arranged by Contractor.
20. Shafts of rotating equipments shall be checked for freeness, alignment and freedom of rotation. In case where the drive unit and driven unit arrive separately, they are to be assembled at site, wherever necessary the contractor shall mark and drill holes including tapping the box plate/ skid/ base frame for fixing motors, fixing of coupling on shaft, if necessary file / scrap the keys and key ways for fixing coupling on shafts, dowelling including providing dowel pins for retaining the alignment of the equipments. The alignment of coupling with and without piping connection shall be done by means of dial gauge. Dial gauge shall be fixed by proper means on the periphery and face of the coupling.
21. Unless otherwise specified, equipments shall be generally supplied in single piece. In case equipment is supplied in multiple pieces where erection of the equipment is not possible in single piece, contractor shall carryout lifting of the pieces, assembling, aligning, welding and hydro test etc. Assembly of component parts such as multiple shafts, multiple couplings, bearings, parts of the motors, rigging, hoisting and placing on foundation, welding of base frame to EP, horizontality & verticality check of components and multiple shafts shall be executed by the contractor as per manufacturer's documents and WD's. Pumps are to be assembled at clean conditions.
22. Wherever dry packing is required during erection of equipment, piping and structures, the dry pack shall consist of 1:2.5 (Cement: Sand), sand passing through No. 16 sieve. Only enough water shall be added to produce a mortar, which will stick together when moulded into a ball by a slight pressure of hand and will not extrude water but will leave the hands just damp. Dry pack material shall be placed and packed in layers having a compacted thickness of about 10mm. Each layer shall be solidly compacted over the entire surface by use of hardwood stick and hammer.

23. All accessories and fittings either shipped separately or removed from main equipment during erection shall be kept tagged separately and installed after completion of erection / installation of the main equipment. All flanged connections and openings shall be kept closed with blanks / plugs / covers to prevent entry of foreign materials and shall be removed while making connections to the respective piping or other associated components after performing FME inspection along with BHEL/NPCIL team. The piping with the equipment flange and connecting flange shall have uniform gap in all directions and flange OD, hole pitch and centre lines shall also match. Welding of pipe connections shall be performed without creating any undue strain or distortion.
24. All the auxiliaries like lube oil system, filters, cooling water systems, and other Inter- connecting piping connections of the equipment shall be erected along with the main equipment by the contractor. Piping connections with the main equipment and auxiliaries shall be installed as per the drawings, specifications and manufacturer's instructions. In addition to the above, cooling water supply, flushing exhaust air and other checks shall be carried out.
25. All loose components and parts which are likely to be damaged such as instruments, gauges, limit switches, fittings, flow-meters, level gauges, sight glasses etc shall be removed, listed and kept in safe custody of the contractor and shall be installed just before handing over to BHEL/NPCIL. All the instruments like pressure gauges, temperature indicators etc., forming part of equipment shall be installed after the main equipment is installed as a part of the main equipment. Equipment such as thermo-wells, level indicators, trays, demister pads, grills etc., shall be properly installed by the contractor after installation of the equipment.
26. Supply of all required consumables in adequate quantity such as birkosit, molybdenum-disulphide, zinc oxide, Ortho phosphoric acid, molykote 1000, hylomar, stag B, loctite, neverseez, white grease, araldite, rustoline, acetone, kerosene, shell ensys 30 oil, insulation spray, varnish, contact cleaner, double boiled linseed oil, white lead, red lead, graphite, diesel, iso-propanol, interplus 634, paint disbonder, lint free cloth etc for assembly of equipments, supply of Ammonia for hydro testing of equipment and pipelines and supply of all welding consumables (except welding electrodes and filler

wire).The list is only indicative and the contractor shall supply all the items deemed necessary for the completion of the work.

1.2.12 MAIN TURBINE, TDFP TURBINE AND AUXILIARIES

1.2.12.1 Erection and assembly of main turbine

Each unit of KKNPP-3&4 consists of 1 set of Main turbine of single-shaft four-cylinder configuration consisting of one high-pressure double flow cylinder and three low-pressure double flow cylinders. The Turbine is of type K-1000-60/3000-2 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. The Turbine set is erected at +16 m floor of turbine building on the vibration isolated TG Deck which is supported over 83 nos. of vibro-isolators (spring supports). Assembled mass of the turbine is approximately 1440 MT. The weight is given here only for the reference to visualize the activities and scope of work. The actual weight may vary based on the supplier of the equipment.

NPCIL will provide Turbine building 180/32 T & 15 T EOT crane for erection of Main turbine, however the contractor shall deploy qualified and experienced EOT Crane operator. Minor maintenance of EOT crane like greasing, cleaning & assistance for repair works is in the scope of the contractor.

In addition to the above general requirements of clause 11.0, the following assembly and erection activities shall be performed by the contractor for the erection of the main turbine.

1. Handling, depreservation, erection and assembly of 1000 MWe Turbine system consisting of 1 HP cylinder, 3 LP cylinder, 5 bearing pedestals including concreting of foundation bolts & base frames with mock-up concreting, TSI & other instrumentations, sensors, field panels, Junction Boxes, welding, NDE, testing of emergency oil tanks, oil flushing of bearing pedestals, deck floating and carrying out all works as per manufacturer drawings, log sheets, documents & specifications and rolling of turbine on baring gear with acceptance of EIC/NPCIL.
2. The scope includes inspection of work front, taking over foundation, survey using total station, temporary barricading of TG floor, marking, axis & slope checking, leveling, blue matching, kerosene leak testing of bearing pedestals, installation of packers, erection & assembly of- bearing system, LP turbine system, HP turbine system and its components, measurement

of vibroisolator spring compression during various stages of erection, centering of all internal components assembly with Laser alignment (Laser alignment kit shall be provided by BHEL), flow path clearance, coupling alignment, shaft turning gear system, governing system components and coupling of all turbine rotors including generator rotor coupling by machining, reaming & honing, measurement of free run out and reaction of supports, fabrication of temporary base frame structure, load balancing, measurement of axial float, calibration and certification of TSI by authorised agency, response check of Instruments, tightening of HP turbine Studs by Induction heating, rolling on shaft turning gear system, FME inspection, preservation, box up of turbines & bearings, seal welding of LP casing vertical joints, preparation of reports and work completion as per manufacturer drawings, documents and specifications with acceptance of EIC. Scope includes supply of dummy shafts for bearing contact checking, dummy bearing for pendulum check, barricading material, temporary support arrangements, temporary and permanent packers, scaffolding & platforms, man power, P&M, Hydraulic Torque wrenches, taper wedges, taper wedge jacks, other tools & tackles, all consumables (excluding welding filler wire & electrode) etc.

3. Providing temporary partition barricading of TG floor, taking over of foundation and survey using total station, marking and verification of TG & condenser axis and elevation of settlement EP's and bench marks, providing cover plate around the annulus gap between Deck and floor, slope checking and blue matching of second stage embedded plates, de-preservation of turbine components, KLT of bearing pedestal and hydro-testing of emergency oil tanks.
4. Assembly of base frame and foundation bolt with bearing pedestal, installation of bearing pedestals with base frame over taper wedges, installation of LPC-2, 1 & 3 base frames along with foundation bolts with bottom casing and test assembly with top casing, assembly of LPC-2, 1 & 3 casing parts, assembly of HPC casing parts, centering of cylinders and bearing pedestals using laser alignment system, use of temporary packer after laser alignment, placement of bearings in bearing pedestals, placement of rotors, measurement of free run out of half couplings and defining reaction of HPC & LPC supports, centering of casings and bearing

pedestals with respect to rotor, alignment of LPRs with respect to half couplings, alignment of HPR–LPR with respect to half couplings.

5. Load balancing of HP & LP casings by dynamometer at various stages of erection activities, installation of permanent packers for bearing support frames, installation of permanent packers for LPC-1, 2 & 3, installation and adjustment of LPC-1, 2 & 3 yokes and diaphragms, installation and adjustment of HPC yokes and diaphragms, flow path clearance measurement in HPC, flow path clearance measurement in LPC-1, 2 & 3, pendulum check of HP rotors and measurement of all bearing clearances on journal bearings and thrust bearings including measurement of axial float.
6. Preservation of turbine components, trial box up of cylinders of LPC-1, 2 & 3 and seal welding of casing vertical joint and release for condenser neck welding, trial box up of cylinders of HPC, blue matching of bursting diaphragm and installation of gaskets, grouting of base frames of casings and bearing pedestals after performing mock-up grouting and Concreting. No extra payment will be made for mock up concreting & final concreting and it is part of the work.
7. Measurement of spring compression in vibroisolators, adjustment of vibroisolators using shims and release of vibroisolators, deck floating and final alignment with and without water in condenser.
8. Reaming and honing of coupling holes, machining of coupling bolts of LPR-3 and Generator rotor, coupling of rotors after mass balancing of coupling bolts, final box up of cylinders of LPC-1, 2 & 3, final box up of HP cylinder and heat tightening of parting plane studs by induction heating, erection of governing column and governing block, alignment of governing shaft and assembly of governing block components, oil flushing of bearing pedestals along with piping including shifting and filling of oil. Oil for the same will be issued by NPCIL.
9. Calibration and certification of TSI by authorised agency and installation of mounting brackets, TSI, secondary convertors & field panels, sensors, junction boxes and response checks, works on bearings and bearing box-up, mounting of shaft turning gear, rolling by barring gear and all other activities required for the successful completion of Turbine erection.

10. Prior to start of the assembly and erection activities, the contractor shall arrange for all the measuring instruments like dial gauge, slip gauge, vernier callipers, inside and outside micrometers (25 to 1000 mm), telescopic gauge, bore dial gauge, feeler gauge, copper rods etc in required quantity with calibration certificate from the NPCIL approved laboratory. The contractor shall have 2 nos. of master plates with calibration certificate and also adequate quantity of secondary master plates. Also the contractor shall have all the required tools and tackles such as hydraulic torque wrench, hydraulic jacks, and induction heating arrangement, wooden sleepers, slings, D-shackles etc. in required quantity with load testing certificate.
11. Supply of materials and fabrication of dummy shafts for bearing contact checking, supply of dummy bearings and other arrangement for pendulum check are in the scope of the contactor. The machining of taper wedges required for installation of pedestals and casings, temporary and permanent packers are in the scope of the contractor. The contractor shall make all necessary arrangements for mock-up grouting including fabrication of temporary base frame structure. Restoration of reinforcement rod shall be carried out by the contractor without any additional cost. Supply and erection of temporary barricading & supporting structural materials is in the scope of the contractor.
12. Calibration of Turbovisory instruments is included in the scope of Assembly and erection of Main Turbine. Turbovisory instruments of Main Turbine shall be calibrated and response shall be checked by an authorized agency as per the manufacturer's recommendation. The Turbovisory instruments that are to be calibrated for the main turbine & BRU-K valves in each unit are approximately 86 No's. Separate procedure shall be prepared and submitted by the Contractor for the approval of BHEL/NPCIL for calibration of instruments. The work will be inspected by BHEL/NPCIL and Russian specialists at site. The instruments shall be checked along with its corresponding secondary convertors. A certification on calibration against each instrument shall be provided and a report prepared and submitted for acceptance of NPCIL/Russian specialists. NPCIL shall issue the manufacturer's documents, Turbovisory instruments and its calibration accessories. Contractors' scope of work includes

arrangement of necessary calibration instruments and facilities other than the calibrating equipments and components supplied by the manufacturer at site, deployment of authorized calibration specialists at KKNPP site, arrangement of test bench for calibration of speed sensors, establishment of temporary calibration shop at Turbine floor, preparation of instruments for calibration, calibration of Turbovisory instruments as per the procedure of manufacturer, certification of instruments as per the analysis of calibration result and validation of instruments for future use and submission of certified calibration reports.

13. De-preservation & Re-preservation: The contractor has to carry out a minimum de-preservation work where ever required to perform the erection activities of main turbine. De-preserved areas shall be properly re-preserved with required preservatives during the course of erection work as a part of main scope of work.
14. On completion of entire erection work of Turbine, the contractor shall de-preserve the protective coating on all the internal components and re-preserve with required preservatives before box-up and heat tighten the HP turbine studs as a part of main scope of work.
15. Temporary structure required during main turbine assembly & erection work: Temporary partitions in B grid at 16 m floor of Turbine building for an approximate length of 96 m and height of 3 m made of GI sheet with CS structural backing members of appropriate size and thickness shall be arranged by the contractor during TG erection work as part of scope of erection work of TG. The work involves, supply fabrication erection and dismantling of the above temporary structures including welding electrodes, all consumables, manpower and P&M. No separate payment shall be made for the temporary structures & arrangements.

NOTE:

1. All the turbine components will be shifted by NPCIL from NPCIL stores to Turbine hall unloading bay based on the request of the contractor through CIV (contractor issue voucher). The contractor shall make all necessary arrangements for unloading the package using 180/32 T turbine hall crane.
2. Deck floating and NDE is a part of scope of Main Turbine erection work.
3. BHEL shall arrange for software based laser alignment system for centering of Turbine components.

4. 180/32T Turbine hall crane shall be provided by NPCIL for unloading the packages, erection & assembly of Main Turbine and crane operator for operation of the crane is in the scope of the contractor.
5. For all the temporary structures, contractor shall supply all the materials including welding electrodes and consumables.
6. All NDE will be part of scope of work and no separate payment shall be made.
7. Incase BHEL / NPCIL decided to de-preservation of all the internal components of Main Turbine & re-preservation with required preservatives before box-up and heat tightening of HP turbine studs are not required to be carried out and permitted for temporary box-up. In such instance, 5% of item weightage will be deducted.

1.2.12.2 Erection & assembly of turbine drive unit for feed pump :

Each unit of KK 3 & 4 consists of 2 sets of Turbine Drive units for feed pumps. The steam turbine drive is of the variable speed type and is intended to drive directly the main feed pump and booster feed pumps through the reduction gear. The turbine drive consists of single cylinder, single flow type with nine stages and is erected on the vibration isolated TG Deck in which the total foundation deck is supported over the 24 nos. of vibroisolators (spring supports).The Turbine drive is located at B-C bay of turbine building at 6.0 m floor. The approximate weight of the main assembly units of the each drive turbine is 50 MT. The weight is given only for the reference to visualize the following activities. The actual weight may vary based on the supplier of the equipment.

The turbine includes components such as drive turbine with the reduction gear, stop valve, governor unit, coupling, barring gear, foundation frames, turbine cover, supporting and wedge gaskets, foundation studs, turbo supervisory instruments, accessories, rack with the control system etc.

In addition to the general requirements of clause 11.0, the following major activities are to be performed by the contractor for the assembly and erection of this Turbine drive of feed pumps.

1. Handling, inspection of work front, taking over foundation, survey using total station,marking, axis & slope checking, leveling, blue matching, supply and installation of packers, KLT of bearing pedestal, depreservation, filling of

base frame with concrete including welding of reinforcement rods, cold phospatizing of base frame, blue matching of mating surfaces, application of steam sealing compound on the flange surfaces & torque tightening, measurement & installation of keys, installation of bearings, erection & assembly turbine components like turbine casing, bearing, rotor, reduction gear box etc., centering of all internal components, flow path clearance, measurement of clearances, runout, thrust collar faceout, axial float, load balancing of cylinders, measurement of turbine deck spring lengths, concreting of foundation bolts & base frames, erection of shaft turning gear system, governing system components and coupling of turbine rotor with reduction gear box, drilling & dowelling, removal of bearing covers & turbine casing, response check of Instruments, FME inspection, oil flushing, box up of turbine, tightening of turbine studs by induction heating, deck floating, mounting of accessories like TSI & other instrumentations, sensors, field panels, Junction Boxes, turbine rolling on barring gear, preservation, welding, NDE, Oil flushing of pedestals and carrying out all works as per manufacturer drawings, log sheets, documents and specifications with acceptance of EIC/NPCIL.

2. Taking over of foundation and survey using total station, marking and verification of Turbine drive & condenser axis and elevation of settlement EP's and bench marks, and providing cover plate around annulus space between deck and floor, kerosene leak testing of bearing pedestal, de-preservation of all turbine components, chipping and grinding the civil foundation, welding of reinforcement rods in inner surface of base frames and grouting, cold phospatizing of base frame mating surfaces, blue matching between the packer plates and concrete/EP surface, taper wedge packer plates, base frames with pedestal & casings, HP, LP & inner casing bottom half with top half and HP casing with LP casing vertical joint.
3. Preparation and application of steam sealing compound on the flange surfaces of HP casing with LP casing vertical joint and torque tightening of fasteners, measurement of key & key way dimensions and installation of keys, centering of the casing and leveling, blue matching of radial journal bearings parting plane, bearing babbit lining with rotor, thrust pads with rotor collar and bearing housing & bearing pad and installation of bearings, installation of bottom half components, placement of rotor, centering and

measurement of all the required clearances, measurement of the butt clearances of diaphragms, front and rear end gland packing.

4. Load balancing of cylinders by dynamometer at various stages of erection activities, checking of rotor shaft journal run out & thrust collar face out and measurement of axial float of the rotor with bearing in open and boxed up condition, measurement of flow path clearances.
5. Temporary box up of Turbine, measurement and recording of turbine deck spring length before condenser neck fit up and welding, dismantling of bearing covers and turbine casing, mounting of field control panel, brackets and accessories such as TSI, RTD's, junction boxes and secondary converters after calibration and response checks, measurement of the rotor centering, slope and casing level, axial float, flow path clearances, and other log sheet measurements after condenser neck welding.
6. Final box up of turbine casing and grouting along with foundation bolts, heat tightening of HP casing and torque tightening of LP casing parting plane studs, completion of oil flushing and box up of bearing pedestals with shaft turning gear, installation of governing system components, alignment of reduction gear box, drilling and dowelling and Turbine drive on barring gear.
7. Prior to start of the assembly and erection activities, the contractor shall arrange for all the measuring instruments like dial gauge, slip gauge, vernier calipers, inside and outside micrometers, telescopic gauge, bore dial gauge, feeler gauge, etc. in required quantity with calibration certificate from the NPCIL approved laboratory. The contractor shall have master plates with calibration certificate and also adequate quantity of secondary master plates. Also the contractor shall have all the required tools and tackles such as hydraulic torque wrench, induction heating arrangement, slings, D-shackles, bow shackles etc. in required tonnage , capacity and quantity with load testing certificate. Preparation of steam mastic compound is in the scope of the contractor. The taper wedges required for installation of pedestals and casings are in the scope of the contractor. NDE is part of scope.

   Scope includes supply of temporary support arrangements, scaffolding & platforms, man power, P&M, hydraulic torque wrenches, taper wedges, other tools & tackles, all consumables (excluding welding filler wire & electrode) etc.

Note:

1. NPCIL will provide Turbine building 20/ 5 T EOT crane for erection of Turbine drive, however the contractor shall deploy qualified and experienced EOT Crane operator.
2. Preparation of steam mastic compound is in the scope of the contractor.
3. In case any temporary structures required, contractor shall supply all the materials including welding electrodes and consumables.

1.2.12.3 Erection and assembly of MSR:

Moisture Separator and re-heaters (MSR) are intended for steam drying and superheating of wet steam downstream of HP cylinder. There are four nos. moisture separator re-heaters in each unit of KKNPP 3 & 4 and are to be erected at + 0.0 m elevation of the Turbine building (UMA). The moisture separator re- heater is supplied in components such as sector plates, gusset plates, separator (50 MT), reheater (100 MT), segregator and chamber in assembly (8 nos.) which are to be assembled and welded at site. The overall dimension of the equipment is

4500 mm in diameter and 15000 mm in height. The overall weight of the each MSR is approximately 176 MT. The weight is given only for the reference to visualize the following activities. The actual weight may vary based on the supplier of the equipment.

In addition to the above general requirements of clause 11.0, the following assembly and erection activities are to be performed by the contractor for the erection of the MSR.

1. Handling, de-preservation, inspection of work front, tilting of seperator and reheater, erection, assembly, alignment, fit up and welding of sector plates on packers, Moisture seperator, Reheater, steam chamber-in- assembly, segregator, thrust pads, sector plate and gusset plates, installation of foundation bolts,levelling, verticality check, pocket grouting, cutting, grinding, removal of thrust pads, lifting lugs, anchor plate matching, torque tightening of foundation bolts, grouting of foundation bolt and frame, shell side hydro test of equipment with chemical addition, draining, neutralizing, drying by hot air, NDE including digitization of RT films, FME, boxup, preparation of reports and work completion as per manufacturer drawings, documents and specifications with acceptance of EIC.

2. Scope includes supply of packer plates and shims including temporary support and tilting arrangements, scaffolding & platforms, man power, P&M, tools & tackles, all consumables (excluding welding electrodes and filler wires) etc
3. Assembly, welding and installation of bearing ring plate (sector plate) over the foundation with foundation bolts, pocket grouting of anchor fasteners, erection of separator after tilting to vertical position using NPCIL heavy duty crane and contractors tailing crane of adequate capacity, welding of separator, sector plate (with post weld heat treatment, if required) and gusset plates, welding of chamber in assembly with re-heater, welding of thrust pads, tilting of re-heater using NPCIL heavy duty crane and contractors tailing crane of adequate capacity, erection of re-heater over separator, fit-up, alignment and welding, welding of segregator and NDE of welded joints.
4. Removal of thrust pads, lifting lugs and performing DPT, anchor plate matching, torque tightening of foundation bolts and grouting of foundation bolt and frame, hydro testing with ammonia addition to DM water, neutralizing & pH checking before draining and hot air drying with all necessary arrangements and FME inspection and box-up of manholes. NDE is part of scope.

Note:

1. NPCIL heavy duty crawler crane will be provided for erection of moisture separator and re-heater. In place of tailing crane, contractor can use tilting stand and the tilting stand supply & fabrication is in the scope of the contractor.
2. Tilting of seperator and reheater before lifting shall be done by using NPCIL's heavy duty crane and Contractor's mobile crane.
3. In case any temporary structures required, contractor shall supply all the materials including welding electrodes and consumables.

1.2.12.4 Fabrication, welding and erection of crossover piping:

1. The cross over piping is intended for the transfer of steam from HP valve block to HP turbine and exhaust steam from HPC outlet to the inlet of LPC through MSR. The cross over piping is classified into two categories as SS cross over and CS cross over.
2. The SS cross over piping includes the four independent lines connecting the exhaust section of HPC to the independent MSR inlet and are to be erected in vertical position running from elevation + 2.250 m to +11.270 m. The

approximate size (OD) of the SS cross over piping is 1140 mm to 1420 mm and the welded joints are subjected to 100% DPT and 100% RT. In addition, the temporary cleat used during fit-up shall be removed by grinding and the surface area shall be inspected by 100% DPT without additional cost.

3. The CS cross over piping consists of four independent lines (MAA) of size 630mm OD from HP valve block to HP turbine and two independent headers (LBJ) connecting between MSR outlet and inlet to all the three LPC. The approximate size (OD) of the CS cross over piping is 1240 mm to 2060 mm and the welded joints are subjected to 100% DPT, 100%UT and 100% RT.
4. The contractor's scope of work involves fabrication, welding, handling, cutting, edge correction, alignment, fit-up and erection of Crossover piping using temporary support structures, cutting and edge preparation of spools with erection allowances, welding and NDE of Cross over piping, blue matching of base of supports of CS cross over piping (LBJ) with the seating area, assembly, alignment and erection with required offset, machining of spacers suit to site for CS cross over (LBJ) piping supports, compression and erection of spring supports of SS cross over piping and release of same after hook up, FME inspection and box up and removal of all the transportation locks in the compensators before releasing the pipelines for insulation works. NDE is part of scope.
5. Erection of Cross over piping :

   Identification of pipe spool & bellows, handling, removal of blank, cutting, erection and alignment of CS and SS crossover piping, FME inspection, release of springs, removal of transportation locks, preparation of erection reports, as-built drawings and work completion as per manufacturer drawings, documents and specifications with acceptance of EIC/NPCIL

   The scope includes temporary support arrangements, scaffolding & platforms, man power, P&M, tools & tackles, all consumables(excluding welding filler wire & electrode) etc.

   Note: Incase any temporary structures required, contractor shall supply all the materials including welding electrodes and consumables.
6. Welding of Cross over piping (CS&SS) :

   Handling, edge correction (for pipe spools issued with prepared edges), edge preparation, fit up, welding using GTAW/ SMAW process, NDE, FME

inspection, preparation of reports as per manufacturer drawings, documents and specifications with acceptance of EIC/NPCIL.

The scope includes joint identification & marking by engraving/ punching, preparation of welding inspection report (WIR), temporary support arrangements, scaffolding & platforms, man power, P&M, tools & tackles, all consumables (excluding welding filler wires & electrodes) etc.

Note : Incase any temporary structures required, contractor shall supply all the materials including welding electrodes and consumables.

7. Erection of Cross over pipe supports :

   Identification of pipe supports, handling, depreservation, blue matching, assembly, alignment, checking of elevation & location, pre-assembly of spring units, hangers, compression of spring supports, machning of spacers, erection and welding of pipe supports, saddle, NDT, release of springs, preparation of support erection report as per manufacturer drawings, documents and specifications with acceptance of EIC/NPCIL.

   The scope includes temporary support arrangements, scaffolding & platforms, man power, P&M, tools & tackles, all consumables (excluding welding filler wire & electrode) etc.

   Note: Incase any temporary structures required, contractor shall supply all the materials including welding electrodes and consumables.

1.2.12.5 Erection and assembly of valve blocks:

The valve blocks are intended for stop and control of steam admission. The HP and LP valve blocks consisting of valves and hydraulic servomotors are installed in the turbine deck on left and right side of the turbine at +16.0 m floor of turbine building. There are 4 nos. of HP valve blocks in each unit consisting of one stop and one control valve installed in the steam inlet line to HP turbine. There are 6 nos. of LP valve blocks in each unit consisting of one stop and one control valve installed in the steam inlet line to LP turbine. Also there are 4 nos. of MSR discharge valve in each unit at +7.8 m floor, 6 nos. of BRU-K valves in each unit at +7.8 m elevation and 1 no. of MSR heating steam valve in each unit at +16.0 m floor. There are two nos. of TDFP stop valve blocks in each unit at + 6 m floor. All the valve blocks are to be installed in Turbine building (UMA).

In addition to the above general requirements of clause 11.0, the following are the major assembly and erection activities to be performed by the contractor for the erection of the valve blocks

Handling, de-preservation, identification, installation in design position , grouting, alignment, fit-up, welding, valve erection, disassembly, removal of internals, measurements, blue matching, internal seal welding for HP valve blocks, assembly, torque tightening, erection of servomotor and coupling of valves/ block and servomotors, NDE of seal welding , FME, boxup, mounting of all accessories, preparation of valve erection reports and carrying out all works as per manufacturer drawings, logsheets, documents and specifications with acceptance of EIC/NPCIL.

Handling, making temporary arrangement for support, alignment, fit-up, welding and NDE of valve block, dis-assembly, de-preservation, removal of internals and taking the measurements, ensuring the tightness of sealing by blue contact method, FME inspection, assembly of internals, preservation, box-up of valve blocks, tightening of cap nuts to the required torque value using hydraulic torque wrench, erection of the servo motor, coupling of valve spindle with the servomotor spindle and installation of brackets, instruments, secondary convertors and junction boxes.

The above activities are common for HP valve blocks, LP valve blocks, MSR discharge valve, BRU-K valves & MSR heating steam valves. Some of the activities are specific to certain valve blocks and the details given below

1. **Valve blocks with seal welding (HP valve Block)-:** In addition to the above mentioned activities, the HP stop & control valves shall be assembled at site and the flange joint between the stop and control valve shall be seal welded to prevent leakage of steam through the flange joint. The internal seal weld joint shall be inspected by DPT method. The approximate weight of **each HP valve block is 14.24 MT.**
2. **Valve blocks without seal welding (LP, MSR heating steam supply and dump valves, BRU-K):** LP valve blocks are installed over supports and welded to CS cross over pipes. MSR heating steam supply valve is welded to heating steam supply pipelines. BRU-K valves are welded to nozzles of main condenser. The approximate weight of each LP valve block is 14.480 MT, MSR heating steam supply valve is 2.730MT and BRU-K valve is 3.975 MT.
3. **Valve blocks without seal welding with blue matching (Stop valves of TDFP)-:** Apart from the above erection activities, the stop valve blocks of TDFP are to be erected over packer plates after blue matching of

packer plates, taper wedges & valve seating area and grouting of the stop valves shall be performed as per the manufacturer's instruction. The approximate weight of each HP valve block is 3.587 MT.

NDE is part of the scope.

The scope includes temporary support arrangements, scaffolding & platforms, man power, P&M, tools & tackles, all consumables (excluding welding filler wire & electrode) etc.

Note : Incase any temporary structures required, contractor shall supply all the materials including welding electrodes and consumables.

1.2.12.6 Assembly and erection of noise absorbing sheathing:

Turbine, generator and exciter are enclosed by a special noise absorbing sheathing for reducing the noise level. The noise-absorbing sheathing shall be assembled and installed by bolting and welding as per the manufacturer drawings at +16 m floor of Turbine building. The inner surface of the sheathing is provided with sound-absorbing insulation material.

Pre-fabricated sheathing structures in dis-assembled form along with electrical lighting, fixtures & fittings and cables will be issued as free issue material. Contractors' scope of work includes Identification, marking, handling, pre & final assembly, welding, bolting, trial installation, welding of support brackets, fixing of entry doors, electrical lighting & fixtures, laying of cables and other electrical fittings, removal of sheathing for insulation work and final installation/ erection, preparation of reports and work completion as per manufacturer drawings, documents and specifications with acceptance of EIC/ NPCIL.

Handling and shifting of sheathing components to Turbine floor, marking and preparation of erection locations, preassembly of sheathing structure by welding and bolting, welding of support brackets on Turbine casings and metal structures after paint removal, fixing of entry doors, electrical lighting & fixtures, laying of cables and other electrical fittings, trial erection of completely assembled sheathing structure, removal of sheathing cover, final installation and bolting with the base of sheathing structure and providing temporary support arrangements and scaffolding & platforms required during assembly and erection. NDE is part of the scope.

Note:

1. NPCIL will provide EOT crane and the contractor shall deploy qualified crane operator for assembly and erection of sheathing.

2. The scope includes providing temporary support arrangements, scaffolding & platforms, man power, P&M, tools & tackles, all consumables (excluding welding filler wire and electrodes) etc.
3. In case any temporary structures required, contractor shall supply all the materials including welding electrodes and consumables.

1.2.12.7 Deck floating:

In KKNPP 3&4 vibro-isolated foundations are provided for Main Turbine & Generator, Turbine drives for feed pumps, Electric driven feed pumps and auxiliary feed water pump. The total number of vibro-isolators in each unit of KK 3&4 are approximately 157 No's (TG deck – 83 no's, TDFP– 48 no's, EDFP – 20 No's and AFWP – 6 no's). BHEL shall arrange representative from M/s.GERB for supervision for deck floating, contractor shall provide manpower assistance by providing skilled/semi skilled/un-skilled workers for removal of cover plates, installation and removal of scaffoldings, releasing of vibro-isolators and measurements including necessary tools, tackles, plant and machinery, consumables etc. Erection of all the above vibro-isolators and casting of decks are in the scope of NPCIL. NPCIL will provide pre pour inspection reports and pre compression reports of vibro-isolators to the contractor.

BHEL shall arrange technical supervision team from M/s.GERB and carryout post measurement after deck casting before equipment erection, releasing of vibro-isolators and final measurements for TG deck, TDFP deck, EDFP deck and AFP deck after equipment erection.

The contractor scope of work includes preparation of work procedures and QAP for post pour measurements, release and final measurements of the vibro-isolators and submission to the EIC for approval before taking up the supervision works, coordination for the inspection and supervision by vibroisolator manufacturer M/s.GERB representatives, arrangement of machinery, scaffolding, manpower, material handling devices, tools & tackles, measuring instruments, lighting including cables, extension boards, etc required for various activities involved till final measurement after release of vibro-isolators, preparation and submission of all inspection reports during post pour measurement, release and final measurements of the vibro-isolators and deposition of balance shims to NPCIL's store.

Note:

1. NPCIL scope of work is limited to the erection of Vibro-isolators.
2. BHEL shall arrange representative from M/s.GERB for supervision for deck floating.

1. Manpower assistance for deck floating: The scope of the contractor is to carry out removal of cover plates installed around the decks by cutting, grinding, chipping by chiseling, cleaning of annular spaces around the concrete deck and removal & disposal of debris, cleaning of all vibroisolator spring units and its concrete slab, installation of scaffolding and platforms and providing access to vibro-isolator spring units axis locators, assisting M/s. GERB representative during post measurements, release of vibro-isolator spring units, adjustment of shims and final measurement of vibro-isolator spring units & axis locators.
2. The quoted rate is inclusive of arrangement of necessary scaffolding, manpower, material handling devices, measuring instruments, lighting including cables, extension boards, tools, tackles, plant and machinery, consumables, PPE's etc

1.2.13 GENERATOR AND EXCITATION SYSTEM

1.2.13.1 Erection & assembly of generator and excitation system :

Each unit of KK 3 & 4 consists of one set of Generator and excitation system. The generator set is 1000 MW, 50 Hz Electrical Generator and is a non-salient, two pole synchronous electrical machine consisting of Stator, End part and End shields, Rotor, Gas coolers, Bearing pedestal, Shaft seals, Exciter & Armature. The approximate total weight of the Generator including Exciter per unit is 610 MT and is located at +16 m floor of the Turbine building. The weight is given only for the reference to visualize the following activities. The actual weight may vary based on the supplier of the equipment.

In addition to the above general requirements of clause 1.2.11, the following activities shall be performed by the contractor for the assembly and erection of Generator and excitation system.

1. Handling, depreservation, erection & assembly of 1000 Mwe Generator and Excitation system, excitation transformer (2 x160 KVA), foundation plate, bearing pedestal, generator stator, stator end parts, hydrogen coolers,end shield, rotor, hydrogen seal body assembly, neutral pole transformers,

neutral terminals, terminal bushings, exciter magnetic system (stator), exciter coolers, flexible connectors and teflon hoses, current carrying wedges, exciter armature, bank of resistors, electrical panels, junction boxes, instruments etc.

2. The scope includes inspection of work front, preparation of foundation, blue matching, centering of stator, fixing of trunion plates, erection & assembly of generator components, alignment, torque tightening, hot water rinsing of terminal bushes, installation of permanent pads, grouting, assembly of rail, bogie & rotor insertion, hydrotest and erection of coolers, FME inspection, boxup of generator, exciter & bearings, hydrogen seal body centering, reaming, honing, alignment & coupling of generator rotor with exciter rotor and torque tightening, generator phase linking with IP bus duct, welding, performing all tests like KLT of bearing pedestal, seal body hydrotest of emergency oil tank, terminal bushings, flexible connectors & teflon hoses, stator windings, hot water rinsing of terminal bushes, HV test of stator, rotor terminal bushings, purge test, airhold test of stator & all other erection checks, pendulum check of rotor, electrical tests like d.c. resistance and a.c. impedance, electrical strength tests, contact resistance test, half-wave reverse voltage test etc, measurement of insulation resistance (IR), gas-tightness test, air gap check, mounting of accessories, copper tubing of refrigeration unit (MKG) with refrigerant filling & leak testing, preparation of reports, obtaining CEA clearance and work completion as per manufacturer drawings, documents, logsheets and specifications with acceptance of EIC/NPCIL/BHEL.
3. Scope includes supply of temporary support arrangements, scaffolding & platforms, man power, torque wrench, P&M, tools & tackles, taper wedges, taper wedge jacks, heaters, measuring instruments, HV test setup, blanks, packer plates, all consumables (excluding welding filler wire & electrode) etc.
4. Taking over and preparation of foundation, slope checking and blue matching of Embedded Plates, installation of foundation plates, blue matching and fixing of trunnion plates with stator and end parts, erection of bottom halves of end parts, removal of protective enclosures, lifting of stator, placement on foundation, magnetic axis centering, preliminary

alignment and tightening of foundation bolts, assembly of end parts with stator, assembly of end shields.

5. Performance of air hold test of stator with fabricated blanks, with mixture of freon gas and leak detection using freon sniffer, rinsing of stator end terminal bushes in hot water at a temperature from 800C to 900C and leak-tightness hydro test, DPT and HV dielectric test at 70 KV of terminal bushings, assembly of terminal bushings after gas tightness testing, Hydro test of flexible connectors and teflon hoses, installation of flexible connectors and teflon hoses and hydro test of stator winding with end terminals, HV test of stator winding at 39.2KV, Hydro test and assembly of gas coolers and KLT of bearing pedestal, performance of d.c. resistance and a.c. impedance, electrical strength test (HV test) at 1 KV, air purge test, gas- tightness test of the current lead and measurement of winding insulation resistance (IR) in generator rotor. Arranging of HV test kit and electrical instruments as required for HV test of bushing and Generator stator & other electrical checks are in the scope of contractor.
6. Assembly of rail, bogie and insertion of Rotor, placement of rotor over the bearings in front and rear end and alignment with LPR-3, alignment of stator with respect to the rotor and checking of air gap, check final positioning of stator relative to rotor, grouting and final torque tightening of foundation bolts, installation and alignment of stator end shields, installation of permanent pads under the foundation plates and grouting, checking of bearing pedestal insulation resistance (IR) relative to the foundation plate, alignment of the bearing pedestal w.r.t to the rotor, reaming and honing of coupling holes of generator rotor, KLT on seal body, erection and centering of seal body and assembly of shaft seals, assembly and box-up of front and rear bearing pedestals.
7. Performance of tests like contact resistance of rectifier units, insulation resistance(IR) of the exciter bearing, IR value of armature winding , field winding, RTDs, brush panel, half-wave reverse voltage test of rectifier units, winding insulation dielectric strength, hydraulic tests of the air coolers before erection of exciter, assembly, erection and alignment of exciter with generator, placement, alignment and pendulum check of exciter rotor with generator rotor, installation of current carrying wedge and coupling of exciter rotor to generator rotor, installation of neutral terminals and its

transformers, installation of bank of resistors and interconnection by copper strips, erection of generator and exciter accessories such as RTD's, moisture traps, neutral terminal covers etc, generator phase linking with IP bus duct and box-up of generator & exciter

8. Performance of air-hold test of generator with auxiliary systems in service, HV test at 39.2 KV of stator with stator water system in service, erection of panels for excitation system in Normal operation power supply building (UBA), supply of copper tubing of size 8x1,10x1,15x1 for a length 4m each per unit for inter connection of evaporator and refrigerant unit, flaring of joints, leak testing of tubing and filling of the unit with refrigerant (quantity approx. 6 kg). Performance of measurements, Tests (Electrical, Mechanical strength tests by hydraulic and air, Leak tests) assembly and erection as per manufacture log sheets.
9. All tesing & measuring instruments for conducting electrical tests on all equipments shall be arranged by the contractor with in the Lump sum quoted price.
10. Prior to start of the assembly and erection activities, the contractor shall arrange for all the measuring instruments like dial gauge, slip gauge, vernier calipers, inside and outside micrometers (25 to 1000 mm), telescopic gauge, bore dial gauge, feeler guage, etc. in required quantity with calibration certificate from the NPCIL approved laboratory. The contractor shall have 2 nos. of master plates with calibration certificate and also adequate quantity of secondary master plates. Also the contractor shall have all the required tools and tackles such as hydraulic torque wrench, slings, D-shackles, heaters etc. in required quantity with load testing certificate. The taper wedges required for installation of pedestals & casings and blanks for performing air hold test are in the scope of the contractor.

Note:

1. For lifting of stator, Turbine hall EOT crane- 180T +180T crane will be provided by NPCIL. However the contractor shall deploy qualified and experienced EOT Crane operator. For threading in and out of rotor, web slings of suitable length and capacity shall be arranged by the contractor.

2. All NDE will be part of scope of work and no separate payment shall be made.
3. In case any temporary structures required, contractor shall supply all the materials including welding electrodes and consumables.

1.2.13.2 CEA clearance on generator:

After carrying out IR value test and HV test, the contractor shall coordinate with BHEL/NPCIL during the performance of tests such as primary and secondary injection test, protection, stability and directional test, annunciation test, relay tests and routine tests. The contractor's licensed Electrical Supervisor shall compile all these test reports, layout drawings, single line diagrams, cable logs, protection & trip documents along with completion certificate. The contractor shall submit the compiled documents along with application form to CEA and obtain clearance.

Note: Performance of IR value test and HV tests are part of Generator erection. NDE is a part of scope of Generator erection work and no separate payment shall be made.

1.2.14 MAIN AND TDFP CONDENSER

1.2.14.1 Erection & assembly of main condensers:

Each unit of KK 3 & 4 consists of 1 set of main condenser, which composes of 3 nos. of condensers located under each of the LP cylinder. The condenser is double flow- single pass, shell and tube type heat exchanger, spring-mounted and is joined to the LP turbines by welding.

The condenser set is delivered in approximately 63 major sub assemblies which are to be assembled in-situ during erection. Titanium tubes will be delivered as a separate package. There are 90000 (30000 x 3) Ti-tubes in each unit. Installation, expansion and welding of tube ends to tube plates shall be carried out by the contractor after assembly of the condenser set. The total mass of dry condenser set in each unit is 1764 MT approximately. The weight is given only for the reference to visualize the following activities. The actual weight may vary based on the supplier of the equipment.

In addition to the above general requirements in clause 11.0, the following are the activities to be performed by the contractor for the assembly and erection of Main Condensers.

1. Handling, depreservation, fabrication, erection & assembly of main condenser (3 nos per Unit), spring units, condenser sub-assemblies like hotwell and collector, sidewall, front and rear walls, tube support plate assembly, tube sheets, titanium tubes, lower dome assembly with LPH-1, upper dome assembly, water boxes, instruments which includes inspection of work front, taking over foundation, blue matching, welding of main condenser assemblies, providing nozzles, alignment of tube holes, titanium tube installation, trimming, facing, titanium tube rolling, welding of tube with tube sheet by orbital TIG welding, mock -up tests, pneumatic testing of tubes and tube to tube sheet joint, condenser neck welding with turbine exhaust, KLT, DPT, arrangements and hydrofill test of shell side with ammonia addition, draining & drying, waviness check of tubes, hotwell cleaning, mouting of accessories, FME inspection and boxup of condenser, all erection checks and measurements, clean room conditions for tubing works, protection of tubes by suitable means at upper dome, preparation of reports and work completion as per manufacturer drawings, documents, log sheets and specifications with acceptance of EIC/NPCIL.
2. Assembly and erection of tube systems, blue matching of top and bottom half of tube systems, alignment of holes in tube support plate, waviness check of tube boards, alignment of holes between tube support plate and tube boards and welding, pre-fabrication, assembly and erection of condenser side walls, front and rear walls, erection and welding of connection branch (lower and upper dome) pipes, welding of stiffeners, L plates, tie rods, welding of steam inlet section to LPH-1 and outlet drain pipe and other subassemblies, providing nozzles on condenser by cutting, grinding, edge preparation and welding, arrangements for protection of tubes and clean room for tubing works.
3. Performance of mock up in test blocks for qualification of initial expansion by rolling, orbital TIG welding and final expansion by rolling, tube insertion with pilot head, tube trimming, facing, initial expansion, orbital TIG welding and final expansion with lubrication, tube integrity test and tube to tube sheet weld joint integrity test, assembly and erection of water chambers, neck welding, mounting of all accessories, NDE of all weld joints, Hot well cleaning before and after fill test, supporting of condenser on temporary screw jack arrangements, water fill test with ammonia addition to

DM water, neutralizing & pH checking before draining and drying with all necessary arrangements, Welding of packer plates of the spring supports with EP and spring supports with the condenser hot well, FME inspection and box-up.

Note: The top of the condenser shall be kept closed with metallic sheets (to be supplied by the contractor) to prevent damage of tubes by inadvertent fall of material. All temporary attachments welded to condenser components (inside and outside) shall be removed and DPT shall be performed before hydro fill test. Screw jacks of fabricated type required for performing water fill test is in scope of the contractor. Hot well cleaning before and after fill test shall be carried out by the contractor as part of condenser erection work. Subsequent hot well cleaning if required any shall be carried out by contractor with in the quoted rates.

4. Temporary structure required during main condenser tubing work: The following temporary structures are to be arranged by the contractor during condenser erection work as part of scope of erection work of the condenser. The work involves, supply fabrication erection and dismantling of the following temporary structures including welding electrodes, all consumables, manpower and P&M. No separate payment shall be made for the temporary structures & arrangements.
   a. During condenser tube erection, canopy type sheet metal roof structure has to be established extending from A-Grid wall of turbine building at the front end of respective condenser opening. During rolling, welding and NDE works, air conditioned cool & clean room environment has to be established by the contractor. For providing such environment contractor shall supply & fabricate a box type metal enclosure on the front and rear side of each condenser water boxes. No of such enclosures required are 12 nos. per unit. The approximate dimensions of each enclosures is 5 m x 5 m x 7 m (Lx W x H). The enclosure will be made from CS structural members and GI sheet of appropriate size and thickness to suit the field conditions.
   b. There are 3 nos. of condenser per unit, each having 2 nos. of upper domes connecting to LP turbine exhaust. During the Turbine erection works and for neck welding of the condenser with Turbine exhaust part, the condenser tubes are to be protected by closing at the top of upper

dome with suitable wooden plank covered with GI sheet of suitable thickness. The approximate size of each dome is 3 m x 8 m. The wooden cover with GI sheet can be placed over the existing stiffener grid of the upper dome.

NDE is a part of scope of Main condenser erection work and no separate payment shall be made.

Scope includes supply of temporary support arrangements pilot heads, metallic sheets for tube protection, packer plates, scaffolding & platforms, man power, torque wrench, screw jacks, P&M, tools & tackles, testing equipment's, all consumables (excluding welding filler wire & electrode) etc.

Note:

1. Positioning of spring units, condenser sub-assemblies like hotwell and collector has already been completed. However, alignment check & minor correction works of erected hotwell assembly are in the scope of the contractor to carry out further condenser erection.
2. For all the temporary structures, contractor shall supply all the materials including welding electrodes and consumables.
3. Scope includes shifting and handling of condenser water boxes (Water chamber) to BHEL grit blasting & painting shed. Grit blasting & anticorrosive coating of inner surface of water box will be carried out by Anticorrosive coating agency. After coating and inspection works, the water boxes shall be shifted to the location assigned by BHEL for safe storage till shifting the same to erection location. The handling of water boxes during the entire process will be in contractor scope. Contractor to take all necessary precautions and to ensure that the coating not getting damaged during the entire process with necessary arrangements/ coverings as and when required till completion of erection and handing over to customer.

1.2.14.2 Erection & assembly of TDFP condensers :

Each unit of KK-3 & 4 consists of 2 sets of TDFP condenser. The TDFP condenser is a single pass dual flow condenser intended to condense the exhaust steam from the turbine drive for feed pump (TDFP) with sea water for cooling and is located in 0.0 m floor in B-C bay of Turbine building. The TDFP condenser consists of assembled units of shell of the steam section, front water box, rear water box, hot well and cooling water tubes. The approximate weight

of the TDFP condenser along with its reducer section is 25 MT and is supported on the spring supports. The weight is given only for the reference to visualize the following activities. The actual weight may vary based on the supplier of the equipment.

In addition to the above general requirements of clause 11.0, the following are the major activities to be performed by the contractor for the assembly and erection of TDFP condensers,

1. Handling, depreservation, erection & assembly of TDFP condenser set (2 sets per Unit), spring units, reducer, inlet and outlet transition pieces, instruments which includes inspection of work front, prepration of foundation, installation of base frame, foundation bolts, grouting, alignment, welding of transition piece, reducer with condenser and turbine exhaust, spring suppports, NDE including digitization of RT films, temporary arrangements and hydrofill test of shell side with ammonia addition, draining & drying, hotwell cleaning, mouting of accessories, FME inspection and boxup of condenser, all erection checks and measurements, protection of tubes by suitable means, preparation of reports and work completion as per manufacturer drawings, documents, logsheets and specifications with acceptance of EIC/NPCIL.
2. Scope includes temporary support arrangements, scaffolding & platforms, man power, metallic sheets for tube protection, packer plates torque wrench, screw jacks, P&M, tools & tackles, all consumables (excluding welding filler wire & electrode) etc
3. Preparation of the foundation, lifting and placing of the reducer section in position using temporary structural arrangements, installation of the foundation frame, foundation bolt and grouting, installation of spring supports over the foundation lowering and shifting from MSR foundation to condenser foundation using I beams with skid rollers, hook chook and chain pulley blocks, erection of the TDFP condenser on spring supports, alignment of the condenser with reference to TDFP turbine and condenser axis, welding of the cooling water inlet and outlet transition reducer sections, alignment and welding of the reducer section in controlled manner after TDFP box-up, mounting of all accessories, NDE of all weld joints, Hot well cleaning before and after fill test and subsequent hot well cleaning if required shall be carried out as per the instructions of EIC. supporting of condenser

on temporary screw jack arrangements, water fill test with ammonia addition to DM water, neutralizing & pH checking before draining and drying with all necessary arrangements, welding of packer plates of the spring supports with base frame and spring supports with the condenser support bracket, FME inspection and box-up. Water box internal surface anticorrosive coating has to carried out with adequate protection cover sheet made to the Tube and Tube sheet without any extra cost. Opening of water box outer cover is envisaged to facilitate painting work and shall be carried out without any extra cost.

4. Temporary structure required during TDFP condenser tubing work: The temporary structures are to be arranged by the contractor during condenser erection work as part of scope of erection work of the condenser. The work involves, supply fabrication erection and dismantling of the following temporary structures including all welding electrodes, consumables, manpower and P&M. No separate payment shall be made for the temporary structures & arrangements. During the reducer section welding of the condenser with drive Turbine exhaust part, the condenser tubes are to be protected by closing at the top of reducer section with suitable wooden plank covered with GI sheet of suitable thickness. The approximate size of each reducer section is 5 m x 2 m. The wooden cover with GI sheet can be placed over the existing stiffener grid of the upper dome.

Note:

1. Positioning of TDFP condenser has already been completed. However, corrections in deviation in aligment, if any, up to 20-25mm shall be carried out by the contractor at no extra cost. All other activities associated with TDFP condenser are in the scope of the contract.
2. NPCIL will provide heavy duty crawler crane for lowering condenser-1 into turbine building through MSR opening. All other arrangements for leading and erection of both the condensers are in contractor's scope.
3. The top of the condenser shall be kept closed with metallic sheets (to be supplied by the contractor) to prevent damage of tubes by inadvertent fall of material. All temporary attachments welded to condenser components (inside and outside) shall be removed and DPT shall be performed before hydro fill test. Screw jacks required for performing hydro fill test is in scope of the contractor, NDE is part of the scope

4. For all the temporary structures, contractor shall supply all the materials including welding electrodes and consumables.

1.2.14.3 Hot-well cleaning:

Hot well cleaning before and after fill test, subsequent cleaning required if any shall be carried out by the contractor as a part of scope of work of Condensers. In each unit of KK-3& 4 consists of 3 No's of Main Condenser and 2 No's of TDFP condensers. Each condenser consists of a hot-well for the collection of condensate from shell side. During the period of work, hot-wells of the condensers are to be checked for presence of sludges, wastes etc and are to be thoroughly cleaned as per the requirements.

Contractor scope includes opening of Man holes of condenser in hotwell, hotwell collector and lower neck, inspection and collection of sludges in the hotwell, hotwell collector and salt compartment and its water wash, ensure throughness of connected nozzle and drain points to salt compartment and hot-well collector by cleaning with air, Water mopping, inspection, FME, closure of manhole with gaskets and preparation of reports with adequate number of manpower including all consumables, tools & tackles, cleaning aids, scaffolding & platforms for cleaning activities.

Note:

1. Main Condenser Hot well- 3 nos per Unit. Total 2 operations (1 operation means cleaning all three condensers)
2. TDFP Condenser Hot well -2 nos per unit. Total 2 operations (1 operation means cleaning all two condensers)

1.2.15 ROTARY EQUIPMENTS

1.2.15.1 Erection of booster and main feed pump :

Each unit of KK 3 & 4 consists of 2 sets of main feed and booster pump with each set having 50% capacity. The booster and main feed pumps are of horizontal multistage centrifugal type pumps fitted with mechanical gland seal arrangement driven by turbine drive. The turbine drive is connected to booster feed pump through reduction gear box and main feed pump through gear coupling. The equipment consists of pump assembly, drive coupling, its auxiliary items and foundation plate arrangement. Pumps are to be erected over vibro-isolated concrete foundation deck at (+) 6.0 m floor in B-C bay of Turbine building. Over all weight of one set of booster and

main feed pump assembly is 28 MT (approximately). The weight is given only for the reference to visualize the following activities. The actual weight may vary based on the supplier of the equipment.

In addition to the general requirements of clause 11.0, the following activities are to be performed by the contractor for the erection of these pumps,

1. Handling, depreservation, inspection of work front, surface preparation on seating areas by blue matching, erection of foundation frame, fixing of foundation bolts, erection of pumps on foundation, levelling, machining of packers, disassembly and reassembly of bearings, inspection of bearing & pump components, checking of clearances, dry packing & grouting of foundation bolts, concreting of base frames & pylons, removal of transportation lock, alignment, coupling of pump with turbine drive unit, flange connections, doweling, erection checks and measurements of main feed and booster pump, mounting its accessories/ instruments, deck floating, preservation & work completion, preparation of reports as per manufacturer drawings, documents and specifications with acceptance of EIC/NPCIL.
2. Erection of foundation frames on packer plates with foundation bolts, blue matching of permanent packers with foundation frame and equipment base, placement of Booster pump and the Main feed pump unit over the foundation, key blocks installations disassembly, de-preservation, removal of axial and radial transportation locks and re-assembly of bearing unit, inspection of shaft journal, bearings, bushes, labyrinth seals, checking of all the required clearances, as per log sheets, coupling installation, alignment and coupling of Booster pump with reduction gear unit and Main Feed pump with the Turbine as per the requirements of alignment chart after deck floating, grouting of base frames of pump unit, grouting of pylons of pump unit, mounting of accessories such as inter-connecting pipelines, RTD's, transducers and other instruments, junction boxes and secondary converters.

   Note:

   1. NPCIL will provide 20/ 5 T EOT crane for erection of main feed and booster pumps, however the contractor shall deploy qualified and experienced EOT Crane operator.
   2. The scope includes supply of temporary support arrangements, packer plates, shims and wedge jacks/taper wedges, oil, scaffolding & platforms,

manpower, torque wrench, P&M, tools & tackles, all consumables as detailed in TCC.

3. Deck floating, concreting and grouting is part of scope of work.

1.2.15.2 Erection of electric driven and Auxiliary feed pump:

The electrical driven & auxiliary feed pumps are of horizontal multistage centrifugal type pumps fitted with mechanical gland seal arrangement driven by 6KV electrical motor. There are two nos. of electrical driven feed pumps with 25% capacity pump and one no. of auxiliary feed pump with 3% capacity in each unit. The equipment consists of pump assembly, motor assembly with coolers, drive coupling, its auxiliary items and foundation plate arrangement. Pumps are to be erected at (+) 6.0 m floor in B-C bay of Turbine building (UMA) over vibro-isolated concrete foundation deck. Over all weight of each electric driven feed pump assembly is 25 MT and auxiliary feed pump 7.5 MT (approximately). The weight is given only for the reference to visualize the following activities. The actual weight may vary based on the supplier of the equipment..

NPCIL will provide 20/5 T EOT crane for erection of these pumps; however the contractor shall deploy qualified and experienced EOT Crane operator.

In addition to the above general requirements of clause 11.0, the following activities are to be performed by the contractor for the erection of these pumps,

1. Erection of Electric driven Feed Pumps: Handling, depreservation, inspection of work front, surface preparation on seating areas by blue matching, erection of foundation frame, erection of pump & motor on foundation, levelling, fixing of foundation bolts, dry packing & grouting of foundation bolts, concreting of base frames & pylons, removal of transportation lock, alignment, deck floating, dismantling & hydrotest of motor coolers, insertion of coupling by heating, coupling of shafts (pump & motor), flange connections, doweling, assembly of bearings, tack welding, erection checks and measurements of Electric driven feed pumps and its motors and mounting its accessories/ instruments, motor coolers, inspection of bearings, preservation & work completion, preparation of reports as per manufacturer drawings, documents and specifications with acceptance of EIC/NPCIL.
2. Erection of Auxiliary Feed Pump : Handling, depreservation, inspection of work front, surface preparation on seating areas by blue matching, erection

of foundation frame, erection of pump & motor on foundation, levelling, fixing of foundation bolts, and baseframe, dry packing & grouting of foundation bolts, concreting of baseframes , removal of transportation lock, alignment, deck floating, coupling of shafts (pump & motor), flange connections, doweling, assembly of bearings, tack welding, erection checks and measurements of auxiliary feed pumps and its motors and mounting its accessories/ instruments, inspection of bearings, preservation & work completion, preparation of reports as per manufacturer drawings, documents and specifications with acceptance of EIC/NPCIL.

3. Erection of foundation frames on temporary packers plates, grouting of base frames of pump and motor unit, blue matching of permanent packers with foundation frame and equipment base, coupling insertion on the pump and motor shaft after heating in oil bath, placement of pump and the motor unit over the foundation, alignment of pump and motor unit, coupling and torque tightening, dismantling of motor air cooler, hydro test and installation of the cooler, removal of transportation locks, de-preservation and inspection of bearing components and clearance checking and application of Fyrquel oil for preservation, assembly of bearings, carrying out pump and motor alignment in various stages like before and after grouting, (with release of Mechanical seal compression) and coupling, tack welding of packer plates with foundation frames, installation and tightening of foundation bolts and grouting, grouting of pylons (damping) of pump unit, final alignment after deck floating, mounting of accessories such as RTD's, transducers and other instruments, junction boxes and secondary converters.

   Note:

   1. Oil bath heating arrangements, with oil, supply of packer plates, shims and wedge jacks/ taper wedges are in the scope of the contactor. Supply of Fyrquel oil is in the scope of NPCIL.
   2. NPCIL will provide 20/ 5 T EOT crane for erection of Electric driven feed pumps & Auxilary feed pumps however the contractor shall deploy qualified and experienced EOT Crane operator.
   3. The scope includes supply of temporary support arrangements, packer plates, shims and wedge jacks/taper wedges, oil, scaffolding & platforms, man power, torque wrench, P&M, tools & tackles, all consumables etc.

1.2.15.3 Erection of condensate extraction (LCB) & transfer (LCT) vertical pumps:

There are 6 nos. condensate extraction pumps and 3nos. of transfer pumps. These pumps are of vertical multistage centrifugal type fitted with mechanical gland seal arrangement driven by 6 KV electrical motor. The equipment consists of pump assembly, motor assembly with coolers, drive coupling, its auxiliary items and foundation plate arrangement. Pumps are to be erected at (-) 7.2 m floor of Turbine building over concrete foundation. Over all weight of each condensate extraction pump assembly is 23 MT (approximately) and that of separated moisture transfer pump assembly is 9.2 MT (approximately).

In addition to the above general requirements of clause 11.0, the following activities are to be performed by the contractor for the erection of these pumps.

1. Handling, depreservation, inspection of work front, surface preparation on seating areas by blue matching, erection of pump on foundation, torque tightening of foundation bolts, erection of motor units along with cooler, levelling, disassembly, removal of transportation lock, alignment, verticality check, coupl ing of shafts (pump & motor), seal welding of packers, assembly of bearings, lubrication, free hand rotation of shafts, preservation, measurement of thrust float & clearances, motor cooler hydrotest, FME inspection, flange connections, drilling & doweling, erection checks, measurements and mounting of RTD's, all accessories/ instruments, preservation & work completion as per manufacturer drawings, documents and specifications with acceptance of EIC/NPCIL.
2. Blue matching of foundation plate EP and placement of packers, erection of assembled pump units, leveling, verticality check and torque tightening of foundation bolts, erection of motor units along with cooler, blue matching the pump lantern and motor base and ensuring the tight contact, disassembly, removal of all transportation locks in pump and motor unit, de-preservation and inspection, mounting of bearing temperature sensors (RTD) after ensuring its healthiness, assembly of bearings, filling of oil and grease for the bearings of pump and motor unit and ensure hand free rotation of pump and motor shafts, measurement of thrust float and other clearances as per manufacturer log sheets, carrying out pump and motor alignment (with release of Mechanical seal compression) and coupling, drilling and doweling of pins, seal welding of packer plates with EP's,

performing motor cooler hydro-test and mounting of all accessories of pump & motor.

Note:

1. NPCIL will provide Turbine building EOT crane for erection of LCB pumps, however the contractor shall deploy qualified and experienced EOT Crane operator.
2. The scope includes supply of temporary support arrangements, packer plates and shims, scaffolding & platforms, man power, torque wrench, P&M, tools & tackles, all consumables etc.

1.2.15.4 Erection of hydro turbine driven vertical pump-LCS :

Hydraulic turbine driven Reheat condensate Transfer Pump is a mono block vertical pump unit consisting of outer casing with nozzles for hot water inlet and outlet for pump and nozzles for reheat condensate inlet and outlet for driving the turbine rotor, inner casing assembly consisting of rotor unit having pump impeller and turbine runner on a common shaft with hydro static combined radial cum thrust bearing, sealing rings, externally mounted filters and its connecting pipes. The pump is to be erected at (-) 7.2 m floor of Turbine building and is supported by spring hangers which is to be erected on the overhead EP Plates. Over all weight of each pump unit is 4.5 MT (approximately). The weight is given only for the reference to visualize the following activities. The actual weight may vary based on the supplier of the equipment.

In addition to the above general requirements of clause 11.0, the following activities are to be performed by the contractor for the erection of these pumps,

1. Handling, cleaning, de-preservation of pump components & inspection, inspection of work front, erection of spring hanger assembly & erection of pump assembly on supporting structure and piping, welding, installation of bearing units, levelling, removal of transportation lock, blue matching, assembly of pump internal & external casings with sealing ring, torque tightening, measurement of thrust float & clearances, alignment, horizontality check, FME inspection, doweling, erection checks and measurements, mounting its accessories/instruments, preservation & work completion as per manufacturer drawings, documents and specifications with acceptance of EIC.

The scope includes supply of temporary support arrangements, scaffolding & platforms, man power, torque wrench, P&M, tools & tackles, all consumables etc.

2. Cleaning, de-preservation and inspection of pump components, blue matching of all mating parts and re-preservation, welding of hook with EP and erection of spring hanger assembly, erection of pump unit by fit-up and welding in a controlled manner (using dial guage) with pipes and hanger support, checking of alignment, horizontality, before and after welding completion, installation and connection of upper and lower bearing filter block units along with its accessories, removal of transportation lock, installation of inner case assembly with sealing ring into the outer casing after completion of pipeline flushing along with pump casing, measurements of thrust float of the rotor and other clearances, installation of outer casing cover with sealing wedge rings and torque tightening of the outer cover cap nuts.

1.2.15.5 Vertical rotary equipments with capacity less than 1000 KW:

There are 42 nos. of pumps for each unit. These pumps of PCC-51&52, PUJ, PUK, PUN, PUP, PUE, PUD, PUA and PUQ are vertical multiple shaft centrifugal pumps. The pumps of different systems have different capacities from 20 cum to 600 cum and head 20 m to 45 m. Weight of each pump & motor unit is approx 0.45 - 4.5 MT. The rated power of electric motor for all these pumps is less than 1000 KW. These pumps except PUQ system shall be erected in UQA and UQC buildings and motor will be at (+) 3.45 m floor. The suction bell mouth will be at (-) 14.00 m max to (-) 7.00 m approximately. PUQ pumps shall be erected in UQZ tunnels.

In addition to the above general requirements of clause 11.0, the following activities are to be performed by the contractor for the erection of these pumps,

1. Handling, de-preservation, inspection of work front, surface preparation on seating areas by blue matching and correction, erection at various elevations on foundation or supporting structures and orientation, leveling, fixing of foundation bolts and base frame, fixing of sole plates/packing plates, supply of shims, fit up, welding, grinding, cutting, drilling, assembly of pump, motor and their component parts, shafts at various elevations, rigging, cleaning, erection of equipment and parts, dry packing & grouting of foundation bolts

and concreting of base frames, removal of transportation lock, alignment, verticality check, horizontality check and corrections, coupling of shafts (pump & motor), checking of running clearances like, wear rings, bearing, and centering of impeller, hydrotest of motor coolers, FME inspection, flange connections, doweling, tightening with required torque, lubrication, free rotation checking, erection checks, IR value checking, measurements and NDE, mounting its accessories/instruments, preservation and work completion as per manufacturer drawings, documents and specifications.

2. The shafts shall be inserted in column pipes, with bearings and passing through different floors. Supports shall be given at floors for the column pipes as in manufacturer manual.
3. Sequence of erection activities: The centre line, grids, axis of pump shall be marked at all floors. The support guides shall be placed and concreted and corrected for elevation, level orientation at different floors. The pump impeller shaft shall be inserted in casing and 1st column pipe connected. Both together shall be lowered using special handling tools and chain blocks. The bearing spider and next shaft with column pipe shall be assembled and connected to 1st shaft and column pipe with accessories. Same way up to motor shaft the pumps shall be assembled. Motor stool support EP shall be placed and concreted. Motor stool shall be placed on the EP and motor shall be fixed on the stool after checking level orientation elevation. Motor and pump shall be coupled after correcting pump lift and alignment. The support rollers shall be fixed as per the erection document. Pump free rotation etc to be checked and corrected.
4. The PUQ system pumps shall be erected in the UQZ tunnels and motor will be at (+) 3.45 m floor. The suction bell mouth will be at (-) 0.9 m max to (-) 2.2 m approximately.

   Note:

   1. The scope includes temporary support arrangements, scaffolding & platforms, man power, torque wrench, P&M, tools & tackles, all consumables etc as detailed etc.
   2. NDE, grouting and concreting is part of scope of work.

1.2.15.6 Vertical rotary equipments with capacity 1000 KW and above-PAC pump:

There are 6 nos. of CCW (PAC) pumps. PAC pump is vertical mixed flow type, each having flow rate of 44,250 m3/hr, static head of 10 to 15 m of wcl., the rated

power of electric motor is 3200 KW, 6 KV voltage, motor speed of 1000 rpm and pump speed of 325 rpm with gear box. Weight of each pump & motor unit is approx 61MT. Erection of each pump and its components involve from approx (-) 7.00 m elevation to approx (+) 11.00 m elevation of pump house.

In addition to the above general requirements of clause 11.0, the following activities are to be performed by the contractor for the erection of these pumps,

1. Handling, de-preservation, inspection of work front, surface preparation on seating areas by blue matching and correction, erection at various elevations on foundation or supporting structures and orientation, leveling, fixing of foundation bolts and base frame, fixing of sole plates/packing plates, supply of shims, fit up, welding, grinding, cutting, drilling, assembly of pump, motor and their component parts, shafts at various elevations, rigging, cleaning, erection of equipment and parts, dry packing & grouting of foundation bolts and concreting of base frames, removal of transportation lock, alignment, verticality check, horizontality check and corrections, coupling of shafts (pump & motor), checking of running clearances like, wear rings, bearing, and centering of impeller, hydrotest of motor coolers, FME inspection, flange connections, doweling, tightening with required torque, lubrication, free rotation checking, erection checks, IR value checking, measurements and NDE, mounting its accessories/instruments, preservation and work completion as per manufacturer drawings, documents and specifications.
2. Preparation of Pump base plate: After making grids, axis and centre line markings. The Pump foundation bolts shall be fixed and grouted at (-) 3.00 m. Orientation and elevation of the bolt PCD shall match with discharge nozzle. The pump base frame / plate shall be placed (-) 3.00 on the grouted pad plates and wedge. After contact checking of seating area, leveling of the pump base plate shall be corrected within the limits specified tightened with foundation bolts. After placing the pump the pump base shall be grouted.
3. Pump erection: Pump assembly of approx 32 MT shall be lifted from horizontal to vertical position and after cleaning the seating surface of pump, shall be placed on the pump base using the suitable cranes. Pump verticality shall be checked after loosening lock nuts and lifting the rotor as in the manufacturer manual. Bearing shall be lubricated before rotating the pump. Impeller wear ring clearances shall be checked.

4. Installation of bellow base: The bellow base shall be erected and concreted at (-) 7.00 m as per the manufacturer manual to match with the pump centre.
5. Erection of Expansion Bellow: The expansion bellow shall be erected between bellow base and pump suction bell and tightened.
6. Erection of Reduction gear box frame and Reduction gear Box: The foundation bolts sole plates shall be placed and grouted as per the orientation and elevation approx (+) 7.00 m as mentioned in manufacturer manual. Blue contact of sole plates and gear box frame base to be checked and corrected. Gear box frame shall be placed and tightened with foundation bolt. Gear box assembly shall be lifted and placed tightened with gear box frame.
7. Erection of coupling spacer: The coupling spacer shall be fixed to connect pump shat and reduction gear box Output shaft. The length of spacer approx 3.7 m. Pump and gear box shaft shall be aligned and coupling shall be done as given in manufacturer manual.
8. Erection of motor stool and motor: The motor stool shall be fixed on the gear box frame and fastened. The motor approx12MT shall be lifted and erected on its stool and tightened. The motor shaft verticality shall be checked and corrected. Motor and gear box shall be aligned and coupled. Pump, motor, gearbox free rotation shall be checked.
9. Pump Discharge connection: Companion flange will be supplied along with pump. Companion flange shall be welded with the CS piping. The pump discharge flange and pipe flange (companion flange) shall be connected by bolting. The cooling water SS piping shall be erected as per the erection documents. NDE is part of the scope.

   Note:

   1. The scope includes temporary support arrangements, scaffolding & platforms, man power, torque wrench, P&M, tools & tackles, all consumables etc as detailed etc.
   2. NDE, grouting and concreting is part of scope of work.

1.2.15.7 Vertical rotary equipments with capacity 1000 KW and above-PCC & PEC pumps:

There are 3 nos. of PCC and 4 nos. of PEC pumps in each unit. PCC pump is vertical centrifugal type, each having flow rate of 4500-5500 m3/hr, static head of 45-55 m of wcl, the rated power of electric motor is 1200 KW, 6 KV voltage, and motor speed of 600 rpm. Weight of each pump & motor unit is approx 28.5 MT.

Each PEC pump is vertical centrifugal type, having flow rate of 4000-4800 m3/hr, static head of 60--55 m the rated power of electric motor is 1200 KW, 6 KV voltage, and motor speed of 600 rpm. Weight of pump & motor unit is approx 28.5 MT.

In addition to the above general requirements of clause 11.0, the following activities are to be performed by the contractor for the erection of these pumps,

1. Handling, de-preservation, inspection of work front, surface preparation on seating areas by blue matching and correction, erection at various elevations on foundation or supporting structures and orientation, leveling, fixing of foundation bolts and base frame, fixing of sole plates/packing plates, supply of shims, fit up, welding, grinding, cutting, drilling, assembly of pump, motor and their component parts, shafts at various elevations, rigging, cleaning, erection of equipment and parts, dry packing & grouting of foundation bolts and concreting of base frames, removal of transportation lock, alignment, verticality check, horizontality check and corrections, coupling of shafts (pump & motor), checking of running clearances like, wear rings, bearing, and centering of impeller, hydrotest of motor coolers, FME inspection, flange connections, doweling, tightening with required torque, lubrication, free rotation checking, erection checks, IR value checking, measurements and NDE, mounting its accessories/instruments, preservation and work completion as per manufacturer drawings, documents and specifications.
2. Erection of each pump and its components involves from approx (-) 4.00 m elevation to approx (+) 7.65 m elevation of pump house and supporting bearing to be installed at each floor (0.00 m, +3.45 m). In general pump shaft, 1st intermediate shaft, 2nd intermediate shaft and motor shaft shall be connected as mentioned in manufacturer document.
3. Pump casing erection: After making grids, axis and centre line marks from (+) 7.65 m to (-) 7.00m. The Pump sole plate foundation bolts shall be fixed and grouted at (-) 4.00 m. The foot plates shall be placed on sole plates and wedges after checking blue contact with casing base as per the orientation and elevation mentioned in manufacturer documents. The pump shaft shall dis-assembled from pump casing after taking the shaft position reference measurements and casing shall be placed on the foot plates elevation, leveling ,centre of casing shall be corrected and tightened

with foot plate. Painting of internal surface of the pump casing and suction piping shall be done as per manufacturer's manual. NDE is part othe scope.

4. Pump shaft assembly erection: After completion of casing erection the pump shaft with impeller shall be erected in to the casing using the special erection tool supplied. The shaft shall be held in position using centering device as per the reference marks and wear clearances. The Embedded plate shall be erected and grouted at (-) 6.00 m elevation.
5. Erection of bearing supports: The fabricated removable frame will be erected at 1.50 m, 3.45m and 7.65m elevation and released by other agency for erection of bearing supports and motors. The Intermediate bearing supports shall be erected at elevations (+) 1.50 m and (+) 3.45m elevations by contractor. The foot pads of the frames shall be checked and corrected by contractor for elevation, level, blue contact and orientation. The bearing supports shall be placed by contractor on the frame work foot pads and all the parameters like level, orientation, elevation, level, and blue contact shall be checked and corrected by contractor with bearing. Inter mediate shafts shall be inserted by contractor in to the bearing supports and held in position using centering tool.
6. Erection of Motor: The fabricated removable frame will be erected at 7.65m elevation and released by other agency for erection of motors. The foot pads of the frames shall be checked and corrected by contractor for elevation, level, blue contact and orientation. The motor shall be placed on the frame. Motor verticality, level shall be checked and corrected by contractor. All the shafts (motor shaft, 2 nos. of intermediate shafts and pump shaft) shall be connected with temporary fasteners and corrected for trueness, verticality as per the requirement mentioned in manufacturer document. The coupling temp fasteners shall be removed one by one and bolt hole shall be reamed to suit the fitted bolts and tightened. The trueness shall be checked together for all shafts, wear ring clearances. Bearings at 1.50 m, 3.45 m and pump shaft shall be checked for clearances and corrected and installed in respective locations.
7. Erection of Suction nozzle and spool: The pump suction bend with support, suction piping shall be erected and concreted as per the manufacturer document. All the works final assembly shall be completed and free rotation of pump unit shall be checked.

8. Bearing lubrication, motor winding heat exchanger cooling water lines for the pumps shall be erected .

Note:

1. The scope includes temporary support arrangements, scaffolding & platforms, man power, torque wrench, P&M, tools & tackles, all consumables etc as detailed etc.
2. NDE, grouting and concreting is part of scope of work.

1.2.15.8 Erection of PUL pump :

There are 3 nos. of PUL pumps for each unit. PUL pump is vertical centrifugal pump with adjustable vane angle operated by electrical motor, each having flow rate of 12600--16970 m3/hr, static head of 20--19 m the rated power of electric motor is 1600 KW, 6 KV voltage, motor speed of 600 rpm. Weight of each pump & motor unit is approx 27 MT. The weight given is indicative, only to visualize the following activities. The actual weight may vary based on the supplier of the equipment.

Erection of each pump and its components involves from approx (-) 9.00 m elevation to approx (+) 0.00 m elevation of UPX structure.

In addition to the above general requirements of clause 11.0, the following activities are to be performed by the contractor for the erection of these pumps,

1. Handling, de-preservation, inspection of work front, surface preparation on seating areas by blue matching and correction, erection at various elevations on foundation or supporting structures and orientation, leveling, fixing of foundation bolts and base frame, fixing of sole plates/ packing plates, supply of shims, fit up, welding, grinding, cutting, drilling, assembly of component parts of motor like stator, rotor, bearing pads, thrust collar, oil coolers, lower and upper brackets etc in-situ after making foundation arrangement, checking of air gap between stator and rotor and corrections, blue contact checking and corrections for bearings, correction of verticality of stator & rotor, IR value checking and corrections between bearing pads, collars, pin s, body of bearing housing as per manufacturer documents, assembly of pump, motor and their component parts, shafts at various elevations, rigging, cleaning, erection of equipment and parts, dry packing & grouting of foundation bolts and concreting of base frames, removal of transportation lock, alignment, verticality check, horizontality check and corrections, coupling of shafts (pump

& motor), checking of running clearances like, wear rings, bearing, and centering of impeller, FME inspection, flange connections, doweling, tightening with required torque, lubrication, free rotation checking, erection checks, measurements, NDE, mounting its accessories/ instruments and work completion as per manufacturer drawings, documents and specifications.

2. The grid, axis and center line shall be marked. Foundation bolts shall be placed and concreted. The pump erection base frame work shall be placed over the flat plates and wedge plates for checking and correction of elevation, level, orientation of base frame etc. Pump shall be placed on the base frame and verticality orientation, level shall be corrected. Shaft verticality shall be adjusted and held in position using special tool. The discharge nozzle orientation, elevation and level shall be checked.
3. The motor will be issued as component parts like stator, rotor, bearing pads, thrust collar, lower and upper brackets etc. Motor shall be assembled in situ after making foundation arrangement. The stator shall be placed and rotor shall be inserted in the stator. The air gap, vertical position of rotor, blue contact checking correction, assembly of thrust collar, thrust bearings, oil coolers, correction of verticality of the motor stator rotor, assembly of guide bearing are in the scope of erection. Motor stator verticality shall be corrected within the limits as mentioned in manufacturer documents. The correction plane will be in thrust collar seating surface. The IR value between bearing pads, collars, pins, body of bearing housing shall be checked and corrected as in manual. Pump shaft shall be coupled to motor rotor and total motor and pump shafts verticality shall be corrected by scraping the correction plane. The coupling bolt holes shall be reamed and fitted bolts shall be provided.
4. After correction of verticality, assembly of lower bracket, fixing of heaters, coolers etc shall be installed. The impeller vane adjustment mechanism shall be lubricated and free operation shall be checked. All the connections and total erection of pump motor assembly shall be completed as per manufacturer document.

Note:

1. The scope includes temporary support arrangements, scaffolding & platforms, man power, torque wrench, P&M, tools & tackles, all consumables etc.
2. NDE, grouting and concreting is part of scope of work.

Erection of other rotary equipment :

1. Handling, depreservation, inspection of work front, surface preparation on seating areas, erection at various elevations on concrete foundation or supporting structures, levelling, fixing of foundation bolts and base frame, dry packing & grouting of foundation bolts and concreting of base frames, torque tightening, removal of transportation lock, checking of free rotation, alignment, verticality check, coupling of shafts (pump & motor), FME inspection, doweling, erection checks and measurements of all rotary equipments like pumps, motor, blowers, fans, level controllers and mounting its accessories/ instruments & work completion as per manufacturer drawings, documents and specifications with acceptance of EIC/NPCIL.
2. Erection of pumps on concrete foundation: There are 22 nos. (approx.) of pumps per unit with individual weight ranging from 0.03 to 4.7 MT approximately. Pumps shall be erected on concrete foundation at various elevations of Turbine building (UMA) and Turbine oil building (UMV). In addition to the above general requirements of clause 11.0, the contractor shall perform the activities of preparation of foundation, placement of pump & motor unit with frame on foundation, checking of orientation, leveling and alignment, grouting of foundation bolt pockets and foundation frame, torque tightening of foundation bolts, removal of transportation locks and checking for free rotation, coupling alignment of pump and motor unit and mounting of all accessories.
3. Erection of pumps on metal structure: There are 33 nos. (approx.) of pumps per unit with individual weight ranging from 0.02 to 1.75 MT approximately. Pumps shall be erected on metal structures at various elevations of Turbine building (UMA) and Turbine oil building (UMV). In addition to the above general requirements of clause 11.0, the contractor shall perform the activities of placement of pump & motor unit on structural steel frame, checking of orientation, leveling, verticality and alignment, torque tightening of bolts, removal of transportation locks and checking for free rotation, coupling alignment of pump and motor unit and mounting of all accessories.
4. Erection of PGC pumps: There are 6 nos. of PGC pumps per unit. PGC pump is horizontal mounted radial flow centrifugal type, each having flow rate of 960-2000 m3/hr, static head of 31-37 m the rated power of electric motor is 132-

250 KW, 6KV voltage, motor speed of 1500 rpm. Weight of each pump & motor unit is approximately 5 MT. Pumps shall be erected at (+) 3.45m floor of UQA. In addition to the above general requirements of clause 11.0, the following activities are to be performed by the contractor for the erection of these pumps,

Flat and wedge plates shall be placed. The base frame shall be placed on wedge plates and tightened with foundation bolt. The pump, motor shall be mounted on frame and tightened after checking the contact. The orientation, level, nozzle verticality, elevation alignment etc., shall be corrected and bearings shall be lubricated. Pump free rotation shall be checked and completion of assembly as per erection documents.

5. Erection of PUT and PUV pumps: There are 14 nos. of PUT, PUV pumps per unit. These pumps are horizontal pumps with frame works, each having flow rate of 1.5 - 6.5 m3/hr, static head of 15-21 m, the rated power of electric motor is 1.5 KW, Weight of each pump & motor unit varies from 40-130Kgs. In addition to the above general requirements of clause 11.0, the following activities are to be performed by the contractor for the erection of these pumps,

   Foundation bolts shall be grouted and frame shall be placed for horizontal pumps. After correction of frame for level and elevation the horizontal pump and motor shall be fixed on the frame. Checking and correction of alignment, coupling and testing shall be as per the manufacturer document.

6. Erection of Booster pumps for PAC: There are 12 nos. of booster pumps per unit. These pumps are horizontal pumps with frame works. The pumps shall be erected at (-)3.00 m elevation for supply of cooling water to PAC pump bearing oil cooling, gear box oil cooling and motor winding Hx cooling. Each Pump has capacity of 60 cu. m/hr, Head 25 m, 11KW approx Wt. 625 Kg. The skid base (Frame work) with arrangements for erection of booster pump and filter will be issued. In addition to the above general requirements of clause 11.0, the following activities are to be performed by the contractor for the erection of these pumps,

   The Foundation bolts shall be placed and grouted and erection of skid base shall be done. The pump assemblies shall be placed and tightened with the base.

7. Erection of PUM compressors: There are 2 nos. of PUM compressors per unit. Compressor is horizontal opposed-balanced piston type straight angled reciprocating compressors, each having capacity of 54 cum/minute, discharge pressure of 2 Kg/sq cm, Motor Speed (synchronous) of 750/375 rpm (two speed) and Electric Motor Capacity of 160/75 kW. In addition to the above general requirements of clause 11.0, the following activities are to be performed by the contractor for the erection of these pumps,

   Compressors shall be erected in UPX structure. The erection activities involve positioning and concreting of foundation bolts and fixing of sole plates. Placing on the plates, correction of level, elevation, orientation and tightening of compressor assembly with foundation bolts. All the suction, discharge nozzles, motor ventilation fans shall be connected. The cooling blocks (Hx assembly) for cooling the jacket water shall also be installed. The accessories shall be connected, lubricated and completion of assembly as per erection documents.

Note:

1. The scope includes supply of temporary support arrangements, supply of packer plates and shims, scaffolding & platforms, man power, torque wrench, P&M, tools & tackles, all consumables etc.
2. Scope of work for already erected Rotary equipments: 20 nos approx
   Alignment, verticality check, coupling of shafts (pump & motor), FME inspection, doweling, erection checks and measurements of all rotary equipments like pumps, motor, blowers, fans, level controllers and mounting its accessories/ instruments & work completion as per manufacturer drawings, documents and specifications with acceptance of EIC is part of scope of work.
3. Hydro test of rotary equipments to be done along with piping to be erected by other agency. Schedule of HT of those equipments to be finalized on mutual agreement and co-ordination.

1.2.15.9 Erection of de-watering pumps :

There are 38 nos. of dewatering pumps for both the units of GQD, GMA, GUD, GML and PUQ systems. PUQ10-40AP004 and GQD04AP001-002 are vertical submergible type. GMA03AP001-08, GUD48AP001-002, GML21-22AP001, GML31-32AP001 are vertical submergible type. These pumps shall be erected in the pit. Before erection of these pumps, the pit shall be cleaned and dried.

In addition to the above general requirements of clause 11.0, the following activities are to be performed by the contractor for the erection of these pumps, Cleaning of pits, supply of flexible hose, clamps and fasteners, connection between the pumps and piping with the flexible hose of approximate length of 400 mm per pump.

Handling and installation of submersible pumps including electrical & instrumentation items, supply and connection of flexible hose with discharge pipes & work completion as per manufacturer drawings, documents and specifications with acceptance of EIC/NPCIL.

The scope includes arrangement of scaffolding & platforms, man power, P&M, tools & tackles, all consumables etc.

1.2.16 ERECTION OF STATIC EQUIPMENT :

1.2.16.1 Erection and assembly of de-aerator tank & column :

Each unit of KK-3 & 4 consists of 1 set of De-aerator tank and column. Steam de- aerator consists of horizontal de-aerating column mounted on the de aerator tank with 400 m3 shell capacity. The De aerator tank comprises of two units to be welded at site and is of diameter 3800 mm and length 36000 mm (2 parts) and de- aerating column is a single unit of diameter 3000 mm, with length 22000 mm. The de-aerator is to be erected in Turbine building (UMA) at B-C- bay with de-aerator tank at +29.77 m elevation and de-aerator column over de-aerator tank at +33.55 m elevation. The total weight of the de-aerator column and tank is approximately 253 MT. The weight is given only for the reference to visualize the following activities.

In addition to the above general requirements of clause 11.0, the following activities are to be performed by the contractor for the erection of De-aerator tank and column,

1. Handling, inspection of work front, preparation of foundation, surface preparation on seating areas, de- preservation, erection of Deaerator tank on foundation plate over roller supports, fixing of foundation bolts, assembly, alignment, fit up, welding of De-aerator tank (2 piece assembly), guides, mounting of De-aerator column over tank, welding of interconnecting pipes between column and tank, pipe nozzles, grouting of foundation, NDE including digitization of RT films, cleaning & de-preservation, FME inspection, hydro testing of De-aerator with ammonia addition, draining, drying, mounting of instruments and accessories, all

erection checks and measurements, preparation of reports and work completion as per manufacturer drawings, documents and specifications with acceptance of EIC/NPCIL.

2. Preparation of foundation surface, installation of fixed and roller supports of de- aerator, fixing of foundation bolts, erection of two parts of de-aerator tank over fixed and roller supports and alignment, assembly and welding of De-aerator tank of size Dia. 3800 mm with wall thickness of 36 mm, welding of locking plates of fixed support, welding of guide stops of 45 mm thick all around guide stops (600 mm x 16 nos. approximately), erection of de-aerator column on de-aerator tank over support lugs, fit up, alignment and welding of all pipe nozzles and sleeves of de-aerator column and tank. The details of pipe/sleeves to be welded are 4 nos. of 2400 mm dia., 4 nos. of 1200 mm dia., 2 nos. of 400 mm dia., 1 no. of 300 mm dia., 2 nos. of 350 mm dia., 1 no. of 250 mm dia., 1 no. of 200 mm dia., 2 nos. of 100 mm dia., 13 nos. of 10 mm dia. and 4 nos. of 25 mm dia, grouting of foundation plate and bolt, NDE of all weld joints, de-preservation of all internals of de-aerator tank and column before hydro test, hydro test with ammonia addition to DM water, neutralizing & pH checking before draining and drying with all necessary arrangements and mounting of all the accessories.

Note:

1. Heavy duty crawler crane will be provided by NPCIL for erection of de- aerator tank and column. De-aerator concrete foundation opening shall be covered with temporary protective metal cover sheet with no extra cost.
2. The scope includes supply of temporary support arrangements, scaffolding & platforms, man power, P&M, tools & tackles, torque wrench, all consumables (excluding welding filler wire & electrode) etc.
3. In case any temporary structures required, contractor shall supply all the materials including welding electrodes and consumables.
4. NDE & grouting is part of the scope.

1.2.16.2 LP & HP heaters :

There are 4 nos. of HP heaters and 3nos. of LP heaters in each unit of Turbine building. All the heaters are of vertical type and are to be erected at

0.0 m floor of Turbine building (UMA) except LP heater-2 (mixed type) which is to be erected at +7.8 m floor. The approximate weight of the HP heater is 112 MT, LP heater-4 is 80 MT, LP heater-3 is 60 MT and LP heater-2 is 35 MT.

Note: HP Heaters (4 nos) and LP Heaters (3 nos) of unit 3 is already erected, aligned & grouted. the following activities are to be performed by the contractor for the above mentioned heaters.

1. Hydrotest of all the HPH's & LPH's are to be carried out as per procedure. Hydro test of shell side of HPH & LPH -2 (mixed type), seal weld cutting, opening & closing of manhole, FME inspection, hydro test of tube side of HPH, LPH 3 &4 with hot water, leak search, seal welding, NDE, draining and drying, mounting of all accessories, all erection checks, preparation of reports and work completion as per manufacturer drawings, documents and specifications with acceptance of EIC/NPCIL.
2. The scope includes supply of scaffolding & platforms, man power, P&M, tools & tackles, all consumables (excluding welding filler wire & electrode) etc as detailed in Technical Specifications & Scope of work.

1.2.16.3 Erection of other static equipment :

1. Other static equipment in Turbine Buildings: There are 258 nos. of other static equipments per unit to be erected at various elevations in Turbine buildings (UMA & UMV). Weight of each equipment varies from 0.015 MT to 31.2 MT. The equipments are such as tanks, filters, heat exchangers/ coolers, ejectors, accumulators, hydro seal of LPH-2 to condenser, and sampling units. In addition to the above general requirements of clause 11.0, the following activities shall be performed by the contractor for the erection of above static equipments,

   Handling, depreservation, inspection of work front, surface preparation on seating areas, blue matching, fabrication and erection of equipment support structures, erection at various elevations on foundation or supporting structures, levelling, fixing of foundation bolts and base frame, dry packing & grouting, alignment, verticality check, welding, FME inspection, torque tightening, doweling, all erection checks and measurements, replacement of gaskets, hydro test , draining , drying of equipments like tanks, filters, heat exc hangers/ coolers, ejectors,

accumulators, hydro seal of LPH-2 to condenser, and sampling units, tight hatches etc, NDE, mounting of all accessories/ instruments, preparation of reports and work completion as per manufacturer drawings, documents and specifications with acceptance of EIC/NPCIL.

Fabrication and erection of equipment support structures, shifting and placement of equipments on foundation/ metal structures, de-preservation of equipment, blue matching of anchor plates with concrete, checking of orientation, level, verticality and alignment, welding of equipments, torque tightening of foundation bolt of equipments, grouting of equipments, hydro test of equipments, draining and drying of the equipment after completion of hydro test, replacement of gaskets, FME inspection and final box up after hydro test, hydro seal of LPH-2 to condenser shall be erected in the pit on flanges of sleeve EP, NDE of weld joints and mounting of all accessories.

Note: Arrangements of heavy duty skid rollers, channel beams, heavy duty jacks etc for shifting and movement to the location is in the scope of contractor. Before hydro test of the filters the filter elements shall be removed, inspection of laterals inside the filters to be performed and re-installation after hydro test. For sampling units drilling and connection of interconnecting hoses and other accessories shall be carried out by the contractor. For accumulator filling of concrete into weight bob to make counterweight the contractor shall carryout the concreting work.

2. Erection of PGD plate type Heat Exchangers in UQA: There are 9 nos of PGD plate type Heat Exchangers per unit each weighing approximately 7 to 8.2 MT. The plate type heat exchangers have the plate material of Titanium. Erection shall be as per the erection documents. The foundation bolts shall be positioned and concreted. Heat Exchanger legs shall be connected and concreted after checking the elevation, orientation, levelness and alignment.

   Heat Exchangers shall be set at level and square so that pipe connections can be made without strain. While setting on foundation bolts, bolts of one end shall be kept loose to allow free expansion of shell if slotted holes are provided in supports to achieve this.
3. Erection of Filters, Tanks and Tight hatches: There are 14 nos. of Hydro cyclone filters each weighing approximately 125Kg and 7 nos. of

self cleaning filters each weighing approximately 175 - 350 Kg in PEB, PEC & PCC systems shall be erected for each unit of UQA, & UQC buildings. These filters shall be erected on base plate and welded as per the elevation and orientation mentioned in manufacturer document.

There are 10 nos. of Tanks each weighing approximately 0.4 – 1.6 MT for each unit of PUV and PUX systems shall be erected in UQA, UQC and UPX buildings. Erection of 32 nos. tight hatches each weighing approximately 250-300 Kg shall be done by contractor for the systems of PAC, PUN, PUJ, PUK, and PUP & PUD of both the units. Self cleaning filter 1 no. weighing approximately 280 Kg of PUS system shall be erected in UQA building. There are 16 nos. of Mussel cleaning filters each weighing approximately 0.4 – 1.5 MT of PEB, PDB, PFB & PCB systems shall be erected in UQA, UKA and UKD buildings.

Fabricated supports shall be placed and concreted as per the erection document. The filters shall be placed on the pedestal supports and aligned for orientation, level, elevation and verticality and tightened.

4. Erection of self cleaning filter for PAC: There are 6 nos. of self cleaning filter for PAC system per unit each weighing approximately 300 to 400 Kg. Self cleaning filter shall be erected at (-)3.00 m elevation for supply of cooling water to PAC pump bearing oil cooling, gear box oil cooling and motor winding HX cooling. The Skid base (Frame work) with arrangements for erection of filter will be issued. The Foundation bolts shall be placed and grouted and erection of skid base shall be done. The filter assembly also shall be placed and fastened with skid base.

Note:

1. The scope includes supply of temporary support arrangements, arrangements of heavy duty skid rollers, channel beams, heavy duty jacks, packer plates and shims, equipment support structures, scaffolding & platforms, man power, P&M, tools & tackles, all consumables (excluding welding filler wire & electrode) etc
2. Before hydro test of the filters (LDF/ LDB/ LDP systems) the filter elements shall be removed, inspection of laterals inside the filters to be performed and re-installation after hydro test. No seperate payment shall be made.
3. For sampling units, drilling and connection of interconnecting hoses and other accessories shall be carried out by the contractor. No seperate

payment shall be made.

4. For MAX system, accumulator filling of concrete into weight bob to make counterweight is in the scope of the contractor.
5. Hydro seal of LPH-2 to condenser shall be erected in the pit on flanges of sleeve EP and shall be part of scope of work.
6. In case any temporary structures required, contractor shall supply all the materials including welding electrodes and consumables.
7. Hydro test of all static equipments (Including already erected static equipments) to be done along with piping to be erected by other agency. Schedule of HT of those equipments to be finalized on mutual agreement and co-ordination.

1.2.16.4 Fabrication and erection of fire grid in rooms/ areas of oil storage equipments :

The combustible fluids self extinguishing fire grids are of prefabricated rectangular panel type honey comb structure. Each fire grid is of size 400 x 400 x 200 mm. There are approximately 470 nos. of fire grids (7 MT weight) to be erected by the contractor at 5 different locations at various elevations (-7.2 m, 0.0 m, + 3.0 m) in each unit of Turbine building. These fire grids are issued as FIM for erection. The above quantity and weight are given only for the reference. The actual quantity and weight may vary based on the supplier of the item.

In addition to the general requirements mentioned in Clause 11.0, the contractor shall perform, handling and shifting to erection location, edge preparation of plates, angles, bushes and other components, trial assembly and erection of fire grids on the metal structures to suit to site and marking, removal of fire grid, fabrication and welding of various assembly components of fire grids, erection of fire grid assembly in the marked location & fixing of sealing strips by self tapping screws and carrying out NDE , for the fabrication and erection of self extinguishing fire grids. Contractor shall provide adequate protection to fire grids and its components against damage. Screw guns required for fixing of self tapping screws is in the scope of the contractor.

1.2.16.5 Re-testing of equipments :

Carrying out Hydro/pneumatic testing of equipments is part of scope of equipment erection. In case of any modification is carried out after equipment

erection and first testing is completed, the re-testing of equipments shall be carried out to check the pressure boundary integrity as required in working documents & Standards. Suitable blanking of equipment shall be done during the testing to suit the site conditions.

1.2.17 WELDING, ERECTION, NDE, FLUSHING AND TESTING OF PIPELINES :

The scope of piping work involves handling, fabrication, welding, erection of CS/SS/Ti pipes and supports, testing and erection of CS/SS/Ti valves, stub welding & drilling, cold bending of small diameter pipes, carrying out NDE, hydro/pneumatic testing of pipelines, supply & making arrangements for flushing and performing flushing operation, sealing of pipe penetrations and digitization of RT films, pickling and passivation, supply of machined components, machining of FIM, orifice fixing, flange assembly. Scope includes cleaning, de-preservation of pipe internal and external surfaces using rotary brush, compressed air and manual wiping.

1.2.17.1 General requirements:

1. The pipe lines shall be erected by the contractor as per the working Drawings and documents issued by NPCIL.
2. The scope of work of pipeline covers both free issue material issued by NPCIL and the material supplied by BHEL .
3. The term “Pipe Line” shall comprise all pipes, pipe fittings, pipe supports and its supporting structure, level gauges, thermo wells, pressure tap bosses, tube zond, vents and drain connections, sampling connections up to and including first isolation valves with threaded nipples, hydro seals/locks, linear separator and other pipe mounted equipments, reinforcing pads for branch connections, valves, valve operators, strainers, traps, flow elements, flanges, gaskets, nuts, bolts, expansion joints, orifices, venturi meter, rotameter, sight glasses, funnel, trays, containment pipe penetration, hanger supports, dampers etc. In brief all items forming part of the pipelines as shown in the drawing, but excluding wiring of motorized valves and instrument tubing (other than process tubing) from the isolation valves to manifold shall be considered part of piping. Threaded pipe nipples wherever required will be fabricated by machining by the contractor.

4. The free issue pipelines sizes 100 NB and above are big bore dia. with weld edge prepared on both sides for butt welding. The free issue pipelines sizes 80 NB and less are small bore dia. and will be supplied in standard length without prepared weld edges.
5. Fabrication, erection and welding of pipelines shall be done by the contractor as per working drawings. Edge preparation for welding shall be as per the working drawings and specifications. Big bore pipes and pipe fittings (100 NB and above) will be issued to the contractor with edge prepared for butt welding. If any edge correction or rectification is required in big bore pipelines, the same shall be done by the contractor as part of pipe welding work.
6. For any cutting and edge preparation of small bore & big bore pipelines required to suit the layout of piping is part of scope.
7. Adherence to safety guidelines, security guidelines, various work permit system and compliance of all statutory requirements of the project.
8. For the equipment/component received as fabricated from manufacturer, the field welding if any shall be done by the contractor with prior approval of the EIC and in accordance with relevant code.
9. Removal of caps and other closures from all equipment nozzles supplied with temporary caps is included in contractor's scope of work. The removal of caps shall be done by grinding or sawing off only. In case arc gouging is to be done, a written procedure shall be submitted and EIC's prior approval shall be sought. Any damage to the equipment during the process of removal of the caps shall have to be made good by the contractor's at his own cost. After completion of weld joint the open edges of pipes shall be fitted with temporary plastic /steel caps.
10. Contractor shall prepare all the work procedures with reference to applicable codes and standards and shall submit the same for the approval of BHEL/NPCIL including WPS and PQR for the pipe welding and qualification of welders.
11. Preparation of reports, documents required at various stages of the work.
12. Providing man power, all tools & tackles, P&M, consumables, necessary pipe end capping, scaffolding, temporary supports, documentation and report submission, all other arrangement to complete the work as per drawings.
13. Care shall be taken to avoid foreign material entry into the pipes during all stages of work. Foreign material exclusion check point to be included in the

erection procedure and report.

14. The contractor shall prepare and submit documents like erection protocol, log sheets, measurement and test reports and any other report deemed necessary to BHEL/NPCIL. Data shall be submitted in inch dia, inch meter as per format provided by BHEL along with RAB. Dedicated manpower shall be deployed with required resources for such documentation works.

1.2.17.2 Fabrication and welding of CS, SS & Ti pipelines :

In addition to the requirements given in clause no 17.1, the contractor shall perform the following activities.

1. Fabrication and welding work includes study of drawings & applicable documents, site survey, identification of joints, marking, cutting & edge preparation (where ever required), cleaning, fit up, welding of pipes, fittings and other components of various sizes and thickness using GTAW/SMAW process, cleaning the joint, visual and measuring inspection, repair of welding if any, engraving, preparation & submission of reports, QAP, JHA and other documents, completion of joints including arrangement of man power, plant & machinery, tools & tackles, scaffolding and platforms, consumables, (except welding filler wire & welding electrode), cleaning aids etc and completion of work as per tender specification and drawings.
2. For SS welding, identification of pipe spools, joints, cleaning, purging dam fixing & purging, fit up, welding, welding of stainless steel pipes using GTAW / SMAW process, cleaning the joint, visual and measuring inspection, repairing weld joint if any, removing purging arrangements, engraving, preparation & submission of report, arrangements of man power, plant & machinery, tools & tackles, scaffolding and platforms, all consumables (except welding filler wire and electrodes), cleaning aids etc and completion of work as per tender specification and drawings.
3. For Titanium (Ti) welding of pipelines in addition to the general requirements of welding the scope includes passivation of weld edge, purging-dam fixing, purging, shielding and trailing gas, welding using GTAW process including hookup joints, visual inspection, repair of welding if any, FME inspection including identification & marking by engraving, preparation of welding inspection report (WIR), purging dam log sheet, consumables (excluding

welding filler wire & electrode) etc and completion of work as per drawings and tender specifications.

4. NPCIL will supply of various electrodes and filler wires for welding of CS/SS/Ti pipes. Contractor shall prepare material accounting for receipt, consumption, wastages and return of electrodes and filler wires and submit to BHEL/NPCIL.

1.2.17.3 Erection of CS, SS, Ti pipelines :

In addition to the general requirements given in clause no 17.1, the contractor shall perform the following activities.

1. Erection of pipes on different types of supports at various elevation, locations, alignment of pipes and slope as per the drawing, providing tapping for vents, drain and sampling connections and providing reinforcing pads for branch connections wherever required.
2. Providing temporary supports for erection of pipelines.
3. Fixing of pressure & temperature stubs, rotameter, venturies and orifice flanges as per specifications. Welding, Drilling of the above stubs. Site bending for small bore lines
4. Preparation of isometric drawings wherever required.

1.2.17.4 Welding requirements:

1. Preparation, submission of welding procedure specification (WPS) and conducting Procedure qualification record tests (PQR) as per relevant standards are in contractor's scope of work.
2. No welding shall be done on surfaces which are wet or exposed to rain or excessive draft. Surfaces to be welded shall be free from paint, rust, oil, grease, dust or any other contamination. Cloths used for cleaning shall be lint free with hemmed edges. Weld edge preparations shall be cleaned only by use of approved solvents.
3. Welds shall be cleaned between passes to remove all traces of slag and flux before successive beads or layers are deposited. Completed weldments shall be cleaned to the same extent. The craters at the starting and stopping points of each individual bead shall be carefully examined and any defects shall be removed by grinding. Peening shall not be permitted.

4. Inspection and Quality Surveillance shall not be limited to examination of the finished weld. All dimensions specified for welding including weld size, reinforcement, edge preparation, fit up etc. shall be checked by gauges approved by the Engineer. All aspects of the materials, fabrication procedures and examination procedures used, that could affect the quality of the finished weld, shall be subjected to the approval of the Quality Surveyor.
5. The welding equipment to be used shall be suitable for the quality of the work specified and the technique employed shall be based on methods which are known to produce good results and which have been verified at site by actual demonstrations.
6. All stages of fit-ups to final welding shall be checked and cleared by qualified inspectors/engineers of contractors. Random inspection shall be carried by QA representative of BHEL/NPCIL. All the reports shall be generated and maintained by the contractor.
7. The welding technique and arc manipulation shall be controlled to ensure the following:
    a. Full Penetration for groove welds.
    b. Full fusion into the preceding bead or layer.
    c. Full fusion into the base metal without undercutting along the sides of the weld.
    d. Uniformity of surface in both single run passes and beaded layers.
    e. Floating all slag, oxide and gases to the surface behind the advancing arc.
    f. Delay in electrode travel until base metal fusion at the starting point is assured and until the crater is well filled at the completion of the weld.
8. Haphazard striking of the electrode on the base metal in establishing the arc shall not be permitted. The arc should be struck either in the joint where the metal surface will be fused into the weld or on a starting tab. Starting tabs shall be of the same material or a material compatible with the base metal being welded. When inadvertent arc strikes occur, the areas affected shall be ground flush and then examined by the liquid penetrant method. High frequency arc starting devices shall be used for GTAW process.

9. Care must similarly be taken when stopping the arc to avoid an unfilled crater and crater cracks. The following techniques are to be used for stopping the arc.
   a. The arc should be drawn off to the side of the joint and stopped on the beveled surface of the joint while extending the arc length rapidly.
   b. In GTAW, the machine should ideally be equipped with a foot or hand control to permit a gradual decrease of current. It is then easier to fill the crater completely and prevent crater cracks. Alternatively the arc shall be extinguished as in (a).
10. During the welding of carbon steel with covered electrodes, the width of the deposited pass shall not exceed three times of the nominal core wire diameter. For vertical position stringer bead is preferred. In GTAW the electrode must be correctly shaped and pointed for DC welding and a spherical end for AC welding. The electrode extension beyond the gas cup should be kept as short as is consistent with the joint being welded. The welding torch should be inclined slightly in the forehand welding position and the filler metal added carefully to avoid contact with the consequent contamination of the tungsten electrode. If contamination does occur, the tungsten electrode shall be cleaned and redressed. Similarly, if the tungsten electrode comes into contact with the weld pool the operator shall break the arc and grind out the tungsten deposit.
11. Gouging and gas cutting operation shall be done by qualified personnel. All material in the surrounding area should be suitably protected during welding, gouging and gas cutting operation.
12. Utmost care shall be taken while carrying out welding job on equipment nozzle, particularly heat exchangers etc. so that no weld spatter etc. falls inside the equipment.
13. Joint design: In all instances the edge preparation for welding shall be done as per the working drawings and specifications. In general all pipes and pipe fittings issued to the contractor shall have edge prepared.
14. Fit-up: Before fitting up the weld joint, the profile and dimensions of the weld edge preparation shall be checked. If the specified tolerances are exceeded this shall be corrected with prior approval, by grinding, machining or any other method acceptable to EIC. All fit-ups shall be examined by the Quality Surveyor prior to welding the root pass.

15. Weld profile: The surface smoothness of the finished weld shall be suitable for proper interpretation of the non-destructive examination of the weld. If grinding is necessary, the weld shall be blended into the parent metal without thinning the basic wall thickness of the parent or weld metal in any way. Uneven or excessive grinding may be cause for rejection or re-work at the discretion of the Quality Surveyor. Fillet welds shall preferably be slightly convex and shall be free from undercutting and over-lap at the toe of the weld. Convexity shall not exceed 1.6mm. Full fusion shall be obtained at the root of the fillet and in no case shall the leg length of the fillet be less than the nominal weld size stated in the drawings or specification. The leg length shall not exceed the specified size by more than 1.6mm. Dimension specified in the drawing and codes shall be adhered.
16. Tack welds: The number and size of the tack welds shall be kept as small as is consistent with adequate strength and joint alignment. All tack welds shall be examined visually for defects and if found defective shall be completely removed. As the welding proceeds, tack welds shall be either removed completely or shall be properly prepared by grinding or filling their stopping and starting ends so that they may be satisfactorily incorporated into the final weld.
17. Seal welds: Seal welding shall be done by qualified welders and in accordance with approved procedures. Threaded joints that shall be seal welded after grinding and removing the threads from the male part at the welding area. The surfaces to be welded shall be cleaned free from paint, grease, oil, rust, seal compound, etc. The threads left outside after making the joint shall be adequately prepared by grinding and circumferentially covered by the seal weld. The surface of the seal weld shall merge smoothly into the parent metal surface and shall be suitable for the proper interpretation of non-destructive examination of the weld. Unless otherwise specified on drawings, seal welding size shall be 3 mm minimum.
18. Fillet welds: Fillet welding of pipelines shall be carried out by qualified manpower by following approved WPQ, WPS and PQR. Fillet welding of SOFF, SORF flanges will be measured in such a way that fillet welding on both the side of the same flange joint will be considered as single joint for Inch-dia measurement. The scope includes cutting of pipes and preparation for fillet welding.

1.2.17.5 Welding materials:

Welding materials intended for welding of free issue equipment and pipes will be issued by NPCIL as free issue materials to the contractor. Electrodes and filler wires shall be supplied by contractor for fabrication of pipes and materials supplied by BHEL. The electrodes as specified in the drawings and specification shall be used for the job.

The Russian supplied electrodes will be:

a. for welding of carbon steel – electrodes УОНИИ -13/45, УОНИИ - 13/55, E42A; filler wire Сб08г2С
b. for welding of corrosion-resistant steel, 08Х18Н10Т, 12Х18Н10Т – electrodes EA-400/10Y, EA-400/10T filler wire Сб -04Х19Н11М3
c. For different steels (carbon + corrosion-resistant) – electrodes EA-395/9, filler wire Сб-10Х16Н25АМ6.
d. For titanium pipe welding, special electrodes and filler wires materials as specified in manufacturers drawing and documents.

For materials supplied by BHEL, only NPCIL approved brand of Electrodes, filler wires shall be used for all the welding works carried out by the Contractor. Approved Electrode list shall be issued regularly to the Contractor. Electrodes to be used shall be as per approved WPS/PQR. In case of any deviation, prior approval from EIC shall be obtained. Welding Procedure and Welder Qualification shall be as per ASME SEC IX/PNAEG-007-003-89.

1.2.17.6 Welding process:

The contractor may use following welding technologies

1. Manual arc welding with coated electrodes (SMAW);
2. Manual argon-arc welding with non-consumable (tungsten) electrodes (TIG/GTAW welding);
3. Automatic argon-arc welding
4. Combined welding (bottom run by argon-arc welding; hot pass and final run by manual arc welding).

1.2.17.7 Weld repairs:

Any weld repair shall be subject to the approval of the Quality Surveyor. No separate measurement and payment will be made for weld repairs and it's NDE including penalty joints.

1. If weld repairs are necessary, they shall be made using qualified welding procedures by qualified welders and shall be examined by a dye penetrant method, or by radiographic as the EIC may direct.
2. Unacceptable defects shall be removed by grinding, machining or chipping. Arc gouging or flame cutting are also permitted provided gouged surfaces are ground back at least 1.6mm below the deepest indentation.
3. If preheat is specified in the appropriate welding procedure then the same preheat must be maintained during flame outing or arc gouging.
4. Liquid penetrant examinations shall be used to check that the defect has been completely removed prior to weld repair. In the event of any doubt regarding complete removal of a defect, radiography may be required at the discretion of the quality surveyor.
5. Weld repairs shall be made using qualified procedures and welders. The preparation for the weld repair shall have the prior approval of the Quality Surveyor.
6. In the event of several unsuccessful repair attempts or if the Quality Surveyor feels that satisfactory repair is not feasible, the joint shall be completely remade. Due consideration should be given to check the damage to the parent metal.
7. The re-welded area shall be re-examined by the methods specified for the original weld. Where radiography is required, a minimum amount of 50 mm film overlap beyond the repair edges must be ensured.
8. Repairs of any base material utilized in fabrication of piping shall not be undertaken unless specifically permitted by the Quality Surveyor.
9. The areas from which temporary attachments have been removed, shall be dressed smooth and examined by liquid penetrant method by the contractor without separate measurement and payment. Defects, if any, shall be removed and the material shall be re-inspected to ensure that the defects have been removed.

1.2.17.8 Electrode storage, control & monitoring:

Contractor shall be responsible for storage, baking, control, calculation and monitoring of electrodes as detailed below.

1. Storage: The contractor shall receive electrodes and filler wire and store it in a specially developed controlled atmosphere. The temperature of

room shall be maintained not lower than +20°C and not more than 50°C. The relative humidity of room should not exceed 50%. Electrodes of different equipment shall be identified till they are consumed.

2. Electrode baking: The electrode of different type needs to be baked at different temperature. The contractor shall have mother baking oven of heating capacity not lower than 400°C. The baked electrode to site should be stored in a transfer oven to 150°C to 200°C. Electrode to site should be sent only through portable oven with heating range of 100°C and above. Electrode should never be taken to site without ovens.
3. Electrode control and calculation: On receipt of drawings of the equipment and piping the contractor shall calculate the quantity of electrodes for completion of particular work and inform the EIC within 15 days about the quantity for welding. As soon as electrodes are received along with equipment and piping once again the requirement shall be reviewed. During execution of work the consumption and availability should be recorded and statement should be sent to EIC once in 14 days. As soon as particular work is completed, the reconciliation of electrodes should be submitted and records to be maintained.
4. Monitoring: The electrode receipt, storage, handling, control should be maintained by experienced technical person only. The records should be maintained with the help of computer and proper data system.

1.2.17.9 Acid pickling :

The pipelines of generator seal oil system (MKW) and oil supply and drain systems (MVA 10) shall be subjected to acid pickling for removal of dirt, rust, scales etc., before filling of oil in the system. In addition to the general requirements given in clause no 17.1, the contractor shall perform the following activities.

Making necessary arrangements for acid pickling of oil pipelines by dipping, soaking and by circulation of chemical agents. NPCIL will provide required quantity of working medium (oil) for preservation after acid pickling. Dipping shall be adopted for pipe fittings, soaking shall be performed on pipes and circulation method shall be adopted after erection of the pipelines. The contractor shall make all necessary arrangements but not limited to the following such as pumps for circulating the pickling solution, electric immersion

heater, industrial thermometer/ temperature gauge, chemical agents, sample testing laboratory, compressed air, blanks & plugs, temporary pipe connections, manpower, tools & tackles, P&M, cleaning aids etc., for successful completion of acid pickling and safe disposal of the consumables without affecting the environment.

Note: Supply of chemicals, acid cleaning tanks and pumps to be arranged by the contractor. Scope includes neutralization & disposal outside/near by facilities.

1.2.17.10 Passivation of SS pipes and fittings :

In addition to the general requirements given in clause no 17.1, the contractor shall perform the following activities.

Contractor shall carryout passivation of SS pipes and fittings where ever required as instructed by the EIC. Scope includes inspection of pipelines, preparation of procedure, supply of consumables, carrying out passivation, supply of preservative materials and carrying out preservation of passivated material, preparation of reports, arrangement of man power, tools & tackles, plant & machinery and cleaning aids.

If passivation is to be carried out inside the plant premises , contractor shall arrange required tanks, chemicals, consumables, manpower, tools/tackles, cleaning agents etc. and complete the work including checking and removal of Contamination with in quoted rate. If the passivation is not to be carried out inside plant premises due to various reasons. The contractor has to carry out same at outside, where the facility is available in nearby location. The cost involved for transportation; passivation cost shall be borne by the agency. No extra payment shall be allowed in this regard.

1.2.17.11 Cold bending :

Where elbows not available for the pipelines of OD 57 mm and below, the contractor shall fabricate bends by cold bending as per the approved procedure and as instructed by the EIC.

In addition to the general requirements given in clause no 17.1, the contractor shall perform the following activities.

Cold bending will be done using formed dyes, and with internal mandrels (where practical), to prevent flattening. Compression bending shall be used

for thick wall pipes and for large radius bends, “Draw” bending shall be used for thin wall pipes and for small radius bends. The use of any filler material during bending is prohibited. Hot bending is not permitted, instead of that minor hot bending correction may be permitted as directed by the EIC. Any bending lubricants shall be subjected to approval of the EIC. Bend curvature shall be uniform and the surfaces shall be free from cracks, bulges, wrinkles, tooling damage and other injurious defects. Sample bends shall be prepared and examined after sectioning for conformance with thickness and ovality requirements. The entire external surfaces of all bends shall be inspected by liquid penetrant technique without separate measurement and payment. However for all the systems 100% visual inspection shall be carried out on all the bends.

1.2.17.12 Assembly of flanged joints :

In addition to the general requirements given in clause no 17.1, the contractor shall perform the following activities,

All the erected flanges shall be properly cleaned and inspected before assembly of the joint, Orifice plates, fasteners, gaskets shall be issued as FIM by NPCIL. The gaskets shall be cut to the required dimensions, placed in position along with orifice plates where ever applicable and fasteners shall be cleaned, lubricated, installed, aligned, sequentially tightened by torque wrench, providing leak tight joint, preparation of flange alignment report.

1.2.17.13 Testing of valves :

Valves shall be issued as FIM for testing and erection. Prior to their installation in the field, all isolation/terminal and check valves are required to be tested for their seat passing, integrity and leak tightness by the contractor. Relief valves and safety valves are also to be tested for opening and resetting pressure for checking the set point and to be adjusted to the required value as mentioned in the working drawing / manufacturers documents. Control valves, Diaphragm valves and solenoid valves are not required to be tested for leak tightness at site in valve testing facility.

The scope for testing of valves includes identification, handling, shifting of valves to VTF, de-preservation, cleaning, loading, valve testing, inspection, acceptance of test, preparation of report, demounting of valve from the bed,

cleaning ,drying with compressed air, re-preservation and capping & tagging of valves., preparation of procedures, arrangement of calibrated pressure gauges, DM/Clean water, compressor, hoses, tools & tackles, valve testing machinery, manpower, P&M, consumables, cleaning aids etc for the completion of work as per working drawings and documents. During testing of valves, in case the leak rates are beyond the acceptable limits, the valves shall be repaired and reconditioned. Repair and reconditioning of valves shall be carried out by NPCIL. The valves opened for repair shall be retested. Such valve shall be stored separately. The contractor shall arrange man power, P&M, tools & tackles for the shifting of the valve to and from the VTF for testing and after testing. The contractor shall prepare all the necessary test reports to ascertain the successful testing of the valve.

Note: Valve testing facility shall be equipped by BHEL

1.2.17.14 Erection of valves:

Valves of various size, type and material (CS/SS/Ti), after testing (if applicable) shall be erected at various locations, floors and buildings as per the drawings.

The scope includes handling, shifting of tested valves to location, making temporary support arrangements, installation in design position, alignment, tightening, FME inspection, box-up and preparation and submission of reports. The work also includes preparation of procedures, arrangement of tools & tackles, plant and machinery, required manpower, scaffolding and all consumables. Adequate care shall be taken during welding of valves. Valve manufacturer's instructions, if any, shall be followed in this regard. Contractor shall take due care and adopt proper welding sequence to avoid distortions of valve seat and body etc.

Generally, valves should be welded in open position and heat input kept to the minimum.

1.2.17.15 Fabrication and erection of pipe supports :

The Contractor scope of work shall comprise the following:

1. All structural attachments such as hangers, saddle, eye, spring block, shoe, pad, clip block, structural members and other ancillary's items shall be issued as free issue material to contractor. The scope includes handling, fabrication of the support structures as per the field

dimensions at shop, shifting the material from the fabrication shop to the site, straightening, cutting, grinding, bolting, welding, drilling, tightening, fixing and aligning in line and level, bending of rods to make U- clamp, visual inspection, complete for all heights, cleaning, handling assembly and erection of pipe supports of all types which includes activities like study of drawings & plant layout, assessing the availability of work front, planning, shifting, making of staging, lifting, handling, welding & installation in design position, alignment, checking of elevation, inspection, locking and release of springs before and after hydro-test respectively for the pipelines as per the drawings including spring height measurement and preparation of reports.

2. In some areas, hangers and supports may require drilling of holes on structural steel parts. Embedded parts are provided in the floors and walls for structurally attaching supports to the floors, ceilings and walls. However, in case of any changes in the pipe routing or support locations where EP does not exist the contractor shall install the EP with anchor fasteners. Drilling of holes in concrete wall / floor / ceiling and fixing Hilti anchors are required to be carried out as per drawing.
3. Where slope of the pipe for draining is mentioned in the drawing, proper care shall be taken to maintain the slope during installation of supports.
4. Where CS supports are used for S.S. pipe, S.S. shim sheet shall be used between pipe and support clamp, and supply & cutting of shims is part of scope of work.

1.2.17.16 Stub/o-let drilling:

Stub/O-let drilling involves study of drawings, identification of pipe spools and Olets/stubs, handling, shifting the pipe spools to contractor's machine shop marking of position and orientation, drilling of primary and secondary holes on pipe stubs/O-lets/equipments/ pipelines of carbon steel /stainless steel in shop/ in-situ using portable magnetic/ other drilling machines with special jigs, fixtures and arrestors along with drill bits/end mill cutter/ special cutting tools, clearing off burrs, removal of metallic chips by pick up tools etc., FME inspection, preparation of reports, arrangement of man power, tools & tackles, plant & machinery, scaffolding and platforms, consumables, cleaning aids etc, as per drawings, documents and specifications. Care shall be taken to avoid

damage of threads in pipe stubs/O-lets. The drilling machine used shall have drill bit locking provision so as to prevent falling of drill bits inside the pipes/equipments etc., In general, all the Stub/O-let drilling shall be completed before erection of pipelines. Scope for Stub/O-let drilling is for primary & secondary drilling. The drilling process shall be carried out in number of stages to get required diameter.

Handling, shifting of pipe spools, marking of position and orientation, drilling of holes (primary and secondary) on pipe bosses/equipments/ pipe lines of carbon steel /stainless steel in shop/In-situ for sizes upto 65 mm diameter and depth upto 120 mm using portable drilling machines with special jigs, fixtures and arrestors along with drill bits/end mill cutter/ special cutting tools, FME inspection, preparation of reports, arrangement of man power, tools & tackles, plant & machinery, consumables, scaffolding & platforms, cleaning aids etc, as per drawings, documents and specifications and work completion.

Note:

1) Stub/O-let drilling is inclusive of both primary & secondary drilling and drilling in number of stages.

2) The drilling machine used shall have drill bit locking provision so as to prevent falling of drill bits inside the pipes/equipments

1.2.17.17 Orifice fixing:

Assembly, welding and erection of all types of Orifices (Spool type and plate type) are included in contractor's scope of work. Orifices if any, which are part of the equipment/pipeline supply shall also form part of the contractor's scope of work. The details of orifices, their location and layout, erection requirements shall be specified in working documents (WD).

In addition to the general requirements of pipelines, the following is the brief Contractor's scope of work for erection of orifices:

1. The Orifices are to be erected only after completion of flushing and integrity testing of the pipelines.

2. Orifices shall be assembled, erected, inspected and tested in accordance with the, working documentation, passport documents supplied along with the equipments, manufacturer's instructions, applicable codes & standards and approved standard procedures.

3. Contractor shall ensure the orifice orientation & flow direction thoroughness of upstream and downstream pressure hole communication before erection and shall be as per the working documentation and manufacturer's instructions.

4. The general instruction/requirements for assembly and erection shall be detailed in WD or manufacturer's documents.

5. Any special manufacturer's instructions regarding assembly, welding, erection etc. shall be strictly adhered to and shall form part of contractor's scope of work.

1.2.17.18 Vent, drain, manholes or instrument connections:

The amount of the piping work is established of each major system and by taking into consideration all the requirements described in this document. However, it is to be noted that vent, drain, manholes or instrument connections on equipment or pipelines may start with pipe and terminate with the valve. Such pipe run may not have separate pipeline code numbers because the EIC's operational requirements are satisfied by code number of valves. All such cases shall be shown as details of a particular main line or equipment in the relevant drawings. In case of small diameter pipelines, the routing shown is only for the guidance, but the actual routing shall be as per the field conditions and the contractor shall carry out the work unto the terminal point as directed by the EIC.

1.2.17.19 Non destructive examination (NDE)

Non Destructive Examinations of welded joints of equipments and pipelines shall be performed by the methods prescribed in working documents. Contractor shall train his NDE personnel for performing the works as per Russian codes and standards. As per the working drawings the quality of weld and extent of Non- Destructive Examinations coverage are based on the category of welds which are defined as follows:

Category I: Welded joints for equipments and pipelines for Group A (Safety class I/QA-1 and Quality group A).

Category II: Welded joints for equipments and pipelines for Group B (Safety class II/QA-2 and Quality group B).

Category III: Welded joints for equipments and pipelines for Group C (Safety class III/QA-3 and Quality group C) and
Category QNC: Welded joints for equipments and pipelines as per working drawings and functional requirements as per SNiP/GOST standards.
TG & Auxiliaries systems under the scope of this contract do not have categories I and II.
With regard to the scope of inspections, the Non Destructive Examinations is subdivided into 100% inspection and selective inspection (Scope 50%, 25%, 15%, 10%, 5% & 1%).

Non Destructive Examinations such as Visual and measuring methods, Capillary method, Radiographic method, Ultrasonic method, Leakage test of weld seams like KLT and VBT shall be performed by the contractor on the equipments and pipelines as per the requirements of working documents. Contractor shall prepare procedure for each NDE method and submit to BHEL/NPCIL for approval before carrying out the examinations.

1. Visual:
Includes visual inspection as per the approved standards and procedures by qualified and authorized QA personnel of contractor and NPCIL. Visual inspection is part of scope of all the activities of work invariably.

2. DPT:
Performance of Dye Penetrant Test of weld joints of piping, supports and other structures as per working drawing and documents includes activities like identification of the test area/joints, pre-cleaning of joints (test area) and post cleaning after testing, shifting of DPT consumable to location, marking, carrying out dye penetrant Testing by ISNT/ ASNT level-II qualified personnel as per the approved procedure, generating reports, report analysis and submission to BHEL/NPCIL for acceptance including arrangements of equipments, manpower, tools tackles materials & consumables and completion of work as per the tender specification, drawings and as per the instructions of the EIC. DPT consumables used shall be as per NPCIL list of approved brand of penetrant materials attached in Annexure- VI.

3. RT:

Performance of Radiographic examination (Gamma ray) of weld joints including intersections of piping, supports and other structures as per the working drawings including providing necessary machinery, radiographic sources, radiographic cameras, storage including storage of source at concrete pits, handling, safety arrangements, surface cleaning of welded joints, removal of paint, grease, slags, burrs, spatters both in CS & SS materials, installation and dismantling of scaffolding /platforms, arranging materials, consumables such as radiographic film, developer, fixer etc., marking, carrying out Radiographic Testing by ISNT/ ASNT level-II qualified personnel as per the approved procedure, developing the films, marking, generating reports, report analysis and submission to BHEL/NPCIL for acceptance including arrangement of manpower, tools, tackles and completion of work as per the tender specification, drawings and as per the instructions of the EIC. (Radiographs shall be submitted to EIC along with RT reports after interpretation). To meet the requirements of Russian codes and standards, contractor shall make arrangements for LP/EP penetrameter by machining.

4. RT (X-Ray):

Performance of Radiographic examination (X –Ray) of joints of Titanium piping of thickness 4 mm and less as per the working drawings including preparation and approval of procedures shall carried out be by ASNT/ISNT Level-II qualified personnel. Scope involves, developing of films, interpretation, repeat of RT for repaired joints including providing necessary equipments, sources etc. Collection of RT films of various sizes, generating reports and submit to BHEL/NPCIL for acceptance. Also, work includes scaffoldings, platforms, storage, handling safety arrangements, all manpower, materials, consumables etc & all other arrangement and completion of work as per tender specification

5. UT:

Performance of Ultrasonic Test of weld joints of piping including intersections, supports and other structures as indicated in working drawings and documents. includes activities like identification of the test area/joints,

pre-cleaning of parts and components on test area and post cleaning after testing, Sourcing and calibration of the UT machines with calibration block, shifting of the Ultrasonic flaw detector along with probes and accessories to location, marking, carrying out Ultrasonic Testing by ISNT/ ASNT level-II qualified personnel using both normal and angle probes, generating reports, report analysis and submission to BHEL/NPCIL for acceptance including arrangements of equipments, tools & tackles, materials & consumables and completion of work as per tender specification, drawings and as per the instructions of the EIC.

Note: NDE required for erection of Main turbine, Generator and Main condenser is part of scope of their respective erection work.

1.2.17.20 Hydro/pneumatic testing :

Contractor shall carryout hydrostatic/pneumatic testing of erected systems. The testing shall be done as specified in the working drawings, specification, applicable Codes & Standards, approved procedures. Hydrostatic/pneumatic testing of pipelines and equipments shall be carried out as part of scope.

The following activities are involved in performing the Hydrostatic/ pneumatic testing.

Preparation of Procedures, QAP, test scheme, as built drawings, CRR (Circuit Release Report) for hydrostatic/pneumatic testing of the pipelines and equipments as per the standard documents, drawings and approved procedures including study of the drawings & layout, identification of test pressure, temperature, leak search pressure, hold time etc and conducting the test.

1. Preparation of As built drawings : Involves preparation of Isometric drawings of the piping layout (including supports, pipe fittings and valves) representing the actual layout at site using 2D drafting software like AutoCAD etc, which includes activities like study of drawings, identification of items no's, pipe spool no's, pipe lengths, support no's, support type, pipe fittings, valves, elevation, study of pipe layout & routing etc, taking measurements at site, reproduction of the actual layout in 2D drawing, marking of supports & their locations, pipe spools & their lengths in the drawing, preparation of reports like list of pipe spools, supports,

supports types, valves etc including arrangement of draftsmen, licensed drafting software, tools, machinery, printer, computer etc and completion of work as per tender specification and as per the instructions of the EIC. As built drawings shall be submitted in both hard and soft form.

2. Preparation of CRR: During the construction, all the systems may be divided or clubbed into various circuits. CRR stands for Circuit Release Report, which is a compilation of various reports giving complete information related to a particular circuit (can be of a single system or combination of systems). CRR includes preparation of list of weld joints with WIR no's, Pipes, supports and valves with erection report no's & valve open/close status, WD's with Rev No's, Manufacturer's Documents Identification nos, FCN/ DCN/ ECN, As-built Drawings, test scheme, Line no's, flange Joint with FAR no's, Terminal points and their location with status and exemptions.
3. Testing requirements:
   - **a.** Arrangement of all required manpower, components, high pressure positive displacement pump for pressurization, compressor, hoses, other hardware, pressure gauges, safety relief valves, NRV's, vents, drains, tools & tackles, plant and machinery, cleaning aids etc required for performing hydro/pneumatic testing**.**
   - **b. DM water required for carrying out hydro test shall be provided by NPCIL at one point inside the plant premises on free issue basis. However, collection and transportation to the required location & its disposal shall be in the scope of contractor.**
   - **c. Arrangement of Compressed Air or nitrogen cylinders for pneumatic testing are in the scope of contractor**
   - d. Preparation of blanks, threaded plugs, using of duly calibrated pressure gauges of required range (gauge range shall not less than one and half times and shall not be more than four times of test pressure), least count and safety and relief valves etc. The contractor shall make arrangements to vent and drain and dry the systems, cleaning of areas using suitable solvents where soap solution, masking/tapes and other adhesive tapes are used.
   - e. Testing of any one system or circuit may be sub-divided into smaller circuits, if called for by the EIC. These circuits may require to be

tested in phases in addition to complete circuit testing. The additional blanking of the circuit/isolation (due to sub division of circuits) shall be in the scope of the contractor at no extra cost.

f. All defects revealed by the above Hydrostatic/ pneumatic test shall be rectified as per approved procedure by the Contractor. During testing of circuits, if leaks are observed in the equipment and piping such circuits may need pressurization and testing more than once. This re-testing and pressurization will be in the scope of the Contractor and no extra payment for this will be made.

g. The contractor shall provide and later remove temporary closures for conducting tests and ensure isolation of sub-system or equipment as per procedures without any extra claim. Dewatering of drained water from sumps to the designated points outside the building.

h. Oil system shall be tested pneumatically or hydraulically using system oil (oil issued as FIM)

i. Co-ordination with various agencies and performing hydro/pneumatic test, preparation of final test reports and documents required at various stages of the work and completion of the work.

j. Blanks required for hydrotest to be arranged by the contractor and to be approved by BHEL/NPCIL engineer.

1.2.17.21 Flushing of pipelines .

After completion of erection and hydro test of pipelines, contractor shall carry out water/steam/air/oil flushing of pipelines. The flushing loops may be open loop or closed loop arrangement. BHEL shall provide required pipes, strainers, valves, gaskets and fasteners. Fabrication & erection of temporary pipelines for flushing arrangements and performing flushing operations and after completion of flushing operation, removal of the temporary arrangements and depositing at BHEL/NPCIL stores is in the scope of contractor.

The scope of the contractor includes preparation of fabrication drawings based on the flushing scheme issued by NPCIL and assess the material required.

Contractor shall fabricate and erect flushing loops from the supplied material to suit field conditions with respect to identified loops for flushing as per the approved scheme and fabrication drawings. Fabrication includes mitre

bend, reducer, Tee, blanks, flanges & spectacle flanges, erection and welding of temporary piping loop (CS) and supports, valves, strainers, gaskets and fasteners, Contractor shall carryout open/closed loop flushing by properly planning the flushing sequence, carrying out flushing activities, operating the valves, filling and venting the piping systems, operating pumps/compressors, open loop and closed loop flushing (loop by loop), flushing in number of stages in repetitive manner till acceptance by EIC, change over from one flushing loop to another, draining, drying of pipelines, dewatering of the sump, dismantling of temporary arrangement after flushing completion, depositing all materials to BHEL/NPCIL's stores, preparation of reports, arrangement of man power, scaffolding & platforms, tools & tackles, arrangement of pumps & compressors, P&M, supply of consumables including welding filler wires / electrodes, cleaning aids etc, as per drawings, documents and specifications as with acceptance of EIC.

Oil flushing is in the scope of contractor. The oil will be issued by NPCIL. The scope involves making arrangements for oil flushing, shifting of oil barrels to and fro from stores and filling of oil to the system tank, carrying out oil flushing operation, collection of oil samples from appropriate locations and making arrangements for testing it at NPCIL laboratory. After completion of oil flushing, draining of oil to drums & shifting of used oil to NPCIL stores, shifting of fresh oil and filling for system charging.

After completion of the flushing operation the system equipments and pipelines are to be normalized by the contractor as per the system drawings.

1.2.17.22 Normalization of systems:

It is the responsibility of the contractor to normalize all the system piping for the systems in the scope of this work. This includes activities like removal of temporary blanks, closure of all the exempted joints, welding of hook up joints, release/adjustment of spring tension in supports after testing, removal of temporary supports, closure of open ends by blanking, etc. In short normalization includes all such activities required to bring the system piping, supports and equipment to the conditions as mentioned in the working drawings and documents.

1. Closure or hook-up welded joints: The welded joints which are made to connect one piping circuit to another piping circuit, equipment etc. in the end and after performing hydrostatic test on both side of the joints are termed as closure or hook-up welded joints, wherever it is not feasible to subject these joints to hydrostatic test or leak test or both. Such joints shall be treated differently for the acceptance purpose. Each of these joints shall be inspected on every weld pass by liquid penetrant examination or 100% radiographed tested whether or not such inspection requirements have been specified in the specifications and drawing. If UT is specified in the WD, the hook up joint shall also be subjected to UT as per the WD. The contractor shall keep a record of all closure or hook up joint.
2. Removal of temporary supports: Contractor shall make arrangements to remove any temporary adjustments, supports, structures etc made during the erection of the piping and equipment. Contractor shall ensure that all such temporary structures shall be properly removed without damaging the equipment and piping. Any damage to the existing structures, piping, component and equipment shall be made good by the contractor at his own cost. Collection, accounting segregation, disposal of the debris, scrap etc to an identified location shall be in the scope of the Contractor. The above activities are part of scope of respective erection work and no separate payment.
3. Release of spring supports: Contractor shall note that for all the spring supports, the spring blocks should be in the locked condition till the completion of the Integrity testing. Once the testing is completed, it is the responsibility of the Contractor, to unlock the springs and set them to the desired value as mentioned in the Working drawings against the respective spring support. Contractor shall prepare and submit a detailed report on the same to the EIC for approval and audit by BHEL/NPCIL.

1.2.17.23 Sealing of pipe penetrations (floor & wall)

The floor and wall openings provided for the pipe penetrations shall be sealed by the contractor after completion of piping work. The scope of work of wall penetration sealing involves cleaning of penetration and pipe surface to remove foreign materials, coating the surface with bitumen paints, filling of the annular space between the pipe and pipe sleeve/EP with manila rope

without air gap by dipped in the bituminous paint, finishing both the ends of the pipe EP with cement mortar and poly sulphide compound. The scope includes arrangement manpower, P&M, tools & tackles, scaffolding and supply of required consumables like bituminous paint, manila rope, cement mortar and poly sulphide compound etc.

The scope of work of floor penetration sealing involves cutting of plates to match with the profile of floor opening and fixing around the pipe penetration to provide proper floor penetration sealing.

1.2.17.24 Digitization of RT films :

The work includes collection of RT films of various sizes, scanning and digitizing the films, converting to soft form in NPCIL acceptable formats, submitting the soft copies along with proper indexing for easy identification and retrieval, generating reports and submits to BHEL/NPCIL for acceptance. This work also includes arranging all necessary P&M, manpower, tools, tackles & consumables completion of work as per tender specification.

1.2.18 STRUCTURAL STEEL WORKS

1.2.18.1 Fabrication and erection of structural steel: (Structural steel shall be supplied by BHEL as Free issue)

1. The work includes fabrication and erection of all structural works like Platforms, handrails, gratings, ladder, pipe and equipment support structures, saddles and clamps, support brackets for material handling equipments, safety cover plates, cross-over staircases/platforms, anchor/EP (Embedded Part) plates and other structural items including chipping and leveling of concrete wherever required.
2. Preparation of structural fabrication and erection detailed drawings & procedures and get approval from BHEL/NPCIL before starting the fabrication.
3. All structural members should be grit blasted and painted
4. Work of fabrication from supplied structural steel material as per approved drawings includes, material testing of structural steel, handling, transportation, storage, drilling, bending, straightening, cutting, bolting, welding, grinding, erection, fixing and aligning in line and level.

5. Arrangement of required man power, tools & tackles, plant & machinery, special tools, cleaning aids, scaffolding etc, supply of consumables including NPCIL approved electrodes and filler wires to complete the work as per drawings.
6. Inspection, testing and making arrangements for the acceptance of the structures by NPCIL, preparation of reports, documents required at various stages of the work.
7. The Contractor may note that embedded plates/fasteners are provided in the floors and walls for fastening the structures to the floors, ceilings and walls.
8. In case of non availability of EP's, the contractor shall install the anchor fasteners .
9. Anchor Fasteners shall be supplied by BHEL as free issue

1.2.18.2 General practice in structural steel works:

The following are the general practice followed in the fabrication and erection of structural steel works.

1. The contractor shall submit the procedures and get it approved well in advance but before the start of the work.
2. Unless specified in the relevant drawing and specification, all erection work shall be carried out in accordance with the latest edition of Standard code of practice for use of structural steel in General building construction SNiP-II-23-81/ IS:800.
3. Tolerances: Standard tolerances as per relevant specifications/ drawing shall be followed.
4. Cutting may be done by shearing, sawing or machine flame cutting. All re-entrant corners shall be shaped notch free. Sheared or gas cut edges shall be dressed to a neat workmanlike finish and shall be free from distortion and burrs.
5. Hand flame cutting shall be undertaken only if so permitted by the EIC and shall only be carried out by an expert in such work. Hand flame cut edges shall be ground smooth and straight.
6. All the fabricated embedded parts of Structural Steel members shall be inspected at all stages of fabrication and assembly to verify that dimensions, tolerances, alignment and surface finish in accordance with

the requirements shown on the Contractor's shop drawings approved by NPCIL and/or Engineer's drawings.

7. In case of any faulty erection, all such dismantling and re-erection required will be at the Contractor's cost. Erection in general shall conform to the relevant clauses in IS: 800.
8. No dragging of fabricated anchor plate is permitted.
9. The Contractor shall protect all existing plants, embedded parts, all permanent and temporary structures, piping, conduits, equipment and facilities against damage during erection. The Contractor shall perform his work in a manner, in no way endangers the operations of any existing plant or structures or hinders other construction activities.
10. The Contractor shall be responsible for all transportation, loading and unloading for erection equipment and material to and from site.
11. Any rework / rectification required on the place of erection (floor / wall / roof EP's) are to be carried out by the Contractor for proper placement of fabricated plates to the satisfaction of the EIC by chipping and additional EPs /plate provided with proper approval issued by EIC. Under any circumstances no flame/gas cutting is permitted for making hole in structural works at site. This shall also include any additional inspection requirements as decided by the EIC.
12. All the erected structures, assembly and welding executed in accordance with the WD requirements are to be checked and offered for inspection by NPCIL Engineer and recorded in a protocol.
13. The works shall be executed as per the WD's, approved procedures and to the Instructions of EIC.

1.2.18.3 ISSUE & ACCOUNTING OF STRUCTURAL MATERIALS:

1. Structural Steel will be issued from BHEL stores on weighment basis (MT). The steel issued to the contractor shall be mainly in standard length and sections as received from the supplier. However, the contractor shall be bound to accept the steel in length as available in the project stores. No claims for extra payment because of issue of non-standard length will be entertained.
2. The contractor shall satisfy himself of the quality and quantity of the materials at the time of taking delivery from BHEL stores. No claims

whatsoever will be entertained by BHEL because of quality or quantity after the materials are taken by the contractor from BHEL stores.

3. The contractor shall submit to the engineer, a statement indicating estimated quantity of steel required during a quarter, at least two months in advance of the quarter. In addition, the contractor shall also furnish the estimated requirement of steel during a month by the third week of the previous month indicating his requirement.

1.2.18.3.1 RETURN OF MATERIALS

1. All surplus steel and all wastage materials will be taken back on weighment basis. Surplus, unused and untampered steel shall be sorted section-wise and returned separately to BHEL stores. Return of such materials will not be entitled to any handling and incidental charges.
2. All wastage / scrap (including melting scrap, wastage, un usable scrap) shall be promptly returned to the stores and a receipt obtained for material accounting purposes. Return of such material will not be entitled to any transportation and incidental charge.

1.2.18.3.2 SCRAP & SERVICEABLE MATERIALS

1. All Structural steel of length above 2 M except M.S. Plate shall be considered as serviceable materials provided the materials is in good and acceptable condition. Structural steel in length less than 2 M shall be treated as scrap.
2. Plates having both sides greater than 1 Metre or if any side is less than 1 M but greater than 0.5 M and the total area is equal or greater than 2 Sq. Metre shall be considered as serviceable.
3. All pipes measuring 2 M and above in length shall be treated as serviceable materials provided they are in good and acceptable condition. Pipe in less than 2 M length shall be treated as scrap.

1.2.18.3.3 WASTAGE ALLOWANCE

STRUCTURAL STEEL, (ROLLED SECTION, PLATES ETC.) CONSUMPTION & WASTAGE.

a) CONSUMPTION

The theoretical consumption of various sections shall be based on approved drawings. Weights shall be calculated considering the sectional weights as

per Indian standard. No extra shall payable to the contractor for any deviation in weights for the two different procedures adopted for issue and calculation of the theoretical consumption including rolling tolerances.

i. Actual consumption = Issue – Surplus.

ii. Surplus = Un-tampered & unused quantity of steel and Serviceable materials as stipulated under clause "Scrap and Serviceable Materials **(Refer Clause 18.3.2 above)"** returned by the contractor to BHEL store along with relevant documents.

iii. Wastage = Actual consumption – Theoretical consumption.

b) WASTAGE

Allowable wastage: +4% (FOUR percent) of the theoretical consumption shall be considered. Wastage shall be considered as cut pieces and scrap material, measured as per actual weighment basis. Invisible wastage (max limit to 0.5%), if any, shall be considered to be included in the specified 4 % allowable wastage.

Sl. No.	**CONSUMPTION OF STRUCTURAL STEEL (ROLLED SECTION, PLATES, SS LINER & RECOVERY)**	**BASIS OF ISSUE & RECOVERY**
S1	Theoretical consumption (without Considering any wastage, scrap or loss) as per spec. & drg.	Free
S2	Wastage limited to plus Four percent (+4%) of the aforesaid theoretical consumption (S-1) towards allowable wastage including invisible wastages (invisible wastages limited to 0.5% of theoretical consumptions).	Free
S3	Wastage beyond Four percent (+4%) of the aforesaid theoretical consumption (S-1).	Penal Rate

1.2.18.3.4 RECONCILIATION OF MATERIALS

i. The contractor shall submit a reconciliation statement of steel issued to him with each RA Bill.

ii. At the time of submission of bills, the contractor shall properly account for the material issued to him as specified herein to the satisfaction of BHEL

certifying that the balance materials are available with contractor's custody at site.

iii. At the time of submission of bills by the contractor, if it is noticed by BHEL that the wastage is high and calls recovery at the penal rate, then, BHEL will proceed for recovery for the excess wastage as per penal recovery rates as specified.

iv. The reference drawings for actual material consumption to be used for the purpose of reconciliation shall be drawings prepared by the BHEL and drawings approved by BHEL for fabrication works and such other drawings approved by BHEL.

1.2.18.3.5 RECOVERY OF MATERIAL

Recovery of wastages shall be made from the bills of contractor at the penal rate mentioned in the table below for the following cases:

a) If wastage exceeds the specified limit

b) If the wastage not exceeded specified limit, but not returned to BHEL store except invisible wastage

c) For not returning the surplus serviceable materials

PENAL RATE OF STRUCTURAL STEEL MATERIALS (MS plates, MS flats, rolled steel joists, channels, and angles, MS pipes, Chequered Plates, etc in sizes and lengths as available) shall be Rs. 48,668/- per MT + GST and/or other taxes & duties.

1.2.18.4 Fabrication and erection of SS liner: (SS liner shall be supplied by BHEL as free issue)

In Turbine building designated rooms are provided with stainless steel floor and wall liner of material grade ASTM A240 Type 321 equivalent to Russian Grade 08X18H10T. The CS angle & channel grids are embedded in floors. The SS plates of 5mm Thickness is welded over embedded channels as backing plate. The SS liners (3mm) are welded on backing plates. This work is to be performed at (-) 7.2 and + 0 m floor of Turbine building. SS trays of 3 mm thickness shall be fabricated and installed over CS structural frame in chemical sampling room of Turbine building.

Fabrication, erection, welding and inspection of SS liner on concrete walled tank & sump, drain trays, preparation of procedures, JHA, reports, NDT and

work completion as per the drawings, documents and specification with acceptance of EIC.

The work includes

1. Preparation and submission of fabrication drawings for approval of NPCIL/BHEL, fabrication, handling, transportation, storage, drilling, bending, straightening, cutting, bolting, welding, grinding, erection, fixing, aligning and fill test of SS trays etc. IMIR, storage, supply of all consumables, electrodes and filler wire, arrangement of manpower, tools and tackles, P&M, reports and work completion.
2. Vacuum box test for the joints of SS liner is in the scope of the contractor.

1.2.18.5 Fixing of Hilti fasteners: (Anchor Fasteners shall be supplied by BHEL as free issue)

Wherever EP's are not provided, the contractor shall fix the anchor fasteners. The anchor fasteners are to be fixed on concrete wall, floor or ceiling at different locations and buildings to fix the EP and provide support to pipe, equipment and structural members.

Scope includes Marking of holes, drilling of concrete to depth specified in drawing, cleaning the holes and anchor fasteners to be fixed using fixing tool and tightened to the required torque as per the manufacturer's catalogue. All consumables, machineries, power supply, approach platforms, scaffolding, tools and tackles and works required for completion is in the scope of contactor, extra holes have to be drilled if any obstruction of reinforcement rods occurs in the location. Unused holes shall be filled with dry pack material, Core drilling using diamond core drill bit on wall/floor/ceiling shall be performed as required with the approval of EIC. Scope includes supply of all consumables including diamond core drill bits.

1.2.18.6 Removal of erected material :

In case of any modification required to be carried out during construction, the erected piping, valves, structures and supports may have to cut and removed as per the instructions of EIC. The work includes the activities of cutting, grinding, drilling, dismantling, removal, handling, shifting of pipes, valves, supports and storing in the identified location. While carrying out the removal activities care shall be taken not to damage the connected and nearby pipes and equipments. Scope includes arranging all necessary

P&M, manpower, tools & tackles, consumables, scaffolding, return of removed material to NPCIL store and preparation of its reports etc and work completion.

1.2.19 GRIT BLASTING AND PAINTING WORKS:

Grit blasting, primer application & painting has to be performed for the various process system pipe lines, fittings, equipments, supports, structural items and other surfaces as mentioned in the working drawings. Pipes and structures shall be cleaned, de-burred, milled scale, oil if any are to be removed before grit blasting. Material shall be inspected for any damage, lamination etc.

Contractor Scope of work includes, supply of NPCIL approved primer, paints and thinner with test certificates, all tools, shots & grits, blasting equipments & air compressors, mechanical mixer, spray guns, hand power tools and all equipments, scaffolding materials, brushes, rollers, accessories and consumables, lighting arrangements, personal protection equipment etc. required for the completion of work, submission of work procedures, Quality Assurance Plan (QAP), Job Hazard Analysis (JHA), and other mandatory documents to NPCIL for acceptance, qualification of grit blasting, grit blaster, paint application process, applicator and procedures at site, testing of sample coupons, arrangement of all measuring and testing tools, testing equipments, testing kits, surface comparators, Press - O film, wet film gauge, digital Elcometer etc, arrangement of suitable and clean storage area, Grit blasting, paint mixing/application workshop, and good office etc. with proper ventilation, exhaust fans, fire extinguishers for fire hazards, carrying out grit blasting and paint application, conducting various tests on the painted surfaces to identify defects and organizing the inspection of painting and testing by BHEL/NPCIL representative and obtaining their approval, repair of the defects any observed and bringing it to acceptable conditions, handling of material at painting shop or at field, shifting of painted material to field and shifting to final erection point, preparation and submission of all relevant documents to BHEL/NPCIL after completion of painting.

1.2.19.1 Removal of existing paint:

Certain pipelines, Valves and equipments, will be issued to contractor with protective coating applied. After completion of erection & testing, the protective coating has to be removed using paint remover for application of required paint. The paint remover shall be of approved brands like Ever strip SH 110 by 'Avudai surface treatments private limited' or its approved equivalents by NPCIL.

Scope of the contractor is supply of paint remover, application for removal of existing paint, wet cleaning for neutralizing and drying of the surface, preparation of reports, inspection, testing and work completion as per the drawings, documents and specification with acceptance of EIC. The prepared surface shall be suitable for application of required final paint, as per paint manufacturer's requirement and with acceptance of EIC.

The work scope includes assessment of material requirement, procurement of paint remover with material test certificate, handling, inspection at contractor's store, preparation of IMIR, application, arrangement of man power, qualification of procedures, scaffolding and platforms, tools & tackles, P&M and consumables.

1.2.19.2 Supply & Application of intermediate & finish paint coats on pipes and various equipments:

Identification of pipelines, equipments, metal structures, surface cleaning, product qualification, supply and application of intermediate & finish paint as per technical specification I02.KK34.0.0.TH.TS.PR017 on outside surface with required thickness as categorized in sub items, inspection, preparation of reports, testing and work completion as per the drawings, documents and specification with acceptance of EIC/NPCIL.

The work scope includes assessment of material requirement, procurement with material test certificate, handling, inspection at contractor's store, preparation of IMIR (incoming material inspection report), establishment of workshop, application, arrangement of man power, qualification of procedures, scaffolding and platforms, tools & tackles, P&M, consumables.

Intermediate coat for Low temperature application (t≤50°C): using Epoxy MIO of minimum 100 microns DFT in single coat.

Finish coat for Low temperature application (t≤50°C):

using Aliphatic Polyurethane of minimum 60 microns DFT (2 coats each 30 micron).

1.2.19.3 Supply & Application of Medium Temperature paint (50°c<t≤150°c):

Identification of pipelines, equipments, supports, surface cleaning, product qualification, supply and application of finish paint of High temperature resistance silicone based ambient curing coating of 50 micron DFT (2 coats each 25 micron) as per technical specification I02.KK34.0.0.TH.TS.PR017 preparation of reports, inspection, testing and work completion as per the drawings, documents and specification with acceptance of EIC.

The work scope includes assessment of material requirement, procurement with material test certificate, handling, inspection at contractor's store, preparation of IMIR (incoming material inspection report), establishment of workshop, application, arrangement of man power, qualification of procedures, scaffolding and platforms, tools & tackles, P&M, consumables.

1.2.19.4 Supply & Application of High Temperature paint (150°c<t<350°c):

Identification of pipelines, equipments, supports, surface cleaning, product qualification, supply and application of finish paint of High temperature resistance silicone based ambient curing coating of 50 micron DFT (2 coats each 25 micron) as per technical specification I02.KK34.0.0.TH.TS.PR017 preparation of reports, inspection, testing and work completion as per the drawings, documents and specification with acceptance of EIC.

The work scope includes assessment of material requirement, procurement with material test certificate, handling, inspection at contractor's store, preparation of IMIR (incoming material inspection report), establishment of workshop, application, arrangement of man power, qualification of procedures, scaffolding and platforms, tools & tackles, P&M, consumables.

1.2.20 MISCELLANEOUS WORKS

1.2.20.1 Receipt and shifting of free issue materials:

All the free issue materials will be issued to the contractor from NPCIL stores. The materials are identified with Item no's. The scope of work includes identification of material, preparation of CIV, clearance from EIC and its submission to NPCIL's Stores, receipt, handling, loading on to the truck/trailer, shifting of materials from 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. Contractor shall return the spares, accessories and instrumentation items issued along with the free issue materials to NPCIL stores, which will not be erected by him, through CCV. This work also includes arranging all the necessary tools and tackles, truck/trailer, P&M, man power and consumables as detailed in erection specification.

Transportation of heavy, critical and ODC equipments is in the scope of NPCIL however the CIV to be submitted by the contractor.

1.2.20.2 Chipping of concrete :

Work front will be released to contractor for the erection of equipment and pipeline. Contractor shall survey the work front and make arrangements by levelling and finishing the area for starting the erection work. During such arrangement in case of any requirement of concrete chipping contractor shall bring to notice of EIC and get clearance for carrying out the chipping work. The scope involves identification, marking, mounting & setting up of machine for chipping of concrete as required, disposal of debris, preparation of reports, arrangement of man power, tools & tackles, plant & machinery, consumables, cleaning aids etc, as per drawings, documents and specifications with acceptance of EIC.

1.2.20.3 Plain Cement Concrete :

The rotary and stationary equipment foundation frames shall be concreted using cement concrete of grade M30, as per the drawings and instructions of EIC. The scope includes providing and laying cement concrete of grade M30 using machine crushed max 6 mm and downgraded stone aggregate including mechanical mixing, conveying, ramming, compacting, leveling, finishing, curing, scaffolding etc including all materials, consumables, tools & tackles, equipments, manpower complete as per drawings and specifications and instructions of EIC.

The requirements for work are as following;

1. All materials shall be procured only from approved sources. The EIC, however reserves the right to reject the materials and also disapprove the source even without conducting any tests on materials, if in his judgment, the EIC considers that the materials are unsuitable. The Contractor shall make necessary arrangements to the satisfaction of the EIC for the storage of cement to prevent deterioration due to moisture and/ or intrusion of foreign matter. All coarse & fine aggregates shall meet the requirements of IS 383. The coarse and fine aggregate shall be tested as per relevant IS code. The fine aggregate shall be free from injurious amounts of dust, clay lumps, pyrites, coal, lignite, soft or shale, alkali, organic matter, loam, mica and other deleterious substances.
2. Water used for both mixing and curing shall be clean and free from injurious amounts of oils, acids, alkalis, salt, sugar, organic materials or other substances that may be deleterious to the concrete or steel. Potable water is generally considered satisfactory for mixing and curing the concrete. The EIC shall approve the sources and treatment of water for concrete. Permissible limits of solids when tested in accordance with IS:3025.
3. Unless otherwise specifically stated as “Ordinary Concrete”, all concrete proposed under this specification shall be taken to mean Controlled concrete. For mix design, IS: 10262, SP 23 and IS 456 shall be used. The grade of concrete, minimum cement concrete maximum water cement ratio and workability for different types of concrete to be used in this work shall be as per IS 456.

   The requirement of concrete mix proportion is considered taking the exposure condition of KKNPP as ‘extreme’ as per IS 456: 2000 Section 2 (Table 5).
4. The curing shall start only after final setting of the concrete. This may be done using any of the following methods suitable to the Site conditions.
   a. Water ponding method.
   b. Continuous spraying of water over exposed surface.
   c. Covering wet burlap over the exposed concrete.
5. To select any one or combination of the methods mentioned above, care shall be taken to see that the final finishing does not get affected. The

period of water curing shall be 7-10 days. Sampling and testing of concrete shall be conducted in accordance with IS:456. No concrete placing shall be started without the permission of the EIC. On each occasion that the contractor intends to place concrete, he shall give the EIC at least 24 hours prior notice.

6. In preparation for the placing of concrete, all sawdust, chips and other construction debris, and extraneous matter shall be removed from the interior of forms. Struts, stays and braces serving temporarily to hold the forms in correct shape and alignment pending the placing of concrete at their locations, shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. These temporary members shall be entirely removed from the forms and not buried in the concrete. No concrete shall be placed on a water- covered surface. However the surface must have been sufficiently soaked and shall be moistened before placement of concrete begins.
7. The form work required for carrying out the above PCC work . The scope of work of formwork includes the supply, erection and removal of formwork for concreting of equipment base frames.
8. The Contractor shall prepare, design and drawings for formwork and centering and get them approved by the EIC well in advance before the fabrication and erection of form work and before commencement of actual shuttering work.
9. Materials for the Formwork shall be of Plywood form work covered with steel sheets, oil tempered hard board. Forms in contact with concrete having F-3 finish shall be plywood (film coated densified) panel formworks.
10. Forms shall conform to the shapes, lines, grades and dimensions including camber of the concrete as called for on the drawings. Ample struts, walers, braces, etc., shall be used to hold the forms in proper position without any distortion whatsoever until the concrete has set sufficiently to permit removal of forms. Formwork shall be rigid and strong enough to with stand effect of vibration practically without any deflection, bulging, distortion or loosening of its supports and shall be such as to prevent loss of slurry from the concrete. The Contractor shall use either foam strips or any suitable sealing tape to prevent loss of slurry through the joints of formwork. Forms shall be braced, strutted, propped and so

supported that it shall not deform under weight and pressure of the concrete and also due to construction facilities. The form work shall be designed and fixed to meet the tolerance in various areas specified in this specification or as specified in the relevant drawings. It should be easily removable without shock, disturbance or damage to the concrete. Temporary openings which can be conveniently closed shall be provided at the base of columns and wall forms and other places necessary to facilitate cleaning, inspection and vibration of concrete. Immediately before concrete is placed, the forms shall be made sufficiently rigid and tight, thoroughly cleaned, properly treated and free from foreign material. When forms appear to be unsatisfactory in any way, either before or during the placing of concrete, the EIC shall order the work to be stopped until the defects have been corrected. The recesses formed by the removable timber wages shall be filled with polysulphide caulking compound on inner surface and with epoxy mortar on the outer surface. Nothing extra shall be paid for such caulking. The work scope includes arrangement of man power, qualification of procedures, scaffolding and platforms, tools & tackles, P&M & consumables.

1.2.20.4 Non-shrink cementitious grout :

Grouting and/or dry packing of equipment supports, piping supports etc. are in contractor's scope of work. Contractor scope shall include supply and place heavy grout consisting of approved high strength cementitious ready mix non-shrink grout 'Conbextra GP-2' (M/S Fosroc make) or equivalent at equipment bases, areas specified in the drawing, preparation of procedures for approval, IMIR, inspection, testing, arrangement of man power and materials, scaffolding, ladder, platform, tools and tackles, grouting pump, mechanical grout mixer, shuttering, formwork etc.

Concrete surfaces to be grouted / dry packed shall be thoroughly roughened and cleaned of all foreign matter and laitance. Anchor bolts, anchor bolt holes and the bottom of equipment and column base plates shall be cleaned of all oil, grease, dirt and loose material. The use of hot strong caustic solution for this purpose will be permitted. Prior to grouting/ dry packing, the hardened concrete surfaces shall be saturated with water.

Forms around base plates shall be reasonably tight to prevent leakage of grout/ dry pack. Adequate clearance shall be provided between formwork and base plate, to permit grout/ dry pack to be worked properly into place. Grouting, once started, shall be done expeditiously and continuously to prevent segregation, bleeding and within the initial setting time. Grout shall be worked from one side to the other, to prevent, entrapment of air. Water in anchor bolt holes shall be removed before grouting is started. Forms and shims shall not be removed and the anchor bolts shall not be tightened for at least 24 hours after placing the grout. After the removal of forms and peripheral shims, area occupied by shims shall be filled and the area between the base and the edge of the foundation shall be finished smooth to allow drainage away from the base.

Interconnecting piping and machinery shall not be attached to the machinery before anchor bolts are tightened. It is desirable to make these connections at least after a minimum of seven days from the date of grouting. During this period, the grout shall be properly cured. All materials supplied by the Contractor and all works or construction performed by the Contractor and rejected - as not in conformity with the specifications and drawings - shall be immediately replaced at no additional expense to BHEL. All grouting shall be protected against damage until final acceptance by the BHEL/NPCIL or his representative. Upon the completion of grouting work, all forms, equipment, construction tools, protective coverings and any debris shall be removed from the area as directed by the EIC.

Non-shrink grout shall be premix type of cementitious (cement pregraded fibre and additive) non-shrink, ready to use grout in dry powder form. It shall have free flow property when mixed with required quantity of water. It shall have initial setting time of 30 minutes.

It shall have features of non corrosive to anchor bolts, base plate/saddle/frame, sliding plate, not harmful to concrete and reinforcing steel, non toxic , frost, oil and fire resistant, normal curing, suitable to use under restraints and grout thickness required, expansive to counteract initial shrinkage, ensure high early strength without surface crack, suitable for temperature of above 0 deg.C to 200 deg.C, maximum flow distance is compatible to the dimensions

of base plate/ saddle/frame, resistance to the chemicals, gases etc. being handled in equipment/machines.

It should have the following physical properties:

Min. Compressive strength at	3 days	25 N/mm2
	7 days	30 N/mm2
	28 days	40 N/mm2
Min. Tensile strength at	28 days	20 N/mm2
Min. Bond strength at	7 days	12 N/mm2
Max. on-strained expansion in	2 hours	4%
Min. Density		2000 kg/m3

The grout shall be prepared only to the extent it can be used within the specified pot life by the manufacturer. Any leftover grout or grouts not consumed within the pot life shall not be used and shall be discarded. The shelf life of the grout shall also be checked before they are used and the grout after the expiry date shall not be used under any circumstances. The grouts shall be chloride free and shall be used following strictly the manufacturer's specification.

1.2.20.5 Secondary concrete of equipments :

Providing and laying cement concrete 1:2:4 using machine crushed max 20 mm downgraded stone aggregate or supply and laying of cement concrete of strength M40 W80 and as specified in manufacturer drawing and specification. Mechanical mixing, conveying, ramming, compacting, leveling, finishing, curing, reinforcement steel work, shuttering & form work, dismantling, scaffolding etc including all materials, consumables, tools & tackles, equipments, manpower complete as per drawings and specifications and instructions of EIC.

1. All materials shall be procured only from approved sources. The EIC, however reserves the right to reject the materials and also disapprove the source even without conducting any tests on materials, if in his judgment, the EIC considers that the materials are unsuitable.

2. The Contractor shall make necessary arrangements to the satisfaction of the EIC for the storage of cement to prevent deterioration due to moisture and/ or intrusion of foreign matter.
3. All coarse & fine aggregates shall meet the requirements of IS 383. The coarse and fine aggregate shall be tested as per relevant IS code. The fine aggregate shall be free from injurious amounts of dust, clay lumps, pyrites, coal, lignite, soft or shale, alkali, organic matter, loam, mica and other deleterious substances.
4. Water used for both mixing and curing shall be clean and free from injurious amounts of oils, acids, alkalis, salt, sugar, organic materials or other substances that may be deleterious to the concrete or steel. Potable water is generally considered satisfactory for mixing and curing the concrete. The EIC shall approve the sources and treatment of water for concrete. Permissible limits of solids when tested in accordance with IS:3025.
5. Unless otherwise specifically stated as “Ordinary Concrete”, all concrete proposed under this specification shall be taken to mean Controlled concrete. For mix design, IS: 10262, SP 23 and IS 456 shall be used.
6. The grade of concrete, minimum cement concrete maximum water cement ratio and workability for different types of concrete to be used in this work shall be as per IS 456.
7. The requirement of concrete mix proportion is considered taking the exposure condition of KKNPP as ‘extreme’ as per IS 456: 2000 Section 2 (Table 5).
8. The curing shall start only after final setting of the concrete. This may be done using any of the following methods suitable to the Site conditions.
   a. Water ponding method.
   b. Continuous spraying of water over exposed surface.
   c. Covering wet burlap over the exposed concrete.
9. To select any one or combination of the methods mentioned above, care shall be taken to see that the final finishing does not get affected. The period of water curing shall be 7-10 days. Sampling and testing of concrete shall be conducted in accordance with IS:456.

10. No concrete placing shall be started without the permission of the EIC. On each occasion that the contractor intends to place concrete, he shall give the EIC at least 24 hours prior notice.
11. In preparation for the placing of concrete, all sawdust, chips and other construction debris, and extraneous matter shall be removed from the interior of forms. Struts, stays and braces serving temporarily to hold the forms in correct shape and alignment pending the placing of concrete at their locations, shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. These temporary members shall be entirely removed from the forms and not buried in the concrete. No concrete shall be placed on a water- covered surface. However the surface must have been sufficiently soaked and shall be moistened before placement of concrete begins.

1.2.20.6 Concrete core cutting :

Wherever penetrations are not available on concrete wall, floor or ceiling but required as per the drawings, contractor shall carryout concrete core cutting operation to continue with the further erection work with approval of EIC. The scope includes marking of holes, drilling and core cutting of concrete to the required depth, cleaning of the hole and disposing of cut pieces to identified location including P&M, drill or core cut tools, all consumables, manpower, power supply, approach platforms, scaffoldings, tools and tackles required for completion.

1.2.20.7 Manpower assistance for repair, preservation and pre-handing over checks, supply of preservation consumables and scaffolding:

1. Repair work :

Contractor shall provide manpower assistance to BHEL/NPCIL's in-case of any requirement of major repair of free issue materials at site (including NPCIL & contractor stores). Contractor shall engage skilled/semi skilled/un-skilled workers along with the necessary machinery, tools & tackles, lighting arrangements, cables, extension boards, general consumables, cleaning aids and applicable PPE's required for carrying out such repair works. The manpower will be assessed by EIC or his representative before engaging them in work. The deployment of personnel, deployment schedule and duration of work

shall be as per the requirements and as instructed by the EIC. Contractor shall obtain necessary permits & clearances as per the prevailing guidelines at the project. Contractor shall prepare report for completion of work and it will be certified by the EIC or his representative. The repair work shall be like repair of deformed structure/components and restoring to original shape by bend removal, straightening (with or without the application of heat), deformation correction etc., preparation of reports and work completion as per the instructions of the EIC.

Carrying out such repair activities by the one labour in a day (8 hrs.) along with general consumables like wire brush, lint free cloth, emery etc and P&M for heating and bend removal, general tool kit will be treated as one operation day

2. **Preservation works :**

On receipt and erection of equipments, the first preservation shall be carried out by contractor within the part of scope of equipment erection. Subsequently the equipments shall be kept in preserved conditions by contractor during the entire contract period.

The scope of the contractor for subsequent preservation is to carry out de- preservation and preservation works for all the piping, equipments and components stored at contractor's stores and those erected at site during the entire period of contract depending upon the requirements as and when the equipments become due for preservation/de-preservation and as directed by the EIC. Contractor shall engage skilled/semi skilled/un-skilled workers along with general consumables like wire brush, lint free cloth, emery etc and general tool kit, the necessary tools & tackles, lighting arrangements, cables, extension boards and applicable PPE's required for carrying out such preservation/de-preservation activities.

Carrying out such preservation activities by the one labour in a day (8 hrs.) will be treated as one operation day. The manpower will be assessed by EIC or his representative before engaging them in work. The preservation work shall be carried-out as per the procedures provided by NPCIL.

3. **Man power assistance during system pre-handing over checks:**

Contractor shall provide manpower assistance to NPCIL's for system pre handing over checks by engaging skilled/semi skilled/un-skilled workers

along with the necessary machinery, tools & tackles, lighting arrangements, cables and extension boards. The manpower will be assessed by EIC or his representative before engaging them in work.

Pre handing over checks involves activities such as cleaning and box-up of oil tanks, shifting of materials for supporting activities, filling/draining of fresh/used oil after flushing, bolt tightening, strainer/filter cleaning, valve internal removal and box-up, valve opening/closing, gasket replacement, greasing, support spring measurements & adjustment of charged and hot systems, etc, preparation of reports as per the instructions of the EIC.

Carrying out such pre-handing activities by the one labour in a day (8 hrs.) along with general consumables like wire brush, lint free cloth, emery etc and general tool kit will be treated as one operation day

4. Scaffolding arrangement for specific work

In general the arrangement of scaffolding shall be part of the scope of work for all activities except for certain specific works such as Preservation, Pre- handing over checks and repair works. For general requirement of scaffolding arrangement Clause no.25 of this section shall be referred.

Scaffolding for specific works shall be erected at various elevations/locations for carrying out preservation/ Pre-handing over checks/repair works as per the instructions of EIC.

The scaffolding for specific works involves erection of scaffolding using standard MS pipes as vertical and horizontal members at spacing not more than 1.5 m apart including providing cross supports, along with MS clamps, making approach/ working platforms to carry out various activities, obtaining clearance from NPCIL safety and its dismantling after the completion of work as instructed by EIC. All the scaffoldings shall be appropriately tagged with safe or unsafe for use instructions. The scope includes arrangement of man power, tools & tackles, P&M & consumables.

Material required for scaffolding viz. pipes, clamps, base plate, platform, ladders, shifting etc shall be provided by contractor.

1.2.20.8 In-situ modification works

Modification work at site involving cutting and welding operation shall be carried out as per the issued drawings/ sketches with approval of EIC. The scope of work involves identification, handling, marking, cutting and edge preparation, fit-up, longitudinal seam/ groove welding of components, grinding, cleaning, visual inspection, disposal of removed materials at NPCIL store, preparation of reports. The work includes arrangement of manpower, P&M, tools & tackles and consumables (excluding electrode) and completion of work as per the instructions of EIC. The cutting work shall be carried out by oxy acetylene flame cutting or grinding machine. All the gas cut edges shall be finished by grinding. Welding shall be done by SMAW process.

The Welded butt/ groove joints shall be measured by volume of weld geometry in units of Cubic Centimeter (CC).The cross-section of joint configuration can be single/double V groove, single/double bevel etc. The volume of weld geometry will be measured during fit-up stage according to the joint configuration including the reinforcement volume. The volume of weld due to fusion will not be taken into account for weld volume calculation.

1.2.21 QUALITY ASSURANCE & TESTING:

1.2.21.1 General requirements

1. The work under this contract/package covers TG & Auxiliaries 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 states of procurement, handling, storage, cleaning, pre-fabrication, erection, inspection and testing of equipments and piping.
2. Not with standing with the quality control requirement given in referred normative document /specification, the following shall be applicable during the quality assurance & testing.
   a. Certification of inspectors;
   b. Inspection of fit-up and welding and thermal equipment;
   c. Incoming control of main materials;
   d. Quality control of welding materials;
   e. Operational and process control;

f. Non-destructive inspection;
g. Destructive inspection;
h. Hydraulic and pneumatic tests

3. The equipment and pipeline erection covered by this contract shall be subjected to stage inspection and final inspection and testing as per approved QAP. The Contractor shall provide all required services and resources to establish and maintain quality of workmanship during erection.
4. All equipment and consumables for destructive/non-destructive testing, examination & inspection, temporary arrangements & provisions for pressure & leak testing, facilities for clean shop with air washing and filtration facilities, detergent wash of SS pipes and cleaning of the pipelines including consumables supplies for the same and the facilities such as filtered water, oil free compressed air unit.
5. 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.
6. All equipment and pipeline erected shall be checked for proper alignment, orientation, bolting/ welding etc. The inspection requirement depends upon the safety class and group of particular codes and standards.
7. Along with the main control methods some complementary control methods are also possible (styloscope method, hardness measurement, etching etc.).
8. Destructive examinations such as mechanical test, IGC test, metallographic analysis, determination of chemical composition, and determination of ferritic phase shall also be carried out to ascertain the quality of the weld and base.
9. The inspection requirements will be indicated in detail in the working drawing and specifications.
10. 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.
11. 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.

12. NPCIL/BHEL shall carry out audit in all phases of the work i.e. procurement, pre- fabrication, erection, inspection, examination and testing.
13. 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.

1.2.22 FOREIGN MATERIALS EXCLUSION (FME):

Proper FME control procedure shall be exercised during the course of erection for equipments as well as piping. During all stages of assembly & erection of equipment and piping, contractor shall maintain utmost care and ensure that no Foreign Material is trapped or locked inside the equipment or piping. It is the responsibility of the contractor to establish proper entry and working procedures at site such as providing proper lockers, preventing the workers from carrying any loose items, training the workers on FME etc. Any damage to the equipment or component due the foreign material inclusion shall be at the cost of the Contractor.

In addition to the requirements of specification, clean environment/shop conditions shall be maintained at site. Internal surfaces of the pipe line shall be cleaned with rotary brush and air and inspected for foreign material before taking up pre- fabrication. All machined surfaces shall be protected from dirt and mechanical damage. All threaded connections shall be either capped or have thread plugs inserted until the associated equipment has been installed. No liquids of any kind, whether for cleaning, testing or other reasons, shall be admitted to the pipe lines or the equipment except when authorized by the EIC.

Note: No additional cost will be paid for FME inspection and is included as a part of equipment and pipeline erection and inspection works.

1.2.23 HOUSEKEEPING, CLEANLINESS & DEWATERING:

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.

The contractor shall thoroughly check and remove the extraneous materials, if any, like electrodes, welding rods, helmets, bolts/nuts, etc. left behind in the pipelines. All erected piping shall be cleaned from inside before testing and making the closure joints. 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.

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. Scope includes but not limited to:

1.2.23.1 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.

1.2.23.2 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.

1.2.23.3 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.

1.2.23.4 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.

1.2.23.5 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.

1.2.24 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.

1.2.24.1 Threading:

The contractor shall be responsible for threading all mating components to suit the threads on valves, pipe fittings and equipment flange bolting, studs, nuts and mounting bases being supplied by the EIC.

Matching threads of hanger components supplied or fabricated by the contractor may be threaded to any commonly accepted standard unless otherwise specified on drawings; however the same thread standard must be used throughout and shall be subjected to the approval of EIC. The threads shall be cut with a sharp and properly adjusted threading tool to the correct taper and lead. Improperly made threads of any discrepancy shall be cut from the pipe and new threads made to the satisfaction of the EIC. Threads shall be concentric with the outside barrel of the pipe. Pipe thread diameters shall be such as to allow sufficient hand engagement and yet allow enough threads for wrench-up to produce a tight joint. All pipe threads shall be cut on machine only and shall be checked with approved gauges.

Prior to making a screwed joint, the threads shall be thoroughly cleaned of all foreign matter, oil, grease etc. Any thread that has become blurred or

deformed shall be repaired using suitable standard and size tap set and die set prior to assembling the joint. If the thread is damaged to the extent that it cannot be repaired without sacrificing the tightness of the joint, then the threaded end shall but cut out from the pipe and new threads made to the satisfaction of the quality surveyor. No lubricants or sealants shall be used on threaded joints of any pipes carrying water, gas.

1.2.24.2 Tightening of bolts:

All bolts and nuts shall be installed properly. At least two threads on bolt should project beyond nut. In bolting of flanged joints with gasket, the contact faces of the flanges shall bear uniformly on the gasket, and the gasket shall be properly compressed in accordance with the design principles applicable to the type of gasket used. The bolt stress in all flanged joints shall be relatively uniform. All threads of bolts and nuts shall be cleaned by suitable means so as to be free from any foreign materials and suitably approved lubricant whenever specified shall be used prior to tightening of bolts. Torque Wrenches shall be used for tightening of bolts to ensure controlled tightening. Torque values for various sizes of bolts for tightening shall be as per specification in drawings.

1.2.25 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.

1.2.26 RECORDS AND REPORTS:

1.2.26.1 Records:

The Contractor shall maintain records pertaining to the storage, fabrication, welding, erection, alignment, inspection and testing 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 report concerning welding, alignment of the equipments and flanges are included in this category. For material supplied by contractor, the contractor shall forward one copy of test certificate to the EIC pertaining to the origin and specification of material. The EIC shall need certain records for verification viz. weld inspection report, stress relieving report, consumable certificate, etc. 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.

1.2.26.2 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. Equipment erection progress report
b. Piping erection, NDT and testing progress reports
c. General statement of activities

d. Welders performance & qualification records
e. 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.

1.2.27 COMPLETION OF WORK AND SUBMISSION OF CCC & MATERIAL ACCOUNTING:

1.2.27.1 Completion of work:

As far as technical requirements are concerned, the contractor's work shall be considered completed when the equipment and piping systems are installed, painted, insulated and have passed all examinations, inspections and test requirements and complete in all respects in accordance with drawings and specifications, CEA clearance obtained and Turbo generator of each unit is operated at full load after synchronization with grid. 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.

1.2.27.2 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. Systems process flow sheets & hook-up joint(s) details

7. Weld inspection reports & radiographic test final results
8. Weld procedures (welding and fabrication procedures, WPS & PQR)
9. Erection procedures for mechanical components (including forming and assembly procedures)
10. Hydro-test results (including pneumatic)
11. Pipe line erection reports
12. Valve erection/testing reports
13. Mechanical joint inspection report [blasting / painting]
14. Equipment erection & alignment report
15. Test Certificate from manufacturers for all the materials supplied by the contractor.
16. Reports generated during manufacturing, fabrication, erection and testing.
17. Inspection/test report/investigation, field tests, concreting reports etc.
18. Drawings/ documents/ reports relevant to the works.
19. 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.

1.2.27.3 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 CCV

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

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	
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
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	Vaccumm 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 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
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,	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 CEP1st,CEP2nd and LCT
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
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
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
PA.	Main cooling water system
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
PC.	Cooling water system of non-essential loads
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
PE.	Cooling water system of essential loads
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
PU.	System of common plants
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
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
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

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
+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 x16.00 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. 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

SYSTEM DESCRIPTION TURBINE GENERATOR & SECONDARY CYCLE SYSTEMS:

FEED WATER SYSTEMS: (LA)
STEAM SUPPLY SYSTEMS: (LB)
CONDENSATE SYSTEMS: (LC)
CONDENSATE POLISHING SYSTEMS (LD)
TURBINE SYSTEMS (MA)
GENERATOR SYSTEM (MK)
COOLING WATER PLANT (PA/PG)
GAS SYSTEMS & EXHAUST SYSTEMS (QJ/SC/O)
SECONDARY AUTOMATED CHEMICAL MONITORING SYSTEM (QU)
OIL SYSTEMS

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.

1. 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 250oC. 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 LBK 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.

2. 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.

3. 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.

4. 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 x 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 edgeways 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 m^3/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/cm^2. 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 20 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.

5. 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 be 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 I2R 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 □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 Iron 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.

6. 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 fed 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.

7. 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.

8. 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.

9. 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.

ANNEXURE – V

Pipe sizes of Free issue materials

Sl.no.	Size of pipe in OD (mm)	Size of pipe in Inch for inch-dia and inch-m calculation
1	10	0.5
2	12	0.5
3	14	0.5
4	16	0.5
5	18	0.5
6	20	0.75
7	25	0.75
8	28	0.75
9	30	1
10	32	1
11	34	1
12	38	1.25
13	40	1.25
14	45	1.5
15	55	2
16	56	2
17	57	2
18	76	2.5
19	89	3
20	108	4
21	133	5
22	159	6
23	219	8
24	220	8
25	273	10
26	325	12
27	377	14
28	426	16
29	465	18
30	530	20
31	630	24
32	720	28
33	820	32
34	920	36
35	1020	40
36	1140	44
37	1220	48
38	1420	56
39	1848	72
40	2060	80
41	2220	88
42	2420	96

न्यूक्लियर पावर कॉर्पोरेशन ऑफ इंडिया लिमिटेड

(भारत सरकार का उद्यम)

NUCLEAR POWER CORPORATION OF INDIA LTD.

(A Government of India Enterprise)

गुणवत्ता आश्वासन निदेशालय

Directorate of Quality Assurance

नाभिकीय ऊर्जा भवन, अणुशक्तिनगर, मुंबई-400 094

Nabhikiya Urja Bhavan, Anushaktinagar, Mumbai - 400 094.

Corporate Identification No. U40104MH1987GOI149458

आर.के. गुप्ता R.K. Gupta
अधिशासी निदेशक (गु.आ.) Executive Director (QA)

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सं.No. एनपीसीआईएलNPCIL/02500/क्यूएडी QAD/एमM/2019/161 दिनांक Date: December 17, 2019

विषय : वेल्डिंग कंज्यूमेबल्स के अनुमोदित ब्रांड की सूची।

Sub: List of approved brands of welding consumables

17/12/2019 की स्थिति में एनपीसीआईएल कार्यों के उपयोग हेतु वेल्डिंग कंज्यूमेबल्स के अनुमोदित ब्रांडों की सूची इसके साथ संलग्न है:

The lists of approved brands of welding consumables for use on NPCIL jobs as on 17/12/2019 are enclosed herewith.

1) अनुमोदित कार्बन स्टील एवं निम्न एलॉय स्टील वेल्डिंग इलेक्ट्रोड्स की सूची (2 शीट)
   List of Approved Carbon Steel & Low Alloy Steel Welding Electrodes (2 Sheets).
2) अनुमोदित स्टेनलेस स्टील एवं अन्य निकिल एलॉय इलेक्ट्रोड्स की सूची (2 शीट)
   List of Approved Stainless Steel & other Ni Alloy Electrodes (2 Sheets).
3) वायर के अनुमोदित ब्रांड एवं वायर फ्लक्स संयोजन की सूची (1 शीट)
   List of Approved Brands of Wire and Wire Flux Combination (1 Sheet).

वेल्डिंग कंज्यूमेबल्स (क्यूएडी/प्रापण/वेल्डिंग कंज्यूमेबल्स/002 संशो.: 2) के अनुमोदन के लिए प्रक्रिया में एवं एएसएमई खंड II भाग C के अद्यतन संस्करण में निर्धारित आवश्यकताओं के अनुसार अनुमोदन प्रदान किया जाता है। तथापि, विशेष मामलों में जहाँ कहीं भी बैच क्वालिफिकेशन अपेक्षित होगा, अलग से निष्पादित किया जाएगा।

The approvals are granted in conformance to the requirements stipulated in Procedure for approval of Welding Consumables (QAD/Proc/Welding Consumables/002 Rev:2) and latest edition of ASME Section II Part C. However, batch qualification wherever called for in specific cases, will have to be carried out separately.

राकेश कुमार गुप्ता
(आर.के. गुप्ता R.K. Gupta) 17.12.19
अधिशासी निदेशक (गु.आ.) Executive Director (QA)

न्यूक्लियर पावर कॉर्पोरेशन ऑफ इंडिया लिमिटेड
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Nabhikiya Urja Bhavan, Anushaktinagar, Mumbai - 400 094.

1) LIST OF APPROVED CARBON STEEL & LOW ALLOY STEEL WELDING ELECTRODES

(2 pages)

As on 17-12-2019

Sr. No.	Manufacturers	Brand name	AWS No.	Valid up to
1.	ADOR WELDING LTD., SILVASSA	SUPABASE X PLUS	E7018	FEB2024
2.	ADOR WELDING LTD., SILVASSA	MOLYTEN	E7018-A1	APR2020
3.	ADOR WELDING LTD., SILVASSA	CHROMOTEN	E8018 B2	APR2020
4.	ADOR WELDING LTD., SILVASSA	CHROMOTEN-C	E9018 B3	APR2020
5.	ADOR WELDING LTD., SILVASSA	TENALLOY Z PLUS	E7018-1	JUN2022
6.	D&H INDIA LTD., INDORE	SUPER -CR-1	E8018 B2	DEC2020
7.	D&H INDIA LTD., INDORE	SUPER -CR-2	E9018 B3	DEC2020
8.	D&H INDIA LTD., INDORE	SUPER –LH (SPL)	E7018-1 (DCEP Only)	FEB2021
9.	D&H INDIA LTD., INDORE	STANDARD	E6013	FEB2021
10.	D&H INDIA LTD., INDORE	SUPER LH	E7018 (DCEP Only)	FEB2021
11.	D&H SECHERON, INDORE	MEDIO	E6013	JUN2020
12.	D&H SECHERON, INDORE	EXOBEL	E6013	JUN2020
13.	D&H SECHERON, INDORE	SUPERTHERME	E7018	JUN2020
14.	D&H SECHERON, INDORE	MOLYTHERME	E7018-A1	JUN2022
15.	D&H SECHERON, INDORE	SUPERTHERME(SPL)	E7018-1	NOV2023
16.	HONAVAR ELECTRODES, THANE	REGULAR S	E6013	JAN2020
17.	HONAVAR ELECTRODES, THANE	ULTIMATE - 18	E7018	JAN2020
18.	HONAVAR ELECTRODES, THANE	ULTIMATE – 18 SPL	E7018-1	JAN2020
19.	MAILAM INDIA LTD., PUDUCHERRY	MAILARC -13R	E6013	SEP2020
20.	MAILAM INDIA LTD., PUDUCHERRY	MAILARC -18	E7018	SEP2020
21.	MAILAM INDIA LTD., PUDUCHERRY	MAILARC -18 PLUS	E7018-1	SEP2020
22.	MAILAM INDIA LTD., PUDUCHERRY	MAILARC -1 CR	E8018-B2	JUN2024
23.	MAILAM INDIA LTD., PUDUCHERRY	MAILARC -2 CR	E9018-B3	JUN2024
24.	RAJ KESARI ELECTRODES, UDAIPUR	SUPERLET 18	E7018	AUG2022
25.	RAJ KESARI ELECTRODES, UDAIPUR	SUPERLET 18 (SPL.)	E7018-1	AUG2022
26.	RAJ KESARI ELECTRODES, UDAIPUR	RAJCORD 13S	E6013	AUG2022
27.	RAJRATNA ELECTRODES, AHEMEDABAD	RATNA 7018 SPL.	E7018-1	MAR2020
28.	RAJRATNA ELECTRODES, AHEMEDABAD	RATNA 7018	E7018	NOV2023
29.	ROYAL ARC ELECTRODES LTD, VASAI	ROYAL THERM SPL.	E7018-1	SEP2021
30.	ROYAL ARC ELECTRODES LTD, VASAI	ROYAL CHROM 1	E8018-B2	FEB2023
31.	ROYAL ARC ELECTRODES LTD, VASAI	ROYAL CHROM 2	E9018-B3	FEB2023
32.	ROYAL ARC ELECTRODES LTD, VASAI	ROYAL THERM MOLY	E7018-A1	MAR2023
33.	ROYAL ARC ELECTRODES LTD, VASAI	ROYAL THERM	E7018	DEC2023
34.	ROYAL ARC ELECTRODES LTD, VASAI	ROYAL S	E6013	DEC2023
35.	SUPERON SCHWEISSTECHNIK INDIA LTD. DELHI	GARANT MO	E7018-A1	SEP2020
36.	SUPERON SCHWEISSTECHNIK INDIA LTD., DELHI	SUPER CROMO 1B	E8018-B2	DEC2020

Sr. No.	Manufacturers	Brand name	AWS No.	Valid up to
37.	SUPERON SCHWEISSTECHNIK INDIA LTD., DELHI	SUPER CROMO 2B	E9018-B3	DEC2020
38.	VIJEY ELECTRODES & WIRES PVT. LTD., CHENNAI	VJ 6013 X	E6013	SEP2020
39.	VIJEY ELECTRODES & WIRES PVT. LTD., CHENNAI	VJ 7018	E7018	SEP2020
40.	VIJEY ELECTRODES & WIRES PVT. LTD., CHENNAI	VJ 7018 - 1	E7018-1	SEP2020
41.	WELD FAST ELECTRODES, NAGPUR	WELDFAST LH 18	E-7018	MAR2020
42.	WELD FAST ELECTRODES, NAGPUR	WELDFAST LH-18-1	E-7018-1	MAR2020
43.	WELD FAST ELECTRODES, NAGPUR	WELDFAST CROMO 0500	E7018-A1	FEB2023
44.	WELD FAST ELECTRODES, NAGPUR	WELDFAST CROMO 1500	E8018-B2	FEB2023
45.	WELD FAST ELECTRODES, NAGPUR	WELDFAST CROMO 2251	E9018-B3	FEB2023

The approvals are granted in conformance to the requirements stipulated in latest edition of ASME Section II Part C. However, batch qualification wherever called for in specific cases, will have to be carried out separately.

17/12/19

(Anoop Singh)
ACE & Head QA (M-6)

Through: Shri A.K. Singh, AD (QA- Opns. & Group-1) 17/12/19 17/12/19

Executive Director (QA) 17.12.'19

न्यूक्लियर पावर कॉर्पोरेशन ऑफ इंडिया लिमिटेड
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2) LIST OF APPROVED STAINLESS STEEL & OTHER NI ALLOY ELECTRODES

(2 Pages)

As on 17-12-2019

Sr. No.	MANUFACTURERS	BRAND NAME	AWS No.	VALID UPTO
1.	ADOR WELDING LTD., SILVASSA	BETANOX-DL	E 309L-16	SEP2020
2.	ADOR WELDING LTD., SILVASSA	SUPERINOX-2C	E 316L-16	SEP2020
3.	ADOR WELDING LTD., SILVASSA	SUPERINOX-1C	E 308L-16	SEP2020
4.	D&H INDIA LTD., INDORE	SV-308L	E 308L-15	DEC2022
5.	D&H INDIA LTD., INDORE	SV-309L	E 309L-15	DEC2022
6.	D&H INDIA LTD., INDORE	CROMALLOY-B	E 308L-16	DEC2022
7.	D&H INDIA LTD., INDORE	CROMALLOY 309L	E 309L-16	DEC2020
8.	ADOR FONTECH, BENGALURU	LH 511	E Ni Cu7	OCT2020
9.	ADOR FONTECH, BENGALURU	LH 521	E Ni Cr Fe 3	OCT2020
10.	D&H SECHERON, INDORE	CRONITHERME 25/12	E 309-16	JUN2022
11.	D&H SECHERON, INDORE	RUTOX-D	E 316L-16	JUN2022
12.	D&H SECHERON, INDORE	BATOX-B	E 308L-15	JUN2020
13.	D&H SECHERON, INDORE	RUTOX-B	E 308L-16	JUN2020
14.	D&H SECHERON, INDORE	D&H 309L	E 309L-16	NOV2023
15.	D&H SECHERON, INDORE	D&H 1250	E NiCu-7	JAN2021
16.	D&H SECHERON, INDORE	D&H 1212NS	E NiCr Fe-3	JAN2021
17.	D&H SECHERON, INDORE	RUTOX-A	E 308-16	NOV2023
18.	D&H SECHERON, INDORE	RUTOX-A St	E 347-16	NOV2023
19.	D&H SECHERON, INDORE	RUTOX-Mo	E 316-16	NOV2023
20.	HONAVAR ELECTRODES, THANE	SILVER SHINE 308L-15	E 308L-15	FEB2024
21.	HONAVAR ELECTRODES, THANE	SILVER SHINE 316L	E 316L-16	FEB2024
22.	RAJRATNA ELECTRODES, AHEMEDABAD	RATNA 308L	E 308L-16	MAR2020
23.	RAJRATNA ELECTRODES, AHEMEDABAD	RATNA 316 L	E 316L-16	MAR2020
24.	MAILAM INDIA LTD., PUDUCHERRY	MAILEX-A	E 308-16	JUN2024
25.	MAILAM INDIA LTD., PUDUCHERRY	MAILEX-AL	E 308L-16	JUN2024
26.	MAILAM INDIA LTD., PUDUCHERRY	MAILEX-AL-15	E 308L-15	JUN2024
27.	MAILAM INDIA LTD., PUDUCHERRY	MAILEX-25/12	E 309-16	JUN2024
28.	MAILAM INDIA LTD., PUDUCHERRY	MAILEX-25/12-L	E 309L-16	JUN2024
29.	MAILAM INDIA LTD., PUDUCHERRY	MAILEX-25/12-Mo	E 309 Mo-16	JUN2024
30.	MAILAM INDIA LTD., PUDUCHERRY	MAILEX Mo	E 316-16	JUN2024
31.	MAILAM INDIA LTD., PUDUCHERRY	MAILEX MoL	E 316L-16	JUN2024
32.	ROYAL ARC ELECTRODES, VASAI,	ROYAL 1C	E 308L-16	OCT2024
33.	ROYAL ARC ELECTRODES, VASAI,	ROYAL 2C	E 316L-16	OCT2024

Sr. No.	MANUFACTURERS	BRAND NAME	AWS No.	VALID UPTO
34.	ROYAL ARC ELECTRODES, VASAI,	ROYAL-D2L	E 309L-16	OCT2024
35.	WELD FAST ELECTRODES, NAGPUR	WELDFAST 308L	E 308L-16	JAN2021
36.	WELD FAST ELECTRODES, NAGPUR	WELDFAST 316L	E 316L-16	JAN2021
37.	WELD FAST ELECTRODES, NAGPUR	WELDFAST 309L	E 309L-16	JAN2021
38.	WELD FAST ELECTRODES, NAGPUR	WELDFAST 309MoL	E 309LMo-16	JAN2021

The approvals are granted in conformance to the requirements stipulated in latest edition of ASME Section II Part C. However, batch qualification wherever called for in specific cases, will have to be carried out separately.

17/12/19

(Anoop Singh)
ACE & Head QA (M-6)

Through: Shri A.K. Singh, AD (QA- Opns. & Group-1) 17/12/19 17/12/19

Executive Director (QA) 17.12.19

न्यूक्लियर पावर कॉर्पोरेशन ऑफ इंडिया लिमिटेड
(भारत सरकार का उद्यम)
NUCLEAR POWER CORPORATION OF INDIA LTD.
(A Government of India Enterprise)
गुणवत्ता आश्वासन निदेशालय
Directorate of Quality Assurance
नाभिकीय ऊर्जा भवन, अणुशक्तिनगर, मुंबई-400 094
Nabhikiya Urja Bhavan, Anushaktinagar, Mumbai - 400 094.

3) LIST OF APPROVED BRANDS OF WIRE AND WIRE FLUX COMBINATION

(1 Page)

As on 17-12-2019

Sr. No.	MANUFACTURERS	BRAND NAME	AWS No.	VALID UPTO
1.	ADOR FONTECH, BENGALURU	TIG 120	ER 308L	OCT2024
2.	ADOR FONTECH, BENGALURU	TIG 121	ER 316L	OCT2024
3.	ADOR FONTECH, BENGALURU	TIG 123	ER 309L	OCT2024
4.	ADOR FONTECH, BENGALURU	TIG 120S	ER 347	OCT2024
5.	ADOR FONTECH, BENGALURU	TIG 521	ER NiCr3	OCT2024
6.	ADOR WELDING LTD., SILVASSA	TIGFIL 70S-2	ER 70S-2	FEB2022
7.	ADOR WELDING LTD., SILVASSA	TIGINOX-308L	ER 308L	SEP2020
8.	ADOR WELDING LTD., SILVASSA	TIGINOX-309L	ER309L	SEP2020
9.	ADOR WELDING LTD., SILVASSA	AUTOMIG 70-S6	ER 70S-6	DEC2023
10.	ADOR WELDING LTD., SILVASSA	AUTOMELT-B71 AUTOMELT-EH 14 WIRE	F7A2-EH14	FEB2024
11.	D&H INDIA LTD., INDORE	SUPER TIG 308L	ER 308L	DEC2020
12.	D&H INDIA LTD., INDORE	SUPER TIG 309L	ER 309L	DEC2020
13.	D&H SECHERON, INDORE	FILLER WIRE FW 308L	ER 308L	FEB2021
14.	D&H SECHERON, INDORE	FILLER WIRE FW 309L	ER 309L	FEB2021
15.	D&H SECHERON, INDORE	F 70 S2	ER 70S-2	JUN2022
16.	RAJRATNA ELECTRODES, AHEMEDABAD	RAAJTIG ER 308L	ER 308L	MAR2020
17.	RAJRATNA ELECTRODES, AHEMEDABAD	RAAJTIG ER 316L	ER 316L	MAR2020
18.	VENUS WIRES, KHOPOLI	VENUS 308L	ER 308L	SEP2021
19.	VENUS WIRES, KHOPOLI	VENUS 316L	ER 309L	SEP2021
20.	VENUS WIRES, KHOPOLI	VENUS 309L	ER 316L	SEP2021
21.	VENUS WIRES, KHOPOLI	VENUS 347	ER 347	SEP2021
22.	WELD FAST ELECTRODES, NAGPUR	TIG FAST-3	ER 70S-2	JAN2021
23.	WELD FAST ELECTRODES, NAGPUR	MIG FAST-1	ER 70S-6	JAN2021

The approvals are granted in conformance to the requirements stipulated in latest edition of ASME Section II Part C. However, batch qualification wherever called for in specific cases, will have to be carried out separately.

17/12/19

(Anoop Singh)
ACE & Head QA (M-6)

Through: Shri A.K. Singh, AD (QA- Opns. & Group-1) 17/12/19 17/12/19

Executive Director (QA) 17.12.19

न्यूक्लियर पावर कॉर्पोरेशन ऑफ इंडिया लिमिटेड

(भारत सरकार का उद्यम)

NUCLEAR POWER CORPORATION OF INDIA LTD.

(A Government of India Enterprise)

गुणवत्ता आश्वासन निदेशालय

Directorate of Quality Assurance

नाभिकीय ऊर्जा भवन, अणुशक्तिनगर, मुंबई-400 094

Nabhikiya Urja Bhavan, Anushaktinagar, Mumbai - 400 094.

Corporate Identification No. U40104MH1987GOI149458

आर.के. गुप्ता R.K. Gupta
अधिशासी निदेशक (गु.आ.) Executive Director (QA)

Phone: 022- 25995030/25558487
Fax.No.: 022-25565354
e-mail: rk_gupta@npcil.co.in

सं. No. एनपीसीआईएलNPCIL/02500/क्यूएडीQAD/ईडीED(क्यूएQA)/एमM/2019/160 December 17, 2019

विषय : वेधी पदार्थों के अनुमोदित ब्रांड की सूची।

Sub: List of approved brands of penetrant materials

17-12-2019 की स्थिति में एनपीसीआईएल के उपयोग हेतु वेधी पदार्थों के अनुमोदित ब्रांड की सूची इसके साथ संलग्न है। यह अनुमोदन हमारी प्रक्रिया संख्या QAD/NDT-PROC-PT-05 (तरल वेधी परीक्षण के लिए उपयोग में आने वाले रसायन परिवार के अनुमोदन हेतु प्रक्रिया) कें अुनसार आवश्यकताओं के अनुरूप प्रदान किया जाता है।

The list of approved brands of penetrant materials for use on NPCIL jobs as on 17-12-2019 is enclosed herewith. The approvals are granted in conformance to the requirements as per our procedure no. QAD/NDT-PROC-PT-05 (Procedure for approval of Family of Chemicals used for Liquid Penetrant Examination).

राकेश कुमार गुप्ता 17.12.19

(आर.के. गुप्ता R. K. Gupta)
अधिशासी निदेशक (गु.आ.) Executive Director (QA)

न्यूक्लियर पावर कॉर्पोरेशन ऑफ इंडिया लिमिटेड
(भारत सरकार का उद्यम)
NUCLEAR POWER CORPORATION OF INDIA LTD.
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गुणवत्ता आश्वासन निदेशालय
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Nabhikiya Urja Bhavan, Anushaktinagar, Mumbai - 400 094.

LIST OF APPROVED PENETRANT TESTING MATERIAL

(As on 17-12-2019)

Sr. No.	Manufacturers	Brand name	Description	Valid up to
1.	DYEGLO PVT. LTD, PUNE	RP-81	Red Coloured Solvent Removable Penetrant	DEC2023
2.	DYEGLO PVT. LTD, PUNE	RP-90	Red Coloured Water Washable Penetrant	DEC2023
3.	DYEGLO PVT. LTD, PUNE	CL-01	Solvent Cleaner	DEC2023
4.	DYEGLO PVT. LTD, PUNE	RD-01	Solvent Base Developer suitable for RP-81 & RP-90	DEC2023
5.	DYEGLO PVT. LTD, PUNE	FP-01	Fluorescent Solvent Removable Penetrant	DEC2023
6.	DYEGLO PVT. LTD, PUNE	WD-01	Solvent Base Developer suitable for FP-01.	DEC2023
7.	FERROCHEM NDT SYSTEM PVT. LTD. PUNE	FC-911, FC-811 FC-711	Solvent Removable (Visible)	FEB2022
8.	FERROCHEM NDT SYSTEM PVT. LTD. PUNE	FC-931, FC-811	Water Washable (Visible)	FEB2022
9.	FERROCHEM NDT SYSTEM PVT. LTD. PUNE	FC-941, FC-821	Water washable (Fluorescent)	FEB2022
10.	FERROCHEM NDT SYSTEM PVT. LTD. PUNE	FC-921, FC-821, FC-721	Solvent removable (Fluorescent)	FEB2022
11.	MAGNAFLUX ITW INDIA PVT.LTD.SECUNDERABAD	SKL-SP 1	Red Coloured Solvent Removable Penetrant	JUL2024
12.	MAGNAFLUX ITW INDIA PVT.LTD.SECUNDERABAD	SKC-1	Solvent Cleaner	JUL2024
13.	MAGNAFLUX ITW INDIA PVT.LTD.SECUNDERABAD	SKD-S2	Solvent Base Developer	JUL2024
14.	MAGNAFLUX ITW INDIA PVT.LTD.SECUNDERABAD	SKL-WP2	Red Coloured Water Washable Penetrant	JUL2024
15.	MAGNAFLUX ITW INDIA PVT.LTD.SECUNDERABAD	SKL-SP2	Red Coloured Solvent Removable Penetrant.	JUL2024
16.	MR CHEMIE INDIA PVT. LTD., HYDERABAD.	MR(R) 62	Solvent Removable Penetrant–Red	JAN2021
17.	MR CHEMIE INDIA PVT. LTD., HYDERABAD.	MR(R) 68 NF	Solvent Removable and Water Washable Penetrant–Red	JAN2021
18.	MR CHEMIE INDIA PVT. LTD., HYDERABAD.	MR(R) 67	Solvent Removable and Water Washable Penetrant–Red	JAN2021
19.	MR CHEMIE INDIA PVT. LTD., HYDERABAD.	MR(R) 672 F	Solvent Removable and Water Washable Penetrant–Fluorescent	JAN2021
20.	MR CHEMIE INDIA PVT. LTD., HYDERABAD.	MR(R) 85	Solvent Remover suitable for MR(R) 68NF, MR(R) 67, MR(R) 672F and MR(R) 62.	JAN2021
21.	MR CHEMIE INDIA PVT. LTD., HYDERABAD.	MR(R) 70	Non-Aqueous Developer suitable for MR(R) 68 NF, MR(R) 67 and MR(R) 672F	JAN2021

Sr. No.	Manufacturers	Brand name	Description	Valid up to
22.	MR CHEMIE INDIA PVT. LTD., HYDERABAD.	MR(R) 70 I	Non-Aqueous Developer suitable for MR(R) 62.	JAN2021
23.	P-MET HIGH TECH CO. PVT. LTD., VADODARA	PP-15/PP-15B	Red Coloured Solvent Removable Penetrant	SEPT2021
24.	P-MET HIGH TECH CO. PVT. LTD., VADODARA	PP-19/PP-19B	Red Coloured Water Washable Penetrant	SEPT2021
25.	P-MET HIGH TECH CO. PVT. LTD., VADODARA	PC-21/PC-21B	Solvent Cleaner	SEPT2021
26.	P-MET HIGH TECH CO. PVT. LTD., VADODARA	PD-31/PD-31B	Solvent Base Developer	SEPT2021
27.	P-MET HIGH TECH CO. PVT. LTD., VADODARA	PP-110/ PP110B	Red Coloured Solvent Removable Penetrant	SEPT2021
28.	P-MET HIGH TECH CO. PVT. LTD., VADODARA	PC 120/ PC-120B	Solvent Cleaner	SEPT2021
29.	P-MET HIGH TECH CO. PVT. LTD., VADODARA	PD 130 /PD-130B	Solvent Base Developer	SEPT2021
30.	P-MET HIGH TECH CO. PVT. LTD., VADODARA	FPS46/FPS46B	Solvent Removable Fluorescent Penetrant	SEPT2021
31.	P-MET HIGH TECH CO. PVT. LTD., VADODARA	FPS49/FPS49B	Water Washable Fluorescent Penetrant	SEPT2021
32.	PRADEEP METAL TREATMENT CHEMICALS PVT. LTD., THANE	Flaw Guide Penetrant (NP Grade)	Red Coloured Solvent Removable Penetrant.	OCT2024
33.	PRADEEP METAL TREATMENT CHEMICALS PVT. LTD., THANE	Flaw Guide Cleaner (NP Grade)	Solvent Cleaner	OCT2024
34.	PRADEEP METAL TREATMENT CHEMICALS PVT. LTD., THANE	Flaw Guide Developer (NP Grade)	Solvent Base Developer	OCT2024
35.	PRADEEP METAL TREATMENT CHEMICALS PVT. LTD., THANE	Flaw Guide Red Dye Penetrant-W	Water Washable Dye Penetrant	OCT2024

Note:-

1. Halogen content in Penetrant, Cleaner and Developer is 25ppm (max) and Sulphur content is 500ppm (max). However when using penetrant materials for Austenitic Stainless Steel, Titanium, Nickel base or other high temperature alloys, Halogen and Sulphur content shall not exceed 25ppm. Manufacture has to mention for each batch, the Sulphur and Halogen content in the label of each container for selection of Penetrant materials for the stated application.
2. Developer is to be used in Aerosol can to get the best results.

17/12/19

(Anoop Singh)
ACE & Head QA (M-6)

Through: Shri A.K. Singh, AD (QA- Opns. & Group-1) 17/12/19 17/12/19

Executive Director (QA) 17.12.19

Sr. No.	QA unit	Test Lab.	Suitable for material testing		
			Physical	Chemical	Micro
1	Noida	M/s R.K. Inspection & Testing Services C-42, Manak Vihar Ext.(Tihar), Subhash Nagar, New Delhi-110018. Phone no. 011 -28122201 Fax No. 011-25122517 E mail-info@rkits.co.in	**1. 0 Physical Testing** 1.1 Tensile testing at room temp. with extensometer 1.2 Impact testing as per ASTM E-23 standard 1.3 Hardness test (Brinell, Vickess, Rockwell, Microhardness up to 1000 grams) 1.4 Bend test, Flattening, Flaring,Proof load, Pull out load, Fillet test.	**2.0 Chemical Testing -** *2.1 Spectrometer analysis	**3.0 Corrosion Test & Micro Examination** 3.1 IGC practice A &E, Micro, Macro, Inclusion rating, Case depth measurement.
2	Noida	M/s SPECTRO E-41, Okhla Indl. Area, Phase-II, New Delhi-110020 Phone no. 011 -40522000 Fax No. 011-40503150 E mail-kd@spectro.in	**1. 0 Physical Testing** 1.1 Tensile testing at room temp. 1.2 Tensile testing at elevated temp. subject to availability of extensometer for 0.2% yield stress measurement. 1.3 Impact testing testing as per ASTM E-23 standard 1.4 Hardness test (Brinell, Vickess, Rockwell, Microhardness up to 1000 grams) 1.5 Bend test, Flattening, Flaring, Proof load, Pull out load, Fillet test.	**2.0 Chemical Testing** 2.1 Wet Analysis 2.2 Spectrometer analysis	**3.0 Corrosion Test & Micro Examination** 3.1 IGC practice A &E, Micro, Macro, Inclusion rating, Case depth measurement. 3.2 Mass of zinc coating 3.3 Paint thickness mesurement

3	Noida	M/s IRC Engg. Services.India (P) Ltd. A-53,Sector-63, Noida, District : G.B.Nagar Phone no. 0120 -3352706 Fax No. 0120-4227940 E mail-	**1. 0 Physical Testing** *****1.1 Tensile testing at room & elevated temp subject to availability of extensometer for 0.2% yield stress measurement. 1.2 Impact testing as per ASTM-E-23 standard 1.3 Hardness test (Brinell, Vickess, Rockwell, Microhardness up to 1000 grams) 1.4 Bend test, Flattening, Flaring, Proof load, Creep test, Stress rupture test, Pull out load, Fillet test.	**2.0 Chemical Testing -** ** 2.1 Spectrometer analysis	**3.0 Corrosion Test & Micro Examination** 3.1 IGC practice A &E, Micro, Macro, Inclusion rating, Case depth measurement.
4	Noida	M/s Inspection & Testing Engg., D-155,Sector-49. Noida, District :G.B.Nagar (UP), Pin-201 307 Phone no. 0120 -2500065 Fax No. 0120-4310675 E mail-	**1. 0 Physical Testing** 1.1 Hardness test (Brinell, Vickess, Rockwell, Microhardness up to 1000 grams) 1.2 Bend test, Flattening	**2.0 Chemical Testing** * 2.1 Spectrometer analysis	**3.0 Corrosion Test & Micro Examination** - Nil

5	Kolkata	M/s Metals& Minerals Testing Laboratories 30/A, Naraasingha Dutta Road, Howrah-711101 Kolkata-26 Phone no. 033 26673185 Fax No. 033 26779422 E mail-	**1. 0 Physical Testing** 1.1 Tensile testing at room temp with extensometer. 1.2 Hardness test (Brinell, Vickess, Rockwell, Microhardness) 1.3 Bend test, Flattening, Flaring, Proof load, Pull out load, Butt & Fillet test.	**2.0 Chemical Testing** * 2.1 Spectrometer analysis	**3.0 Corrosion Test & Micro Examination** 3.1 IGC practice A , Micro, Macro, Inclusion rating, Case depth measurement. 3.2 Mass of zinc coating 3.3 Paint thickness measurement
6	Kolkata	M/s Aglow Quality Control Laboratories Pvt.Ltd. P 47,Kasba Industrial Estate,Kolkatta-107 Phone no. 033 40089633 Fax No. 033 40625177 E mail-	**1.0 Physical Testing** 1.1 For Rubber Testing : Tensile, Hardness, elongation, adhesion, Tension & compression, abrasion, flexing, load deflection, hydro testing, aging.	**2.0 Chemical Testing** 2.1 For Rubber Testing: Rubber polymer content, hydrocarbon Content, neoprene rubber, identification of rubber, resistance to oil, density, analysis of ash. 2.2 Painting related tests(Abrasion, cohesion , adhesion , impact resistance, % elongation, etc.)	**3.0 Corrosion Test & Micro Examination** 3.1 Not Application

7	Kolkata	M/s ID & RL Pvt. Ltd. 33/2A,atish Mukherjee Road, Kolkatta-26 Phone no. 033 24644527 Fax No. 033 24644812 E mail-	**1. 0 Physical Testing** 1.1 Tensile testing at room temp with extensometer. 1.2 Hardness test (Brinell, Vickess, Rockwell, Microhardness up to 1000 grams) 1.3 Bend test, Flattening, Flaring, Proof load, Pull out load, Butt & Fillet test.	**2.0 Chemical Testing** 2.1 Wet Analysis * 2.2 Spectrometer analysis	**3.0 Corrosion Test & Micro Examination** 3.1 IGC practice A &E, Micro, Macro, Inclusion rating, Case depth measurement. 3.2 Mass of zinc coating 3.3 Paint thickness measurement
8	Kolkata	M/s Inspection Survey & Surveillance (India) Pvt. Ltd. 26D/27,Park Lane, Kolkatta-16 Phone no. 033 65454984 Fax No. 033 22297658 E mail- insurveylab@yahoo.com	**1.0 Physical Testing** 1.1 Tensile testing at room temp with extensometer. 1.2 Hardness test (Brinell, Vickess, Rockwell, Microhardness up to 1000 grams) 1.3 Bend test, Flattening, Flaring, Proof load, Pull out load, Butt weld Fillet test.,	**2.0 Chemical Testing** * 2.1 Spectrometer analysis	**3.0 Corrosion Test & Micro Examination** 3.1 IGC practice A &E, Micro, Macro, Inclusion rating, Case depth measurement. 3.2 Mass of zinc coating 3.3 Paint thickness measurement
9	Kolkata	M/s TREATS, 14,Ramnath Pal Road, Kidderpore Kolkata-23 Phone no. 033 24584142 Fax No. 033 2495818 E mail-	**1.0 Physical Testing** 1.1 Tensile testing at room temp with extensometer. 1.2 Hardness test (Brinell, Rockwell, Microhardness up to 1000 grams)	**2.0 Chemical Testing** 2.1 Wet analysis * 2.2 Spectrometer analysis.	**3.0 Corrosion Test & Micro Examination** 3.1 IGC practice A &E, Micro, Macro, Inclusion rating, Case depth measurement.

			1.3 Bend test, Flattening, Flaring, Proof load, Pull out load, Butt weld Fillet test.		3.2 Mass of zinc coating 3.3 Paint thickness measurement
10	Mumbai	M/s. TCR Engg. Services Pvt.Ltd., EL-182,TTC Ind.Area,Mahape, Vashi, Navi-Mumbai - 400 705, (India). Phone no- 27610921/22/23 Fax no.- 2761 2044 Email- sales@tcreng.com	**1.0 Physical Testing** 1.1 Tensile testing at room temp with extensometer. 1.2 Impact test as per ASTM E-23 Standard. 1.3 Hardness test (Brinell, Vickess, Rockwell, Microhardness upto 1000 grams. 1.4 Bend test, Flattening, Flaring, Proof load, Pull out load, Butt weld ,Fillet test, Reverse bend test	**2.0 Chemical Testing** 2.1 Wet analysis * 2.2 Spectrometer analysis	**3.0 Corrosion Test & Micro Examination** 3.1 IGC practice A &E, Micro, Macro, Inclusion rating, Case depth Measurement, ferrite content measurement 3.2 Mass of zinc coating
11	Mumbai	M/s. Subodh Technologiests R-874, M.I.D.C.,Rabale , Navi Mumbai - 400 701. Phone no- 27690817 Fax no.- 27690817 Email- sudhakar@subodhlabs.com	**1.0 Physical Testing** 1.1 Tensile testing at room temp with extensometer. 1.2 Hardness test (Brinell, Vickess, Rockwell, Microhardness up to 1000 grams 1.3 Bend test, Flattening, Flaring, Proof load, Pull out load, Butt weld Fillet test.	**2.0 Chemical Testing** * 2.1 Spectrometer analysis	**3.0 Corrosion Test & Micro Examination** 3.1 IGC practice A &E, Micro, Macro, Inclusion rating, 3.2 Mass of zinc coating
12	Mumbai	M/s Geo Chem Laboratories Pvt Ltd., (Mumbai) 36, Raja Industrial Estate, Purushottam Kheraj Marg, Mulund (W), Mumbai 400 080. Phone no- 67974999 Fax no.- 67974616 Email-	**1.0 Physical Testing** 1.1 Tensile testing at room temp with extensometer. 1.2 Hardness test (Brinell, Vickess, Rockwell) 1.3 Bend Test, Flattening, Flarring,	**2.0 Chemical Testing** 2.1 Wet analysis * 2.2 Spectrometer analysis	**3.0 Corrosion Test & Micro Examination** 3.1 IGC practice A &E, Case depth Measurement, Micro, Macro 3.2 Mass of zinc coating

		laboratory@geochemgroup.com	Proof Load for nuts		
13	Mumbai	M/s. Jewel Metallochem Laboratory Pvt. Ltd., A-12, Ghatkopar Indl. Estate, Ghatkopar (W), Mumbai 400 086. Phone no. 25007745 Fax No. 25001263 E mail- info@jewelmetallochem.com jewelmetal@rediffmail.com www.jewelmetallochem.com	**1.0 Physical Testing** 1.1 Tensile testing at room temp with extensometer. 1.2 Impact test as per ASTM E-23 Standard. 1.3 Hardness test (Brinell, Vickers, Rockwell, Microhardness 50 to 1000 grams. 1.4 Bend test, Flattening, Flaring, Proof load, Pull out load, Butt weld Fillet test, Reverse bend test	**2.0 Chemical Testing** 2.1 Wet analysis * 2.2 Spectrometer analysis	**3.0 Corrosion Test & Micro Examination** 3.1 IGC practice A &E, Micro, Macro, Inclusion rating, Case depth measurement. 3.2 Mass of zinc coating
14	Mumbai	M/s. Metallurgical Services, Mehta House, Ashok Silk Mills Lane, L.B.S. Marg, Ghatkopar (W), Mumbai 400 086. Phone no. 25000240 Fax No. 25001740 E mail- info@metallurgicallab.com metallurgicalservices@gmail.com www.metallurgicallab.com	**1.0 Physical Testing** 1.1 Tensile testing at room & elevated temp with extensometer. 1.2 Impact test as per ASTM E-23 Standard. 1.3 Hardness test (Brinell, Vickess, Rockwell, Microhardness 50 to 1000 gm 1.4 Bend test, Flattening, Flaring, Proof load, Pull out load, Butt weld Fillet test, Creep test, Fracture toughness and stress rupture test, Reverse bend test , Fatigue test	**2.0 Chemical Testing** 2.1 Wet analysis * 2.2 Spectrometer analysis	**3.0 Corrosion Test & Micro Examination** 3.1 IGC practice A &E, Micro, Macro, Inclusion rating, Case depth measurement, ferrite content measurement 3.2 Mass of zinc coating

15-A	Mumbai	M/s Elca Laboratories Plot No.A-444, Road No.37, (Off Road No.28) Near Rubber Products, Wagle Estate, Thane – 400 094. Phone no. 25824499 Fax No. 25825394 E mail-info@elcalabs.com www.elcalabs.com	**1.0 Physical Testing** 1.1 Tensile testing at room temp with extensometer. 1.2 Hardness test (Brinell, Vickess, Rockwell, Microhardness 50 to 1000 grams. 1.3 Bend test, Flattening, Flaring, Proof load for nuts, Pull out load, Fillet test.	**2.0 Chemical Testing** 2.1 Wet analysis * 2.2 Spectrometer analysis	**3.0 Corrosion Test & Micro Examination** 3.1 IGC practice A & E, Micro, Macro 3.2 Mass of zinc coating
15-B	Mumbai	Elca Laboratories, Unit-II, W-361, TTC Industrial Area, MIDC, Rabale, Navi Mumbi-400701 25824499 25822047 25823142 25833410 Fax No. 25825394 E mail-rabale@elcalabs.com	**1.0 Physical Testing** 1.1 Tensile testing at room temp with extensometer 1.2 Impact testing 1.3 Hardness test (Brinell, Vickess, Rockwell, Microhardness. 1.4 Bend test, Flattening, Flaring, Proof load for nuts, Pull out load, Fillet test.	**2.0 Chemical Testing** 2.1 Spectrometer analysis	**3.0 Corrosion Test & Micro Examination** 3.1 IGC practice A
16	Mumbai	M/s Metal Analysis & Services Pvt.Ltd., 219, Bussa Udyog Bhavan, Tokersey Jivraj Road, Sewree (W), Mumbai 400 015. Phone no. 24131160 Fax No. 66624514 E mail-hmj@bom7.vsnl.net.in	1**.0 Physical Testing** 1.1 Tensile testing at room temp with extensometer. 1.2 Hardness test (Brinell, Vickess, Rockwell, Microhardness upto 1000 grams. 1.3 Bend test, Flattening, Flaring, Proof load, Pull out load, Butt weld Fillet test, Reverse bend test	**2.0 Chemical Testing** 2.1 Wet analysis * 2.2 Spectrometer analysis	**3.0 Corrosion Test & Micro Examination** 3.1 IGC practice A &E, Micro, Macro 3.2 Mass of zinc coating
17	Mumbai	M/s Offshore Testing &	**1.0 Physical Testing**	**2.0 Chemical Testing**	**3.0 Corrosion Test & Micro**

		Inspection Services (India) Pvt .Ltd., W-147, M.I.D.C., Pawane, Thane Belapur Road, Navi-Mumbai 400 710. Tel. 022 4144414 /15/16/17 Fax : 022 27633982 /25560401	1.1 Tensile testing at room temp with extensometer. 1.2 Impact test as per ASTM E-23 Standard. 1.3 Hardness test (Brinell, Vickess, Rockwell) 1.4 Bend test, Flattening, Flaring, Proof load, Pull out load, Butt weld Fillet test	2.1 Wet analysis * 2.2 Spectrometer analysis	**Examination** 3.1 IGC practice A & E
18	Mumbai	M/s Reliable Testing Services, Unit Number 59, 2nd floor, Bindal Industrial Estate,Kurla Andheri Road, Sakinaka, Mumbai 400 072. Phone no. 28516406 Fax No. 42154942 E mail-reliable1983@rediffmail.com www.reliabletestingservices.com	**1.0 Physical Testing** 1.1 Tensile testing at room temp with extensometer.	**2.0 Chemical Testing** 2.1 Spectrometer analysis	**3.0 Corrosion Test & Micro Examination** 3.1 Mass of zinc coating 3.2 IGC practice A &E

19	Mumbai	M/s. Soham Analytical Services, A-121/101, B33/35, Amargian Industrial Estate, Pokhran Road No.1, Khopoli, Thane (W), Maharashtra. Tel. 022-25471297/93/94 Fax : 022 25471295 Email : lab_support@sohmanalytical.com	**1.0 Physical Testing** 1.1 Tensile testing at room temp with extensometer. 1.2 Impact test as per ASTM E-23 Standard. 1.3 Hardness test (Brinell, Vickess, Rockwell, Microhardness 1.4 Bend test, Flattening, Flaring, Proof load, Pull out load, Butt weld, Fillet test, Reverse bend test, Through thickness tensile test, Nick break test (pipes), Compression test	**2.0 Chemical Testing** 2.1 Wet analysis 2.2 Spectrometer analysis	**3.0 Corrosion Test & Micro Examination** 3.1 IGC practice A & E, Micro, Macro, Inclusion rating, Case depth Measurement, Ferrite content 3.2 Mass of zinc coating 3.3 Hydrogen Induced corrosion test, Ferrite Chloride pitting & crevice corrosion test
20	Chennai	M/s Chennai Mettex Lab P.Ltd. Jyothi Complex, No.83, M .K.N.Road, Guindy , Chennai – 600 032 Ph. 044-22323163, 42179490/91 Fax :044-43534270 email address test@mettexlab.com	**1. 0 Physical Testing** 1.1 Tensile testing at room temp with and without extensometer. ** 1.2 Impact test as per ASTM E-23 Standard. 1.3 Hardness test (Brinell, Vickess, Rockwell) and Microhardness 1.4 Bend test, Flattening, Flaring, Proof load, Pull out load, Butt weld Fillet test, Reverse bend test 1.5 Tensile testing of rubber material	**2.0 Chemical Testing** * 2.1 Spectrometer analysis 2.2 Polymer identification (rubber)	**3.0 Corrosion Test & Micro Examination** 3.1 Micro, Macro, Inclusion rating, Case depth measurement. 3.2 Mass of zinc coating

21	Chennai	M/s Micro Lab, SP.101, 2 nd Main Road , Ambattur Industrial Estate, Chennai – 600 058 Ph. 044-26242525, Fax :044-26244872 E mail: cre@micrilabchennai.com	**1. 0 Physical Testing** 1.1 Tensile testing at room temp with and without extensometer. 1.2 Tensile testing at elevated temp with and without extensometer. 1.3 Impact test as per ASTM E-23 Standard. 1.4 Hardness test (Brinell, Vickess, Rockwell) and Microhardness 1.5 Bend test, Flattening, Flaring, Proof load, Pull out load, Reverse bend test	**2.0 Chemical Testing** 2.1 Spectrometer analysis (OES)	**3.0 Corrosion Test & Micro Examination** 3.1 IGC practice A &E, Micro, Macro, Inclusion rating, Case depth measurement. 3.2 Mass of zinc coating
22	Chennai	M/s. Commando Lab No. 3A 5th South Street, Avarampalayam, Coimbatore 641 006 Phone : 0422 2560907	**1. 0 Physical Testing** 1.1 Tensile testing at room temp with extensometer as applicable. 1.2 Hardness test (Brinell,, Vickers, Rockwell) 1.3 Bend test, Reverse bend test, Flattening test, Flaring test, Proof load test, Pull out load test.		

23	Bangaluru	M/s Geological and Metallurgical Laboratories (GML) 105X, 3rd Main, 3rd Cross, II Stage, Yeshwanthpur Indl. Suburb, Goraguntepalya, BANGALORE - 560 022 Ph. 2347 1065 , 2347 2020 Fax 2347 1011	**1. 0 Physical Testing** 1.1 Tensile testing at room temp with extensometer. 1.2 Hardness test (Brinell, Vickess, Rockwell, Microhardness upto 1000 grams. 1.3 Bend test, Flattening, Flaring , Proof load, Pull out load, Butt weld Fillet test, Reverse bend test	**2.0 Chemical Testing** 2.1 Wet analysis * 2.2 Spectrometer analysis.	**3.0 Corrosion Test & Micro Examination** 3.1 IGC practice A &E, Micro, Macro, Inclusion rating, Case depth measurement. 3.2 Mass of zinc coating 3.3 Paint thickness measurement
24	Baroda	M/s Met Heat Engineers Pvt. Ltd, Vadodara 857/2,G.I.D.C. Industrial Estate, Makarpura , Vadodara -390 010 Ph. (0265)2643655, 3046493, 6548715-16 Fax email address: info@metheat.com	**1. 0 Physical Testing** 1.1 Tensile testing at room temp with extensometer. 1.2 Impact test as per ASTM E-23 Standard. 1.3 Hardness test (Brinell, Vickess, Rockwell, Microhardness upto 1000 grams. 1.4 Bend test, Flattening, Flaring, Proof load, Pull out load, Butt weld Fillet test, Reverse bend test	**2.0 Chemical Testing** 2.1 Wet analysis * 2.2 Spectrometer analysis	**3.0 Corrosion Test & Micro Examination** 3.1 IGC practice A &E, Micro, Macro, Inclusion rating, Case depth measurement. 3.2 Mass of zinc coating 3.3 Paint thickness measurement

25	Baroda	M/s TCR Advanced Engineering Pvt. Ltd. , 36/2/9, First Floor, Abhishek Complex, GIDC Estate, Makarpura, Vadodara-390 010 Ph. 0265 2657233, 2634375 Fax 0265 2643024 email address	**1. 0 Physical Testing** 1.1 Tensile testing at room temp with extensometer. 1.2 Impact test as per ASTM E-23 Standard. 1.3 Hardness test (Brinell, Vickess, Rockwell, Microhardness upto 1000 grams. 1.4 Bend test, Flattening, Flaring, Proof load, Pull out load, Butt weld Fillet test, Reverse bend test	**2.0 Chemical Testing** 2.1 Wet analysis * 2.2 Spectrometer analysis	**3.0 Corrosion Test & Micro Examination** 3.1 IGC practice A &E, Micro, Macro, Inclusion rating, Case depth measurement. 3.2 Mass of zinc coating 3.3 Paint thickness measurement
26	Pune	M/s Elca Quality Systems & Calibration Pvt.Ltd. S.Np. 232/2, Pune Nasik Road, Bhosari, Pune 411 039. Phone no.-020 27129194, 27125024 e-mail- qc@elcalabs.com	**1. 0 Physical Testing** 1.1 Cold/Hot tensile 1.2 Impact test as per ASTM E-23 Standard. 1.3 Hardness/Bend/Flattening etc.	**2.0 Chemical Testing** 2.1 Spectro 2.2 Wet	**3.0 Corrosion Test & Micro Examination** 3.1 IGC 3.2 Micro/Macro 3.3 Coating thickness etc.
27	Pune	M/s Perfect Laboratory Services, 58,59/13,14/Unit 2 DII Blolck, MIDC, Chinchwad, Pune 411 019. Phone no.-020 27458150, 27454716 e-mail- trust_perfectlab@yahoo.com	**1. 0 Physical Testing** 1.1 Room temperature Tensile testing 1.2 Impact test as per ASTM E-23 Standard. 1.3 Hardness/Bend/Flattening etc.	**2.0 Chemical Testing** 2.1 Spectro 2.2 Wet	**3.0 Corrosion Test & Micro Examination** 3.1 IGC 3.2 Micro/Macro 3.3 Coating thickness etc.

28	Hyderabad	M/s. Jyothi Spectro Analysis (P) Ltd., A-30, APIE, Balanagar, Hyderabad 500 037. Tel. No. 040- 23771193 23771194 23773676 23778042 E-mail : sdsingh@jyothispectro.com	**1.0 Physical Testing :** 1.1 Hardness test (Brinell, Vickers, Rockwell) 1.2 Bend test, Flattening, Flaring, Pull out load, Proof load test and Fillet test.	**2.0 Chemical testing** 2.1 Spectrometer analysis for low carbon, alloy steels, ASS and aluminium bronze.	**3.0 Corrosion Test & Micro Examination** 3.1 IGC Practice A&E, Micro, macro, Inclusion rating. 3.2 Mass of zinc coating.
29	Hyderabad	M/s. Lucid Laboratories (P) Ltd., B-1/A, TIE, Phase II, B alanagar, Hyderabad 500 037. Te. No. 040-23720678 23720680 23720681 23720406 E-mail : info@lucidlabsindia.com lucidlabs@rediffmail.com	**1.0 Physical Testing :** 1.1 Hardness test (Vickers, Rockwell) 1.2 Bend test, Flattening and Fillet test.	**2.0 Chemical testing** 2.1 Spectrometer analysis for low carbon, alloy steels and ASS	**3.0 Corrosion Test & Micro Examination** 3.1 Mass of zinc coating.

Annexure - VII

Technical specification for Grit Blasting & supply and application of Painting

GRIT BLASTING AND PAINTING

1.0 Scope

This specification defines the requirements for Surface preparation, Grit blasting, supply, application of Paint coating on Pipes, Pipe Fittings, Valves, and all their Support structures of piping and equipments.

2.0 Grit Blasting and Primer Application:

Pipelines/equipments and supporting elements should be grit blasted to the surface profile of 35-65 microns or as recommended in paint manufacturers datasheet. Mill scale, rust, rust scale and foreign matter shall be removed fully by blast cleaning and the blasted surface shall be clean and free from any scale or rust and must show a grey white metallic luster.

The blast cleaned surface shall be coated with one complete application of primer of Inorganic Zinc Silicate primer of minimum 75 microns dry film thickness (DFT) as soon as practicable but not later than 4 hrs from completion of grit blasting.

3.0 Low Temperature Application:

Pipelines, supports, structural sections and equipments subjected to temperature less than 50^0C ($\leq 50^0$C) are coated with 2 coats (each coat of 100 microns DFT) of low temperature paints with 200 microns dry film thickness (DFT). The paints are applied after surface cleaning of primer coated surface with soft brush and cloth for removing all deposited dust, oil and grease etc .The finish coat of 50 micron is applied over the first coat.

Paints for Low temperature application (T≤50^{0}C)

Type of coating	Approved Paints	Approved Brand	Application method	Minimum number of Coating	Minimum Dry Film Thickness in microns (DFT)	preparation of surface
First coat	INTERSEAL 670 HS	Akzo Noble	As recommended bypaint manufacturer	2 *(per coat 100 Micron)*	200	After Dust cleaning of primer coated surface.
	Or PROTECTOMASTIC	Berger				
	Or RUST-O-CAP	Asian Paints				
	Or NPCIL approved equivalents					
Finish coat	INTERGARD – 740	Akzo Noble	As recommended by paint manufacturer	1 *coat 50 Micron*	50	After Dust cleaning of coated surface.
	Or EPILUX155 or EPILUX 89 HB	Berger				
	Or APCODUR CF 693 LX	Asian Paints				
	Or NPCIL approved equivalents					

4.0 Medium Temperature Application:

Pipelines, supports, structural sections and equipments subjected to temperature range 50<t≤150^{0}C are coated with 2 coats of medium temperature

paints with dry film thickness(DFT) as mentioned in table below. The paints are applied after surface cleaning of primer coated surface. Only pipe/equipment supports like saddle, shoe, clamps that comes in contact with pipeline/equipment and are subjected to pipeline temperature range $50<t\leq150^0C$, should be coated with medium temperature paint. Other supporting elements that subjected to $t<50^0C$ should be coated with low temperature paint.

Paints for Medium temperature application ($50<t\leq150^0C$)

Type of coating	Approved Paints	Approved Brand	Application method	Minimum number of Coating	Minimum Dry Film Thickness in microns (DFT)	preparation of surface
Finish coat	INTERPLUS– 256	Akzo Noble	As recommended bypaint manufacturer	2 *(per coat 75 Micron)*	150	After Dust cleaning of primer coated surface.
	Or FERROTOL HR ALUMINUM PAINT	Berger		2 *(per coat 25Micron)*	50	
	Or RUST-O-CAP MIO	Asian Paints				
	Or NPCIL approved equivalents			2 *(per coat 75 Micron)*	150	

5.0 High Temperature Application:

Pipelines, supports, structural sections and equipments subjected to temperature range $t>150^0C$ are coated with 2 coats of High temperature paints with dry film thickness(DFT) as mentioned in table below. The paint are applied after surface cleaning of primer coated surface. Only pipe/equipment supports

like saddle, shoe, clamps that comes in contact with pipeline /equipment and are subjected to pipeline temperature i.e, t>150^{0}C ,should be coated with high temperature paint. Other supporting elements that subjected to t<50^{0}C should be coated with low temperature paint.

Paints for High temperature application (t>150C)

Type of coating	**Approved Paints**	**Approved Brand**	**Application method**	**Minimum number of Coating**	**Minimum Dry Film Thickness in microns (DFT)**	**preparation of surface**
Finish coat	INTERTHERM – 50	Akzo Noble	As recommended bypaint manufacturer	2 *(per coat 25 Micron))*	50	After Dust cleaning of primer coated surface.
	Or CORROHEAT ALUMINUM	Berger				
	Or HEAT RESISTING SILICONE ALUMINUM PAINT	Asian Paints				
	or NPCIL approved equivalents					

6.0 <u>Requirements for Grit blasting:</u>

1. The minimum acceptable standard for blast cleaning is Sa 2-½ as per Swedish Standard SIS-05 5900 (latest edition) or SSPC or ISO 8501-01.

2. In case manual or hand tool cleaning shall be St. 2 or equivalent, in case of mechanical or power tool cleaning it shall be St. 3 or equivalent.

3. Before blast cleaning, visible deposits of oil, grease, or other contaminants

shall be removed and clean, dry compressed air shall be used for nozzle blasting.

4. The surfaces shall be blast cleaned using one of the abrasives like chilled cast iron or malleable iron, shall be in the form of shot or grit of size GP25/GP16 (G42 grade maximum) and S250 grade size of steel shots (maximum) to obtain a desired surface profile. The combination of steel grits and shots shall be normally in the ratio of 3:1.

5. The quality of abrasives shall be free from contaminants and impurities and shall meet the requirements of SSPC AB1.

6. Power tool cleaning shall be done only where blast cleaning is not possible like site weld joints of erected pipeline, structures etc. It involves cleaning by mechanical striking tools, chipping hammers, grinding wheels or rotating steel wire-brushes.

7.0 Requirements for paint application:

1. Airless spray /conventional air spray/brush/roller as recommended by paint manufacturer should be used for primer/paint application.

2. The paints used for first coat, intermediate and finish coats shall be from the same manufacturer and shall be compatible as per the manufacturers data sheet.

3. Unused and left over paints shall be immediately removed from the site, at the end of the each day and shall be disposed off properly.

4. Paint components such as base, epoxy, curing agents once mixed shall be consumed within the pot life period and also validity expired paints shall not be used for application.

5. Paint application by brush shall be used for touch up painting such as site weld joints.

6. Surface shall not be coated in rain, wind or in environment and when the steel surface temperature is less than 5^0F above dew point when the relative humidity is greater than 85% or when the temperature is below 40^0F and when the ambient/substrate temperature is below the paint

manufacturer's recommended temperature for application and curing.

7. Each coat shall be in proper state of cure or dryness before the application of succeeding coat. No coat shall be applied until the preceding coat has dried.

8. Material shall be considered dry for recoating when an additional coat can be applied without the development of any detrimental film irregularities, such as lifting or loss of adhesion of the under coat. Manufacturer's instruction shall be followed for inter coat interval.

9. No paint shall be force dried under conditions which will cause chalking, wrinkling, blistering formation of pores, or detrimentally affect the conditions of the paint.

10. To the maximum extent practicable, each coat of material shall be applied as a continuous film of uniform thickness.

11. Any spots or areas missed in application shall be recoated and permitted to dry before the next coat is applied. Applied paint should have the desired wet film thickness.

12. The painting equipment used shall be suitable for the intended purpose, shall be capable of properly atomizing the paint to be applied, and shall be equipped with suitable pressure regulators and gauges.

13. Ingredients shall be kept properly mixed in the spray pots or containers during application by continuous mechanical agitation.

14. Paint shall be applied in a uniform layer and spray patterns shall be adjusted so that the paint is deposited uniformly.

15. No drier shall be added to a paint on the job unless specifically called for in the manufacturer's specification for the paint.

16. Paint shall be protected from rain, condensation, contamination, snow and freezing until dry to the fullest extent practicable.

17. Where paint has been damaged in handling and in transportation, the repair of damaged coating should be cleaned by mechanical scraping or

grinding wheels or rotating steel wire-brushes and inorganic zinc silicate and subsequent coats shall be applied.

8.0 Testing:

1. Material test certificate as per the IS or relevant standards shall be submitted along the material supply for acceptance.

2. The cleaned surface shall be inspected visually and using press-o-film for the required roughness for application of the primer / paint coating.

3. The existing coated surface with paint/primer shall be inspected after surface cleaning visually for absence of any dust, oil or grease.

4. The applied paint coats shall be examined for its specified coating thickness (DFT) by the latest and NPCIL approved measuring instruments.

5. Adhesion test or any other relevant test shall be conducted at site on coated surface for verification as per relevant standards (ASTM D-3359, ASTM D3363) as per the instruction of NPCIL.

9.0 Color Coding:

The color of paint required for the major systems are furnished below.

Sl. no.	System/ Description	Ground Colour
1	Cooling water system (PGB)	French Blue
2	Ordinary (Raw) water	Grass Green
3	Domestic or Drinking water	Grass Green
4	Domestic hot water	Grass Green
5	De-mineralized water	French Blue
6	Condenser cooling water (Sea water) (PAB)	Oriental Blue
7	Sea water for normal loads	Oriental Blue
8	Condensate system water	Sky Blue
9	Boiler feed water	Sky Blue
10	Re heater return	Sky Blue
11	Fire fighting water	Signal Red

12	Drainage system (Inactive)	Black
13	Steam systems	Aluminium
14	Compressed Air (Instrument & Service)	White
15	Compressed gases	White
16	Vacuum system	White
17	Turbine oil systems	Light Brown
18	Acids	Light purple brown
19	Alkali	Light salmon pink
20	Hydrazine, Ammonia, Chemical waste	Lemon
21	Turbine & Generator	Orange

10.0 **Reference standards/codes**:

IS 101 - Methods of test for ready mixed paints and enamels.

IS 1200- for measurement of painted surface

ASTM D 1005 – 95 Standard Test Method for Measurement of Dry-Film thickness of Organic Coatings Using Micrometers.

ASTM D-3359-Standard Test Methods for Measuring Adhesion by Tape Test

ASTM D3363-Standard Test Method for Film Hardness by Pencil Test

11.0 **Measurement of finished area:**

Measurement of the finished painted area of the valves, Pipe Flange and Spring hanger of pipe support shall be as per the following methodology.

1. Valve:

The quantity of valves shall be measured in terms of numbers referred to the pipe outside diameter. The term valves shall be deemed to include all flanged component (all type of valves, sight glasses, strainers, level indicators, steam traps) irrespective of pressure rating and their installed length and including operating elements (hand wheels, levers). Valves with welding ends and threaded ends shall be considered as 0.8 piece. A valve up to size DN 50 shall be considered as straight pipe length of 1 m and a valve size above DN 50 shall

be considered as straight pipe length of 2 m of corresponding pipe size. This additional measurement is in addition to the total length of pipeline including the valve body.

2. Flange:

   The surface area of flange or blind flange shall be measured as a straight pipe length of 0.3 m of the corresponding pipe size of all pressure rating and type of flanges. This 0.3 m is in addition to the total length of pipe includes the flange length. The surface area of a flange is derived as $A = \pi DL$, where, D=Outer diameter of the pipeline (m) & L= 0.3mtr.

3. Spring hanger of pipe support:

   The surface area of spring hanger of a pipe support for any size of pipe line and of any size of spring hanger support shall be measured as $A = \pi DL$, considering πD= 0.2 m multiplied by the actual length L of spring hanger support. The area measured by this method of spring hanger support, including the area of EP, support plate, upper tie rod, spring assembly and lower tie rod. The area of bottom channel of spring hanger support is taken separately.

NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A Government of India Enterprise)

KUDANKULAM NUCLEAR POWER PROJECT-3&4

TECHNICAL SPECIFICATION FOR PAINTING OF STRUCTURES, SYSTEMS AND COMPONENTS OF FREE ACCESS AREA (NON RADIOACTIVE)

Number of the Document	I02	KK34	0	0	TH	TS	PR017

Title	Total Number of Pages	Date	Revision Number
TECHNICAL SPECIFICATION FOR PAINTING OF STRUCTURES, SYSTEMS AND COMPONENTS OF FREE ACCESS (NON RADIOACTIVE) AREA	40	Sept, 2018	1

NPCIL PROPRIETARY

NUCLEAR POWER CORPORATION OF INDIA LTD.
(A Government of India Enterprise)

2 X 1000 MWe KUDANKULAM NUCLEAR POWER PROJECT
UNITS –3&4

DOCUMENT NO.: I02.KK34.0.0.TH.TS.PR017

TECHNICAL SPECIFICATION FOR PAINTING OF STRUCTURES, SYSTEMS AND COMPONENTS OF FREE ACCESS (NON RADIOACTIVE) AREA

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Revision No.	Description of Revision	Revised by Name & Signature	Checked by Name & Signature	Reviewed by Name & Signature	Approved by Name & Signature
1. 2.	Parameter related to zinc dust has been included in Table No-1 of Annex.A Parameter related to zinc dust content in Table-2 of Annex.A	14/09/18 **P.C.Gaurav, EE(Engg.-LWR)**	14/9/18 **V.H. Scaria, Sr.EE (Engg.-LWR)** 21/09/18 **R.Gurnule, DCE (Engg.-LWR)**	24/9/18 **R. R. Sahaya,** **(CE -CONTT, RP&S & CFD - Engg.-LWR)** **S K Sinha CE (Engg.-LWR)**	**Smt Rajee Guptan** **(AD-PSA-Engg-LWR)**

CONTENTS

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1.0 SCOPE

This technical specification is intended to cover selection, supply of coating materials, coating application, inspection, testing, repair and handling of paint related work for all non-radioactive (free access) area such as UMA, UMV, UKD etc. except sea water system structures. For sea water systems & structures refer Technical Specification I02.KK34.0.0.TH.TS.PR009.

1.1 EXTENT OF SPECIFICATIONS

a. All Carbon Steel Storage Tanks , pipes, ducts, support, structures.

b All G.I. ducts, support, structures.

c. Painting of color bands on all piping as required for identification including insulated aluminum clad, SS, plastic or plastic coated and nonferrous piping/ equipment if any.(specification of identification and color coding to be given to the successful bidder at the time of execution of the work)

d. Identification lettering/ numbering on all painted surfaces of equipment/piping insulated aluminum clad, SS and non-ferrous piping.

e. Repair work of damaged pre-erection/ fabrication and shop primer and weld joints in the field/site before and after erection as required.

f. Supply, handling, storage of all primers, paints and all other materials required for painting.

1.2 EXCLUSION

a. Painting of Non-ferrous materials like aluminum, plastic material, Stainless steel and duplex steel structure until and unless specified by NPCIL.

2.0 COATING MATERIAL SPECIFICATION :

The coating material should be as per properties indicated in Annexure- A.

3.0 REFERENCE CODES & STANDARDS

CODE /STANDRAD	TITLE
ISO 12944	Paint and varnish – corrosion protection of steel structure by protective paint system.
ISO 8501	Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness
ISO 8502-3	Preparation of steel substrates before application of paints and related products – Test for the assessment of surface cleanliness – Assessment of dust on steel surfaces prepared for painting, pressure sensitive tape method.
ISO 8503	Preparation of steel substrates before application of paints and related products – Surface roughness characteristics of blast cleaned substrates.
ISO 8504-2	Preparation of steel substrates before application of paints and related products – Surface Preparation Methods – Abrasive blast-cleaning.
ISO 1513	Paints and varnishes – Examination and preparation samples for testing.
ISO 2808	Determination of film thickness
ISO 2409	Cross cut test.
SSPC-SP	Steel Structures Painting Council, U.S.A.
ASTM G 62-85	Standard Test Methods for Holiday Detection in Pipeline Coatings
ASTM D520	Standard Specification for Zinc Dust Pigment
ASTM D521	Standard Test Methods for Chemical Analysis of Zinc Dust (Metallic Zinc Powder)
IS 101	Methods of sampling and test for paints, varnishes and related products
ASTM D2697	Standard Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings
ASTM D 5895	Standard Test Methods for Evaluating Drying or Curing During Film Formation of Organic

ASTM D 1200	Standard Test Method for Viscosity by Ford Viscosity Cup
ASTM D 1186	Standard Test Measurement DFT.
ASTM D 4060	Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D 1653	Standard Test Methods for Water Vapor Transmission of Organic Coating Films
ASTM G-154	Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials
ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
ISO 4624	Pull of test for adhesion

4.0 TECHNICAL REQUIRMENT FORPAINT APPLICATION

4.1 PRE-BLASTING :

4.1.1 Scope of work include treatment of surface for application of protective coating such as removal of dust,oil/grease contamination, removal of salt deposit and other water soluble compounds.

4.1.2 The surfaces shall be free from any foreign matter such as weld flux, residue, slivers, oil, grease, salt etc. prior to blast cleaning.

4.1.3 Surface preparation of Galvanized steel :

The surface shall be cleaned by using suitable detergent to remove oil and grease etc. Salt and other contamination may be removed by high pressure water cleaning.
Surface must be free from zinc salt. A dull rough profile on substrate is required for paint application.

4.2 BLAST CLEANING :

4.2.1 Blasting abrasives shall be dry, clean and free from contaminants which will be detrimental to the performance of the coating.

4.2.2 In case of rain or bad weather, surface preparation shall not be carried out outdoors.

4.2.3 When surface is wet, surface preparation shall not be carried out.

4.2.4 Surface preparation/Roughness profile of the cleaned surface shall conform to the paint manufacturer recommendations.

4.2.5 Substrate condition during blasting must be 3 degree Celsius above dew point temperature.

4.2.6 Irrespective of whether external or internal surface to be coated, blast cleaning shall not be performed where dust can contaminate surfaces undergoing such cleaning or during humid weather conditions having humidity exceed 85%. Relative Humidity reading shall be recorded every 2 hour during the blasting operation in the immediate vicinity of operation.

4.2.7 If wet abrasive method is used for cleaning then the substrate shall be fully dried before application of any coating.

4.2.8 Compressed air used for blast cleaning shall be clean, dry and free of moisture and oil.

Moisture separators, oil separator, traps or other equipment may be necessary to achieve clean, dry air.

4.2.9 The maximum content of soluble impurities on the blasted surface as sampled using ISO 8502-6 and distilled water, shall not exceed a conductivity corresponding to a NaCl content of 20 mg/m^2. Equivalent methods to determine salt contamination, may be used.

4.3 PAINT APPLICATION :

4.3.1 Pre-fabrication primer is not a part of the paint system. It might need to be removed.

4.3.2 Paint/primer shall be applied after ensuring assessment of prepared surfaces as per ISO 8501-1 / ISO 8501-2 .

4.3.3 The elapsed time between the abrasive blasting of surface and coating shall not exceed the maximum as given in the following table

Relative humidity	Maximum Time elapsed
Above 80%	2.0 Hour
50% to 80%	3.0 Hour
Up to 50 %	4.0 Hour

4.3.4 At the end of pipe joint where welding is to take place a cut back (160 mm) may be allowed in the coating depending upon the field joint coating method selected. The actual distance if any, shall be agreed upon, prior to application.

4.3.5 Area not to be coated shall be masked with disposable plastic sheets, tapes, cardboards etc.

4.3.6 Prior to the application of each coat, a stripe coat shall be applied by brush to all welds, corners, behind angles, sharp edges of beams etc. and areas not fully reachable by spray, in order to obtain the specified coverage and thickness.

4.3.7 Surface shall not be coated in rain, wind or in environment where injurious airborne elements exists, when the Steel surface temperature is less than 3° C. above dew point, when the relative humidity is greater than 85% or when the temperature is below 5 ° C

4.3.8 If wind speed exceed 10 km/h than proper shielding arrangement to be provided by

applicator.

4.3.9 All nameplates, manufacturer's identification tags, machined surfaces, instrument glass, finished flange faces, control valve items and similar items shall be masked to protect coating deposition. If these surfaces are coated, the component shall be cleaned and resorted to its original condition.

4.3.10 For top coating application, manufacturer's recommended over coat interval time to be followed.

4.3.11 No drier shall be added to a paint on the job unless specifically called for in the manufacturer's specification for the paint.

4.3.12 Painted surface shall be protected from rain, condensation, contamination until dry to the fullest extent practicable.

4.3.13 The method of application shall be governed by the coating manufacturer's recommendation for the particular coating being applied.

4.3.14 In organic Zinc silicate primer shall not be applied below relative humidity of 65%.

5.0 GENERAL REQUIRMENT

5.1 The bidder shall provide comprehensive documentations detailing his previous experiences of using the specified coating systems. In particular this shall address internal lining of both large and small bore pipelines/ equipment's. This information shall be submitted with the bid.

5.2 The bidder may be required to set up a coating facilities at site complete with all necessary equipment, consumables and personnel to complete the work. The bidder is to confirm his intention to do this at the bid stage and submit details of the facility he proposes, including size of area required and utilities.

5.3 The bidder shall provide with his bid an inventory of the proposed equipment and personnel that will be used to execute the contract in line with the project schedule.

5.4 The bidder shall provide a comprehensive execution plan and methodology of coating with the proposal.

5.5 The bidder shall perform all work in accordance with this specification and other requirements noted herein.

5.6 The bidder shall also supply along with his offer copies of test reports conducted by reputed test agencies evidencing that materials conform to minimum performance requirements attached else where in this specification.

5.7 The contractor will be totally responsible for field coating, field weld joint coating including testing and inspection of coated area.

5.8 All tools, brushes, rollers, spray guns, blast material, hand power tools for cleaning and all equipments, scaffolding materials, shot & grit blasting equipment's & air compressors etc. required to be used shall be suitable for the work and all in good order and shall be arranged by the contractor at site and in sufficient quantity/nos. The manufacturer's test certificates / data sheets for all the above items shall be reviewed by NPCIL Engineer-in-charge at site before start of work.

5.9 Mechanical mixer shall be used for paint mixing operations, except that the NPCIL `Engineer-In-Charge may allow the hand mixing of small quantities at his discretion in case of specific requirement for touch up work only.

5.10 Where paint has been damaged in handling and in transportation, the repair of damaged coating of pre-erection / fabrication and Shop primer shall be done by contractor.

5.11 The contractor shall prepare a field weld joint coating and a repair procedure for review and approval by NPCIL Engineer-in-charge.

5.12 Defective work shall be rectified/repaired by the contractor at his own expenses.

6.0 INSPECTION AND TESTING

6.1 COATING PROCEDURE QUALIFICATION :

6.1.1 Prior to actual application on job, sample application shall be carried out to establish that the coating operation and coating material meet the requirements of this specifications.

6.1.2 Quality control tests shall be performed as follows :

- Blast cleanliness standard and profile inspection.
- Salt contamination test
- Visual testing.
- Thickness testing, holiday inspection, adhesion testing, curing testing as per approved standard specified in this specification.
- Repair procedure , as approved by NPCIL

6.1.3 No application/production shall commence until the Contractor has performed all the above tests to complete satisfaction of NPCIL Engineer-in –charge.

6.2 VISUAL INSPECTION

6.2.1 Assessment of the prepared surfaces shall be visually assessed as described in ISO-8501.

6.2.2 Testing for soluble salt and other invisible contamination on visually cleaned surface by physical and chemical method shall assessed as per ISO 8502.

6.2.3 The surface roughness profile accordance with paint manufacturer shall be assessed as per ISO 8503.

6.3 THICKNESS TESTS

6.3.1 The paint thickness shall be checked using non-destructive test.

6.3.2 Dry Film Thickness (DFT) Meter used shall be calibrated before each inspection and shall be witnessed by the Inspector. It is the duty of the Inspector to satisfy himself with the performance of the DFT Meter.

6.3.3 The Dry Film Thickness (DFT), as measured in accordance with ASTM D-1186, shall not vary by 10 % of the specified value.

6.3.4 The Area coverage of DFT measurement is as per SSPC-PA2.

6.4 HOLIDAY DETECTION

6.4.1 100% of the internally coated pipe shall be tested.

6.4.2 Holiday testing shall be done in accordance with ASTM G-62 after curing of paints.

6.4.3 No holidays are accepted and all holidays shall be repaired. The maximum repair rates allowable for holidays shall be 4 per day.

If number is exceeded, or the daily average if exceeded for any 5 consecutive days of production , then application shall cease and the cause shall be investigated and resolved.

6.5 **Adhesion test** is destructive test and shall be done on applied surface selected by NPCIL Engineer- in-charge, if required, as per ISO 4624 or ASTM D4541.

6.6 Environment condition test.

6.6.1 Following parameter to be checked

a. Air Temperature (Max. & Min.)
b. Relative humidity (Min. & Max.)
c. Dew Point Temperature.
d. Surface Temperature.
e. Wind Speed (Max.)

6.6.2 In an interval of eight hour, data to be collected and recorded in data sheet. More frequent measurement to be done if conditions are changing rapidly and will be decided by NPCIL Engineer-in-charge.

6.6.3 Sling Psychrometer to be used as per ASTM E337 to record wet & dry Temperature record Humidity. Alternatively, equivalent approved instrument may also be used.

7.0 QUALIFICATION REQUIREMENTS

7.1 Selection of products :

7.1.1 Selection of products shall be carried out based on certificate submitted by paint manufacturer as indicated in Annexure- A from an independent reputed Government lab agreed between contractor and NPCIL.

7.1.2 Test method mentioned in test certificate should be as per test standard mentioned in Annexure- A. However, equivalent standard other than specified in Annexure-A, may be followed subjected to NPCIL approval.

7.1.3 Only product approved by NPCIL as per Annexure- A shall be used for application.

7.1.4 Paint qualification cost, if applicable shall be borne by EPC contractor/ Paint Manufacturer.

7.2 Qualification of Personnel

7.2.1 Qualification of paint applicator

Applicator shall be qualified to perform the task viz blast cleaning, application etc. The personnel shall have relevant knowledge of health and safety hazard, coating materials, use of protection equipment, etc.

If not qualified, personnel shall carry out a test in accordance with the standard Coating Procedure Specification. The test shall be supervised by a qualified supervisor and inspected and accepted by qualified QC personnel. A test certificate shall be issued.

The test shall be carried out on a test panel (minimum 1mt x 1 mt),1 angle, 1 spool piece of pipe Alternatively a location providing similar geometrical complexity on the component to be coated may be used.

The acceptance criteria are the requirements to the coating system described in this document. Variation in the film thickness shall be within the limits described in this specification. Applicator failing to meet the requirements shall not be allowed to carry out work in accordance with thisdocument.

7.2.2 Qualification of procedures

Coating Procedure Specification (CPS)

Supplier shall establish a detailed CPS based on the requirements of this document.

The CPS shall contain the following:
- Identification of equipment for surface preparation and application.

- Information given on Coating System Data Sheet.
- Personal protective equipment to be used.
- Safety data sheets for each product.

The qualified CPS shall be followed during all coating work.
The following changes in the coating application parameters requires the CPS to be requalified.
- Any change of coating material.
- Change of method and equipment for surface preparation and coating application.

8.0 QUALITY ASSURANCE PLAN

QAP shall be submitted by vendor according to this specification. Acceptance is subjected to NPCIL approval.

9.0 RECOMMENDED PROTECTIVE COATING SYSTEM.

Sl.No.	Equipment's		System recommended	DFT/coat µm	No.of coats	Detailed specifications
1.0	**Pipeline**					
Material – Carbon Steel						
1.1	**Area -** Indoor & outdoor **Fluid-** Sea water **Application-** Internal surface.		Polyester Glass Flake **Total thickness (Min.)**	500-550 **1000-1100**	2	Table no-5 of Ann.-A
1.2	**Area-** Indoor & outdoor **Application-**External surface.	Temperature< 50°c	**Primer:** Inorganic Zinc Silicate. **Under coat:** Epoxy MIO intermediate coat. **Top coat:** Aliphatic Polyurethane **Total DFT (Min.)**	70-80 100-120 30 **230-260µ**	1 1 2	Table No.- 1,3,4 of Ann.-A
		Temperature up to 300°c (for under insulation paint)	**Primer :** Inorganic Zinc silicate **Top coat :** High temperature resistance silicone based ambient curing coating. **Total Thickness**	70-80 25 **120-130 µ**	1 2	Table-1,6 of Ann.-A

1.3	**Area-** Indoor & outdoor **Fluid-**DM water. **Application-**Internal surface	No coating required.			
1.4	**Area-** Under-ground **Application-** External surface	Polyester Glass Flake **Total thickness (Min.)**	500-550 **1000-1100**	2	Table no-5 of Ann.-A
Material – Galvanized steel.					
1.6	**Area-** outdoor **Application-**External surface	**Under coat-** Wash primer (poly vinyl butyral resin) **Top Coat –** Aliphatic Polyurethane **Total DFT (min.)**	8-10 µ 30 µ **68-70 µ**	1 2	Table- 3 of Ann.-A
2.0	**Tank**				
Material- Carbon steel.					
2.1	**Area-** Indoor & outdoor	**i). Fluid- Chemicals/ Acid**	Rubber lines. Thickness- 4.5 mm.	NA	NA	As per IS 4682

	Application-Internal surface	**ii). Fluid – Diesel oil, DM water, fire water.**	High Build epoxy phenolic tank liner. **Total thickness**	150 µ **300 µ**	2	Table – 8 of Ann.-A
		iii). Fluid-Potable water	Polyamine cured epoxy paint approval from CFTRI Mysore.	**Total thickness-** 225-250 µ	-	Table-9 of Ann.-A
2.2	**Area** – Indoor & outdoor **Application** –External surface (except bottom portion)	Temprature < 50°c	**Primer:** Inorganic Zinc Silicate. **Under coat:** Epoxy MIO intermediate coat. **Top coat:** Aliphatic Polyurethane **Total DFT (Min.)**	70-80 µ 100-120 µ 30 µ **230-260µ**	1 1 2	Table No.- 1,3,4. Of Ann.-A
		Temprature upto 200°c (For under insulation paint.)	**Primer :** Inorganic Zinc silicate **Top coat :** High temperature resistance silicone based ambient curing coating. **Total Thickness**	70-80 µ 25 µ **120-130 µ**	1 2	Table-1,6 of Ann.-A
2.3	**External surfaces of CS tank (soil side)**		Coal Tar Epoxy **Total thickness (Minimum)**	100 **200µ**	2	IS 14948:2001
Material- Stainless steel						
2.4	**Area-** Indoor & outdoor **Application-**Internal surface		No coating.			

2.5	**Area-** Indoor & outdoor **Application-** Internal surface	For Under insulation tank	Aluminum foil.			
		Others	Not Applicable.			
3.0	**Ducts.**					
3.1	**Material** – Carbon steel. **Area-** Indoor **Application-**External surface.		**Primer-** Zinc Rich Epoxy **Top Coat-** High build epoxy **Total thickness (Minimum)**	75-80 µ 125 µ **325-330 µ**	1 2	Table No.-2,7 of Ann.-A
	Material – Carbon steel. **Area-** outdoor **Application-**External surface.		**Primer-** Zinc Rich Epoxy **Under coat-** Epoxy MIO **Top Coat-** Aliphatic PU **Total thickness (Minimum)**	75-80 µ 100-120 µ 30µ **230-240 µ**	1 1 2	Table No.-2,3,4 of Ann.-A

3.2	**Material** – Galvanized Iron **Area-** Indoor & outdoor **Application-**External surface.		**Under coat-** Wash primer (poly butyl) **Top Coat** – Acrylic PU **Total DFT (min.)**	8-10 µ 30 µ **60-70 µ**	1 2	Table no- 3 of Ann.-A
4.0	**Metal Structures.**					
	Material - Carbon steel **Area** – Indoor & Outdoor	Structure where SA 2.5 could be achieved.	**Primer:** Inorganic Zinc Silicate. **Under coat:** Epoxy MIO intermediate coat. **Top coat:** Aliphatic Polyurethane **Total DFT (Min.)**	70-80 µ 100-120 µ 30 µ **230-260µ**	1 1 2	Table-1,3,4 of Ann.-A
		Structure where SA 2.5 could not be achieved. Forsuch structure at least St-3 is required.	**Primer-** Zinc Rich Epoxy **Top Coat-** Aliphatic Polyurethane **Total thickness (Minimum)**	75-80 µ 30 µ **135-140 µ**	1 2	Table No.-2,3 of Ann.-A

5.0	**Support**				
5.1	**Material-** Carbon steel **Area** – Indoor	**Primer-** Zinc Rich Epoxy **Top Coat-** High build epoxy **Total thickness (Minimum)**	75-80 µ 125 µ **325-330 µ**	1 2	Table No.-2,7 of Ann.-A
5.2	**Material-** Carbon steel **Area** – Outdoor	**Primer-** Zinc Rich Epoxy **Top Coat-** Aliphatic Polyurethane **Total thickness (Minimum)**	75-80 µ 30 µ 135-140 **µ**	1 2	Table No.-2,3 of Ann.-A
6.0	**Exhaust Duct of Diseal Generator**	**Primer :** Inorganic Zinc silicate **Top coat :** High temperature resistance silicone based ambient curing coating. **Total Thickness**	70-80 µ 25 µ **120-130 µ**	1 2	Table-1,6 of Ann.-A

10.0 PAINT DATA REQUIREMENT

DATA TO BE FURNISHED BY THE COATING CONTRACTOR AT THE TIME OF COATING SYSTEM APPROVAL.

Sl. No.	*Parameters	Test Code (As specified according to Standard specified in the specification or equivalent)	Value / Details
1.0	**Coating Details**		
1.1	Type		
1.2	Resin		
1.3	Pigment		
1.4	Volume of Solids		
1.5	Total coating thickness to be achieved as per Tender.		
1.6	No. of main coats considered for achieving required thickness		
1.7	Each coat thickness		
1.8	Primer required (Type)		
1.9	Primer coat thickness		
2.0	Blasting material to be used for carbon steel		
	Main Coat Physical Properties		
2.1	Impact Resistance		
2.2	Color		
2.3	Density		
	Service Properties		
2.4	Adhesion to Steel		
2.5	Abrasion Resistance		
2.6	Water vapor permeability/ Transmission rate		Not for zinc silicate primer.
2.7	Accelerated weathering		
2.8	Accelerated Salt Spray		
2.9	Chemical resistance immersion of 30 days in sea water -		
	% wt change		
	% hardness change		
	% tensile strength change		

	% bond strength change		
3.0	Application		
3.1	Flash point at 30 degree cel.		
3.2	Mixing ratio		
3.3	Practical spreading rate		
3.4	Curing time		
	- for next coat		
	- for full cure		
3.5	Pot life at 30 oC		
3.6	Thinner if any		
3.7	Storage life / Self life		
3.8	Cleaning fluid		

*Parameter which apply to the product, to be specified.

ANNEXURE –A

Table number- 01			
Inorganic Zinc Silicate			
Sl. No.	**Parameters**	***Method**	**Acceptance criteria**
			Primer
1.0	**Coating Details**		
1.1	Type		Inorganic zinc silicate
1.2	Resin		EthylSilicate
1.3	Pigment		Metallic Zinc Dust
1.4	Zinc size	ASTM D520 ASTM D521	6-9 microns
1.5	Zinc shape		spherical
1.6	Zinc purity		> 98% Zinc dust conforming to ASTM type II purity grade.
1.7	Total solids % Total Zinc dust in dry flim	ASTM D 2369	> 80%, by weight > 84% by weight
1.8	Volume of Solids	ASTM – D-2697	> 65%
1.9	Flash Point for primer and finish	IS 101 1964	> 15 degree C.
2.0	Pot life @ 30 deg.C		>4hour
2.1	Shelf life @ 30 deg.C		Liquid >6 Months. Power > 12 months.
2.2	Area Coverage (Theoretical)	IS 101, 1964	>8.5m^2/l @ 75 micron thickness
2.3	Practical Coverage		Min. 6.25 micron thickness @ 75 micron thickness
2.4	Application		spray
2.5	Drying Time (minimum)	ASTM D 5895	Surface dry <3Hr Hard dry < 18 hrs
2.6	Cure test	ASTM D 4752	The coated test panels air dried for 48 hrs shall pass the cure test .
2.7	Impact Resistance	ASTM D 2794	> 10 Joule
2.8	Viscosity (Kinematics) at 25 degree cel. in stokes.	ASTM D 1200	3 to 5
2.9	Thickness per coat	ASTM D 1186	70-80 μ
3.0	**Total thickness**		**70-80** μ

3.1	Abrasion Resistance [Material Loss for 1000 cycle at 1 kg load with CS17 wheel]	ASTM - D – 4060	< 250 mg
3.2	Accelerated Salt spray Test	IS 2074 or ASTM B117	The coated test panels dried for 48 hrs System should pass 3000hrs exposure without blistering and corrosion.
3.3(a)	Practical Adhesion by sandwich pull off technique.	ISO 4624	>90 kg/sq cm.
3.4(b)	Failure in cohesion by sandwich pull off technique	ISO 4624	>80%
3.5	Flexibility test panel bent 1 inch dia cylindrical mandrel	ASTM D-1979	System should pass free from detachment,crack,surface deformation, etc.

Table number- 02			
Zinc Rich Epoxy Primer			
Sl. No.	**Parameters**	***Method**	**Acceptance criteria**
			Primer
1.0	**Coating Details**		**Zinc Rich Primer**
1.1	Type		
1.2	Resin		Epoxy
1.3	Pigment		Metallic Zinc Dust
1.4	Zinc size	ASTM D520 ASTM D521	6-9 microns
1.5	Zinc shape		spherical
1.6	Zinc purity		> 98% Zinc dust conforming to ASTM Type II high purity grade
1.7	Zinc dust content in dry flim	ASTM D 2369	> 80%
1.8	Flash Point for primer and finish	IS 101 1964	> 15 degree C.
1.9	Pot life @ 30 deg.C		>3 hour
1.10	Shelf life @ 30 deg.C		Liquid >6 Months. Power > 12 months.
1.11	Volume of Solids	ASTM – D-2697	> 60%
1.12	Application		Airless spray
1.13	Impact Resistance	ASTM D 2794	> 10 J
1.14	Thickness per coat	ASTM D 1186	70-80 µ
1.15	**Total thickness**		**70-80** µ
1.16	Accelerated Salt spray Test	ASTM B117	System should pass 1500 hrs exposure without blistering and corrosion.
1.17	Practical Adhesion by sandwich pull off technique.	ISO 4624	> 100 kg/sq cm.
1.18	Abrasion Resistance [Material Loss for 1000 cycle at 1 kg load with CS17 wheel]	ASTM - D – 4060	< 200 mg

Table number- 03			
Aliphatic Polyurethane.			
Sl. No.	**Parameters**	***Method**	**Acceptance criteria**
1.1	Type		Aliphatic PU
1.2	Resin		Aliphatic Poly-Isocyanate
1.3	Pigment		R.TiO_2
1.4	Flash Point for primer and finish	IS 101(part 1/sec 6) 1987	Not below 20 deg.C
1.5	Pot life @ 27 deg.C, min.	Annexure-E, IS 13213:1991	4 hour
1.6	Volume of Solids	Annexure-D, IS 13213:1991	40% (Min.)
1.8	Drying Time a). Surface dry, Max b). Hard dry, Max	IS 101 (Part 3/Sec 5) : 1987	 3 Hr 8 Hr.
1.9	Dry Film Thickness	IS 13213:1991	35 Micron
2.0	Colour	As per IS 101 (Part 4/sec2) : 1989	
2.1	Finish	IS 101 (Part 3/ sec.4):1987.	Smooth and Glossy
2.2	Flexibility and Adhesion Bend test 6.25 diameter mandrel type 1 apparatus.	IS 101 (Part 5/ Sec 2) : 1988	No visible damage or detachment of film
2.3	Scratch hardness 1500 gram.	IS 101 (Part 5/ Sec 1) : 1988	No such scratch as to show bare metal
2.4	Gloss at 45 degree angle of incidence, minimum	IS 101 (Part 5/ Sec 1) : 1988	52
2.5	Accelerated tests:		
	a).Resistance to sulphuric acid b).Resistance to caustic potash c).Resistance to solvent.	IS 13213:1991	Shall not show any signs of blistering, wrinkling and lifting. Difference in gloss and color between immersed and unimmersed area of paint film shall be minimum.
2.6	Durability Test		
	a). out doorexposure	IS 13213:1991	Chalking 10

	b).Accelerated weathering test		Checking 10 Cracking 10 Flaking 10 Spotting 10 Blistering 10 Colour changes 7-8 Gloss :The film shall have a minimum gloss retention of 90 percent of its original value.

Table number- 04			
Epoxy MIO			
Sl. No.	**Parameters**	***Method**	**Acceptance criteria**
1.0	**Coating Details**		
1.1	Type		Epoxy MIO
1.2	Resin		Epoxy
1.3	Micaceous Iron oxide in percentage by mass	IS 101 clause 6 of IS 6947 (Part II)	50
1.3	Pigment		MIO
1.4	Area Coverage (Theoretical)		5.0 m2/liter @ 100 micron
1.5	Volume of Solids (Min.)		55%
1.6	Application		Spray/Brush
1.7	Drying Time (minimum)		Surface dry 3 hour. Hard dry 16 hour.
1.8	Color		brown
1.9	Thickness per coat		100-120
2.0	Total thickness		100-120
2.1	Scratch Hardness (1500 gram)	IS 101 Clause 3 of part 5/sec 2	Pass
2.2	Flexibility and adhesion	Clause 2 of part 5/ sec. 2 IS 101	Pass
2.3	Resistance to humidity under condition of condensation at 500 hr. a). Resistance to humidity 500 hr.	IS 101 clause 2 of part 6 /sec.1	Pass
	b). Salt spray 500 hrs.	Clause 3 of part 6/sec 1.	Pass

Table number- 05

Polyester Glass Flake

Sl. No.	Parameters	*Method	Acceptance criteria
1.	Shelf life		>6 months
2.	Pot life		>45 min at 30 deg C
3.	Volume solids	ASTM D 2697	>95 %
4.	Cathodic Disbondment	ASTM G8	Typically less than 1 mm disbondment following 30 days exposure
5.	Immersion	ISO 2812 Part 2 (Modified)- "Resistance to sea water immersion @ 40 Deg C.	No film defects following 8000 hours exposure.
6.	Salt Spray	ASTM B 117 Resistance to neutral salt spray (fog) @ 35 Deg C.	No film defects, and no rust creep at the scribe following 10000 hours exposure.
7.	Abrasion	ASTM D 4060-	< 224mg weight loss per 1000 cycles using H18 wheels and a 1 Kg loading.
8.	Adhesion	ISO 4624 /ASTM D 4541	Not less than 90 Kg/cm^2 when using a PAT adhesion tester on 5mm thick steel.

9.	Impact	ASTM D 2794	> 9 Joule.
10.	Tensile Strength	ASTM-D 2370	Not less than 200 Kg/cm2
11.	Elongation @ Break	ASTM-D 2370	> 0.5%
12.	Water vapour Permeability	ASTM- D 1653	< 0.2gm/m^2-hr/mil

Table Number-06			
Heat Resistance Silicone based paint			
Sl.no.	**Parameter**	***Method**	**Accept.Criteria**
1.	Curing method		Ambient curing
2.	Volume solids	ASTM D 2697	>40 %
3.	Shelf life		> 1 year
4.	Flash point	ISO 3679	> 25 °c
5.	Temperature resistance	ASTM D 2485	> 350 °c
6.	Pot life @ 25°c		> 45 min.
7.	Drying time @ 25°c a). Touch dry b). hard dry		30 min. 2 hour
8.	Adhesion	ASTM D 4541	Not less than 70 Kg/cm^2 when using a PAT adhesion tester on 5mm thick steel.
9.	Abrasion Resistance [Material Loss for 1000 cycle at 1 kg load with CS17 wheel]	ASTM D 4060	< 250 mg
10.	Resistance to thermal shock		No sign of cracking and flaking after 3 cyclic exposure from 300 °C to 30 °C

Table Number-07			
High Build Epoxy			
Sl.no.	**Parameter**	***Method**	**Accept.Criteria**
1.	Colour		As per color coding requirment
2.	Volume solids	ASTM D 2697	>80%
3.	Shelf life		> 1 year
4.	Pot life at 25 °c		> 1 hour
5.	Impact Resistance	ASTM D 2794	>6 Joule
6.	Adhesion	ASTM D 4541	> 10 Mpa
7.	Salt spray test	ASTM B 117	> 1000 hrs.
9.	Abrasion test	ASTM D 4060	< 200 mg [Material Loss for 1000 cycle at 1 kg load with CS17 wheel]
10.	Tensile Strength	ASTM-D 2370	>100 Kg/cm2
11.	Elongation @ Break	ASTM-D 2370	> 6%
12.	Accelerated Weathering	ASTM D 4587	Should pass 500 hours a). Chalking b).Cracking and blistering.

Table Number-08			
Epoxy Phenolic tank liner			
Sl.no.	**Test**	***Method**	**Accept.Criteria**
1.	Color		As per requirement
2.	Volume solid	ASTM D 2697	>65%
3.	Pot Life @25°c		> 2 hour
4.	Shelf life		> 1 year
5.	Flash point	ISO 3679	> 25 °c
6.	Abrasion	ASTM D 4060-	< 200mg weight loss per 1000 cycles using CS17 wheels and a 1 Kg loading.
7.	Impact test	ASTM D 2794	> 7 Joule
8.	Adhesion	ISO 4624	>110 Kg/cm^2
9.	Tensile Strength	ASTM-D 2370	> 100 Kg/cm2
10.	Elongation @ Break	ASTM-D 2370	> 6%
11.	Immersion test a). DM Water b). Petrol	ASTM D-1308	500 hrs System should pass free from defult like blistering, loss of adhension
12.	Water vapour permeability	ASTM D 1653	< 4 gm/m^2-hr/mil.

Table number-09			
Potable water storage tank			
Sl. No.	**Parameters**	***Test Code**	Specification for coating system
a). Eplilux 78- Burger HBTL b). Apcodur CF699- Asian Paints c). Or equivalent approval from CFTRI Mysore.			

Note-

*a). Equivalent standard other than specified in paint specification table can be accepted subjected to approval from NPCIL.

APPENDIX–B

COATING SCHEDULE

Project Name :
Client :
W.O. No. :

Inspection Agency :
Site :
Others :

SURFACE DESCRIPTION SURFACE A,B (ECT)	APPROX. SURFACE AREA SQUARE METER	SURFACE PREPARATION TYPE	PROFILE RANGE	FIRST COAT			SECOND COAT			THIRD COAT		
				TYPE	WFT / DFT	COLOUR	TYPE	WFT / DFT	COLOUR	TYPE	WFT / DFT	COLOUR

APPENDIX–C

COATING SYSTEM DAILY INSPECTION REPORT

DATE	REPORT NO.	PROJECT REF. NO.	PAGE OF
PROJECT DESCRIPTION	LOCATION	CONTRACTOR	
INSPECTION ORGANISATION	INSPECTOR	APPLICABLE SPECIFICATION NO.	
I. **DESCRIPTION OF ITEMS AND / OR AREAS**			
II. **DESCRIPTION OF WORK PERFORMED / REMARKS**			

II. **PRE-WORK SURFACE CONDITION**	**OBSERVED DEFECTS**	IV. **ENVIRONMENTAL CONDITIONS**
• SUBSTRATE _____ • GENERAL DESCRIPTION _____ _____ • PRIMED FOR SUBSEQUENT COATS. • REFERENCE REPORT DATED ---------- • PREVIOUSLY PAINTED – DEGREE OF CORROSION --------- ---------- • NEW METAL – DEGREE OF CORROSION --------	OIL & GREASE ** SHARP EDGES ** WELD SPATTER ** MOISTURE ** LAMINATIONS ** SOLUBLE SALTS ** ---------- ** ---------- **	TIME ---------- AIR TEM/^{O}C ---------- WET BULB TEMP ^{O}C ---------- RELATIVE HUMIDITY ^{O}C ---------- DEW POINT ^{O}C ---------- SURFACE TEMP MIN / MAX. ^{O}C ---------- REMARKS : _____ ----------

ANNEXURE -D

DRY FILM THICKNESS MEASUREMENT WORKSHEET

DATE	REPORT NO.	PROJECT REF. NO.	APPLICABLE SPECIFICATION	PAGE OF

ITEM / AREA DESCRIPTION	SPOT	SPOT READINGS (MICRON)			TOTAL	AVERAGE	% MIN	REMARKS
		1	2	3				
	A							
	B							
	C							
APPROX. SQ. MTR	D							
	E							
						TOTAL AVG		

SPECIFICED DFT---------- MICRON
RANGE ACHIEVED ---------- MICRON

REFERENCE REPORT DATED ---------- FOR APPLICATION RECORD

REMARKS

INSPECTOR'S SIGNATURE DATE

कुडानकुलम परियोजना प्रलेखीकरण केन्द्र
KK-3&4 I/H/TS/312/00/R1
दिनांक/DATE: 25/09/2018
एनपीसीआईएल / NPCIL
KUDANKULAM PROJECT DOCUMENTATION CENTRE

VOLUME IA PART – I CHAPTER – III

FACILITIES 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	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	

1.3.1.2.2.1	Distribution from single point including supply of materials and service		Yes	
1.3.1.2.2.2	Supply, installation and connection of material of energy meter including operation and maintenance		Yes	Calibration certificate to be provided
1.3.1.2.2.3	Duties and deposits including statutory clearances for the above		Yes	
1.3.1.2.2.4	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		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 (min 2 Nos of PC & Printer) – 2 Data entry operator with computer knowledge		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	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- example		Yes	
1.3.2.1.5	Shipping lists etc for reference and planning the activities	Yes		
1.3.2.1.6	Valve testing facility	Yes		Shifting, handling of valves and operation in bidders scope
1.3.2.1.7	Grit blasting & Painting shed (only empty shed)	Yes		Equipments for grit blasting & Painting in Bidder scope.
1.3.2.1.8	Coating Application Methods & Procedures	Yes		
1.3.2.1.9	Preparation of site erection schedules and other input requirements		Yes	In consultation with BHEL
1.3.2.1.10	Review of performance and revision of site erection schedules in order to achieve the end dates and other commitments		Yes	

1.3.2.1.11	Weekly erection schedules based on Sl No 1.3.2.1.9		Yes	
1.3.2.1.12	Daily erection / work plan based on Sl No 1.3.2.1.11		Yes	
1.3.2.1.13	Preparation of preassembly bay		Yes	
1.3.2.1.14	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 & STORAGE AREA

1.3.3.1. Minimum 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 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 / fabrication yard shall be discussed and mutually agreed to.

1.3.4. ELECTRICITY:

1.3.4.1. Construction power will be provided to the contractor – one point of requried capacity from BHEL Panel board located in Turbine building of unit-3 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 amount

The 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 including sea water pump house area 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.

1.3.5. 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 out side . Bore well is not permitted in side 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 the plant area.

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 licenser:

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 2 computers (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 10 OS, 8 GB RAM.

1.3.10. SECURITY OF CAMP:

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

iii) The contractor shall furnish a statement in every quarter showing the number of people permitted and occupying the area allotted by the Corporation.

iv) The contractor shall control unlawful activities in the camp.

v) 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. For executing the work on free issue material from NPCIL, welding electrodes and filler wire will be issued as free issue material by NPCIL and only supply of welding consumables like gases will be in the scope of contractor.

ii. For executing the work on BHEL supplied structural steel work for making platforms and permanent supports, the supply of welding electrodes, filler wires, and welding consumables are in the scope of contractor.

iii. 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.

iv. Supply, machining of permanent packer plates, shims for all equipments are in the scope of contractor.

v. All gases (inert, welding, and cutting), soldering material, dye penetrants, radiography films. Other erection consumables such as wrap cloth, tapes, jointing compound, grease, lubricants, M-seal, Araldite, 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.

vi. Supply of all required consumables in adequate quantity such as birkosit, molybdenum-disulphide, zinc oxide, Ortho phosphoric acid, molykote 1000, hylomar, stag B, loctite, neverseez, white grease, araldite, rustoline, acetone, kerosene, shell ensys 30 oil, insulation spray, varnish, contact cleaner, double boiled linseed oil, white lead, red lead, graphite, diesel, iso-propanol, interplus 634, paint disbonder, lint free cloth etc for assembly of equipments, supply of Ammonia for hydro testing of equipment and pipelines & supply of gases like N2 with required purity for preservation. The list is only indicative and the contractor shall supply all the items deemed necessary for the completion of the work.

vii. For all the temporary structures, contractor shall supply all the materials including welding electrodes and consumables.

viii. In the event of failure of contractor to bring necessary and sufficient consumables, BHEL shall arrange for the same at the risk and cost of the contractor. The entire cost towards this along with standard BHEL overhead shall be deducted from the contractor's immediate due bills.

1.3.13. MATERIAL SUPPLY BY NPCIL (Free issue material):

i. Materials required for the work covered under this tender such as equipment, pipelines, tubes, pipe fittings, valves, supports, and other connected components of systems including welding electrode and filler

wire will be supplied as free issue as specified in respective items by NPCIL. 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. MATERIAL SUPPLY BY BHEL (Free issue material):

i. Required structural steel for fabrication of permanent pipe/equipment supports & platforms.
ii. Required quantity of SS liner for fabrication of trays & SS works.
iii. Required quantity of Hilti anchor fasteners.
iv. Tarpaulin sheets for covering of original equipments.

1.3.15. MATERIAL SUPPLY BY CONTRACTOR

i. Supply and machining of permanent packer plates, shims for all equipments.
ii. Supply and machining of dummy shafts for bearing contact checking, dummy bearing for pendulum check in turbine works.
iii. Supply and preparation of blanks for hydro test & flushing.
iv. Supply of primer & paint as per technical specification.
v. Supply of grouting & concreting material as per technical specification.
vi. Supply of preservative materials like silica gel, polythene sheets, nylon ropes for tarpaulin covering, heating oven for regeneration of silica gel, gasket material for manhole flanges, pressure gauges, associated fittings and regulator etc required during Nitrogen filling and all other consumables which may be deemed necessary from time to time as per the manufacturer documents, preservation requirements and as per the instructions of Engineer Incharge.

Note: Contractor to obtain prior approval of BHEL/NPCIL for all supplies in his scope.

1.3.16. 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 noncompliance of above and dual benefit to contractor of any govt announced scheme will be passed to the contractor.

1.3.17. 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.

1.3.18. 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

T&PS and MMEs TO BE DEPLOYED BY CONTRACTOR

1.4.1 The following indicative major 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.

SUGGESTIVE P&M LIST		
Sl. No.	**Description of Equipment**	**Tentative Qty (Nos)**
	Welding	
1	Welding machine	20
2	High frequency TIG welding machine	10
3	Orbital TIG welding machine	6
4	Condenser tube expander (5 roller)	As required
5	Tube cutter, tube end trimmer/facer for condenser tubes (set)	5
6	Pipe chamfering machine	As required
7	Pipe bending machine	As required
8	Grinding Machine	15
9	Mother oven	2
10	Portable oven	15
11	Transfer oven	2
12	De humidifier	As required
13	Plasma cutting machine	As required
14	Pug cutting machine	As required
15	Gas cutting set	10
16	Fitter tool kit	20
17	Engraving machine	As required
	NDT	
18	RT source with camera	2
19	X-ray machine	1
20	UT machine & instruments (Recordable type)	2
21	RT film Digitization equipment	As required
22	Vacuum box , vacuum pump along with accessories	As required
	Facilities	
23	DG set	1 no

24	Pickling facility	As required
25	Elcometer, Surface comparator	As required
	MHE and load carrier	
26	Mobile crane (75 T)	1
27	12 T to 20T Mobile Crane	2
28	Electric winch 10T	As required
29	Trailer 40 Feet	1
30	Tractor trailer upto 60 MT	1
	Rigging	
31	Hydraulic jacks 100T	2
32	Hydraulic jacks 50T	5
33	Hydraulic jacks 25T (button type)	8
34	Hydraulic jacks 10T (button type)	2
35	Hydraulic jacks 5T (button type)	2
36	Screw jack for condenser fill test	216
37	Chain pulley block (Upto 20 T)	As required
38	Wire rope slings up to 100 T capacity	As required
39	Web sling up to 100 T	As required
40	D- shackle	As required
41	Bow shackle	As required
42	Eye bolt	As required
43	Manila rope	As required
44	Skid roller	As required
45	Taper wedge jack for Turbine erection	240
46	Screw jacks	As required
	Machines	
47	Hand Drilling machine	As required
48	Insitu boss drilling machine	2
49	Air Compressor 400 cfm	2
50	Bench Grinding machine	1
51	Flexible grinding machine	3
52	Magnetic base surface grinding machine	1
53	Magnetic base drilling machine	1
54	Torque wrench	As required
55	Hydraulic torque wrench	As required
56	Induction heater for bolt tightening	1
57	Plate rolling machine	1
58	Radial drilling machine	1
59	Power hacksaw	1

	Testing and Measurements	
60	Maus gun G150	As required
61	Maus gun G650	As required
62	Surface plate (Master)	1
63	Surface plate (reference)	2
64	Surface plate (working)	As required
65	Water pot with micrometer	6
66	Dial gauges with magnetic base	25
67	Total station	As required
68	Dumpy level	As required
69	Freon sniffer	1
70	HV test kit	1
71	Outside micrometer up to 650 mm	As required
72	Inside micrometer up to 2000 mm	As required
73	3 pin micrometer	2
74	Straight edge	As required
75	Master level with micrometer	As required
76	Bore dial gauge	As required
77	Telescopic gauge	As required
78	Taper gauge	As required
79	Feeler gauge	As required
80	Feeler strips	As required
81	Go-No Go gauge 25mm range	As required
82	Pressure gauges	As required
83	Electric hydro test pump up to 250Kgf/cm^2	2
84	Theodalite	As required
85	Calibration test bench	1
86	Vernier calipers	As required
87	Boroscope for FME inspection	As required
	Concreting	
88	Jack hammer	As required
89	Hilti hammer/core drilling machines	As required
90	Concrete Core cutting machine	As required
91	Transit mixer, Vibrator	As required
	Grit blasting & Painting	
92	Compressor	2
93	Blasting Hopper	2
94	Spray Pump	2
95	Electrical Stirrer	1
96	Coating Pot	As required

97	Whirling Hygrometer	1
98	Infrared Thermometer	1
99	Dial Thickness Gauge	1
100	Salt Soluble Tester	1
101	DFT Gauge	1
102	Holiday Tester	1
103	Adhesion Tester	1
104	Multiple Gas Detector	1
	Miscellaneous	
105	Vacuum cleaner	As required
106	Silica gel regeneration oven	1
107	Pump Required for filling and flushing	1
108	Oil filling pumps	1
109	Hot Air blower	1
110	24V transformer	6
111	Dewatering pumps	4
112	Tapset, Dieset and Reamers	As required
113	Scaffolding set	As required
114	Plotter and printers	As required
115	Water tanker	As required
116	Lux Meter	1
117	Sound Meter	1
118	Exhaust fan	As required
119	Air Blower	As required
120	5KV Megger	1
121	Winding resistance Kit	1
122	Electrical clamp Meter	1
123	Turns ratio Meter	1
124	Multi Meter	1

1.4.2 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 major 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.

1.4.3 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.

1.4.4 Fill pumps of sufficient capacity shall be arranged by the contractor, wherever required, within quoted rates.

1.4.5 For testing pipelines necessary Hydraulic Test pumps/ Hand pumps are to be arranged by the contractor with in the quoted rates

1.4.6 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.

1.4.7 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, Rails etc. are to be arranged by the contractor.

1.4.8 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.

1.4.9 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.

1.4.10 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.

1.4.11 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.

1.4.12 In the event of non-mobilization of Cranes, Tools, Plants, Machinery, Equipment 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 at the risk and cost of the contractor. Actual expenses incurred by BHEL along with applicable overheads will be back charged to the contractor.

VOLUME-IA PART-I CHAPTER - V
ERECTION & TESTING FACILITIES TO BE PROVIDED BY NPCIL/BHEL

1.5.1 NPCIL will provide turbine hall crane 180/32 T, 15T crane & 20/5T TDFP crane without crane operator.

1.5.2 Shifting of heavy, critical and ODC equipments from NPCIL stores to delivery point is in the scope of NPCIL. **List attached in Annexure -1**

1.5.3 NPCIL will provide heavy duty crawler crane with operator free of cost for erection of special equipments such as De-aerator, Main condenser, LDB, LDP & LDF filters, MAV tank and MSR.

NOTE**:**

i. Unloading of heavy, critical and ODC equipment's at the delivery point is in the scope of the contractor. Heavy duty crawler crane will be provided by NPCIL for unloading, required T & P's and assist crane are in the scope of contractor. All lifting tools and tackles should be load tested and due clearance to be obtained from BHEL/NPCIL safety before put in use.

ii. Till availability of EOT crane, Erection work shall be carried out with Heavy duty crawler crane provided by NPCIL on sharing basis at free of cost with ENC concurrence. Detailed plan for the activities to be submitted by the contractor for requesting allocation/slots of the NPCIL crane. Allocation will be made on mutually agreed plan and review of progress.

iii. Contractor shall deploy qualified and experienced EOT Crane operator.

1.5.4 List of Erection &Testing facilities to be made available by BHEL to contractor at free of cost on sharable basis for execution of works within the scope of this tender are as below.

1.5.4.1 Valve testing Lab will be provided on sharing basis. However, shifting, handling & testing of valves to be carried out by contractor at his quoted rates. The contractor shall deploy experienced operator for this purpose at his cost.

1.5.4.2 Grit blasting & painting shed. Only empty shed will be provided by BHEL. Any partition required for Grit blasting & painting shed shall be carryout by the contractor at his cost. Grit blasting & painting equipment's are in the scope of contractor.

1.5.5 All the erection facilities mentioned in clause 1.6.4 above shall be provided to contractor on shareable basis and the allotment is made by BHEL on need basis for erection / pre-commissioning activities only.

1.5.6 Any other Tools & Plants, testing facilities. Measuring instruments which are required for satisfactory completion of the work has to be arranged by the contractor.

1.5.7 The Contractor shall be responsible for the safe and proper use of the above equipments issued to him. Day-to-day maintenance and operation of equipment's shall be the contractor's responsibility and shall be as per instructions / standard practice of BHEL Engineer

1.5.8 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.

1.5.9 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.

1.5.10 Contractor shall have at all times experienced operators and technicians for routine and breakdown maintenance of the equipment. Any delay in rectification of defects will warrant BHEL rectifying the defect and charging the cost to the contractor.

1.5.11 If at any time it is noticed that contractor is not using any of the facilities or equipment properly according to the instructions of BHEL, BHEL will have the right to withdraw any and all such equipment and facilities.

1.5.12 Any loss / damage to any or part of the above equipment's 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.

ANNEXURE -1

MAIN TG Package Unit 3 of KKNPP			
List of Heavy, Critical, ODC equipment's (Shifting by NPCIL from NPCIL stores to delivery point)			
S.no	**Description**	**Qty**	**Approx Wt (MT)**
A	**Main Turbine & its all assembly parts - MAA**		
1	HP outer cylinder (Upper)	1	37
2	HP outer cylinder (Lower)	1	47
3	HPC Right diaphragm holder of stage 5-right	1	7
4	HPC Left diaphragm holder of stage 5-left	1	7
5	HP rotor	1	42

6	Journal bushing Dia 574-III/Dia 450-II	1	31
7	LPR-2-HPR bearing frame	1	14
8	LP-1 rotor	1	92
9	LP-2 rotor	1	92
10	LP-3 rotor	1	92
11	L.P.C -1 cover front	1	28
12	L.P.C -1 cover rear	1	28
13	L.P.C -1 casing front	1	45
14	L.P.C -1 casing rear	1	45
15	LPC-1 Middle part inner cylinder (upper)	1	15
16	LPC-1 Middle part inner cylinder (lower)	1	18
17	LPC-1 (right) diaphragm stage 5	1	14
18	LPC-1 (left) diaphragm stage 5	1	14
19	Bearing pedestal -3	1	30
20	L.P.C -2 cover front	1	28
21	L.P.C -2 cover rear	1	28
22	L.P.C -2 casing front	1	45
23	L.P.C -2 casing rear	1	45
24	LPC-2 Middle part inner (upper) cover guide rings	1	15
25	LPC-2 Middle part inner (lower) cover guide rings	1	18
26	LPC-2 (right) diaphragm stage 5	1	14
27	LPC-2 (left) diaphragm stage 5	1	14
28	Bearing pedestal -4	1	30
29	L.P.C-3 cover front	1	28
30	L.P.C-3 cover rear	1	28
31	L.P.C-3 casing front	1	45
32	L.P.C-3 casing rear	1	45
33	LPC-3 Middle part inner (upper) cover guide rings	1	15
34	LPC-3 Middle part inner (lower) cover guide rings	1	18
35	LPC-3 (right) diaphragm stage 2	1	14
36	LPC-3 (left) diaphragm stage 5	1	14
37	Bearing pedestal -5	1	30
B	**Main Generator & its all assembly parts - MKA**		
1	Wound stator	1	366
2	Generator rotor	1	99
3	Stator winding bar	1	3
4	Bearing pedestal -6	1	17
5	Brushless Exciter	1	25
6	Input section	1	2

C	**Main Condenser & its all assembly parts - MAG**		
1	Tube board	1	14
2	Condenser Tube	1	25
3	Condenser Tube	1	26
4	Condenser Tube	1	25
5	Condenser Tube	1	25
6	Condenser Tube	1	24
7	Condenser Tube	1	24
8	Condenser Tube	1	25
9	Condenser Tube	1	24
10	Condenser Tube	1	25
11	Condenser Tube	1	26
12	Condenser Tube	1	26
13	Condenser Tube	1	25
14	Condenser Tube	1	24
15	Condenser Tube	1	25
16	Condenser Tube	1	25
17	Condenser Tube	1	24
18	Condenser Tube	1	25
19	Condenser Tube	1	25
20	Condenser Tube	1	25
21	Condenser Tube	1	25
22	Condenser Tube	1	25
23	Condenser Tube	1	25
24	Tube system upper part	1	38
25	Tube system lower part	1	30
26	Tube system upper part	1	38
27	Tube system lower part	1	30
28	Tube board	1	14
29	Tube system upper part	1	41
30	Tube system lower part	1	31
31	Tube board	1	14
32	Tube system upper part	1	38
33	Tube system lower part	1	30
34	Tube board	1	14
35	Tube system upper part	1	38
36	Tube system lower part	1	30
37	Tube board	1	14
38	Tube system upper part	1	38
39	Tube system lower part	1	30
40	Tube board	1	14

41	Water chamber	1	23
42	Water chamber	1	24
43	Water chamber	1	24
44	Water chamber	1	23
45	Water chamber	1	22
46	Water chamber	1	22
47	Water chamber	1	23
48	Water chamber	1	24
49	Water chamber	1	24
50	Water chamber	1	23
51	Water chamber	1	22
52	Water chamber	1	22
53	Block of connection branch pipe	1	24
54	Block of connection branch pipe	1	24
55	Block of connection branch pipe	1	19
56	Block of connection branch pipe	1	35
57	Block of connection branch pipe	1	19
58	Block of connection branch pipe	1	24
59	Block of connection branch pipe	1	24
60	Block of connection branch pipe	1	19
61	Block of connection branch pipe	1	35
62	Block of connection branch pipe	1	19
63	Block of connection branch pipe	1	24
64	Block of connection branch pipe	1	24
65	Block of connection branch pipe	1	19
66	Block of connection branch pipe	1	34
67	Block of connection branch pipe	1	19
68	Branch	1	1
D	**Deaerator column & Tank & assembly parts - LAA**		
1	Deaerator Tank	1	70
2	Deaerator Tank	1	80
3	Deaerator Column	1	72
E	**LP Heaters**		
1	Hydraulic back pressure valve (Hydro lock)	1	7
F	**Mositure Seperator Re-heater (MSR)**		
1	Moisture seperator unit - LBJ10	1	50
2	Re-heater unit - LBJ10	1	101
3	Moisture seperator unit - LBJ20	1	50

4	Re-heater unit - LBJ20	1	101
5	Moisture seperator unit - LBJ30	1	50
6	Re-heater unit - LBJ30	1	101
7	Moisture seperator unit - LBJ40	1	50
8	Re-heater unit - LBJ40	1	101
G	**TDFP - Turbine - XAC**		
1	Turbine casing Exhaust section - Lower half	1	15
2	Lube oil tank - XAC10BB001	1	5
3	Oil pump unit	1	7
H	Regeneration filter - LDP10AT001	1	8
	Regeneration filter - LDP20AT001	1	8
J	H- Cation Filter - LDF	1	14
K	Lube oil tank - MAV10BB001	1/2	2
	Lube oil tank - MAV10BB001	2/2	21
TOTAL		**131**	**4280**

VOLUME-IA PART-I CHAPTER - VI
TIME SCHEDULE

1.6.1 TIME SCHEDULE

1.6.1.1. The entire work of Erection work of Turbine, Generator, Condenser and piping including painting, and structural steel works in Turbine Buildings of KKNPP Unit 3 shall be completed within 40 (Forty) months from the date of commencement of work at site.

1.6.1.2. 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.

1.6.1.3. 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.

1.6.1.4. 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.

1.6.2 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.

1.6.3 MOBILISATION FOR ERECTION AND TESTING

1.6.3.1. The activities for erection, testing etc shall be started as per directions of Construction Manager of BHEL.

1.6.3.2. 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.

1.6.4 TENTATIVE MILESTONE SCHEDULE FOR UNIT 3

Sl. No.	Milestone Description	Milestone Month (Tentative)
1	Start of condenser erection	1st Month
2	Erection of MSR	3rd Month
3	Start of Turbine erection	6th Month
4	Erection of Deaerator	10th Month
5	Erection & assembly of condensate pumps (LCB)	15th Month
6	Completion of erection of TDFP & Feed pumps **(M1)**	20th Month
7	Erection of condenser cooling water pumps (PAC) and PEC & PCC pumps	31st Month
8	Completion of erection & assembly of Main condenser **(M2)**	35th Month
9	Completion of erection & assembly of Main Turbine & Its auxiliaries	38th Month
10	Completion of erection & assembly of generator & Its auxiliaries	38th Month
11	TG barring gear	39th Month

1.6.4.1. 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.

1.6.4.2. 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.

1.6.5 MAJOR INTERMEDIATE MILESTONES

Sl. No.	Intermediate Milestone Description	Intermediate Milestone Month (Tentative)	Intermediate Milestone
1	Completion of erection of TDFP & Feed pumps **(M1)**	20th Month	**M1**
2.	Completion of erection & assembly of Main condenser **(M2)**	35th Month	**M2**

Note: Please refer Sl No. 7 Part II Chapter-1 of Technical Conditions of Contract (Volume 1A of Volume I Book I) for Penalty for Intermediate Milestones

1.6.6 CONTRACT PERIOD

The contract period for completion of entire work under scope shall be **40 months** from the "COMMENCEMENT OF CONTRACT PERIOD" as specified earlier for completion of the entire work under this package.

1.6.7 GUARANTEE PERIOD

Guarantee period of Twelve (12) 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 - VII
TERMS OF PAYMENT

1.7.1 **Secured Advance**
Not applicable

1.7.2 **Advance for Mobilization**
Not applicable

1.7.3 Total lump sum rate, mentioned in rate schedule of this package is divided as below:

Sl No	Description of Major Item	Weightage in %
1	**Main Turbine** (In case BHEL / NPCIL decided to de-preservation of all the internal components of Main Turbine & re-preservation with required preservatives before box-up and heat tightening of HP turbine studs are not required to be carried out and permitted for temporary box-up . In such instance, 5% of item weightage will be deducted. i.e Max allowable % for this item is 23.75%)	**25**
2	**Valve blocks**	**4**
3	**MSR**	**3.5**
4	**Sheathing covers for Turbine, Generator & Exciter**	**1**
5	**Turbine drive feed pumps**	**4**

Sl No	Description of Major Item	Weightage in %
6	Generator and Excitation system	9
7	Main Condenser	24
8	TDFP condenser	1
9	Deaerator tank & column (Vertical)	1.5
10	HPH and LPH	1
11	Fire Extinguishing Grid	1
12	Rotary Equipments	6
13	Static equipment	6
14	Integral Piping/Cross over piping/ Structural steel/SS liner works	8
15	Painting/concreting / Manpower assistance	5
TOTAL		100

1.7.4 The following percentage of weightage will be paid on submission of respective reports along with RA bill after completion of relevant activities of the work and acceptance of Engineer -in- Charge.

S.NO	Terms of Payment for major items (Payment is on Pro-rata basis)						
1	Main Turbine	**Weightage 25%**					
		The following percentage of weightage will be paid on submission of respective reports along with RA bill after completion of relevant activities of the work and acceptance of Engineer -in- Charge.					
	Stage	**1**	**2**	**3**	**4**	**5**	
	Work	**2%**	**5x1=5%**	**3x5=15%**	**4%**	**5%**	
	Erection of Main Turbine	2nd stage EP blue matching Report	Placement of all the bearing pedestals over the temporary packers , KLT of bearing casings	Assembly of LPC casing including the permanent vertical joint with the application of steam mastic compound	Placement of HPC bottom and top half over the palm keys	Laser alignment centering of all the cylinder casing, bearing pedestal casing	
		6	**7**	**8**	**9**	**10**	
		3x1=3%	**1%**	**3%**	**3x2=6%**	**2%**	
		Centering of LP cylinder bottom half components	Centering of HP cylinder bottom half components	Coupling alignment of all the rotors	Placement and centering of LP cylinder top half components including inner casing	Placement and centering of HP cylinder top half components including inner casing	
		11	**12**	**13**	**14**	**15**	
		3%	**3x3=9%**	**2%**	**3%**	**3x3=9%**	
		Preliminary box up of HP cylinder	Preliminary box up of all the LP cylinders	Erection and alignment of governing system components	Response check of TSI	Final box up of all the LP cylinders	

		16	**17**	**18**	**19**	**20**	**21**
		6%	**4%**	**3%**	**5%**	**5%**	**5%**
		Final box up of HP turbine & heat tightening	Final coupling alignment and coupling of all the rotors after deck floating	Final box up of all the bearing pedestals	Barring gear	CCC	Material Accounting Statement
2	**Valve blocks**	**Weightage 4%**					
		The following percentage of weightage will be paid on submission of respective reports along with RA bill after completion of relevant activities of the work and acceptance of Engineer -in- Charge.					
	Stage	**1**	**2**	**3**	**4**	**5**	**6**
	Work	**30%**	**30%**	**20%**	**10%**	**5%**	**5%**
	Erection of Valve Blocks	Erection, alignment and grouting	Disassembly and de-preservation	Blue matching of components and reassembly of valve block	Installation of servomotor, limit switch and coupling.	CCC	Material Accounting Statement
3	**MSR**	**Weightage 3.5%**					
		The following percentage of weightage will be paid on submission of respective reports along with RA bill after completion of relevant activities of the work and acceptance of Engineer -in- Charge.					
	Stage	**1**	**2**	**3**	**4**	**5**	**6**
	Work	**30%**	**30%**	**20%**	**10%**	**5%**	**5%**
	Erection of MSR	Assembly, erection, welding and NDT of Moisture separator and segregator	Assembly, erection, welding and NDT of Re-Heater	Hydro test and Drying of MSR	FME inspection and box up of MSR	CCC	Material Accounting Statement

4	**Sheathing covers for Turbine, Generator & Exciter**	**Weightage 1%**					
		The following percentage of weightage will be paid on submission of respective reports along with RA bill after completion of relevant activities of the work and acceptance of Engineer -in- Charge.					
	Stage	**1**	**2**	**3**	**4**	**5**	**6**
	Work	**20%**	**20%**	**20%**	**20%**	**10%**	**5%**
	Erection of sheathing covers (Noise enclosures) for Turbine, Generator & Exciter	Assembly, welding and erection of HPC cover	Assembly, welding and erection of cover between LPC	Assembly, welding and erection of cover of LPC middle part	Assembly, welding and erection of cover of generator and exciter	Final installation of HPC cover, cover between LPC and middle part of LPC after completion of insulation works	CCC
		7					
		5%					
		Material Accounting Statement					
5	**Turbine drive feed pumps**	**Weightage 4%**					
		The following percentage of weightage will be paid on submission of respective reports along with RA bill after completion of relevant activities of the work and acceptance of Engineer -in- Charge.					
	Stage	**1**	**2**	**3**	**4**	**5**	**6**
	Work	**2%**	**10%**	**10%**	**5%**	**5%**	**10%**
	Erection of TDFP	Blue matching of packer plates	Erection of foundation frames	Assembly of HP & LP casing	Placement of bearing pedestal, centering of cylinder casing	Placement and centering of cylinder bottom half components	Placement of rotor and centering of casing w.r.t. rotor

		7	**8**	**9**	**10**	**11**	**12**
		5%	**10%**	**5%**	**10%**	**3%**	**5%**
		Placement and centering of cylinder top half components	Preliminary box up of casing, dynamometer loading of casing	Installation of field control panel and field calibration of TSI	Final box up of cylinders including heat tightening of the parting plane bolts	Installation and alignment of Reduction gear unit	Final coupling alignment and coupling of the rotors after deck floating
		13	**14**	**15**	**16**	**17**	
		3%	**2%**	**5%**	**5%**	**5%**	
		Erection and alignment of governing system components	Completion of final box up of the bearing pedestals after oil flushing	TDFP on barring gear	CCC	Material Accounting Statement	
6	**Generator and Excitation system**	**Weightage 9%**					
		The following percentage of weightage will be paid on submission of respective reports along with RA bill after completion of relevant activities of the work and acceptance of Engineer -in- Charge.					
	Stage	**1**	**2**	**3**	**4**	**5**	
	Work	**2%**	**2%**	**3%**	**10%**	**4%**	
	Erection of Generator & Exciter	2nd stage EP blue matching Report	Fixing of Trunnion	Centering of end parts	Erection of stator	HT of H2 Coolers	
		6	**7**	**8**	**9**	**10**	
		3%	**5%**	**3%**	**5%**	**3%**	
		Assy of end part with stator	Air hold test of stator	HV test Report of bushing	HV test Report of Stator	KLT of bearing pedestal & HT of EOT	
		11	**12**	**13**	**14**	**15**	
		2%	**5%**	**2%**	**5%**	**5%**	
		Purge test of rotor	Threading of rotor	Placement of bearing pedestal	Installation of permanent packer	Installation of bank of resistors	

		16	**17**	**18**	**19**	**20**	
		3%	**2%**	**10%**	**6%**	**3%**	
		Reaming & honing	Exciter air cooler HT	Assy & Installation of Exciter	Pendulum check & Coupling	TSI & response checks	
		21	**22**	**23**	**24**		
		5%	**2%**	**5%**	**5%**		
		Box up of generator & exciter	Box up of bearing pedestals	CCC	Material Accounting Statement		
7	**Main Condenser**	**Weightage 24%**					
		The following percentage of weightage will be paid on submission of respective reports along with RA bill after completion of relevant activities of the work and acceptance of Engineer -in- Charge.					
	Stage	**1**	**2**	**3**	**4**	**5**	
	Work	**Completed**	**3x4= 12%**	**3x4=12%**	**3x5=15%**	**3x8=24%**	
	Erection of Main Condenser	Welding Inspection Report, Erection Report, NDT Report of hot well	Welding Inspection Report, Erection Report, NDT Report of Tube System	Welding Inspection Report, Erection Report, NDT Report of Sidewall plates	WIR,ER, NDT Report of Lower & upper dome	WIR,ER, NDT & Integrity test Report of Tubing works	
		6	**7**	**8**	**9**	**10**	
		3x3=9%	**3x3=9%**	**3x3=9%**	**5%**	**5%**	
		WIR,ER, NDT Report of neck welding with Turbine	WIR,ER of Water box	Hydrofill test Report	CCC	Material Accounting Statement.	
8	**TDFP condenser**	**Weightage 1%**					
		The following percentage weightage will be paid on submission of respective reports along with RA bill after completion of relevant activities of the work and acceptance of Engineer -in- Charge.					

	Stage	**1**	**2**	**3**	**4**	**5**	
	Work	**Completed**	**40%**	**50%**	**5%**	**5%**	
	Erection of TDFP condenser	Erection Report	Neck welding IR	Hydrofill test Report	CCC	Material Accounting Statement.	
9	**Erection and assembly of Deaerator tank & column (Vertical)**	**Weightage 1.5%**					
		The following percentage of weightage will be paid on submission of respective reports along with RA bill after completion of relevant activities of the work and acceptance of Engineer -in- Charge.					
	Stage	**1**	**2**	**3**	**4**	**5**	
	Work	**30%**	**30%**	**20%**	**10%**	**5%**	
	Erection and assembly of Deaerator tank & column (Vertical)	Assembly, erection, welding and NDT of De-aerator tank	Assembly, erection, welding and NDT of De-aerator column	Hydro test and drying of Deaerator	Completion of FME inspection & box up	CCC	
		6					
		5%					
		Material Accounting Statement.					
10	**HPH and LPH**	**Weightage 1%**					
		The following percentage of weightage will be paid on submission of respective reports along with RA bill after completion of relevant activities of the work and acceptance of Engineer -in- Charge.					
	Stage	**1**	**2**	**3**	**4**	**5**	
	Work	**Completed**	**30%**	**60%**	**5%**	**5%**	
	Erection of HPH and LPH	Erection of the heaters over the foundation pedestal, verticality check and torque tightening of foundation bolts	Completion of mounting of accessories, instruments	Completion of hydro test, FME inspection & box up	CCC	Material Accounting Statement.	

11	**Erection of Fire Extinguishing Grid**	**Weightage 1%**					
		The following percentage of weightage will be paid on submission of respective reports along with RA bill after completion of relevant activities of the work and acceptance of Engineer -in- Charge.					
	Stage	**1**	**2**	**3**	**4**	**5**	
	Work	**2 x 15 = 30%**	**2 x 20 = 40%**	**20%**	**5%**	**5%**	
	Erection of Fire Extinguishing Grid	Completion of fire extinguishing grid erection in TDFP oil tank room	Completion of fire extinguishing grid erection in oil cooler area	Completion of fire extinguishing grid erection in turbine governing oil tank area	CCC	Material Accounting Statement.	
12	**Rotary equipments**	**Weightage 6%**					
		The following percentage of weightage will be paid on submission of respective reports along with RA bill after completion of relevant activities of the work and acceptance of Engineer -in- Charge.					
	Stage	**1**	**2**	**3**	**4**	**5**	
	Work	**10%**	**45%**	**35%**	**5%**	**5%**	
	Erection of Rotary equipments	Handling, transportation, de-preservation, preparation of IMIR and submission of approved reports	Handling, assembly, erection, alignment, fit up, inspection, submission of reports and acceptance by Engineer.	Completion of welding, inspection, testing, submission of relevant reports & acceptance of the Engineer.	submission and acceptance of CCC	Material Accounting Statement.	

13	**Static equipments**	**Weightage 6%**					
		The following percentage of weightage will be paid on submission of respective reports along with RA bill after completion of relevant activities of the work and acceptance of Engineer -in- Charge.					
	Stage	**1**	**2**	**3**	**4**	**5**	
	Work	**10%**	**45%**	**35%**	**5%**	**5%**	
	Erection of Static equipments	Handling, transportation, de-preservation, preparation of IMIR and submission of approved reports	Handling, assembly, erection, alignment, fit up, inspection, submission of reports and acceptance by Engineer.	Completion of welding, inspection, testing, submission of relevant reports & acceptance of the Engineer.	submission and acceptance of CCC	Material Accounting Statement.	
14	**Integral Piping/Cross over piping/ Structural steel work**		**Weightage 8%**				
			The following percentage of weightage will be paid on submission of respective reports along with RA bill after completion of relevant activities of the work and acceptance of Engineer -in- Charge.				
	Stage		**1**	**2**	**3**	**4**	
	Work		**70%**	**20%**	**5%**	**5%**	
	14.1	**Integral Piping (Weightage 3%)**	Erection report, welding report	NDT & Flushing Report	submission and acceptance of CCC	Material Accounting Statement.	
	14.2	**Cross over Piping (Weightage 3%)**	Erection report, welding report	CRR and FME Inspection	submission and acceptance of CCC	Material Accounting Statement.	
	14.3	**Fabrication, erection of Pipe supports/ metal structures / platforms/SS liner works (Weightage 2%)**	Fabrication report	Erection report, welding report	submission and acceptance of CCC	Material Accounting Statement.	

15	**Painting/concreting / Manpower assistance**		**Weightage 5%** The following percentage of weightage will be paid on submission of respective reports along with RA bill after completion of relevant activities of the work and acceptance of Engineer -in- Charge.				
	Stage		**1**	**2**			
	Work		**95%**	**5%**			
	15.1	**Painting (weightage 2%)**	Painting & inspection Report	submission and acceptance of CCC			
	15.2	**Concreting/grouting (weightage 2%)**	Concreting/Grouting Report	submission and acceptance of CCC			
	15.3	**Manpower assistance (weightage1%)**	FIM Repair/ preservation/ pre handing over check Repot (100%)				

NOTE: For Performance Security Deposit, please refer Sl No. 16 of Technical Conditions of Contract (Volume- I Book- I) Part II Chapter 1: Corrections/ Revisions in Special Conditions of Contract, General Conditions of Contract and Forms & Procedures.

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

1.8.1 Goods and Service Tax (GST) & Cess

1.8.1.1 The successful bidder shall furnish proof of GST registration with GSTN Portal in the State in which the Project is being executed, covering the 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.

1.8.1.2 Contractor's price/rates shall be exclusive of GST & Cess (if applicable) (herein after termed as GST). Contractor shall submit to BHEL the GST compliant tax invoice/debit note/revised tax invoice on the basis of which BHEL will claim the input tax credit in its return. Since this is a works contract, the applicable rate shall be @ 18% GST, as applicable presently

1.8.1.3 Bidder shall note that the GST Tax Invoice complying with GST Invoice Rules wherein the 'Bill To' details will as below:

BHEL GSTN- 33AAACB4146P2ZL
NAME - BHARAT HEAVY ELECTRICALS LIMITED
ADDRESS - KUDANKULAM NUCLEAR POWER PROJECT, UNIT 3 & 4, 2X 1000 MWe KUDANKULAM PO, RADHAPURAM TALUK, TIRUNELVELI DISTRICT, TAMILNADU - 627106

1.8.1.4 GST charged in the tax invoice/debit note/revised tax invoice by the contractor shall be released separately to the contractor only after contractor files the outward supply details in GSTR-1 on GSTN portal and input tax credit of such invoice is matched with corresponding details of outward supply of the contractor and has paid the GST at the time of filing the monthly return.

1.8.1.5 In case BHEL has to incur any liability (like interest / penalty etc.) due to denial/reversal / delay of input tax credit in respect of the invoice submitted by the contractor, for the reasons attributable to the contractor, the same shall be recovered from the contractor.

1.8.1.6 Further, in case BHEL is deprived of the Input tax credit due to any reason attributable to contractor, the same shall not be paid or Recovered if already paid to the contractor.

1.8.1.7 Tax invoice/debit Note/revised tax invoice shall contain all such particulars as prescribed in GST law and comply to the timelines for issue of the same. Invoices shall be submitted on time to the concerned BHEL Engineer In Charge.

1.8.1.8 TDS under GST (if/ as & when applicable) shall be deducted at prevailing rates on gross invoice value from the running bills.

1.8.1.9 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 Contractor only.

1.8.1.10 BHEL shall not reimburse any amounts towards any interest / penalty etc., incurred by contractor. Any additional claim at a later date due to issues such as wrong rates / wrong classification by contractor shall not be paid by BHEL.

1.8.2 All taxes and duty other than GST & Cess

The contractor shall pay all (except the specific exclusion viz GST & Cess) taxes, fees, license charges, deposits, duties, tools, royalty, commissions, Stamp Duties, or other charges / levies, which may be levied on the input goods & 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.

1.8.3 Statutory Variations

Statutory variations are applicable under the GST Acts, against production of proof. The changes implemented by the Central / State Government during the tenure of the contract viz. increase / decrease in the rate of taxes, applicability, etc. and its impact on upward revision / downward revision are to be suitably paid/ adjusted from the date of respective variation. The bidder shall give the benefit of downward revision in favour of BHEL. No other variations shall be allowed during the tenure of the contract.

1.8.4 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.

1.8.5 Direct Tax

BHEL shall not be liable towards Income Tax of whatever nature including variations thereof arising out of this contract as well as tax liability of the bidder and their personnel. Deduction of tax at source at the prevailing rates shall be effected by BHEL before release of payment as a statutory obligation, unless exemption certificate is produced by the bidder. TDS certificate will be issued by BHEL as per the provisions of Income Tax Act.

VOLUME-IA PART-I CHAPTER -IX
BILL OF QUANTITY

TENTATIVE WEIGHT SCHEDULE FOR KUDANKULAM
TG MAIN PACKAGE WORKS IN UNIT 3

1. KUDANKULAM - UNIT 3 MAIN TG PACKAGE TENTATIVE WEIGHT SCHEDULE			
SL NO	**DESCRIPTION**	**UOM**	**Approx WT**
1	Main Turbine & Auxilaries, TDFP Turbine, MSR and Sheathing Covers (Schedule-A)	MT	2272
2	Generator and Excitation system (Schedule-B)	MT	610
3	Main Condenser (Schedule-C)	MT	1566
4	Rotary Equipments (Schedule-D)	MT	1093
5	De-Aerator and Other Static Equipment (Schedule-E)	MT	720
6	Turbine Integral Piping, Valves, Valve Blocks & Cross Over Piping (Schedule-F)	MT	695
7	Structural steel (BHEL supply)	MT	272
8	SS liner works (BHEL supply)	MT	8
Total		**MT**	**7236**

NOTE:

1. The weight indicated above is approximate and there may be a variation in weight of equipment's.
2. A lump sum price is to be quoted in the price bid for STG system consisting of all equipments detailed under **Weight Schedule** of this chapter that shall also cover works like cross over & integral piping, structural steel works and Misc works
3. The Lump sum quoted value for Erection Works shall include the Variation of +15% (Fifteen percent) in total indicated weight. In case of variation in weight beyond +15%, the quantity exceeding +15% of the tendered quantity will be paid at the average tonnage rate arrived at by dividing the lump sum quoted/accepted value by 115% of total indicated weight.

2.MISC WORKS			
SL NO	**DESCRIPTION**	**UOM**	**QTY (Approx)**
1	Manpower assistance for Repair Re-preservation and System Pre-handing over checks:		
a	Skilled Man power operation	Operation Day	800
b	Semi-Skilled Man power operation	Operation Day	1000
c	Un-Skilled Man power operation	Operation Day	1200
2	Plain Cement Concrete	Cubic Meter	175
3	Grouting by non-shrink Grout	Cubic Meter	150
4	Secondary Concrete	Cubic Meter	100
5	Grit blasting and Painting Works of Piping, Structures & Equipments	SQ.M	32000
6	Supply, machining of permanent packer plates and shims for all equipments	Lot	01
7	Supply and filling of Silica gel - Indicative and Regenerative Type	KG	1250
8	Supply and filling ofSilica gel- Non Indicative and Regenerative Type	KG	1250
9	Supply and covering of Polythene sheets - Size 36 inch width X 2 fold in LDPE	KG	1200

Sl no (2,3,4,5,6) list of Misc works are tentative and approximate. The quantity required to complete the entire package shall be carried out by the contractor with in the lump sum quoted value.

Sl no (1a, 1b, 1c, 7, 8, 9) Manpower operation, Silica gel & Polythene sheets are limited to the quantity as mentioned above.

List of Equipments in Nos. & MT (system wise & type wise) as FIM in KUDANKULAM - UNIT 3 MAIN TG PACKAGE									
Sr. No.	**SCH**	**KKS Code of the Equipment**	**Equipment Description**	**Category of Equipment**	**Type of Equipment**	**Location of the equipment**	**Horizontal/ Vertical**	**Weight of Equipment (Approx)**	**Quantity**
				Rotary or Static	**Pump/HX/ Filter/Tank/ Turbine etc**	**KKS code of Building / Elevation**		**MT**	**Nos.**
1	A	MAA	HP Turbine	Rotary	Turbine	UMA16	Horizontal	268.466	1
2	A	MAC	LP Turbine	Rotary	Turbine	UMA16	Horizontal	1171.521	3
3	A	XAC10AN001	Turbine drive of feed water pump	Rotary	Turbine	UMA+6.000	Horizontal	46.919	1
4	A	XAC20AN001	Turbine drive of feed water pump	Rotary	Turbine	UMA+6.000	Horizontal	46.919	1
5	A	LBJ10AT001	Moisture Seperator Re-Heater	Static	Filter	UMA0	Horizontal	175.8	1
6	A	LBJ20AT001	Moisture Seperator Re-Heater	Static	Filter	UMA0	Horizontal	175.8	1
7	A	LBJ30AT001	Moisture Seperator Re-Heater	Static	Filter	UMA0	Horizontal	175.8	1
8	A	LBJ40AT001	Moisture Seperator Re-Heater	Static	Filter	UMA0	Horizontal	175.8	1
9	A		sheathing covers (Noise en closures) for Turbine, Gener ator & Exciter					35.000	1
10	B	MKA	Generator/Exciter	Static	Generator	UMA16	Horizontal	610	1
11	C	MAG10AC001	Main condenser (Except Hotwell)	Static	HX	UMA0	Horizontal	522	1
12	C	MAG20AC001	Main condenser (Except Hotwell)	Static	HX	UMA0	Horizontal	522	1

13	C	MAG30AC001	Main condenser (Except Hotwell)	Static	HX	UMA0	Horizontal	522	1
14	D	LAC10AP001	Booster feedwater pump	Rotary	Pump	UMA+6.000	Horizontal	8.2	1
15	D	LAC10AP002	Main feedwater pump	Rotary	Pump	UMA+6.000	Horizontal	19.95	1
16	D	LAC20AP001	Booster feedwater pump	Rotary	Pump	UMA+6.000	Horizontal	8.2	1
17	D	LAC20AP002	Main feedwater pump	Rotary	Pump	UMA+6.000	Horizontal	19.95	1
18	D	LAC30AP001	Standby electric feedwater pump	Rotary	Pump	UMA+6.000	Horizontal	24.63	1
19	D	LAC40AP001	Standby electric feedwater pump	Rotary	Pump	UMA+6.000	Horizontal	24.63	1
20	D	LAJ01AP001	Auxiliary feedwater pump	Rotary	Pump	UMA+6.000	Horizontal	7.337	1
21	D	PAC10AP001	Main condensor cooling water pump	Rotary	Pump	UQA, -7.0 to +7.85	Vertical	61	1
22	D	PAC20 AP001	Main condensor cooling water pump	Rotary	Pump	UQA, -7.0 to +7.85	Vertical	61	1
23	D	PAC 30 AP001	Main condensor cooling water pump	Rotary	Pump	UQA, -7.0 to +7.85	Vertical	61	1
24	D	PAC40AP001	Main condensor cooling water pump	Rotary	Pump	UQA, -7.0 to +7.85	Vertical	61	1
25	D	PAC 50 AP001	Main condensor cooling water pump	Rotary	Pump	UQA, -7.0 to +7.85	Vertical	61	1
26	D	PAC60AP001	Main condensor cooling water pump	Rotary	Pump	UQA, -7.0 to +7.85	Vertical	61	1
27	D	LCB11AP001	Electric 1-st stage condensate pump	Rotary	Pump	UMA-5.170	Vertical	21.1	1
28	D	LCB12AP001	Electric 1-st stage condensate pump	Rotary	Pump	UMA-5.170	Vertical	21.1	1
29	D	LCB13AP001	Electric 1-st stage condensate pump	Rotary	Pump	UMA-5.170	Vertical	21.1	1

30	D	LCB41AP001	Second stage condensate electric pump	Rotary	Pump	UMA-5.170	Vertical	23.4	1
31	D	LCB42AP001	Second stage condensate electric pump	Rotary	Pump	UMA-5.170	Vertical	23.4	1
32	D	LCB43AP001	Second stage condensate electric pump	Rotary	Pump	UMA-5.170	Vertical	23.4	1
33	D	LDB10AP001	Contaminated condensate pump	Rotary	Pump	UMA-6.350	Horizontal	1.455	1
34	D	LDB10AP002	Contaminated condensate pump	Rotary	Pump	UMA-6.350	Horizontal	1.455	1
35	D	LDP10AP001	Sulphuric acid dosing pumpwith electric motor with blowing cap	Rotary	Pump	UMA+0.600	Horizontal	0.136	1
36	D	LDP10AP002	Sulphuric acid dosing pumpwith electric motor with blowing cap	Rotary	Pump	UMA+0.600	Horizontal	0.136	1
37	D	LDP20AP001	Caustic soda / Alkali dosing pump with electric motor with blowing cap	Rotary	Pump	UMA+0.600	Horizontal	0.139	1
38	D	LDP20AP002	Caustic soda / Alkali dosing pump with electric motor with blowing cap	Rotary	Pump	UMA+0.600	Horizontal	0.139	1
39	D	LDP30AP001	Ammonia dosing pump with electric motor with blowing cap	Rotary	Pump	UMA+0.600	Horizontal	0.156	1
40	D	LDP30AP002	Ammonia dosing pump with electric motor with blowing cap	Rotary	Pump	UMA+0.600	Horizontal	0.156	1
41	D	LDP40AP001	Drain tank pump (submersible)	Rotary	Pump	UMA-5.375	Vertical	0.3	1

42	D	LDP40AP002	Drain tank pump (submersible)	Rotary	Pump	UMA-5.375	Vertical	0.3	1
43	D	LDR40AP001	Loosening waters pump with electric motor АИМ180S2 N=22 kWт n=2900 rpm. X 80-50-200-К-5 Q=50 m3/h H=0,5 MPA	Rotary	Pump	UMA-6.650	Horizontal	0.32	1
44	D	LDR40AP002	Loosening waters pump with electric motor АИМ180S2 N=22 kWт n=2900 rpm. X 80-50-200-К-5 Q=50 m3/h H=0,5 MPA	Rotary	Pump	UMA-6.650	Horizontal	0.32	1
45	D	QUC31AP001	Pump with electric motor AIR63A4 N=0,25	Rotary	Pump	UMA-6.790	Vertical	0.065	1
46	D	QUC32AP001	Pump with electric motor AIR63A4 N=0,26	Rotary	Pump	UMA-6.790	Vertical	0.065	1
47	D	QUC33AP001	Pump with electric motor AIR63A4 N=0,27	Rotary	Pump	UMA-6.790	Vertical	0.065	1
48	D	QUC34AP001	Pump with electric motor AIR63A4 N=0,28	Rotary	Pump	UMA-6.790	Vertical	0.065	1
49	D	QUC35AP001	Pump with electric motor AIR63A4 N=0,25 кВт	Rotary	Pump	UMA-6.790	Vertical	0.065	1
50	D	QUC36AP001	Pump with electric motor AIR63A4 N=0,30	Rotary	Pump	UMA-6.790	Vertical	0.065	1
51	D	MKW01AP001	Seal oil supply pump	Rotary	Pump	UMV +0.200	Vertical	0.201	1

52	D	MKW02AP001	Seal oil supply pump	Rotary	Pump	UMV +0.200	Vertical	0.201	1
53	D	MKW03AP001	Seal oil supply pump	Rotary	Pump	UMV +0.200	Vertical	0.201	1
54	D	XAV10AP001	pump oil block	Rotary	Pump	UMA-6.750	Horizontal	1.066	1
55	D	XAV10AP002	pump oil block	Rotary	Pump	UMA-6.750	Horizontal	1.066	1
56	D	XAV10AP003	regulating pump	Rotary	Pump	UMA-6.750	Horizontal	1.385	1
57	D	XAV10AP006	Recirculation pump	Rotary	Pump	UMA+0.100	Horizontal	0.115	1
58	D	XAV20AP001	pump oil block	Rotary	Pump	UMA-6.750	Horizontal	1.066	1
59	D	XAV20AP002	pump oil block	Rotary	Pump	UMA-6.750	Horizontal	1.066	1
60	D	XAV20AP003	Regulatingpump	Rotary	Pump	UMA-6.750	Horizontal	1.385	1
61	D	XAV20AP006	Recirculation pump	Rotary	Pump	UMA+0.100	Horizontal	0.115	1
62	D	LCM04AP001	Pump of low point tank	Rotary	Pump	UMA-5.645	Vertical	0.360	1
63	D	LCM05BN001	Water jet pump	Rotary	Pump	UMA-6.598	Horizontal	0.025	1
64	D	MAK11AP001	Jack oil pump	Rotary	Pump	UMV 8.100	Vertical	1.75	1
65	D	MAK12AP001	Jack oil pump	Rotary	Pump	UMV 8.100	Vertical	1.75	1
66	D	MAV11AP001	Lube Oil pump	Rotary	Pump	UMV 8.100	Vertical	0.665	1
67	D	MAV12AP001	Lube Oil pump	Rotary	Pump	UMV 8.100	Vertical	0.665	1
68	D	MAV13AP001	Lube Oil pump	Rotary	Pump	UMV 8.100	Vertical	1.5	1
69	D	MVA27AP001	Used oil pump HMIII5-25-4/4B-1-T2	Rotary	Pump	UMV0	Horizontal	0.081	1
70	D	MVA70AP001	Used oil pump HMIII5-25-4/4B-1-T2	Rotary	Pump	UMV 3.900	Horizontal	0.081	1
71	D	MVB20AP001	Pump for oil filtration and circulation	Rotary	Pump	UMV 8.100	Horizontal	0.24	1
72	D	MVC23AP001	Pump for oil filtration and circulation	Rotary	Pump	UMV3	Horizontal	0.09	1
73	D	MVD24AP001	Pump for governing system oil filter& circulation	Rotary	Pump	UMV 0.000	Horizontal	0.09	1
74	D	LCP10AP001	Demineralized water pump	Rotary	Pump	UMA-6.25	Horizontal	2.35	1
75	D	LCP20AP001	Demineralized water pump	Rotary	Pump	UMA-6.25	Horizontal	2.35	1

76	D	LDN10AP001	Phosphate dosing pump with electric motor with blowing cap	Rotary	Pump	UMA0.505	Horizontal	0.0285	1
77	D	LDN10AP002	Phosphate dosing pump with electric motor with blowing cap	Rotary	Pump	UMA0.505	Horizontal	0.0285	1
78	D	LFN10AP001	Hydrazine dosing pump with electric motor	Rotary	Pump	UMA0.6	Horizontal	0.029	1
79	D	LFN10AP002	Hydrazine dosing pump with electric motor	Rotary	Pump	UMA0.6	Horizontal	0.029	1
80	D	LFN10AP003	Hydrazine dosing pump with electric motor	Rotary	Pump	UMA0.6	Horizontal	0.029	1
81	D	LFN20AP001	Ammonia dosing pump with electric motor	Rotary	Pump	UMA0.6	Horizontal	0.119	1
82	D	LFN20AP002	Ammonia dosing pump with electric motor	Rotary	Pump	UMA0.6	Horizontal	0.119	1
83	D	MXN01AP001	Oil supply pump (BRU-K) mounted on governing oil tank	Rotary	Pump	UMV 0.000	Vertical	1.63	1
84	D	MXN02AP001	Oil supply pump (BRU-K) mounted on governing oil tank	Rotary	Pump	UMV 0.000	Vertical	1.63	1
85	D	LCS50AP001	MSR condensate pump	Rotary	Pump	UMA-4.5	Vertical	4.5	1
86	D	LCT51AP001	Electric-driven discharge pump set of MSR and LPH-4	Rotary	Pump	UMA-6	Vertical	9.2	1
87	D	LCT52AP001	Electric-driven discharge pump set of MSR and HPH-5	Rotary	Pump	UMA-6	Vertical	9.2	1

88	D	LCT53AP001	Electric-driven discharge pump set of MSR and HPH-6	Rotary	Pump	UMA-6	Vertical	9.2	1
89	D	GMA03AP001	Electric submerged portable pump	Rotary	Pump	UMA-7.2	Vertical	0.039	1
90	D	GMA03AP002	Electric submerged portable pump	Rotary	Pump	UMA-7.2	Vertical	0.039	1
91	D	GMA03AP003	Electric submerged portable pump	Rotary	Pump	UMA-7.2	Vertical	0.039	1
92	D	GMA03AP004	Electric submerged portable pump	Rotary	Pump	UMA-7.2	Vertical	0.039	1
93	D	GMA03AP005	Electric submerged portable pump	Rotary	Pump	UMA-7.2	Vertical	0.039	1
94	D	GMA03AP006	Electric submerged portable pump	Rotary	Pump	UMA-7.2	Vertical	0.039	1
95	D	GMA03AP007	Electric submerged portable pump	Rotary	Pump	UMA-7.2	Vertical	0.039	1
96	D	GMA03AP008	Electric submerged portable pump	Rotary	Pump	UMA-7.2	Vertical	0.039	1
97	D	GUD23AP001	Electric submerged portable pump	Rotary	Pump	UMA-7.2	Vertical	0.039	1
98	D	GUD23AP002	Electric submerged portable pump	Rotary	Pump	UMA-7.2	Vertical	0.039	1
99	D	PAC 10AP002	PAC booster	Rotary	Pump	UQA, -7.0 to	Horizontal	0.625	1
100	D	PAC 20AP002	PAC booster	Rotary	Pump	UQA, -7.0 to	Horizontal	0.625	1
101	D	PAC 30 AP002	PAC booster	Rotary	Pump	UQA, -7.0 to	Horizontal	0.625	1
102	D	PAC 40AP002	PAC booster	Rotary	Pump	UQA, -7.0 to	Horizontal	0.625	1
103	D	PAC 50 AP002	PAC booster	Rotary	Pump	UQA, -7.0 to	Horizontal	0.625	1
104	D	PAC 60 AP002	PAC booster	Rotary	Pump	UQA, -7.0 to	Horizontal	0.625	1
105	D	PAC 10AP003	PAC booster	Rotary	Pump	UQA, -7.0 to	Horizontal	0.625	1

106	D	PAC 20AP003	PAC booster	Rotary	Pump	UQA, -7.0 to	Horizontal	0.625	1
107	D	PAC 30 AP003	PAC booster	Rotary	Pump	UQA, -7.0 to	Horizontal	0.625	1
108	D	PAC 40AP003	PAC booster	Rotary	Pump	UQA, -7.0 to	Horizontal	0.625	1
109	D	PAC 50 AP003	PAC booster	Rotary	Pump	UQA, -7.0 to	Horizontal	0.625	1
110	D	PAC 60 AP003	PAC booster	Rotary	Pump	UQA, -7.0 to	Horizontal	0.625	1
111	D	PCC11AP001	Non - essential load pumps	Rotary	Pump	UQA, -4.2 to 7.85	Vertical	28.5	1
112	D	PCC12AP001	Non - essential load pumps	Rotary	Pump	UQA, -4.2 to 7.85	Vertical	28.5	1
113	D	PCC13AP001	Non - essential load pumps	Rotary	Pump	UQA, -4.2 to 7.85	Vertical	28.5	1
114	D	PCC51AP001	Cooling water supply to 0-5 UKD diesel generator	Rotary	Pump	UQA, 3.0	Vertical	2.56	1
115	D	PCC52 AP001	Cooling water supply to 0-5 UKD diesel generator	Rotary	Pump	UQA, 3.0	Vertical	2.56	1
116	D	PGC11AP001	Intermediate circulation pump to Turbine building	Rotary	Pump	UQA, 3.0	Horizontal	5.725	1
117	D	PGC12 AP001	Intermediate circulation pump to Turbine building	Rotary	Pump	UQA, 3.0	Horizontal	5.725	1
118	D	PGC13 AP001	Intermediate circulation pump to Turbine building	Rotary	Pump	UQA, 3.0	Horizontal	5.725	1
119	D	PGC21AP001	Intermediate circulation pump to Turbine building	Rotary	Pump	UQA, 3.0	Horizontal	3.775	1
120	D	PGC22AP001	Intermediate circulation pump to Turbine building	Rotary	Pump	UQA, 3.0	Horizontal	3.775	1
121	D	PGC23AP001	Intermediate circulation pump to Turbine building	Rotary	Pump	UQA, 3.0	Horizontal	3.775	1
122	D	PUA01 AP001	Dewatering pump PAC & PCC system	Rotary	Pump	UQA, 3.0 to -13.5	Vertical	4.44	1

123	D	PUA02AP001	Dewatering pump PAC & PCC system	Rotary	Pump	UQA, 3.0 to -13.5	Vertical	4.44	1
124	D	PUD10 AP001	Essential loads dewatering pump	Rotary	Pump	UQA, 7.85	Vertical	2.98	1
125	D	PUD20 AP001	Essential loads dewatering pump	Rotary	Pump	UQA, 7.85	Vertical	2.98	1
126	D	PUD30 AP001	Essential loads dewatering pump	Rotary	Pump	UQA, 7.85	Vertical	2.98	1
127	D	PUD40AP001	Essential loads dewatering pump	Rotary	Pump	UQA, 7.85	Vertical	2.98	1
128	D	PUD10 AP002	Essential loads dewatering pump	Rotary	Pump	UQA, 7.85	Vertical	2.98	1
129	D	PUD20 AP002	Essential loads dewatering pump	Rotary	Pump	UQA, 7.85	Vertical	2.98	1
130	D	PUD30 AP002	Essential loads dewatering pump	Rotary	Pump	UQA, 7.85	Vertical	2.98	1
131	D	PUD40AP002	Essential loads dewatering pump	Rotary	Pump	UQA, 7.85	Vertical	2.98	1
132	D	PUE10AP001	Drainage pump in UQC	Rotary	Pump	UQC, -4.2	Vertical	0.48	1
133	D	PUE20AP001	Drainage pump in UQC	Rotary	Pump	UQC, -4.2	Vertical	0.48	1
134	D	PUE30AP001	Drainage pump in UQC	Rotary	Pump	UQC, -4.2	Vertical	0.48	1
135	D	PUE40AP001	Drainage pump in UQC	Rotary	Pump	UQC, -4.2	Vertical	0.48	1
136	D	PUE10 AP002	Drainage pump in UQC	Rotary	Pump	UQC, -4.2	Vertical	0.48	1
137	D	PUE20AP002	Drainage pump in UQC	Rotary	Pump	UQC, -4.2	Vertical	0.48	1
138	D	PUE30AP002	Drainage pump in UQC	Rotary	Pump	UQC, -4.2	Vertical	0.48	1
139	D	PUE40AP002	Drainage pump in UQC	Rotary	Pump	UQC, -4.2	Vertical	0.48	1
140	D	PUJ 01 AP001	Pump for flume flushing	Rotary	Pump	UQA, 3.0	Vertical	1.65	1
141	D	PUJ02 AP001	Pump for flume flushing	Rotary	Pump	UQA, 3.0	Vertical	1.65	1
142	D	PUJ 01AP002	Pump for flume flushing	Rotary	Pump	UQA, 3.0	Vertical	1.65	1
143	D	PUJ02AP002	Pump for flume flushing	Rotary	Pump	UQA, 3.0	Vertical	1.65	1

144	D	PUK 01AP001	Pump for Secondary screens and meshes flushing	Rotary	Pump	UQA, 3.0	Vertical	2.58	1
145	D	PUK 02 AP001	Pump for Secondary screens and meshes flushing	Rotary	Pump	UQA, 3.0	Vertical	2.58	1
146	D	PUK 01 AP002	Pump for Secondary screens and meshes flushing	Rotary	Pump	UQA, 3.0	Vertical	2.58	1
147	D	PUK 02 AP002	Pump for Secondary screens and meshes flushing	Rotary	Pump	UQA, 3.0	Vertical	2.58	1
148	D	PUL 10 AP001	Fish diversion facility pump	Rotary	Pump	UPX, 0.0	Vertical	27	1
149	D	PUL 20AP001	Fish diversion facility pump	Rotary	Pump	UPX, 0.0	Vertical	27	1
150	D	PUL 30AP001	Fish diversion facility pump	Rotary	Pump	UPX, 0.0	Vertical	27	1
151	D	PUN 10AP001	sea water supply pump for chlorination plant	Rotary	Pump	UQA, 3.0	Vertical	2.56	1
152	D	PUN 10AP002	sea water supply pump for chlorination plant	Rotary	Pump	UQA, 3.0	Vertical	2.56	1
153	D	PUP10 AP001	pumps for racks and tray flushing equipment	Rotary	Pump	UQA, 7.85	Vertical	2.456	1
154	D	PUP10 AP002	pumps for racks and tray flushing equipment	Rotary	Pump	UQA, 7.85	Vertical	2.456	1
155	D	PUP20 AP001	pumps for racks and tray flushing equipment	Rotary	Pump	UQA, 7.85	Vertical	2.456	1
156	D	PUP20 AP002	pumps for racks and tray flushing equipment	Rotary	Pump	UQA, 7.85	Vertical	2.456	1

157	D	PUQ 10 AP001	Drain water removal system. Water removal from tunnels in case of pipeline break	Rotary	Pump	UUP, 0.0	Vertical	0.54	1
158	D	PUQ 20 AP001	Drain water removal system. Water removal from tunnels in case of pipeline break	Rotary	Pump	UUP, 0.0	Vertical	0.54	1
159	D	PUQ 30 AP001	Drain water removal system. Water removal from tunnels in case of pipeline break	Rotary	Pump	UUP, 0.0	Vertical	0.54	1
160	D	PUQ 40 AP001	Drain water removal system. Water removal from tunnels in case of pipeline break	Rotary	Pump	UUP, 0.0	Vertical	0.54	1
161	D	PUQ 10 AP002	Drain water removal system. Water removal from tunnels in case of pipeline break	Rotary	Pump	UUP, 0.0	Vertical	0.54	1
162	D	PUQ 20 AP002	Drain water removal system. Water removal from tunnels in case of pipeline break	Rotary	Pump	UUP, 0.0	Vertical	0.54	1
163	D	PUQ 30 AP002	Drain water removal system. Water removal from tunnels in case of pipeline break	Rotary	Pump	UUP, 0.0	Vertical	0.54	1

164	D	PUQ 40 AP001	Drain water removal system. Water removal from tunnels in case of pipeline break	Rotary	Pump	UUP, 0.0	Vertical	0.54	1
165	D	PUQ 10 AP003	Drain water removal system. Water removal from tunnels in case of pipeline break	Rotary	Pump	UUP, 0.0	Vertical	0.54	1
166	D	PUQ 20 AP003	Drain water removal system. Water removal from tunnels in case of pipeline break	Rotary	Pump	UUP, 0.0	Vertical	0.54	1
167	D	PUQ 30 AP003	Drain water removal system. Water removal from tunnels in case of pipeline break	Rotary	Pump	UUP, 0.0	Vertical	0.54	1
168	D	PUQ 40 AP003	Drain water removal system. Water removal from tunnels in case of pipeline break	Rotary	Pump	UUP, 0.0	Vertical	0.54	1
169	D	PUQ 10 AP004	Drain water removal system. Water removal from tunnels in case of pipeline break	Rotary	Pump	UUP, 0.0	Vertical	0.54	1
170	D	PUQ 20 AP004	Drain water removal system. Water removal from tunnels in case of pipeline break	Rotary	Pump	UUP, 0.0	Vertical	0.54	1

171	D	PUQ 30 AP004	Drain water removal system. Water removal from tunnels in case of pipeline break	Rotary	Pump	UUP, 0.0	Vertical	0.54	1
172	D	PUQ 40 AP004	Drain water removal system. Water removal from tunnels in case of pipeline break	Rotary	Pump	UUP, 0.0	Vertical	0.54	1
173	D	PUP10AP001	Drain water pumping out system from fish protection facility	Rotary	Pump	UPX, -4.2	Horizontal	0.13	1
174	D	PUP20AP001	Drain water pumping out system from fish protection facility	Rotary	Pump	UPX, -4.2	Horizontal	0.13	1
175	D	PUP10AP002	Drain water pumping out system from fish protection facility	Rotary	Pump	UPX, -4.2	Horizontal	0.13	1
176	D	PUP20 AP002	Drain water pumping out system from fish protection facility	Rotary	Pump	UPX, -4.2	Horizontal	0.13	1
177	D	PEC10AP001	Essential load pumps	Rotary	Pump	UQC, 7.85 to -4.2	Vertical	28.5	1
178	D	PEC20AP001	Essential load pumps	Rotary	Pump	UQC, 7.85 to -4.2	Vertical	28.5	1
179	D	PEC30AP001	Essential load pumps	Rotary	Pump	UQC, 7.85 to -4.2	Vertical	28.5	1
180	D	PEC40AP001	Essential load pumps	Rotary	Pump	UQC, 7.85 to -4.2	Vertical	28.5	1
181	D	PUV02AP001	Pump for Oil facilities	Rotary	Pump	UQA, UQC	Horizontal	0.045	1
182	D	PUV80AP001	Pump for Oil facilities	Rotary	Pump	UQA, UQC	Horizontal	0.045	1

183	D	PUV90AP002	Pump for Oil facilities	Rotary	Pump	UQA, UQC	Horizontal	0.045	1
184	D	PUV90AP001	Pump for Oil facilities	Rotary	Pump	UQA, UQC	Horizontal	0.045	1
185	D	PUV80AP002	Pump for Oil facilities	Rotary	Pump	UQA, UQC	Horizontal	0.045	1
186	D	PUV01AP001	Pump for Oil facilities	Rotary	Pump	UQA, UQC	Horizontal	0.045	1
187	D	PUV03AP001	Pump for Oil facilities	Rotary	Pump	UQA, UQC	Horizontal	0.045	1
188	D	PUV84AP001	Pump for Oil facilities	Rotary	Pump	UQA, UQC	Horizontal	0.045	1
189	D	PUV91AP001	Pump for Oil facilities	Rotary	Pump	UQA, UQC	Horizontal	0.045	1
190	D	PUV84AP002	Pump for Oil facilities	Rotary	Pump	UQA, UQC	Horizontal	0.045	1
191	D	GQD	Electric Pump/submersible	Rotary	Pump	UGW	Horizontal/submersible	0.185	1
192	D	GQD	Electric Pump/submersible	Rotary	Pump	UGW	Horizontal/submersible	0.185	1
193	D	GQD	Electric Pump/submersible	Rotary	Pump	UGW	Horizontal/submersible	0.185	1
194	D	GQD	Electric Pump/submersible	Rotary	Pump	UGW	Horizontal/submersible	0.185	1
195	D	GQD	Electric Pump/submersible	Rotary	Pump	UGW	Horizontal/submersible	0.185	1
196	D	GQD	Electric Pump/submersible	Rotary	Pump	UGW	Horizontal/submersible	0.185	1
197	D	GQD	Electric Pump/submersible	Rotary	Pump	UGW	Horizontal/submersible	0.185	1
198	D	GQD	Electric Pump/submersible	Rotary	Pump	UGW	Horizontal/submersible	0.185	1
199	D	GQD	Electric Pump/submersible	Rotary	Pump	UGW	Horizontal/submersible	0.185	1
200	D	GQD	Electric Pump/submersible	Rotary	Pump	UGW	Horizontal/submersible	0.185	1
201	D	GQD	Electric Pump/submersible	Rotary	Pump	UGW	Horizontal/submersible	0.185	1

202	D	GQD	Electric Pump/submersible	Rotary	Pump	UGW	Horizontal/su bmersible	0.185	1
203	D	GML21AP001	GML pumps floor drain discharge pumps	Rotary	Pump	UQA, -7.0	Horizontal/su bmersible	0.3	1
204	D	GML22AP001	GML pumps floor drain discharge pumps	Rotary	Pump	UQA, -7.0	Horizontal/su bmersible	0.3	1
205	D	GML31AP001	GML pumps floor drain discharge pumps	Rotary	Pump	UQA, -7.0	Horizontal/su bmersible	0.3	1
206	D	GML32AP001	GML pumps floor drain discharge pumps	Rotary	Pump	UQA, -7.0	Horizontal/ Submersible	0.3	1
207	D	GAF11AP001	sea water supply pumps for Desalination plant	Rotary	Pump	2UQC	Vertical	1.63	1
208	D	GAF12AP001	sea water supply pumps for Desalination plant	Rotary	Pump	2UQC	Vertical	1.63	1
209	D	GAF13AP001	sea water supply pumps for Desalination plant	Rotary	Pump	2UQC	Vertical	1.63	1
210	D	GAF14AP001	sea water supply pumps for Desalination plant	Rotary	Pump	2UQC	Vertical	1.63	1
211	D	PUM 10AN 001	Compressed air supply system for fish protection facility	Rotary	Compressor	UPX, 0.0	Horizontal/ V ertical	4.5	1
212	D	PUM 20AN 001	Compressed air supply system for fish protection facility	Rotary	Compressor	UPX, 0.0	Horizontal/ V ertical	4.5	1
213	D	MKW70AN001	Centrifugal fan of oil supply system of GSS	Rotary	Fan	UMV +8.100	Horizontal	0.0405	1
214	D	MKW72AN001	Centrifugal fan of oil supply system of GSS	Rotary	Fan	UMV +8.100	Horizontal	0.0405	1

215	D	MKW73AN001	Centrifugal fan of oil supply system of GSS	Rotary	Fan	UMV +16.000	Horizontal	0.0405	1
216	D	MAQ10AN001	Exhaust fan to evacuate oil vapour	Rotary	Fan	UMV 14.750	Horizontal	0.09	1
217	D	MAQ20AN001	Exhaust fan to evacuate oil vapour	Rotary	Fan	UMA6.695	Horizontal	0.103	1
218	D	MAQ30AN001	Exhaust fan to evacuate oil vapour	Rotary	Fan	UMV 8.100	Horizontal	0.07	1
219	D	MKW36AT001	Blowing Unit	Rotary	Other	UMV +16.000	Vertical	0.015	1
220	D	MKW66AT002	Blowing Unit	Rotary	Other	UMV +16.000	Vertical	0.015	1
221	E	MAJ11BN001	Main ejector	Static	Pump	UMA7.8	Vertical	0.62	1
222	E	MAJ12BN001	Main ejector	Static	Pump	UMA7.8	Vertical	0.62	1
223	E	MAJ13BN001	Main ejector	Static	Pump	UMA7.8	Vertical	0.62	1
224	E	MAJ14BN001	Main ejector	Static	Pump	UMA7.8	Vertical	0.62	1
225	E	MAJ15BN001	Ejector of GSC	Static	Pump	UMA7.8	Vertical	0.52	1
226	E	XAC10AC002	Air bleed ejector	Static	Hx	UMA+6.100	Vertical	0.76	1
227	E	XAC10AC003	Main steam jet -ejector	Static	Hx	UMA+6.100	Vertical	0.86	1
228	E	XAC12AC001	Oil cooler	Static	Hx	UMA-6.800	Vertical	0.68	1
229	E	XAC12AC002	Oil cooler	Static	Hx	UMA-6.800	Vertical	0.68	1
230	E	XAC12AC003	Oil cooler	Static	Hx	UMA-6.800	Vertical	0.68	1
231	E	XAC12AC004	Oil cooler	Static	Hx	UMA-6.800	Vertical	0.68	1
232	E	XAC15AC001	Oil cooler turbine feeding pump	Static	Hx	UMA+2.060	Horizontal	0.262	1
233	E	XAC15AC002	Oil cooler turbine feeding pump	Static	Hx	UMA+2.060	Horizontal	0.262	1
234	E	XAC20AC002	Air bleed ejector	Static	Hx	UMA+6.100	Vertical	0.76	1
235	E	XAC20AC003	Main steam jet -ejector	Static	Hx	UMA+6.100	Vertical	0.86	1
236	E	XAC22AC001	Oil cooler	Static	Hx	UMA-6.800	Vertical	0.68	1
237	E	XAC22AC002	Oil cooler	Static	Hx	UMA-6.800	Vertical	0.68	1
238	E	XAC22AC003	Oil cooler	Static	Hx	UMA-6.800	Vertical	0.68	1

239	E	XAC22AC004	Oil cooler	Static	Hx	UMA-6.800	Vertical	0.68	1
240	E	XAC25AC001	Oil cooler turbine feeding pump	Static	Hx	UMA+2.060	Vertical	0.262	1
241	E	XAC25AC002	Oil cooler turbine feeding pump	Static	Hx	UMA+2.060	Vertical	0.262	1
242	E	LCM52AC001	Vapour cooler of drains surge tank (steam condenser)	Static	HX	UMA7.75	Vertical	3.200	1
243	E	MAM70AC001	Gland steam condenser	Static	HX	UMA7.8	Vertical	10.12	1
244	E	MAV21AC001	Oil cooler	Static	HX	UMV 8.100	Vertical	4.462	1
245	E	MAV22AC001	Oil cooler	Static	HX	UMV 8.100	Vertical	4.462	1
246	E	MAV23AC001	Oil cooler	Static	HX	UMV 8.100	Vertical	4.462	1
247	E	MAV24AC001	Oil cooler	Static	HX	UMV 8.100	Vertical	4.462	1
248	E	MXN41AC001	Oil cooler (BRU-K)mounted on governing oil tank	Static	HX	UMV 0.000	Vertical	0.832	1
249	E	MXN42AC001	Oil cooler (BRU-K)mounted on governing oil tank	Static	HX	UMV 0.000	Vertical	0.832	1
250	E	PGD11AC001	Heat Exchanger	Static	HX	UQA, 7.85	Vertical	8.046	1
251	E	PGD12AC001	Heat Exchanger	Static	HX	UQA, 7.85	Vertical	8.046	1
252	E	PGD13AC001	Heat Exchanger	Static	HX	UQA, 7.85	Vertical	8.046	1
253	E	PGD11AC002	Heat Exchanger	Static	HX	UQA, 7.85	Vertical	8.046	1
254	E	PGD12AC002	Heat Exchanger	Static	HX	UQA, 7.85	Vertical	8.046	1
255	E	PGD13AC002	Heat Exchanger	Static	HX	UQA, 7.85	Vertical	8.046	1
256	E	PGD21AC001	Heat Exchanger	Static	HX	UQA, 7.85	Vertical	7.446	1
257	E	PGD22AC001	Heat Exchanger	Static	HX	UQA, 7.85	Vertical	7.446	1
258	E	PGD23AC001	Heat Exchanger	Static	HX	UQA, 7.85	Vertical	7.446	1
259	E	LAA10AC001	Deaerator column	Static	Tank	UMA+29.775	Horizontal	77.13	1
260	E	LAA10BB001	Deaerator tank	Static	Tank	UMA+29.775	Horizontal	176.7	1
261	E	LCB10BB001	Replenishment tank	Static	Tank	UMA+20.500	Vertical	0.455	1

262	E	LDP10BB001	Sulfuric acid measuring tank V=3m3	Static	Tank	UMA+0.600	Vertical	1.04	1
263	E	LDP10BB002	Sulfuric acid measuring tank V=3m4	Static	Tank	UMA+0.600	Vertical	1.04	1
264	E	LDP20BB001	Caustic soda measuring tank 3	Static	Tank	UMA+0.600	Vertical	1.04	1
265	E	LDP20BB002	Causti soda measuring tank 3	Static	Tank	UMA+0.600	Vertical	1.04	1
266	E	LDP30BB001	Ammonia solution tank	Static	Tank	UMA+0.600	Vertical	1.397	1
267	E	MKF01BB001	Stator water Tank	Static	Tank	UMA0.8	Vertical	1.738	1
268	E	MKW01BB001	Tank of oil supply system of generator shaft sealing(GSS)	Static	Tank	UMV +3.900	Horizontal	5.186	1
269	E	MKW30BB001	Damper tank of oil supply system of GSS	Static	Tank	UMV +24.470	Horizontal	1.293	1
270	E	MKW60BB001	Damper tank of oil supply system of GSS	Static	Tank	UMV +24.470	Horizontal	1.293	1
271	E	MKW70AT001	Hydrogen separating tank	Static	Tank	UMV +3.900	Horizontal	0.47	1
272	E	XAV10BB001	Oil tank turbine feeding pump	Static	Tank	UMA+2.120	Horizontal	3.552	1
273	E	XAV10BB003	Drain. Tank	Static	Tank	UMA-6.750	Horizontal	0.407	1
274	E	XAV20BB001	Oil tank turbine feeding pump	Static	Tank	UMA+2.120	Horizontal	3.552	1
275	E	XAV20BB003	Drain. Tank	Static	Tank	UMA-6.750	Horizontal	0.407	1
276	E	XAV10BB002	Emergency oil tank	Static	Tank	UMA+17.400	Horizontal	0.599	1
277	E	XAV20BB002	Emergency oil tank	Static	Tank	UMA+17.400	Horizontal	0.599	1
278	E	LAV30BB001	Oil System for EDBFP	Static	Tank	UMA+3.300	Horizontal	1.103	1
279	E	LAV40BB001	Oil System for EDBFP	Static	Tank	UMA+3.300	Horizontal	1.103	1
280	E	MAL10BB001	HP Drain flash tank (BRU-K system)	Static	Tank	UMA0	Vertical	2.1	1

281	E	MAL20BB001	LP Drain flash tank (BRU-K system)	Static	Tank	UMA0	Vertical	1.75	1
282	E	MAV10BB001	Oil Tank	Static	Tank	UMV 8.100	Horizontal	25.4	1
283	E	LDN10BB001	Tank for phosphate solution	Static	Tank	UMA0	Vertical	0.22	1
284	E	LFN10BB001	Hydrazine solution tank	Static	Tank	UMA0.6	Vertical	0.69	1
285	E	LFN10BB002	Hydrazine solution tank	Static	Tank	UMA0.6	Vertical	0.69	1
286	E	LFN20BB001	Ammonia solution tank	Static	Tank	UMA0.6	Vertical	0.69	1
287	E	LFN20BB002	Ammonia solution tank	Static	Tank	UMA0.6	Vertical	0.69	1
288	E	MXN10BB001	Governing oil tank (BRU-K)	Static	Tank	UMV 0.000	Horizontal	11.8	1
289	E	MAX10BB002	Additional Tank	Static	Tank	UMA3	Vertical	0.492	1
290	E	MAX52	Turbine control stack	Static	Tank	UMA15.95	Vertical	0.677	1
291	E	PGB03BB001	Tank-compensator	Static	Tank	UMA21	Vertical	1.1	1
292	E	PGB80BB001	Tank-compensator	Static	Tank	UMA11.5	Vertical	1.6	1
293	E	LCN01BB001	HP steam drain tank	Static	Tank	UMA0.8	Vertical	3.6	1
294	E	LCT51BB001	Replenishment tank	Static	Tank	UMA1	Horizontal	0.25	1
295	E	QJB30BB001	Nitrogen receiver	Static	Tank	2USF 0.000	Vertical	14.07	1
296	E	QJB30BB002	Nitrogen receiver	Static	Tank	2USF 0.000	Vertical	14.07	1
297	E	PUV03BB001	Oil Tank	Static	Tank	UQA, -3.0	Horizontal	1.575	1
298	E	PUV04BB001	Oil Tank	Static	Tank	UQA, -3.0	Horizontal	0.67	1
299	E	PUV06BB001	Oil Tank	Static	Tank	UQA, -3.0	Horizontal	1.62	1
300	E	PUV81 BB001	Oil Tank	Static	Tank	UQC, 0.0	Horizontal	0.4	1
301	E	PUV82 BB001	Oil Tank	Static	Tank	UQC, 0.0	Horizontal	0.4	1
302	E	PUV83 BB001	Oil Tank	Static	Tank	UQC, 0.0	Horizontal	0.4	1
303	E	PUV84 BB001	Oil Tank	Static	Tank	UQC, 0.0	Horizontal	0.4	1
304	E	PUV91 BB001	Oil Tank	Static	Tank	UPX, -4.02	Horizontal	0.4	1
305	E	PUV92 BB001	Oil Tank	Static	Tank	UPX, -4.02	Horizontal	0.4	1
306	E	PUX01BB001	Air reciever	Static	Tank	UPX, 0.0	Vertical	0.96	1
307	E	MAX31AK001	Cargo accumulator	Static	Pump	UMA7.35	Horizontal	6.3	1
308	E	MAX32AK001	Cargo accumulator	Static	Pump	UMA7.35	Horizontal	6.3	1

309	E	LDB10AT001	Mixed-bed filter with internal regeneration	Static	Filter	UMA+16.850	Vertical	3.92	1
310	E	LDB10AT002	Mixed-bed filter with internal regeneration	Static	Filter	UMA+16.850	Vertical	3.92	1
311	E	LDB10AT003	Strainer (catcher filter)	Static	Filter	UMA+17.940	Vertical	0.456	1
312	E	LDF11AT001	Mixed-bed filter with external regeneration	Static	Filter	UMA+16.850	Vertical	13.598	1
313	E	LDF12AT001	Mixed-bed filter with external regeneration	Static	Filter	UMA+16.850	Vertical	13.598	1
314	E	LDF13AT001	Mixed-bed filter with external regeneration	Static	Filter	UMA+16.850	Vertical	13.598	1
315	E	LDF14AT001	Mixed-bed filter with external regeneration	Static	Filter	UMA+16.850	Vertical	13.598	1
316	E	LDF15AT001	Mixed-bed filter with external regeneration	Static	Filter	UMA+16.850	Vertical	13.598	1
317	E	LDF21AT001	Mixed-bed filter with external regeneration	Static	Filter	UMA+16.850	Vertical	13.598	1
318	E	LDF22AT001	Mixed-bed filter with external regeneration	Static	Filter	UMA+16.850	Vertical	13.598	1
319	E	LDF23AT001	Mixed-bed filter with external regeneration	Static	Filter	UMA+16.850	Vertical	13.598	1
320	E	LDF24AT001	Mixed-bed filter with external regeneration	Static	Filter	UMA+16.850	Vertical	13.598	1
321	E	LDF25AT001	Mixed-bed filter with external regeneration	Static	Filter	UMA+16.850	Vertical	13.598	1
322	E	LDF31AT001	Strainer (catcher filter)	Static	Filter	UMA+18.845	Vertical	1.082	1
323	E	LDF32AT001	Strainer (catcher filter)	Static	Filter	UMA+18.845	Vertical	1.082	1
324	E	LDF33AT001	Strainer (catcher filter)	Static	Filter	UMA+18.845	Vertical	1.082	1
325	E	LDF34AT001	Strainer (catcher filter)	Static	Filter	UMA+18.845	Vertical	1.082	1
326	E	LDF35AT001	Strainer (catcher filter)	Static	Filter	UMA+18.845	Vertical	1.082	1

327	E	LDP10AT001	Regeneration filter	Static	Filter	UMA+16.850	Vertical	7.885	1
328	E	LDP20AT001	Regeneration filter	Static	Filter	UMA+16.850	Vertical	7.885	1
329	E	LDP30AT001	Filter for middle ionite layer unloading	Static	Filter	UMA+16.850	Vertical	2.717	1
330	E	MKF21AT001	Water filter	Static	Filter	UMA8.845	Vertical	0.164	1
331	E	MKF22AT001	Water filter	Static	Filter	UMA8.845	Vertical	0.164	1
332	E	MKF23AT001	Water filter	Static	Filter	UMA8.845	Vertical	0.164	1
333	E	MKF50AT001	Ion exchange filter	Static	Filter	UMA4.545	Vertical	0.205	1
334	E	MKF50AT002	Ion exchange filter	Static	Filter	UMA4.545	Vertical	0.205	1
335	E	MKF51AT001	Ion exchange filter	Static	Filter	UMA4.545	Vertical	0.205	1
336	E	MKF31AT001	Magnetic filter	Static	Filter	UMA8.25	Vertical	0.101	1
337	E	MKF32AT001	Magnetic filter	Static	Filter	UMA8.25	Vertical	0.101	1
338	E	MKF33AT001	Magnetic filter	Static	Filter	UMA8.25	Vertical	0.101	1
339	E	MKF34AT001	Magnetic filter	Static	Filter	UMA8.25	Vertical	0.101	1
340	E	MKF35AT001	Magnetic filter	Static	Filter	UMA8.25	Vertical	0.101	1
341	E	MKW16AT001	Mechanical filter	Static	Filter	UMV +17.433	Vertical	0.083	1
342	E	MKW17AT001	Mechanical filter	Static	Filter	UMV +17.433	Vertical	0.083	1
343	E	MKW21AT001	Magnetic filter	Static	Filter	UMV +17.433	Vertical	---	1
344	E	MKW22AT001	Magnetic filter	Static	Filter	UMV +17.433	Vertical	---	1
345	E	XAV10AT001	Oil filter	Static	Filter	UMA+0.500	Vertical	0.132	1
346	E	XAV10AT002	Oil filter	Static	Filter	UMA+0.500	Vertical	0.132	1
347	E	XAV20AT001	Oil filter	Static	Filter	UMA+0.500	Vertical	0.132	1
348	E	XAV20AT002	Oil filter	Static	Filter	UMA+0.500	Vertical	0.132	1
349	E	MAV16AT001	Fine Filter	Static	Filter	UMV 8.100	Vertical	0.475	1
350	E	MAV17AT001	Fine Filter	Static	Filter	UMV 8.100	Vertical	0.475	1
351	E	MXN70AT001	FIne OIL filter (BRU-K) mounted on governing oil tank	Static	Filter	UMV 0.000	Vertical	0.582	1
352	E	LCE36AT001	Fine Filters	Static	Filter	UMA+ 7.80	Vertical	0.25	1
353	E	LCE36AT002	Fine Filters	Static	Filter	UMA+ 7.80	Vertical	0.25	1

354	E	LCE36AT003	Fine Filters	Static	Filter	UMA+ 7.80	Vertical	0.25	1
355	E	LCE36AT004	Fine Filters	Static	Filter	UMA+ 7.80	Vertical	0.25	1
356	E	LCE36AT005	Fine Filters	Static	Filter	UMA+ 7.80	Vertical	0.25	1
357	E	LCE36AT006	Fine Filters	Static	Filter	UMA+ 7.80	Vertical	0.25	1
358	E	0PDB01AT001	Mussle cleaning Filter	Static	Filter	05UKD, 7.85	Horizontal	0.49	1
359	E	0PDB01AT001	Mussle cleaning Filter	Static	Filter	05UKD, 7.85	Horizontal	0.49	1
360	E	PDB31AT001	Mussle cleaning Filter	Static	Filter	UQA, -4.2	Horizontal	0.65	1
361	E	PDB32AT001	Mussle cleaning Filter	Static	Filter	UQA, -4.2	Horizontal	0.65	1
362	E	PDB33AT001	Mussle cleaning Filter	Static	Filter	UQA, -4.2	Horizontal	0.65	1
363	E	PDB60AT001	Mussle cleaning Filter	Static	Filter	UQA, 0.00	Horizontal	0.8	1
364	E	PDB21AT001	Mussle cleaning Filter	Static	Filter	UQA, -4.2	Horizontal	1.325	1
365	E	PDB22AT001	Mussle cleaning Filter	Static	Filter	UQA, -4.2	Horizontal	1.325	1
366	E	PDB23AT001	Mussle cleaning Filter	Static	Filter	UQA, -4.2	Horizontal	1.325	1
367	E	PUS01AT001	Self cleaninig filter	Static	Filter	UPX, 0.0	Vertical	0.28	1
368	E	1PFB01AT001	Mussle cleaning Filter	Static	Filter	UKD, 0.0	Horizontal	0.52	1
369	E	2PFB01AT001	Mussle cleaning Filter	Static	Filter	UKD, 0.0	Horizontal	0.52	1
370	E	3PFB01AT001	Mussle cleaning Filter	Static	Filter	UKD, 0.0	Horizontal	0.52	1
371	E	4PFB01AT001	Mussle cleaning Filter	Static	Filter	UKD, 0.0	Horizontal	0.52	1
372	E	PFB11AT001	Mussle cleaning Filter	Static	Filter	UKA, +0.3	Vertical	1.395	1
373	E	PFB21AT001	Mussle cleaning Filter	Static	Filter	UKA, +0.3	Vertical	1.395	1
374	E	PFB31AT001	Mussle cleaning Filter	Static	Filter	UKA, +0.3	Vertical	1.395	1
375	E	PFB41AT001	Mussle cleaning Filter	Static	Filter	UKA, +0.3	Vertical	1.395	1
376	E	PEB 10 AT 001	Self cleaninig filter	Static	Filter	UQC, 7.85	Vertical	0.19	1
377	E	PEB 20 AT 001	Self cleaninig filter	Static	Filter	UQC, 7.85	Vertical	0.19	1
378	E	PEB 30 AT 001	Self cleaninig filter	Static	Filter	UQC, 7.85	Vertical	0.19	1
379	E	PEB 40 AT 001	Self cleaninig filter	Static	Filter	UQC, 7.85	Vertical	0.19	1
380	E	PEC13 AT001	Cyclone filter	Static	Filter	UQC, 7.85	Vertical	0.125	1
381	E	PEC23 AT001	Cyclone filter	Static	Filter	UQC, 7.85	Vertical	0.125	1
382	E	PEC33 AT001	Cyclone filter	Static	Filter	UQC, 7.85	Vertical	0.125	1

383	E	PEC43 AT001	Cyclone filter	Static	Filter	UQC, 7.85	Vertical	0.125	1
384	E	PEC13 AT002	Cyclone filter	Static	Filter	UQC, 7.85	Vertical	0.125	1
385	E	PEC23 AT002	Cyclone filter	Static	Filter	UQC, 7.85	Vertical	0.125	1
386	E	PEC33 AT002	Cyclone filter	Static	Filter	UQC, 7.85	Vertical	0.125	1
387	E	PEC43 AT002	Cyclone filter	Static	Filter	UQC, 7.85	Vertical	0.125	1
388	E	PAC10 AT001	Self cleaninig filter	Static	Filter	UQA, -3.0	Vertical	0.326	1
389	E	PAC20 AT001	Self cleaninig filter	Static	Filter	UQA, -3.0	Vertical	0.326	1
390	E	PAC30 AT001	Self cleaninig filter	Static	Filter	UQA, -3.0	Vertical	0.326	1
391	E	PAC40 AT001	Self cleaninig filter	Static	Filter	UQA, -3.0	Vertical	0.326	1
392	E	PAC50 AT001	Self cleaninig filter	Static	Filter	UQA, -3.0	Vertical	0.326	1
393	E	PAC60 AT001	Self cleaninig filter	Static	Filter	UQA, -3.0	Vertical	0.326	1
394	E	PCC11AT001	Self cleaninig filter	Static	Filter	UQA, 7.85	Vertical	0.19	1
395	E	PCC12 AT001	Self cleaninig filter	Static	Filter	UQA, 7.85	Vertical	0.19	1
396	E	PCC13AT001	Self cleaninig filter	Static	Filter	UQA, 7.85	Vertical	0.19	1
397	E	PCC41 AT001	Cyclone filter	Static	Filter	UQA, 7.85	Vertical	0.125	1
398	E	PCC42 AT001	Cyclone filter	Static	Filter	UQA, 7.85	Vertical	0.125	1
399	E	PCC43 AT001	Cyclone filter	Static	Filter	UQA, 7.85	Vertical	0.125	1
400	E	PCC41 AT002	Cyclone filter	Static	Filter	UQA, 7.85	Vertical	0.125	1
401	E	PCC42 AT002	Cyclone filter	Static	Filter	UQA, 7.85	Vertical	0.125	1
402	E	PCC43 AT002	Cyclone filter	Static	Filter	UQA, 7.85	Vertical	0.125	1
403	E	0GQD06BB001	Biofilter 189KY296778CE	Static	Filter	0UGW	Vertical	0.586	1
404	E	0GQD06BB002	Biofilter 189KY296778CE	Static	Filter	0UGW	Vertical	0.586	1
405	E	0GQD	Sand Trap	Static	Filter	0UGW	Vertical	0.585	1
406	E	0PCD01BB001	Jet Break Tank	Static	Filter	0UGW	Vertical	0.163	1
407	E	MKC	Bank of resistors	Static	BANK OF RESISTORS	UMA4	Vertical	4.8	10
408	E	MKF12AC001	Water cooler	Static	Cooler	UMA4.545	Vertical	2.763	1
409	E	MKF13AC001	Water cooler	Static	Cooler	UMA4.545	Vertical	2.763	1
410	E	MKW12AC001	Oil cooler	Static	Cooler	UMV +3.900	Vertical	1.88	1
411	E	MKW13AC001	Oil cooler	Static	Cooler	UMV +3.900	Vertical	1.88	1

412	E	PAS61BN001	Ejector of circulation system	Static	Ejector	UMA7.8	Vertical	0.21	1
413	E	PAS62BN001	Ejector of circulation system	Static	Ejector	UMA7.8	Vertical	0.21	1
414	E	MKC	Input section and thyristor section for Excitation board-panels	Static	Electric Panel	UBA+16.000	Vertical	1.612	4
415	E	MKC01GT001	CRS and protection section for excitation board-transformers	Static	Electric Panel	UBA+16.000	Vertical	0.9	1
416	E	MKC01GT002	CRS and protection section for excitation board-transformers	Static	Electric Panel	UBA+16.000	Vertical	0.9	1
417	E	XAC10GH101	TDFP MCDS panel	Static	Electric Panel	UMA6	Vertical	0.12	1
418	E	XAC20GH101	TDFP MCDS panel	Static	Electric Panel	UMA6	Vertical	0.12	1
419	E	MKF05BB001	Hydroulic seal	Static	Other	UMA0.65	Vertical	0.067	1
420	E	MKG01AW701	Gas control stand	Static	Other	UMA11	Vertical	0.386	1
421	E	MKG20AH001	Evaporator	Static	Other	UMA7.8	Vertical	0.181	1
422	E	MKG20AH002	Refrigeration unit	Static	Other	UMA7.8	Horizontal	0.071	1
423	E	MKG22AH001	Evaporator	Static	Other	UMA7.8	Vertical	0.181	1
424	E	MKG22AH002	Refrigeration unit	Static	Other	UMA7.8	Horizontal	0.071	1
425	E	MKW30BP001	Pressure drop regulator	Static	Other	UMV +17.433	Vertical	---	1
426	E	MKW60BP001	Pressure drop regulator	Static	Other	UMV +17.433	Vertical	---	1
427	E	MKW71AT001	Hydroseal(air)	Static	Other	UMV +3.900	Vertical	0.033	1
428	E	MKW70AT002	Oil catcher of oil supply system of GSS	Static	Other	UMV +8.100	Vertical	0.113	1
429	E	MKW72AT001	Oil catcher of oil supply system of GSS (oil trap)	Static	Other	UMV +8.100	Vertical	0.113	1
430	E	MKW73AT001	Oil catcher of oil supply system of GSS (oil trap)	Static	Other	UMV +16.000	Vertical	0.113	1

431	E	MKW66AT001	Hydroseal (Hydrogen)	Static	Other	UMV +0.300	Vertical	0.565	1
432	E	MKW67AT001	Hydroseal (Hydrogen)	Static	Other	UMV +0.300	Vertical	0.565	1
433	E	MAN51	Control oil block (Bracket of control oil unit BRU-K)	Static	Others	UMA8.88	Horizontal	0.34	1
434	E	MAN61	Control oil block (Bracket of control oil unit BRU-K)	Static	Others	UMA8.88	Horizontal	0.34	1
435	E	QUB10AX001	Sample preparation and measurement panel	Static	Sampling unit	UMA0	Vertical	0.05	1
436	E	QUB10CQ001	Sample preparation and measurement panel	Static	Sampling unit	UMA0	Vertical	0.05	1
437	E	QUB20AX001	Sample preparation and measurement panel	Static	Sampling unit	UMA0	Vertical	0.05	1
438	E	QUB20CQ001	Sample preparation and measurement panel	Static	Sampling unit	UMA0	Vertical	0.05	1
439	E	QUB30AX001	Sample preparation and measurement panel	Static	Sampling unit	UMA0	Vertical	0.05	1
440	E	QUB30CQ001	Sample preparation and measurement panel	Static	Sampling unit	UMA0	Vertical	0.05	1
441	E	QUB40AX001	Sample preparation and measurement panel	Static	Sampling unit	UMA0	Vertical	0.05	1
442	E	QUB40CQ001	Sample preparation and measurement panel	Static	Sampling unit	UMA0	Vertical	0.05	1
443	E	QUC00AX001	Samples and measurements preparation system SPP-B	Static	Test and monitoring equipment	UMA+0.800	Vertical	0.05	1
444	E	QUC20AX001	Samples and measurements preparation system SPP-B	Static	Test and monitoring equipment	UMA+0.800	Vertical	0.05	1

445	E	QUC10AX001	Samples and measurements preparation system SPP-A	Static	Test and monitoring equipment	UMA+0.800	Vertical	0.05	1
446	E	QUC31AX001	Samples and measurements preparation system SPP-A	Static	Test and monitoring equipment	UMA+ 0.00 m	Vertical	0.065	1
447	E	QUC32AX001	Samples and measurements preparation system SPP-A	Static	Test and monitoring equipment	UMA+ 0.00 m	Vertical	0.05	1
448	E	QUC33AX001	Samples and measurements preparation system SPP-A	Static	Test and monitoring equipment	UMA+ 0.00 m	Vertical	0.05	1
449	E	QUC34AX001	Samples and measurements preparation system SPP-A	Static	Test and monitoring equipment	UMA+ 0.00 m	Vertical	0.05	1
450	E	QUC35AX001	Samples and measurements preparation system SPP-A	Static	Test and monitoring equipment	UMA+ 0.00 m	Vertical	0.05	1
451	E	QUC36AX001	Samples and measurements preparation system SPP-A	Static	Test and monitoring equipment	UMA+ 0.00 m	Vertical	0.05	1
452	E	QUC40AX001	Samples and measurements preparation system SPP-B	Static	Test and monitoring equipment	UMA+0.800	Vertical	0.05	1
453	E	QUA10AX001	Samples and measurements preparation system SPP-B	Static	Test and monitoring equipment	UMA+0.800	Horizontal	0.08	1
454	E	QUA10AX002	Samples and measurements preparation system SPP-B	Static	Test and monitoring equipment	UMA+0.800	Horizontal	0.08	1

455	E	PAC10AB601	Tight hatches	Static	Tight hatches	UQA, -7.0	Horizontal	0.252	1
456	E	PAC20 AB601	Tight hatches	Static	Tight hatches	UQA, -7.0	Horizontal	0.252	1
457	E	PAC30 AB601	Tight hatches	Static	Tight hatches	UQA, -7.0	Horizontal	0.252	1
458	E	PAC40 AB601	Tight hatches	Static	Tight hatches	UQA, -7.0	Horizontal	0.252	1
459	E	PAC50 AB601	Tight hatches	Static	Tight hatches	UQA, -7.0	Horizontal	0.252	1
460	E	PAC 60 AB601	Tight hatches	Static	Tight hatches	UQA, -7.0	Horizontal	0.252	1
461	E	PCB51 AB601	Tight hatches	Static	Tight hatches	UQA, 3.0	Horizontal	0.252	1
462	E	PCB52 AB601	Tight hatches	Static	Tight hatches	UQA, 3.0	Horizontal	0.252	1
463	E	PUN10AB601	Tight hatches	Static	Tight hatches	UQA, 3.0	Horizontal	0.252	1
464	E	PUP20AB601	Tight hatches	Static	Tight hatches	UQC, 0.0	Horizontal	0.252	1
465	E	PUP10AB602	Tight hatches	Static	Tight hatches	UQC, 0.0	Horizontal	0.252	1
466	E	PUP20AB601	Tight hatches	Static	Tight hatches	UQC, 0.0	Horizontal	0.252	1
467	E	PUP20AB602	Tight hatches	Static	Tight hatches	UQC, 0.0	Horizontal	0.252	1
468	E	PUD10AB601	Tight hatches	Static	Tight hatches	UQC, -4.2	Horizontal	0.252	1
469	E	PUD20AB601	Tight hatches	Static	Tight hatches	UQC, -4.2	Horizontal	0.252	1
470	E	PUD30AB601	Tight hatches	Static	Tight hatches	UQC, -4.2	Horizontal	0.252	1
471	E	PUD40AB601	Tight hatches	Static	Tight hatches	UQC, -4.2	Horizontal	0.252	1
472	E	QUH20BR001	Tray	Static	Tray	UMA+ 0.00 m	Horizontal	0.04	1
473	E	QUH30BR001	Tray	Static	Tray	UMA+ 0.00 m	Horizontal	0.04	1
474	E	QUH40BR001	Tray	Static	Tray	UMA+ 0.00 m	Horizontal	0.04	1
475	E	QUH30AC001	Sampling heat exchanger	Static	HX	UMA+ 16.00 m	Vertical	0.0251	1
476	E	BEPX	LCX Valve station	Static	VALVE STATION	UMA+ 0.00	Horizontal	0.686	1
Total Qty per Unit								**6261**	**489**
Note: Over and above list, if any equipment issued by NPCIL which are integral part of STG system shall be erected by the contractor with in the Lump sum quoted price									

TG INTEGRAL PIPING, CROSS OVER PIPING & VALVE BLOCKS IN KUDANKULAM - UNIT 3 MAIN TG PACKAGE (Approx)																				
SL NO	SCH	System	WORKING DOCUMENTS								SUB SYSTEM	Pipe (MT)		Support (MT)	Valves	Inch dia	Inch mtr	Painting Area SqM		
												CS	SS		Nos			HT>150C	MT(50C-150C)	LT<50C
1	F	MAA	R03.KK.1UMA.MAA.TUMC.WD001									36.6		2.22	8	576	2208	184.6		15.8
2	F	MAJ	R03.TU.MC.WD001									12.22		2.52	36	2174	2319		194.7	42.8
	F		R03.TU.MC.WD002																	
3	F	MAQ	R03	KK	2	UMA	MAQ	TU	MC	WD001	INTEGRAL PIPING	3.3		1.7	17	1001	1221			132.2
	F		R03	KK	2	UMA	MAQ	TU	MC	WD002										
	F		R03	KK	2	UMA	MAQ	TU	MC	WD003										
4	F	MAV	R03	KK	2	UMA	MAV	TU	MC	WD001	INTEGRAL PIPING		30.7	4.4	31	3418	4939			107.8
	F		R03	KK	2	UMA	MAV	TU	MC	WD002										
	F		R03	KK	2	UMA	MAV	TU	MC	WD003										
	F		R03	KK	2	UMA	MAV	TU	MC	WD004										
5	F	MAX	R03	KK	2	UMA	MAX	TU	MC	WD001	INTEGRAL PIPING		10.5	1.8	58	3758	3190			67.7
	F		R03	KK	2	UMA	MAX	TU	MC	WD002										
	F		R03	KK	2	UMA	MAX	TU	MC	WD003										
	F		R03	KK	2	UMA	MAX	TU	MC	WD005										
6	F	MAK	R03	KK	2	UMA	MAK	TU	MC	WD001			1.9	0.2	6	349	440			10.8
7	F	MKF	R41	KK	2	UMA	MKF	TM	OK	WD001	INTEGRAL PIPING		6.8	1	53	1387	1338			35
8	F	MKG	R41	KK	2	UMA	MKG	TM	OK	WD001	INTEGRAL PIPING	3		0.3	69	883	918		99.4	16
9	F	MKW	R41	KK	2	UMV	MKW	TM	OK	WD001	INTEGRAL PIPING	10		4.2	101	3806	3715		200	90
	F		R41	KK	2	UMV	MKW	TM	OK	WD002										
	F		R41	KK	2	UMV	MKW	TM	OK	WD003										
	F		R41	KK	2	UMV	MKW	TM	OK	WD004										
	F		R41	KK	2	UMV	MKW	TM	OK	WD005										

10	F	MVA10	R01	KK	2	UMA	MVA10	TM	OK	WD001	INTEGRAL PIPING	1.3		1.5	19	488	617			200.5
	F		R01	KK	2	UMA	MVA10	TM	OK	WD002										
	F	MVA50	R01	KK	2	UMA	MVA50	TM	OK	WD001	INTEGRAL PIPING	5		0.41	9	348	1050			
	F	MVA60	R01	KK	2	UMV	MVA60	TM	OK	WD001		0.74		0.13	10	182	108			
11	F	MXN	R03	KK	2	UMA	MXN	TU	MC	WD002	INTEGRAL PIPING		2.41	0.4	18	837	740			21.3
	F		R03	KK	2	UMA	MXN	TU	MC	WD003										
	F		R03	KK	2	UMA	MXN	TU	MC	WD004										
12	F	MAM	R41	KK	2	UMA	MAM	TU	MC	WD002	INTEGRAL PIPING	12.5		3.42	36	2874	3203	322.8	34.4	39.7
	F		R41	KK	2	UMA	MAM	TU	MC	WD003										
	F		R03	KK	2	UMA	MAM	TU	MC	WD004										
	F		R03	KK	2	UMA	MAM	TU	MC	WD006										
13	F	LAV	R01.KK34.UMA.0.TM.OK.WD005								CROSS OVER PIPING & VALVE BLOCKS	0.26			8	172	117			40
14	F	LBJ	R03.KK1UMA.LBJ.TU.MC.WD001										49.38	4.37		1936	5227	1700		
	F		1441443									220.9		9.46	12	3390	9996			
	F		R41.KK12.UMA.LBJ.WD001									5.82		0.94	4	416	1159			
	F		R41.KK12.UMA.LBJ.WD002									0.28		0.64	12	330	113			
	F		R03.KK12.UMA.LBJ.WD003									11.06		1.91	12	988	1821			
	F		R03.KK12.UMA.LBJ.WD004									0.97		0.13		175	153			
	F		R03.KK12.UMA.LBJ.WD005									0.99				322	337			
15	F	LBR	R143.UMA.MT.CE.MC.WD001									7.89		0.58	6	688	1008	200		
16	F	LBW11	R01	KK	2	UMA	LBW11	TM	OK	WD001	INTEGRAL PIPING	0.76		0.61		84	300	357.2		96.3
	F	LBW	R41	KK	2	UMA	LBW	TU	MC	WD001		16.24		3.42	50	3188	4016			
	F		R03	KK	2	UMA	LBW	TU	MC	WD005										
	F	LBW	R143.KK34.UMA.MT.CE.MC.WD001									1.87		1.1	34	1024	671			

		(TDB FP)											
17	F	LCW	R143.UMA.MT.CE.MC.WD001	INTEGRAL PIPING	1.06		0.44	12	459	323			
18	F	LVA	R143.KK34.UMA.XAV.TU.SB.WD001	INTEGRAL PIPING		9.54	2.27	134	4308	2322			
19	F	XAG	R143.KK34.UMA.LCF.TU.SB.WD001	INTEGRAL PIPING	1.76		0.2	22	1186	569			308.4
20	F	XAQ	R41.KK.UMA.XAQ.TM.OK.WD001		2.39		0.7	16	664	711			
		CROSS OVER PIPING			**357**	**111**	**51**	**793**	**41410**	**54848**	**2765**	**529**	**1224**

VALVE BLOCKS	**Approx WT (MT)**
Valve blocks with seal welding (HP valve Block)	60
Valve blocks without seal welding (LP, MSR heating steam supply and dump valves, BRU-K):	125
Valve blocks without seal welding & with blue matching (Stop valves of TDFP)	8
TOTAL	**193**

List of Pipelines in MT System wise as FIM in KUDANKULAM - UNIT 3 MAIN TG PACKAGE			
System KKS code	**Material**	**Building**	**Approx Weight in MT**
LBJ	CS	UMA	221
LBJ	CS	UMA	19
LBW	CS	UMA	17
LBW	CS	UMA	2
MAA	CS	UMA	37
MAM	CS	UMA	12

MAQ	CS	UMA/UMV	3
MVA	CS	UMA/UMV	7
MAX	CS	UMA	0.004
MAJ	CS	UMA	12
MKG	CS	UMA	3
MKW	CS	UMA/UMV	10
LAV	CS	UMA	0.3
LBR	CS	UMA	8
LCW	CS	UMA	1
XAG	CS	UMA	2
XAQ	CS	UMA	2
LBJ	SS	UMA	49
MAK	SS	UMA/UMV	2
MAV	SS	UMA/UMV	31
MXN	SS	UMA	2
MAX	SS	UMA	10
LBJ	SS	UMA	0.01
MKF	SS	UMA	7
LVA	SS	UMA	10
Total Wt of CS pipeline (MT)			356
Total Wt of SS pipeline (MT)			111
Total			**467**

List of pipelines in MT (size & system wise) as FIM in KUDANKULAM - UNIT 3 MAIN TG PACKAGE (Approx)																		
Pipe OD (mm)				10	12	14	16	18	20	25	28	30	32	34	38	40	45	55
Thickness range(mm)		System wise (MT)		2	2-3.5	2	2	2 - 4	2 - 3	2-3	3	3.5-4	2 - 3.5	3-6.7	2 - 3.5	3-6.7	2 - 3	9
System KKS code	Material	Building		MT	MT	MT	MT	MT	MT	MT	MT	MT	MT	MT	MT	MT	MT	MT
LBJ	CS	UMA	220.95															
LBJ	CS	UMA	19.107					0.046					0.147		0.001			
MAA	CS	UMA	36.6844															
MAM	CS	UMA	12.4956							0.152			0.082		0.331			
MAQ	CS	UMA/UMV	3.333							0.037					0.130			
MVA	CS	UMA/UMV	7.0218				0.002	0.544							0.044			
MAX	CS	UMA	0.0035							0.002			0.0015					
MAJ	CS	UMA	12.2276										0.0933					
MKG	CS	UMA	2.9988			0.014		0.208					0.0948					
MKW	CS	UMA/UMV	9.9742			0.037		0.0654	0.0008				0.2213					
LAV	CS	UMA	0.26					0.0088					0.0484					
LBR	CS	UMA	7.89							0.03								
LBW	CS	UMA	17.003							0.020			0.234		0.489			
LBW	CS	UMA	1.856			0.004		0.02		0.06			0.16		0.15		0.002	
LCW	CS	UMA	1.02					0.03		0.05			0.16					
XAG	CS	UMA	1.7615					0.023		0.023								
XAQ	CS	UMA	2.4			0.01				0.16			0.12					
LBJ	SS	UMA	49.38															
LBJ	SS	UMA	0.010835															
MAK	SS	UMA/UMV	1.8516										0.368		0.005			

MAV	SS	UMA/UMV	30.745					0.002		0.010			0.010		0.008			
MAX	SS	UMA	10.4834					0.1196		0.196			0.0398		0.04		0.001	
MXN	SS	UMA	2.4096			0.002		0.0444		0.0283					0.6615			
MKF	SS	UMA	6.765			0.0759			0.0004				0.1827					
LVA	SS	UMA	9.51			0.03		0.01		0.01			0.38		0.14		0.2	
Total Wt of CS pipeline (MT)				**0.00**	**0.00**	**0.07**	**0.00**	**0.95**	**0.00**	**0.53**	**0.00**	**0.00**	**1.36**	**0.00**	**1.15**	**0.00**	**0.00**	**0.00**

Pipe OD (mm)				**57**	**65**	**76**	**89**	**108**	**125**	**133**	**159**	**219**	**273**	**325**	**377**	**426**	**465**
Thickness range (mm)		**System wise (MT)**		**3 - 5.5**	**3.5**	**3 - 7**	**4.5 - 8**	**4-8**	**4.5-6**	**5.00**	**5 - 7**	**7 - 12**	**5 - 11**	**8 - 12**	**6 - 9**	**8 - 10**	**10.5-16**
System KKS code	**Material**	**Building**		MT	MT	MT	MT	MT	MT	MT	MT	MT	MT	MT	MT	MT	MT
LBJ	CS	UMA	220.95														
LBJ	CS	UMA	19.107	0.267				0.365			0.580				0.970	10.910	
MAA	CS	UMA	36.6844														
MAM	CS	UMA	12.4956	2.066		0.448	0.216	0.427			1.713	2.971	0.590		0.852	0.987	
MAQ	CS	UMA/UMV	3.333	0.291		0.477		0.728			1.670						
MVA	CS	UMA/UMV	7.0218	1.385		0.025						1.698		3.325			
MAX	CS	UMA	0.0035														
MAJ	CS	UMA	12.2276									5.0398		4.2151			
MKG	CS	UMA	2.9988	0.63							0.193	1.859					

MKW	CS	UMA/UMV	9.9742	1.473		0.7121	2.751			1.164	2.562	0.3256	0.258	0.404			
LAV	CS	UMA	0.26	0.0252		0.0376		0.14									
LBR	CS	UMA	7.89	0.1										7.76			
LBW	CS	UMA	17.003	0.744		0.684	1.328	1.593		0.479	0.905	4.107	0.764		0.429		
LBW	CS	UMA	1.856	0.18		0.25		0.47			0.56						
LCW	CS	UMA	1.02				0.15	0.06			0.22		0.35				
XAG	CS	UMA	1.7615	0.02		0.3546	0.0469	0.7908			0.5032						
XAQ	CS	UMA	2.4				0.03	0.7			1.38						
LBJ	SS	UMA	49.38														
LBJ	SS	UMA	0.010835	0.010835													
MAK	SS	UMA/UMV	1.8516	0.081		0.040	1.327	0.031									
MAV	SS	UMA/UMV	30.745	0.426		0.016	1.428	0.527			0.213	6.806	1.814	13.200	0.496	1.020	
MAX	SS	UMA	10.4834	3.3063		1.9379	0.3269	1.9183		2.0339	0.5637						
MXN	SS	UMA	2.4096	0.1761		0.5841		0.9086			0.0046						
MKF	SS	UMA	6.765	0.074				0.146			2.344	3.942					
LVA	SS	UMA	9.51	0.59		0.3		2.41		0.32	0.38	3.36	0.44	0.94			
Total Wt of CS pipeline (MT)				**7.18**	**0.00**	**2.99**	**4.52**	**5.27**	**0.00**	**1.64**	**10.29**	**16.00**	**1.96**	**15.70**	**2.25**	**11.90**	**0.00**
Total Wt of SS pipeline (MT)				**4.65**	**0.00**	**2.88**	**3.08**	**5.94**	**0.00**	**2.35**	**3.51**	**14.11**	**2.25**	**14.14**	**0.50**	**1.02**	**0.00**

Pipe OD (mm)				530	630	720	820	920	1020	1140	1200	1220	1420	1848	2060	2420
Thks range (mm)		Systemwise (MT)		8 - 10	8 - 25	8.00	9.00	10.5-20	9.5-10	20	9 -11	12-16	10-16	24	24	14
System KKS code	Material	Building		MT	MT	MT	MT	MT	MT	MT	MT	MT	MT	MT	MT	MT
LBJ	CS	UMA	220.95									30.124	70.680	37.766	82.380	
LBJ	CS	UMA	19.107		5.821											
MAA	CS	UMA	36.6844		36.684											
MAM	CS	UMA	12.4956	1.662												
MAQ	CS	UMA/UMV	3.333													
MVA	CS	UMA/UMV	7.0218													
MAX	CS	UMA	0.0035													
MAJ	CS	UMA	12.2276		2.8794											
MKG	CS	UMA	2.9988													
MKW	CS	UMA/UMV	9.9742													
LAV	CS	UMA	0.26													
LBR	CS	UMA	7.89													
LBW	CS	UMA	17.003	5.227												
LBW	CS	UMA	1.856													
LCW	CS	UMA	1.02													

XAG	CS	UMA	1.7615													
XAQ	CS	UMA	2.4													
LBJ	SS	UMA	49.38							4.700			44.680			
LBJ	SS	UMA	0.010835													
MAK	SS	UMA/UMV	1.8516													
MAV	SS	UMA/UMV	30.745	4.771												
MAX	SS	UMA	10.4834													
MXN	SS	UMA	2.4096													
MKF	SS	UMA	6.765													
LVA	SS	UMA	9.51													
Total Wt of CS pipeline (MT)			**356.99**	**6.89**	**45.38**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**30.12**	**70.68**	**37.77**	**82.38**	**0.00**
Total Wt of SS pipeline (MT)			**111.16**	**4.77**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

List of valves in MT (size & system wise) as FIM in KUDANKULAM - UNIT 3 MAIN TG PACKAGE (Approx)					
Sr. No.	**System KKS**	**WORKING DOCUMENT NO**	**Valve KKS Code**	**Size (DN)**	**Weight of Valve (Kg)**
1	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG10AA101	50	8.5
2	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG10AA102	50	8.5
3	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG10AA103	50	8.5
4	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG11AA101	50	8.5
5	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG10AA401	10	0.5
6	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG10AA402	10	0.5
7	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG12AA101	15	0.5
8	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG12AA102	15	0.5

9	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG12AA103	15	0.5
10	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG12AA001	15	23.3
11	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG12AA002	15	23.3
12	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG12AA201	15	6.5
13	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG12AA601	15	2.1
14	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG04AA401	50	0.5
15	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG80AA101	50	8.5
16	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG81AA101	50	8.5
17	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG80AA401	10	0.5
18	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG81AA401	10	0.5
19	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG80AA102	50	8.5
20	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG81AA102	50	8.5
21	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG80AA402	10	0.5
22	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG81AA402	10	0.5
23	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG90AA001	150	200
24	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG90AA002	150	200
25	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG90AA101	150	125
26	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG90AA401	10	0.5
27	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG90AA402	10	0.5
28	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG30AA101	50	8.5
29	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG30AA102	50	8.5
30	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG30AA103	50	8.5
31	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG31AA101	50	8.5
32	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG39AA101	50	8.5
33	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG39AA102	50	8.5
34	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG32AA101	50	8.5

35	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG32AA102	50	8.5
36	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG32AA001	50	30
37	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG32AA002	50	30
38	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG32AA401	10	0.5
39	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG39AA401	10	0.5
40	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG02AA101	50	8.5
41	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG03AA101	50	8.5
42	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG53AA101	50	8.5
43	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG58AA101	50	8.5
44	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG04AA101	10	8.5
45	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG02AA401	10	0.5
46	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG50AA402	10	0.5
47	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG52AA401	10	0.5
48	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG54AA401	10	0.5
49	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG56AA401	10	0.5
50	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG57AA401	10	0.5
51	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG55AA401	10	0.5
52	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG54AA401	10	0.5
53	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG53AA401	50	8.5
54	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG58AA401	50	8.5
55	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG51AA401	10	0.5
56	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG50AA401	10	0.5
57	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG20AA101	50	8.5
58	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG20AA102	50	8.5
59	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG21AA101	50	8.5
60	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG06AA101	25	4.0

61	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG60AA101	25	4
62	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG60AA102	25	4
63	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG80AA103	50	8.5
64	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG80AA104	50	8.5
65	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG60AA401	10	0.5
66	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG06AA401	10	0.5
67	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG67AA101	10	0.5
68	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG68AA101	10	0.5
69	MKG	R01.KK34.UMA.MKG.TM.OK.WD001	MKG12AA401	10	0.5
70	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF02AA101	200	48.3
71	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF03AA101	200	48.3
72	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF40AA102	200	48.3
73	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF02AA601	150	40
74	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF03AA601	150	40
75	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF02AA102	150	39.8
76	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF03AA102	150	39.8
77	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF11AA101	150	39.8
78	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF12AA101	150	39.8
79	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF12AA102	150	39.8
80	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF13AA101	150	39.8
81	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF13AA102	150	39.8
82	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF21AA101	150	39.8
83	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF21AA102	150	39.8
84	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF22AA101	150	39.8
85	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF22AA102	150	39.8
86	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF23AA101	150	39.8

87	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF23AA102	150	39.8
88	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF30AA101	25	0.5
89	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF04AA101	10	0.5
90	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF04AA401	10	0.5
91	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF04AA102	14	10.1
92	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF05AA401	25	0.8
93	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF07AA101	50	2.4
94	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF01AA103	25	0.8
95	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF06AA901	20/32	13
96	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF01AA102	50	2.4
97	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF01AA201	50	17
98	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF01AA101	50	2.4
99	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF08AA101	50	2.4
100	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF40AA403	10	0.5
101	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF41AA401	25	0.8
102	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF42AA101	25	0.8
103	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF40AA401	25	0.8
104	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF35AA102	25	0.8
105	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF35AA101	25	0.8
106	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF50AA201	25	8.1
107	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF50AA101	25	0.8
108	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF52AA101	25	0.8
109	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF50AA401	25	0.8
110	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF50AA402	10	0.5
111	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF50AA106	10	0.5
112	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF50AA102	25	0.8

113	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF51AA401	25	0.8
114	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF51AA101	25	0.8
115	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF53AA101	25	0.8
116	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF51AA402	10	0.5
117	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF51AA105	10	0.5
118	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF51AA102	25	0.8
119	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF21AA103	25	0.8
120	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF22AA103	25	0.8
121	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF23AA103	25	0.8
122	MKF	R01.KK34.UMA.MKF.TM.OK.WD001	MKF40AA201	150	55.8
123	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW01AA101	80	5.6
124	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW02AA101	80	5.6
125	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW03AA101	80	5.6
126	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW01AA103	25	2.9
127	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW02AA103	25	2.9
128	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW03AA103	25	2.9
129	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW01AA601	80	12.5
130	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW02AA601	80	12.5
131	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW03AA601	80	12.5
132	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW01AA102	80	5.6
133	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW02AA102	80	5.6
134	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW03AA102	80	5.6
135	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW11AA101	80	5.6
136	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW12AA101	80	5.6
137	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW13AA101	80	5.6
138	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW12AA102	80	5.6

139	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW13AA102	80	5.6
140	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW66AA109	50	2.6
141	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW12AA102	80	5.6
142	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW30AA107	25	2.9
143	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW66AA107	25	1
144	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW66AA201	50	18.8
145	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW66AA105	50	2.6
146	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW67AA105	25	1
147	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW66AA108	25	1
148	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW67AA201	50	18.8
149	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW67AA103	50	18.8
150	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW66AA104	25	2.6
151	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW67AA102	25	2.6
152	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW67AA101	65	9
153	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW88AA102	50	7.3
154	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW83AA102	50	7.3
155	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW61AA103	50	7.3
156	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW36AA102	65	9
157	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW66AA103	65	9
158	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW88AA101	50	7.3
159	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW83AA101	50	7.3
160	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW61AA102	50	7.3
161	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW36AA101	65	9
162	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW60AA107	25	2.9
163	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW66AA112	25	2.9
164	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW66AA110	15	2.9

165	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW66AA111	15	2.9
166	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW35AA601	150	42
167	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW35AA101	25	2.9
168	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW65AA601	150	42
169	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW73AA101	10	0.5
170	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW65AA101	25	2.9
171	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW73AA601	150	42
172	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW60AA101	80	5.6
173	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW66AA102	15	2.9
174	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW87AA101	15	2.9
175	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW80AA602	50	7.5
176	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW84AA102	50	7.3
177	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW84AA101	50	7.3
178	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW84AA105	25	3.7
179	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW84AA103	50	2.6
180	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW85AA101	25	3.7
181	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW80AA601	50	7.5
182	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW81AA101	50	7.3
183	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW81AA105	25	3.7
184	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW81AA103	50	2.6
185	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW82AA101	25	3.7
186	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW81AA102	50	7.3
187	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW70AA101	10	0.5
188	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW72AA102	10	0.5
189	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW72AA101	50	2.6
190	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW30AA106	25	0.5

191	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW36AA103	15	2.9
192	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW36AA104	15	2.9
193	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW34AA101	80	5.6
194	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW64AA101	80	5.6
195	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW16AA102	80	5.6
196	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW16AA101	80	5.6
197	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW17AA101	80	5.6
198	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW17AA102	80	5.6
199	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW30AA601	50	12.5
200	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW62AA101	10	0.5
201	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW32AA101	10	0.5
202	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW60AA105	80	5.6
203	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW60AA104	80	5.6
204	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW60AA103	80	5.6
205	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW61AA101	15	2.9
206	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW60AA102	80	5.6
207	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW63AA201	50	18.8
208	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW60AA101	80	5.6
209	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW30AA101	80	5.6
210	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW31AA101	15	2.9
211	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW30AA102	80	5.6
212	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW30AA105	80	5.6
213	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW30AA103	80	5.6
214	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW30AA104	80	5.6
215	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW14AA101	50	2.6
216	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW81AA104	50	2.6

217	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW84AA104	50	2.6
218	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW33AA201	50	18.8
219	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW81AA104	50	2.6
220	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW84AA104	50	2.6
221	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW30AA108	25	3.7
222	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW60AA108	25	3.7
223	MKW	R01.KK34.UMA.MKW.TM.OK.WD001,002,003,004,005	MKW14AA102	25	3.7
224	LVA	TDFP-1	XAV20AA134	150	213
225	LVA	TDFP-1	XAV20AA138	200	222
226	LVA	TDFP-1	XAV20AA103	150	213
227	LVA	TDFP-1	XAV20AA107	150	213
228	LVA	TDFP-1	XAV20AA116	200	222
229	LVA	TDFP-1	XAV20AA	10	2.4
230	LVA	TDFP-1	XAV20AA	10	2.4
231	LVA	TDFP-1	XAV20AA	10	2.4
232	LVA	TDFP-1	XAV20AA	10	2.4
233	LVA	TDFP-1	XAV20AA	10	2.4
234	LVA	TDFP-1	XAV20AA	10	2.4
235	LVA	TDFP-1	XAV20AA	10	2.4
236	LVA	TDFP-1	XAV20AA	10	2.4
237	LVA	TDFP-1	XAV20AA	10	2.4
238	LVA	TDFP-1	XAV20AA	10	2.4
239	LVA	TDFP-1	XAV20AA	10	2.4
240	LVA	TDFP-1	XAV20AA	10	2.4
241	LVA	TDFP-1	XAV20AA	10	2.4
242	LVA	TDFP-1	XAV20AA	10	2.4
243	LVA	TDFP-1	XAV20AA	10	2.4
244	LVA	TDFP-1	XAV20AA	10	2.4

245	LVA	TDFP-1	XAV20AA	10	2.4
246	LVA	TDFP-1	XAV20AA	10	2.4
247	LVA	TDFP-1	XAV20AA	10	2.4
248	LVA	TDFP-1	XAV20AA	10	2.4
249	LVA	TDFP-1	XAV20AA	10	2.4
250	LVA	TDFP-1	XAV20AA	10	2.4
251	LVA	TDFP-1	XAV20AA	10	2.4
252	LVA	TDFP-1	XAV20AA	10	2.4
253	LVA	TDFP-1	XAV20AA	10	2.4
254	LVA	TDFP-1	XAV20AA	10	2.4
255	LVA	TDFP-1	XAV20AA	10	2.4
256	LVA	TDFP-1	XAV10AA117	25	2.9
257	LVA	TDFP-1	XAV20AA001	25	19
258	LVA	TDFP-1	XAV20AA607	10	1.4
259	LVA	TDFP-1	XAV20AA608	10	1.4
260	LVA	TDFP-1	XAV10AA603	50	7.4
261	LVA	TDFP-1	XAV10AA118	100	104
262	LVA	TDFP-1	XAV10AA119	100	104
263	LVA	TDFP-1	XAV10AA120	100	104
264	LVA	TDFP-1	XAV10AA121	100	104
265	LVA	TDFP-1	XAV10AA122	100	104
266	LVA	TDFP-1	XAV10AA123	100	104
267	LVA	TDFP-1	XAV10AA124	100	104
268	LVA	TDFP-1	XAV10AA125	100	104
269	LVA	TDFP-1	XAV10AA126	100	104
270	LVA	TDFP-1	XAV10AA127	100	104
271	LVA	TDFP-1	XAV10AA128	100	104
272	LVA	TDFP-1	XAV10AA129	100	104

273	LVA	TDFP-1	XAV10AA130	100	104
274	LVA	TDFP-1	XAV10AA131	100	104
275	LVA	TDFP-1	XAV10AA132	100	104
276	LVA	TDFP-1	XAV10AA139	100	104
277	LVA	TDFP-1	XAV10AA101	50	25.4
278	LVA	TDFP-1	XAV10AA102	50	25.4
279	LVA	TDFP-1	XAV10AA103	50	25.4
280	LVA	TDFP-1	XAV10AA104	50	25.4
281	LVA	TDFP-1	XAV10AA106	50	25.4
282	LVA	TDFP-1	XAV10AA110	50	25.4
283	LVA	TDFP-1	XAV10AA111	50	25.4
284	LVA	TDFP-1	XAV10AA112	50	25.4
285	LVA	TDFP-1	XAV10AA113	50	25.4
286	LVA	TDFP-1	XAV10AA115	50	25.4
287	LVA	TDFP-1	XAV10AA601	100	32.6
288	LVA	TDFP-1	XAV10AA602	100	32.6
289	LVA	TDFP-1	XAV10AA604	100	32.6
290	LVA	TDFP-1	XAV10AA609	100	32.6
291	LBW	TDBFP-1	LBW30AA201	50	53
292	LBW	TDBFP-1	LBW30AA202	50	53
293	LBW	TDBFP-1	LBW30AA005	25	19
294	LBW	TDBFP-1	LBW30AA001	32	20.5
295	LBW	TDBFP-1	LBW30AA002	32	20.5
296	LBW	TDBFP-1	LBW30AA011	32	20.5
297	LBW	TDBFP-1	LBW30AA006	50	27
298	LBW	TDBFP-1	LBW30AA007	50	27
299	LBW	TDBFP-1	LBW30AA008	50	27
300	LBW	TDBFP-1	LBW30AA102	100	104.2

301	LBW	TDBFP-1	LBW30AA003	100	141
302	LBW	TDBFP-1	LBW30AA004	100	141
303	LBW	TDBFP-1	LBW30AA101	80	31
304	LBW	TDBFP-1	LBW30AA009	80	52.5
305	LBW	TDBFP-1	LBW30AA103	100	46.6
306	LBW	TDBFP-1	LBW30AA104	100	46.6
307	LBW	TDBFP-1	LBW30AA010	150	213
308	XAG	TDFP-1	LCR30AA201	80	53
309	XAG	TDFP-1	LCR30AA202	80	53
310	XAG	TDFP-1	LCR30AA103	40	4.6
311	XAG	TDFP-1	LCR30AA104	10	4.6
312	XAG	TDFP-1	LCR30AA102	15	2.3
313	XAG	TDFP-1	LCR30AA007	50	43.8
314	XAG	TDFP-1	LCR30AA006	100	164
315	XAG	TDFP-1	LCR30AA005	100	141
316	XAG	TDFP-1	LCR30AA004	150	275
317	XAG	TDFP-1	LCR30AA008	150	252
318	XAG	TDFP-1	LCR30AA101	100	104.2
319	LCW	TDFP-1	LCW10AA102	15	2.3
320	LCW	TDFP-1	LCW10AA104	15	2.3
321	LCW	TDFP-1	LCW10AA103	15	2.3
322	LCW	TDFP-1	LCW10AA002	20	19
323	LCW	TDFP-1	LCW10AA001	20	19
324	LCW	TDFP-1	LCW10AA101	25	2.9
325	LBR	TDFP-1	LBR01AA101	10	4.6
326	LBR	TDFP-1	LBR01AA004	50	27
327	LBR	TDFP-1	LBR01AA005	50	27
328	LVA	TDFP-2	XAV30AA134	150	213

329	LVA	TDFP-2	XAV30AA138	200	222
330	LVA	TDFP-2	XAV30AA107	150	213
331	LVA	TDFP-2	XAV30AA116	200	222
332	LVA	TDFP-2	XAV30AA	10	2.4
333	LVA	TDFP-2	XAV30AA	10	2.4
334	LVA	TDFP-2	XAV30AA	10	2.4
335	LVA	TDFP-2	XAV30AA	10	2.4
336	LVA	TDFP-2	XAV30AA	10	2.4
337	LVA	TDFP-2	XAV30AA	10	2.4
338	LVA	TDFP-2	XAV30AA	10	2.4
339	LVA	TDFP-2	XAV30AA	10	2.4
340	LVA	TDFP-2	XAV30AA	10	2.4
341	LVA	TDFP-2	XAV30AA	10	2.4
342	LVA	TDFP-2	XAV30AA	10	2.4
343	LVA	TDFP-2	XAV30AA	10	2.4
344	LVA	TDFP-2	XAV30AA	10	2.4
345	LVA	TDFP-2	XAV30AA	10	2.4
346	LVA	TDFP-2	XAV30AA	10	2.4
347	LVA	TDFP-2	XAV30AA	10	2.4
348	LVA	TDFP-2	XAV30AA	10	2.4
349	LVA	TDFP-2	XAV30AA	10	2.4
350	LVA	TDFP-2	XAV30AA	10	2.4
351	LVA	TDFP-2	XAV30AA	10	2.4
352	LVA	TDFP-2	XAV30AA	10	2.4
353	LVA	TDFP-2	XAV30AA	10	2.4
354	LVA	TDFP-2	XAV30AA	10	2.4
355	LVA	TDFP-2	XAV30AA	10	2.4
356	LVA	TDFP-2	XAV30AA	10	2.4

357	LVA	TDFP-2	XAV30AA	10	2.4
358	LVA	TDFP-2	XAV30AA	10	2.4
359	LVA	TDFP-2	XAV20AA117	25	2.9
360	LVA	TDFP-2	XAV30AA001	25	19
361	LVA	TDFP-2	XAV30AA607	10	1.4
362	LVA	TDFP-2	XAV30AA608	10	1.4
363	LVA	TDFP-2	XAV20AA603	50	7.4
364	LVA	TDFP-2	XAV20AA118	100	104
365	LVA	TDFP-2	XAV20AA119	100	104
366	LVA	TDFP-2	XAV20AA120	100	104
367	LVA	TDFP-2	XAV20AA121	100	104
368	LVA	TDFP-2	XAV20AA122	100	104
369	LVA	TDFP-2	XAV20AA123	100	104
370	LVA	TDFP-2	XAV20AA124	100	104
371	LVA	TDFP-2	XAV20AA125	100	104
372	LVA	TDFP-2	XAV20AA126	100	104
373	LVA	TDFP-2	XAV20AA127	100	104
374	LVA	TDFP-2	XAV20AA128	100	104
375	LVA	TDFP-2	XAV20AA129	100	104
376	LVA	TDFP-2	XAV20AA130	100	104
377	LVA	TDFP-2	XAV20AA131	100	104
378	LVA	TDFP-2	XAV20AA132	100	104
379	LVA	TDFP-2	XAV20AA139	100	104
380	LVA	TDFP-2	XAV20AA101	50	25.4
381	LVA	TDFP-2	XAV20AA102	50	25.4
382	LVA	TDFP-2	XAV20AA103	50	25.4
383	LVA	TDFP-2	XAV20AA104	50	25.4
384	LVA	TDFP-2	XAV20AA106	50	25.4

385	LVA	TDFP-2	XAV20AA110	50	25.4
386	LVA	TDFP-2	XAV20AA111	50	25.4
387	LVA	TDFP-2	XAV20AA112	50	25.4
388	LVA	TDFP-2	XAV20AA113	50	25.4
389	LVA	TDFP-2	XAV20AA115	50	25.4
390	LVA	TDFP-2	XAV10AA601	100	32.6
391	LVA	TDFP-2	XAV10AA602	100	32.6
392	LVA	TDFP-2	XAV10AA604	100	32.6
393	LVA	TDFP-2	XAV10AA609	100	32.6
394	LVA	TDFP-2	XAV30AA133	150	213
395	LBR	TDFP-2	LBR02AA101	10	4.6
396	LBR	TDFP-2	LBR02AA004	50	27
397	LBR	TDFP-2	LBR02AA005	50	27
398	XAG	TDFP-2	LCR40AA201	80	53
399	XAG	TDFP-2	LCR40AA202	80	53
400	XAG	TDFP-2	LCR40AA103	40	4.6
401	XAG	TDFP-2	LCR40AA104	10	4.6
402	XAG	TDFP-2	LCR40AA102	15	2.3
403	XAG	TDFP-2	LCR40AA007	50	43.8
404	XAG	TDFP-2	LCR40AA006	100	164
405	XAG	TDFP-2	LCR40AA005	100	141
406	XAG	TDFP-2	LCR40AA004	150	275
407	XAG	TDFP-2	LCR40AA008	150	252
408	XAG	TDFP-2	LCR40AA101	100	104.2
409	LCW	TDFP-2	LCW20AA102	15	2.3
410	LCW	TDFP-2	LCW20AA104	15	2.3
411	LCW	TDFP-2	LCW20AA103	15	2.3
412	LCW	TDFP-2	LCW20AA002	20	19

413	LCW	TDFP-2	LCW20AA001	20	19
414	LCW	TDFP-2	LCW20AA101	25	2.9
415	LBW	TDBFP-2	LBW40AA201	50	53
416	LBW	TDBFP-2	LBW40AA202	50	53
417	LBW	TDBFP-2	LBW40AA005	25	19
418	LBW	TDBFP-2	LBW40AA001	32	20.5
419	LBW	TDBFP-2	LBW40AA002	32	20.5
420	LBW	TDBFP-2	LBW40AA011	32	20.5
421	LBW	TDBFP-2	LBW40AA006	50	27
422	LBW	TDBFP-2	LBW40AA007	50	27
423	LBW	TDBFP-2	LBW40AA008	50	27
424	LBW	TDBFP-2	LBW40AA102	100	104.2
425	LBW	TDBFP-2	LBW40AA003	100	141
426	LBW	TDBFP-2	LBW40AA004	100	141
427	LBW	TDBFP-2	LBW40AA101	80	31
428	LBW	TDBFP-2	LBW40AA009	80	52.5
429	LBW	TDBFP-2	LBW40AA103	100	46.6
430	LBW	TDBFP-2	LBW40AA104	100	46.6
431	LBW	TDBFP-2	LBW40AA010	150	213
432	MVA	MVA50-WD001	30MVA54AA001	100	130
433	MVA	MVA50-WD001	30MVA54AA101	100	100
434	MVA	MVA50-WD001	30MVA50AA001	300	370
435	MVA	MVA50-WD001	30MVA55AA001	200	225
436	MVA	MVA50-WD001	30MVA50AA101	300	320
437	MVA	MVA50-WD001	30MVA55AA101	200	150
438	MVA	MVA50-WD001	30MVA50AA102	15	7.3
439	MVA	MVA50-WD001	30MVA54AA102	15	4.2
440	MVA	MVA50-WD001	30MVA55AA102	15	4.2

441	MVA	MVA10-WD001	30MVA11AA101	50	16.5
442	MVA	MVA10-WD001	30MVA12AA101	50	16.5
443	MVA	MVA10-WD001	30MVA15AA101	32	10
444	MVA	MVA10-WD001	30MVA16AA101	32	10
445	MVA	MVA10-WD001	30MVA25AA101	32	10
446	MVA	MVA10-WD001	30MVA26AA101	32	10
447	MVA	MVA10-WD001	30MVA27AA101	50	4.5
448	MVA	MVA10-WD001	30MVA10AA101	50	3.4
449	MVA	MVA10-WD001	30MVA13AA101	50	3.4
450	MVA	MVA10-WD001	30MVA20AA101	50	3.4
451	MVA	MVA10-WD001	30MVA27AA102	50	3.4
452	MVA	MVA10-WD001	30MVA11AA102	50	3.4
453	MVA	MVA10-WD001	30MVA11AA401	15	7.3
454	MVA	MVA10-WD001	30MVA13AA401	15	7.3
455	MVA	MVA10-WD001	30MVA27AA401	15	7.3
456	MVA	MVA10-WD002	30MVA23AA103	50	25
457	MVA	MVA10-WD002	30MVA24AA103	50	25
458	MVA	MVA10-WD002	30MVA23AA401	10	7.3
459	MVA	MVA10-WD002	30MVA23AA402	10	7.3
460	MVA	MVA60-WD001	30MVA60AA102	50	8.03
461	MVA	MVA60-WD001	30MVA70AA102	50	8.03
462	MVA	MVA60-WD001	30MVA70AA103	50	8.03
463	MVA	MVA60-WD001	30MVA70AA104	50	8.03
464	MVA	MVA60-WD001	30MVA70AA101	50	4.5
465	MVA	MVA60-WD001	30MVA65AA401	15	7.3
466	MVA	MVA60-WD001	30MVA60AA401	15	7.3
467	MVA	MVA60-WD001	30MVA70AA401	15	7.3
468	MVA	MVA60-WD001	30MVA60AA101	50	4.5

469	MVA	MVA60-WD001	30MVA70AA105	50	4.5
470	MAJ	MAJ-WD001	MAJ31AA101	200	230
471	MAJ	MAJ-WD001	MAJ31AA102	200	230
472	MAJ	MAJ-WD001	MAJ32AA101	200	230
473	MAJ	MAJ-WD001	MAJ32AA102	200	230
474	MAJ	MAJ-WD001	MAJ33AA101	200	230
475	MAJ	MAJ-WD001	MAJ33AA102	200	230
476	MAJ	MAJ-WD001	MAJ34AA101	200	230
477	MAJ	MAJ-WD001	MAJ34AA102	200	230
478	MAJ	MAJ-WD001	MAJ35AA101	200	230
479	MAJ	MAJ-WD001	MAJ35AA102	200	230
480	MAJ	MAJ-WD001	MAJ36AA101	200	230
481	MAJ	MAJ-WD001	MAJ36AA102	200	230
482	MAJ	MAJ-WD001	MAJ41AA001	300	431
483	MAJ	MAJ-WD001	MAJ42AA001	300	431
484	MAJ	MAJ-WD001	MAJ43AA001	300	431
485	MAJ	MAJ-WD001	MAJ44AA001	300	431
486	MAJ	MAJ-WD001	MAJ51AA001	300	488.7
487	MAJ	MAJ-WD001	MAJ52AA001	300	488.7
488	MAJ	MAJ-WD001	MAJ41AA601	300	294
489	MAJ	MAJ-WD001	MAJ42AA601	300	294
490	MAJ	MAJ-WD001	MAJ43AA601	300	294
491	MAJ	MAJ-WD001	MAJ44AA601	300	294
492	MAJ	MAJ-WD001	MAJ31AA401	25	2.3
493	MAJ	MAJ-WD001	MAJ31AA402	25	2.3
494	MAJ	MAJ-WD001	MAJ32AA401	25	2.3
495	MAJ	MAJ-WD001	MAJ32AA402	25	2.3
496	MAJ	MAJ-WD001	MAJ33AA401	25	2.3

497	MAJ	MAJ-WD001	MAJ33AA402	25	2.3
498	MAJ	MAJ-WD001	MAJ34AA401	25	2.3
499	MAJ	MAJ-WD001	MAJ34AA402	25	2.3
500	MAJ	MAJ-WD001	MAJ35AA401	25	2.3
501	MAJ	MAJ-WD001	MAJ35AA402	25	2.3
502	MAJ	MAJ-WD001	MAJ36AA401	25	2.3
503	MAJ	MAJ-WD001	MAJ36AA402	25	2.3
504	MAJ	MAJ-WD002	MAJ45AA101	300	360
505	MAJ	MAJ-WD002	MAJ45AA401	25	2.3
506	MAK	MAK-WD001	MAK11AA101	80	37
507	MAK	MAK-WD001	MAK12AA101	80	37
508	MAK	MAK-WD001	MAK11AA102	80	240
509	MAK	MAK-WD001	MAK12AA102	80	240
510	MAK	MAK-WD001	MAK20AA101	25	15
511	MAK	MAK-WD001	MAK20AA102	25	15
512	MAV	MAV-WD004	MAV14AA101	50	10.4
513	MAV	MAV-WD004	MAV14AA102	25	2.3
514	MAV	MAV-WD004	MAV15AA101	50	10.4
515	MAV	MAV-WD004	MAV15AA102	50	10.4
516	MAV	MAV-WD004	MAV18AA101	50	10.4
517	MAV	MAV-WD004	MAV19AA101	50	10.4
518	MAV	MAV-WD004	MAV19AA102	50	10.4
519	MAV	MAV-WD004	MVB20AA102	50	10.4
520	MAV	MAV-WD004	MVB20AA104	50	10.4
521	MAV	MAV-WD004	MAV15AA103	50	10.4
522	MAV	MAV-WD001	MAV11AA601	300	305
523	MAV	MAV-WD001	MAV11AA602	300	305
524	MAV	MAV-WD001	MAV12AA601	300	305

525	MAV	MAV-WD001	MAV12AA602	300	305
526	MAV	MAV-WD001	MAV13AA601	300	305
527	MAV	MAV-WD001	MAV13AA602	300	305
528	MAV	MAV-WD001	MAV11AA102	300	153
529	MAV	MAV-WD001	MAV12AA102	300	153
530	MAV	MAV-WD001	MAV13AA102	300	153
531	MAV	MAV-WD001	MAV21AA101	300	153
532	MAV	MAV-WD001	MAV21AA102	300	153
533	MAV	MAV-WD001	MAV22AA101	300	153
534	MAV	MAV-WD001	MAV22AA102	300	153
535	MAV	MAV-WD001	MAV23AA101	300	153
536	MAV	MAV-WD001	MAV23AA102	300	153
537	MAV	MAV-WD001	MAV24AA101	300	153
538	MAV	MAV-WD001	MAV24AA102	300	153
539	MAV	MAV-WD001	MAV25AA101	300	153
540	MAV	MAV-WD001	MAV26AA240	300	345
541	MAV	MAV-WD003	MAV50 AA101	50	10.4
542	MAV	MAV-WD003	MAV52AA101	50	10.4
543	MAQ	MAQ	MAQ01AA101	65	13
544	MAQ	MAQ	MAQ02AA101	65	13
545	MAQ	MAQ	MAQ03AA101	65	13
546	MAQ	MAQ	MAQ04AA101	65	13
547	MAQ	MAQ	MAQ05AA101	65	13
548	MAQ	MAQ	MAQ06AA101	65	13
549	MAQ	MAQ	MAQ07AA101	50	9.5
550	MAQ	MAQ	MAQ08AA101	50	9.5
551	MAQ	MAQ	MAQ10AA201	150	32
552	MAQ	MAQ	MAQ20AA201	100	18

553	MAQ	MAQ	MAQ23AA201	100	18
554	MAQ	MAQ	MAQ23AA101	100	18
555	MAQ	MAQ	MAQ24AA101	100	18
556	MAQ	MAQ	MAQ11AA101	150	88
557	MAQ	MAQ	MAQ12AA101	150	88
558	MAQ	MAQ	MAQ21AA101	100	18
559	MAQ	MAQ	MAQ22AA101	100	18
560	XAQ	XAQ-WD001	XAQ10AA101	10	2.5
561	XAQ	XAQ-WD001	XAQ20AA101	10	2.5
562	XAQ	XAQ-WD001	XAQ10AA103	10	2.5
563	XAQ	XAQ-WD001	XAQ20AA103	10	2.5
564	XAQ	XAQ-WD001	XAQ10AA102	25	5
565	XAQ	XAQ-WD001	XAQ20AA102	25	5
566	XAQ	XAQ-WD001	XAQ10AA104	20	5.2
567	XAQ	XAQ-WD001	XAQ20AA104	20	5.2
568	XAQ	XAQ-WD001	XAQ10AA105	20	5.2
569	XAQ	XAQ-WD001	XAQ20AA105	20	5.2
570	XAQ	XAQ-WD001	XAQ10AA106	20	5.2
571	XAQ	XAQ-WD001	XAQ20AA106	20	5.2
572	XAQ	XAQ-WD001	XAQ10AA107	100	75.2
573	XAQ	XAQ-WD001	XAQ20AA107	100	75.2
574	XAQ	XAQ-WD001	XAQ10AA108	80	47.1
575	XAQ	XAQ-WD001	XAQ20AA108	80	47.1
576	MAX	MAX	MAX11AA601	100	55
577	MAX	MAX	MAX12AA601	100	55
578	MAX	MAX	MAX11AA102	100	200
579	MAX	MAX	MAX12AA102	100	200
580	MAX	MAX	MAX31AA601	80	30.5

581	MAX	MAX	MAX32AA601	80	30.5
582	MAX	MAX	MAX16AA101	50	10.4
583	MAX	MAX	MVA23AA101	50	19.5
584	MAX	MAX	MVC23AA102	50	19.5
585	MAX	MAX	MVA13AA102	50	19.5
586	MAX	MAX	MVA13AA103	50	19.5
587	MAX	MAX	MAX18AA101	50	43
588	MAX	MAX	MAX18AA103	50	43
589	MAX	MAX	MAX21AA101	50	43
590	MAX	MAX	MAX70AA101	65	42.5
591	MAX	MAX	MAX70AA102	20	2.6
592	MAX	MAX	MAX16AA102	50	10.4
593	MAX	MAX	MAX11AA602	50	45
594	MAX	MAX	MAX12AA602	50	45
595	MAX	MAX	MAX21AA103	50	43
596	MAX	MAX	MAX11AA401	20	14
597	MAX	MAX	MAX11AA402	20	14
598	MAX	MAX	MAX11AA403	20	14
599	MAX	MAX	MAX11AA404	20	14
600	MAX	MAX	MAX12AA401	20	14
601	MAX	MAX	MAX12AA402	20	14
602	MAX	MAX	MAX12AA403	20	14
603	MAX	MAX	MAX12AA404	20	14
604	MAX	MAX	MAX30AA401	20	14
605	MAX	MAX	MAX30AA402	20	14
606	MAX	MAX	MAX30AA403	20	14
607	MAX	MAX	MAX30AA404	20	14
608	MAX	MAX	MAX30AA405	20	14

609	MAX	MAX	MAX30AA406	20	14
610	MAX	MAX	MAX30AA407	20	14
611	MAX	MAX	MAX30AA408	20	14
612	MAX	MAX	MAX30AA409	20	14
613	MAX	MAX	MAX30AA410	20	14
614	MAX	MAX	MAX30AA411	20	14
615	MAX	MAX	MAX30AA412	20	14
616	MAX	MAX	MAX30AA413	20	14
617	MAX	MAX	MAX30AA414	20	14
618	MAX	MAX	MAX30AA415	20	14
619	MAX	MAX	MAX30AA416	20	14
620	MAX	MAX	MAX30AA417	20	14
621	MAX	MAX	MAX30AA418	20	14
622	MAX	MAX	MAX50AA401	20	14
623	MAX	MAX	MAX50AA402	20	14
624	MAX	MAX	MAX55AA401	20	14
625	MAX	MAX	MAX55AA402	20	14
626	MAX	MAX	MAX55AA403	20	14
627	MAX	MAX	MAX55AA404	20	14
628	MAX	MAX	MAX56AA401	20	14
629	MAX	MAX	MAX56AA402	20	14
630	MAX	MAX	MAX57AA401	20	14
631	MAX	MAX	MAX57AA402	20	14
632	MAX	MAX	MAX58AA401	20	14
633	MAX	MAX	MAX58AA402	20	14
634	MXN	MXN	MXN01AA601	100	55
635	MXN	MXN	MXN02AA601	100	55
636	MXN	MXN	MXN01AA102	100	215

637	MXN	MXN	MXN02AA102	100	215
638	MXN	MXN	MXN01AA401	15	6.1
639	MXN	MXN	MXN01AA402	15	6.1
640	MXN	MXN	MXN02AA401	15	6.1
641	MXN	MXN	MXN02AA402	15	6.1
642	MXN	MXN	MXN30AA401	15	6.1
643	MXN	MXN	MXN30AA402	15	6.1
644	MXN	MXN	MXN17AA101	50	43
645	MXN	MXN	MVA14AA101	50	19.5
646	MXN	MXN	MVD14AA102	50	19.5
647	MXN	MXN	MVA24AA101	50	19.5
648	MXN	MXN	MVA24AA102	50	19.5
649	MXN	MXN	MXN17AA102	50	43
650	MXN	MXN	MXN17AA105	50	43
651	MXN	MXN	MXN50AA101	50	43
652	MAM	MAM	MAM39AA101	32	25
653	MAM	MAM	MAM39AA102	32	25
654	MAM	MAM	MAM39AA103	32	25
655	MAM	MAM	MAM39AA104	32	25
656	MAM	MAM	MAM39AA105	32	25
657	MAM	MAM	MAM39AA106	32	25
658	MAM	MAM	MAM39AA107	32	25
659	MAM	MAM	MAM39AA108	32	25
660	MAM	MAM	MAM39AA109	32	25
661	MAM	MAM	MAM39AA110	32	25
662	MAM	MAM	MAM39AA111	32	25
663	MAM	MAM	MAM39AA112	32	25
664	MAM	MAM	MAM39AA113	32	25

665	MAM	MAM	MAM39AA114	32	25
666	MAM	MAM	MAM39AA115	32	25
667	MAM	MAM	MAM39AA116	32	25
668	MAM	MAM	MAM39AA117	32	25
669	MAM	MAM	MAM39AA118	32	25
670	MAM	MAM	MAM39AA119	32	25
671	MAM	MAM	MAM39AA120	32	25
672	MAM	MAM	MAM39AA121	32	25
673	MAM	MAM	MAM39AA122	32	25
674	MAM	MAM	MAM39AA123	32	25
675	MAM	MAM	MAM39AA124	32	25
676	MAM	MAM	MAM60AA401	20	14
677	MAM	MAM	MAM60AA402	20	14
678	MAM	MAM	MAM60AA403	20	14
679	MAM	MAM	MAM60AA404	20	14
680	MAM	MAM	MAM60AA405	20	14
681	MAM	MAM	MAM60AA406	20	14
682	MAM	MAM	MAM60AA407	20	14
683	MAM	MAM	MAM60AA408	20	14
684	MAM	MAM	MAM60AA409	20	14
685	MAM	MAM	MAM60AA410	20	14
686	MAM	MAM	MAM60AA411	20	14
687	MAM	MAM	MAM60AA412	20	14
688	LBW	R524.KK34.LBW.TU.MC.WD001	LBW10AA001	500	1682
689	LBW	R524.KK34.LBW.TU.MC.WD001	LBW10AA003	150	174
690	LBW	R524.KK34.LBW.TU.MC.WD001	LBW13AA101	50	45.3
691	LBW	R524.KK34.LBW.TU.MC.WD001	LBW13AA102	50	45.3
692	LBW	R524.KK34.LBW.TU.MC.WD001	LBW13AA103	50	45.3

693	LBW	R524.KK34.LBW.TU.MC.WD001	LBW13AA104	50	45.3
694	LBW	R524.KK34.LBW.TU.MC.WD001	LBW13AA105	50	45.3
695	LBW	R524.KK34.LBW.TU.MC.WD001	LBW13AA106	50	45.3
696	LBW	R524.KK34.LBW.TU.MC.WD001	LBW13AA107	50	45.3
697	LBW	R524.KK34.LBW.TU.MC.WD001	LBW13AA108	50	45.3
698	LBW	R524.KK34.LBW.TU.MC.WD001	LBW13AA109	50	45.3
699	LBW	R524.KK34.LBW.TU.MC.WD001	LBW13AA110	50	45.3
700	LBW	R524.KK34.LBW.TU.MC.WD001	LBW13AA111	50	45.3
701	LBW	R524.KK34.LBW.TU.MC.WD001	LBW13AA112	50	45.3
702	LBW	R524.KK34.LBW.TU.MC.WD001	LBW10AA101	200	230
703	LBW	R524.KK34.LBW.TU.MC.WD001	LBW10AA201	150	231
704	LBW	R524.KK34.LBW.TU.MC.WD001	LBW23AA101	80	39
705	LBW	R524.KK34.LBW.TU.MC.WD001	LBW24AA101	80	39
706	LBW	R524.KK34.LBW.TU.MC.WD001	LBW25AA101	80	39
707	LBW	R524.KK34.LBW.TU.MC.WD001	LBW26AA101	80	39
708	LBW	R524.KK34.LBW.TU.MC.WD001	LBW27AA101	80	39
709	LBW	R524.KK34.LBW.TU.MC.WD001	LBW28AA101	80	39
710	LBW	R524.KK34.LBW.TU.MC.WD001	LBW10AA402	65	36
711	LBW	R524.KK34.LBW.TU.MC.WD001	LBW10AA401	25	9.1
712	LBW	R524.KK34.LBW.TU.MC.WD001	LBW23AA401	25	9.1
713	LBW	R524.KK34.LBW.TU.MC.WD001	LBW23AA402	25	9.1
714	LBW	R524.KK34.LBW.TU.MC.WD001	LBW24AA401	25	9.1
715	LBW	R524.KK34.LBW.TU.MC.WD001	LBW24AA402	25	9.1
716	LBW	R524.KK34.LBW.TU.MC.WD001	LBW25AA401	25	9.1
717	LBW	R524.KK34.LBW.TU.MC.WD001	LBW25AA402	25	9.1
718	LBW	R524.KK34.LBW.TU.MC.WD001	LBW26AA401	25	9.1
719	LBW	R524.KK34.LBW.TU.MC.WD001	LBW26AA402	25	9.1
720	LBW	R524.KK34.LBW.TU.MC.WD001	LBW27AA401	25	9.1

721	LBW	R524.KK34.LBW.TU.MC.WD001	LBW27AA402	25	9.1
722	LBW	R524.KK34.LBW.TU.MC.WD001	LBW28AA401	25	9.1
723	LBW	R524.KK34.LBW.TU.MC.WD001	LBW28AA402	25	9.1
724	LBW	R524.KK34.LBW.TU.MC.WD005	LBW31AA001	100	86
725	LBW	R524.KK34.LBW.TU.MC.WD005	LBW31AA601	100	35
726	LBW	R524.KK34.LBW.TU.MC.WD005	LBW31AA101	32	25
727	LBW	R524.KK34.LBW.TU.MC.WD005	LBW31AA102	32	25
728	LBW	R524.KK34.LBW.TU.MC.WD005	LBW31AA103	32	25
729	LBW	R524.KK34.LBW.TU.MC.WD005	LBW31AA104	32	25
730	LBW	R524.KK34.LBW.TU.MC.WD005	LBW31AA105	32	25
731	LBW	R524.KK34.LBW.TU.MC.WD005	LBW31AA106	32	25
732	LBW	R524.KK34.LBW.TU.MC.WD005	LBW31AA107	32	25
733	LBW	R524.KK34.LBW.TU.MC.WD005	LBW31AA108	32	25
734	LBW	R524.KK34.LBW.TU.MC.WD005	LBW31AA109	32	25
735	LBW	R524.KK34.LBW.TU.MC.WD005	LBW31AA110	32	25
736	LBW	R524.KK34.LBW.TU.MC.WD005	LBW31AA111	32	25
737	LBW	R524.KK34.LBW.TU.MC.WD005	LBW31AA112	32	25
738	LAV	LAV	LAV30AA101	38	30
739	LAV	LAV	LAV30AA102	38	30
740	LAV	LAV	LAV30AA601	100	35
741	LAV	LAV	LAV30AA602	100	35
742	LAV	LAV	LAV40AA101	38	30
743	LAV	LAV	LAV40AA102	38	30
744	LAV	LAV	LAV40AA601	100	35
745	LAV	LAV	LAV40AA602	100	35
TOTAL Wt in KG					**34418.52**

List of Supports in Kg. (size & system wise) as FIM in KUDANKULAM - UNIT 3 MAIN TG PACKAGE (Approx)						
Sr. No.	**KKS Code system**	**Pipe size (OD in mm)**		**Quantity per unit**	**Total Approx. weight per unit (KG)**	**Pipe category**
1	MAJ	325	630	21	2521	Big Bore
2	MKG	159	219	6	169	Big Bore
3	LBW	0	89	96	729	Small Bore
4	LBW	108	159	18	364	Big Bore
5	LCW	0	89	49	294	Small Bore
6	LCW	108	273	4	148	Big Bore
7	XAG	0	89	20	62	Small Bore
8	XAG	108	159	29	181	Big Bore
9	LBW	0	89	65	408	Small Bore
10	LBW	108	325	45	1049	Big Bore
11	LBW	326	600	13	900	Big Bore
12	LBW	0	89	52	698	Small Bore
13	LBW	108	325	3	47	Big Bore
14	LBW	108	325	22	613	Big Bore
15	MAM	108	325	3	126	Big Bore
16	MAM	108	325	8	201	Big Bore
17	MAM	0	89	26	287	Small Bore
18	MAM	0	89	27	349	Small Bore
19	MAM	108	325	19	625	Big Bore
20	MAM	326	630	9	1211	Big Bore
21	LBJ	0	89	16	641	Small Bore
22	LBJ	325	630	21	1908	Big Bore
23	LBJ	325	630	2	129	Big Bore
24	LBJ	325	600	5	940	Big Bore
25	LBJ	108	325	5	136	Big Bore
26	MKF	108	219	33	932	Big Bore

27	MKW	108	273	43	1053	Big Bore
28	LBR	0	89	22	242	Small Bore
29	LBR	108	325	4	968	Big Bore
30	LVA	0	89	82	534	Small Bore
31	LVA	108	325	182	1737	Big Bore
32	XAQ	0	89	31	514	Small Bore
33	XAQ	108	159	17	185	Big Bore
34	LAV	0	89	2	350	Small Bore
35	LAV	108	159	2	350	Big Bore
36	LBJ	630	Above	10	4360	Big Bore
37	LBJ	630	Above	52	9456	Big Bore
38	MAA	325	600	8	2218	Big Bore
39	MAK	0	89	55	207	Small Bore
40	MAK	108	325	1	9	Big Bore
41	MAQ	0	89	13	225	Small Bore
42	MAQ	108	325	28	564	Big Bore
43	MAQ	108	325	8	113	Big Bore
44	MAQ	0	89	25	674	Small Bore
45	MAQ	108	325	7	125	Big Bore
46	MAV	108	325	22	1165	Big Bore
47	MAV	0	89	33	442	Small Bore
48	MAV	108	325	21	487	Big Bore
49	MAV	0	89	4	93	Small Bore
50	MAV	108	325	36	708	Big Bore
51	MAV	325	630	20	1254	Big Bore
52	MAV	0	89	11	40	Small Bore
53	MVA10	0	89	74	341	Small Bore
54	MVA10	0	89	11	113	Small Bore
55	MVA50	108	325	18	392	Big Bore

56	MVA60	0	89	18	131	Small Bore
57	MXN	0	89	43	288	Small Bore
58	MXN	108	325	14	116	Big Bore
59	MAX	0	89	179	1329	Small Bore
60	MAX	108	325	75	882	Big Bore
61	MKG	57	57	41	83	Small Bore
62	MKF	57	57	4	34	Small Bore
63	MKW	14	89	182	2753	Small Bore
Total Qty per Unit				**2015**	**50203**	

List of Oils in Barrels as FIM in KUDANKULAM - UNIT 3 MAIN TG PACKAGE (Approx)				
Sr. No.	**KKS Code**	**Description**	**Quantity (Barrels)**	**Remarks**
			Unit-3	
1	UMA20WY	Fire resistant oil (FYRQUEL)	1153	Lube Oil
2	UMA20WY	Turbine oil Тп22 C of grade 1.	148	Seal oil

WEIGHT SCHEDULE SUMMARY FOR ALREADY ERECTED STATIC AND ROTARY EQUIPMENTS FOR KUDANKULAM UNIT-3			
Sl No.	**Equipment Description**	**Quantity**	**Approx Weight in MT**
1	HP Heater- 6	2 Nos	222
2	HP Heater- 5	2 Nos	224
3	LP Heater- 4	1 No	80
4	LP Heater- 3	1 No	60
5	LP Heater- 2	1 No	35
6	Rotary Equipment (Pumps)	20 Nos	30
7	Static Equipment (Tanks)	12 Nos	68
8	TDFP condensers	2 Nos	56
9	Condenser Hot well & Spring supports	3 Sets	198
TOTAL			**973**

VOLUME-IA PART-I CHAPTER -X
GENERAL

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

1.10.1 Payment Bidders are requested to furnish the following at PSSR-HQ, Chennai immediately after release of Letter of Intent (LOI)

I. Security Deposit and Additional Security Deposit (As applicable).
II. Unqualified Acceptance for Detailed LOI/ Work Order.
III. Rs.100/- Stamp Paper for preparation of Contract Agreement.
IV. Option (whether a or b of said clause) exercised towards Performance Security Deposit for the subject contract as per Sl. No. 16 of Volume IA Part II Chapter 1 of TCC.

1.10.2 Bidders are requested to furnish the proof of documents for the following at PSSR- Site.

I. PF Regn No.
II. Labour License No.
III. Workmen Insurance Policy No.

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

1.10.4 **BOCW Act & BOCW Welfare Cess Act**

1.10.4.1 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.

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

1.10.4.3 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.,

1.10.4.4 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.

1.10.4.5 Contractor shall make remittance of the BOCW cess as per Act in consultation with BHEL as per the rates in force (presently 1%). BHEL shall reimburse the same upon production of documentary evidence. However, BHEL shall not reimburse the Fee paid towards the registration of establishment, fess paid towards registration of beneficiaries and contribution of beneficiaries remitted.

1.10.4.6 Non-compliance to provisions of the BOCW act and BOCW welfare Cess act is not acceptable. In case of any non-compliance, BHEL reserves the right to withhold any sum it deems fit. Only upon total compliance to the BOCW act and also discharge of total payment of Cess under the BOCW Cess act by the contractor, BHEL shall consider refund of the amounts.

1.10.5 **PROVIDENT FUND**

1.10.5.1 The contractor is required to extend the benefit of Provident Fund to the labour employed by the contractor in connection with this contract as per the Employees Provident Fund and Miscellaneous Provisions Act 1952. For due implementation of the same, the contractor is hereby required to get themselves registered with the Provident Fund authorities for the purpose of reconciliation of PF dues and furnish to us the code number allotted to them by the Provident Fund authorities within one month from the date of issue of this letter of intent. Please note that in the event of contractor's failure to comply with the provisions of said Act, if recoveries therefore are enforced from payments due to BHEL by the customer or paid to statutory authorities by BHEL, such amount will be recovered from payments due to the contractor.

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

1.10.6 **OTHER STATUTORY REQUIREMENTS**

1.10.6.1 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. Labour license is compulsory in Kudankulam Nuclear power plant irrespective of number of labour engaged by contractor.

1.10.6.2 The contactor 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.

1.10.6.3 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 contactor, BHEL will reserve its right to pay the workmen under the orders of Appropriate authority at the risk and cost of the Contractor.

1.10.6.4 The Contractor shall submit copies of Final Settlement statement of disbursal of retrenchment benefits on retrenchment of each workman under I D 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 Act1948 (If applicable) to BHEL along with the Final Bill.

1.10.6.5 In case of any dispute pending before the appropriate authority under I D 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 Contractor which will be released on submission of proof of settlement of issues from the appropriate authority under the act.

1.10.6.6 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.

1.10.7 **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. 100 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.

1.10.8 **RECOVERY OF COMPENSATION PAID TO VICTIM(S) BY BHEL IN CASES OF DEATH/ PERMANENT INCAPACITATION OF PERSON DUE TO AN ACCIDENT DURING THE WORKS**

BHEL shall recover the amount of compensation paid to victim(s) by BHEL towards loss of life / permanent disability due to an accident which is attributable to the negligence of contractor, agency or firm or any of its employees as detailed below.

1.10.8.1 Victim: Any person who suffers permanent disablement or dies in an accident as defined below.

1.10.8.2 Accident: Any death or permanent disability resulting solely and directly from any unintended and unforeseen injurious occurrence caused during the manufacturing / operation and works incidental thereto at BHEL factories/ offices and precincts thereof, project execution, erection and commissioning, services, repairs and maintenance, trouble shooting, serving, overhaul, renovation and retrofitting, trial operation, performance guarantee testing undertaken by the company or during any works /during working at BHEL Units/ Offices/ townships and premises/ Project Sites.

1.10.8.3 Compensation in respect of each of the victims:

(i) In the event of death or permanent disability resulting from Loss of both limbs: Rs. 10,00,000/- (Rs. Ten Lakh)

(ii) In the event of other permanent disability: Rs. 7,00,000/- (Rs. Seven Lakh)

1.10.8.4 Permanent Disablement: A disablement that is classified as a permanent total disablement under the proviso to Section 2 (I) of the Employee's Compensation Act, 1923.

1.10.9 **GENERAL**

1.10.9.1 Site Visit by the Bidder

Prior to submitting his tender for the work, the bidder shall visit, examine and acquire full knowledge & information of 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.

1.10.9.2 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 as to the risks, contingencies and other circumstances which may influence or affect the work or the cost thereof under this contract.

1.10.9.3 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.

1.10.9.4 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.

1.10.9.5 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.

1.10.9.6 Scope of work covered under this specification requires quality workmanship, engineering and green belt management along with the supply of all consumables, tools and tackles and testing instruments. The contractor shall ensure timely completion of work. The contractor shall have adequate tools, measuring instruments etc. in his possession. He shall also have adequate trained, qualified and experienced engineers, supervisory staff and skilled personnel. The manpower deployment identified by contractor shall match with above scope of works.

1.10.9.7 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.

1.10.9.8 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.

1.10.9.9 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.

1.10.9.10 The contractor shall carryout additional tests, if any, which the Engineer feels necessary because of site conditions and also to meet system specification.

1.10.9.11 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.

1.10.9.12 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.

1.10.9.13 Wherever Construction sequences are furnished by BHEL, the contractor shall follow the same sequence.

1.10.9.14 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.

1.10.9.15 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.

1.10.9.16 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.

1.10.9.17 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.

1.10.9.18 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 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.

1.10.9.19 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.

1.10.9.20 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.

1.10.9.21 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.

1.10.9.22 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.

1.10.9.23 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.

1.10.9.24 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.

1.10.9.25 No member of the already erected structure / buildings, other component and auxiliaries should be removed / modified without specific approval of BHEL engineer.

1.10.9.26 Contractors shall ensure that all their Staff / Employees are exposed to periodical training programme conducted by qualified agencies/ personnel on latest ISO 9001 Standards.

1.10.9.27 Some time 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.

1.10.9.28 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.

1.10.9.29 Crane operators deployed by the contractor shall be tested by BHEL before he is allowed to operate the cranes.

1.10.9.30 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.

1.10.9.31 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.

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

1.10.9.33 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.

1.10.9.34 SITE INSPECTION

1.10.9.34.1 BHEL 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 / employer without any extra cost to the owner / employer. No cost whatsoever such duplication of inspection of work be entertained.

1.10.9.34.2 BHEL / Customer 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 customer / BHEL.

1.10.9.34.3 Wherever the performance of work by the contractor is not satisfactory in respect of workmanship, deployment of sufficient labour or equipment, delay in execution of work or any other matter, BHEL shall have the right to engage labour at normal ruling rates and get the work executed through other agency and debit the cost to the contractor and the contractor shall have no right to claim compensation thereof. In such a case, BHEL shall have the right to utilize the materials and tools brought by the contractors for the same work.

1.10.9.35 DOCUMENTATION

1.10.9.35.1 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.

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

a) Hindrance Register.

b) Site Order Book.

c) Test Check of measurements.

d) Steel & Cement Supply and Consumption Daily Register

e) Records of Test reports of Field tests.

f) Records of manufacture's test certificates.

g) Records of disposal of scraps generated during and after the work completion.

h) List of T&Ps and MMEs

1.10.9.35.3 Other documents / records as specified in chapter -Progress of work in PART- I of Technical conditions of Contract Volume IA (Volume I Book I).

1.10.9.35.4 Schedule as specified in chapters of Technical conditions of Contract Volume IA (Volume I Book I).

VOLUME – IA PART-I CHAPTER – XI
PROGRESS OF WORK

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 The monthly report as a booklet shall be submitted at the end of every month and shall contain the following details: -

a. Erection progress in terms of tonnage, welding joints, radiography, stress relieving, etc., completed as relevant to the respective work areas against planned.

b. Site Organization chart of engineers & supervisors as on the last day of the month with further mobilization plan.

c. Category- wise man hours engaged during the previous month under the categories of fitters, welders, riggers, khalasis, grinder-men, gas-cutters, electricians, crane operators and helpers.

d. Consumables report giving consumption of all types of gases and electrodes during the previous month.

e. Availability report of cranes.

f. Safety implementation report in the format.

g. Pending material and any other inputs required from BHEL for activities planned during the subsequent month.

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 Shifting of heavy, critical and ODC equipments from NPCIL stores to delivery point is in the scope of NPCIL.
Note: Unloading of heavy, critical and ODC equipment's at the delivery point is in the scope of the contractor. Heavy duty crawler crane will be provided by NPCIL for unloading, required T & P's and assist crane are in the scope of contractor. All lifting tools and tackles should be load tested and due clearance to be obtained from BHEL/NPCIL safety before put in use.

1.12.2 Loading of all other items except mentioned in 1.12.1 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.

1.12.3 The storage yard is located in more than one location within the Main Plant Boundary.

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 Open ends of piping valves, pipes and tubes shall be covered with plastic caps or will be closed with wooden plugs as the case may be.

1.12.10 The contractor shall provide any fixtures, concrete blocks & wooden sleepers, which are required for temporary supporting of the components at site.

1.12.11 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
FOUNDATIONS, GROUTING AND CIVIL WORKS

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.)

1.13.1 Foundation for the equipments to be erected shall be provided by BHEL/ clients of BHEL. The dimension of the foundation and anchor bolt pits shall be checked by the contractor for their correctness as per drawings. Further, top elevation of foundations shall be checked with respect to bench mark etc. Contractor should log before taking over the foundations for erection. All adjustments of foundations surfaces, enlarging the pockets in foundations etc. as may be required for the erection of equipments, plants shall be carried out by the contractor within the quoted rate.

1.13.2 Cleaning of foundation surfaces, pocket holes and anchor bolt pits etc., de-watering, making them free of oil, grease, sand and other foreign materials by soda wash, water wash, compressed air or any other approved methods etc., form / shuttering work are within the scope this work.

1.13.3 It shall be contractor's responsibility to check the various equipment foundations for their correctness with respect to level, orientation, dimensions etc., and ascertained dimensions shall be measured and submitted to BHEL for approval before erection. Also minor chipping, dressing of foundations up to 25 mm for obtaining proper face / elevation for packer plates/shims, and may be required for the erection of the equipment/plants shall have to be carried out as per BHEL Engineers instructions by the contractor within the quoted rate.

1.13.4 Preparation of foundation: Providing necessary skilled and other labour to BHEL / Customer for checking of dimensional accuracy, axis, elevation, levels etc., with reference to bench marks of foundations and anchor bolts pits shall be in the scope of the work. Contractor should log before taking over the foundations for erection.

1.13.5 The concrete foundation, surfaces shall be properly prepared by chipping, dressing of foundations up to 25 mm as required to bring the top of such foundation to the required level to provide the necessary roughness for bondage and to ensure enough bearing strength. All laitance and surface

film shall be removed and cleaned and the packers placed with suitable mortar prior to erection of the equipment.

1.13.6 The surface of foundations shall be dressed to bring the surface of the foundations to the required level and smoothness prior to placement of equipments. All minor adjustments up to 25 mm of foundation level, dressing, chipping of foundation surface enlarging the pockets in foundations and grouting of equipments etc. as may be required for the erection of equipments / plants shall be carried out by the Contractor.

1.13.7 Foundation pockets are to be cleaned thoroughly before placing the columns/ equipments. Verticality of foundation bolts to be checked along with correctness of the threads and freeness of the nuts movement. If required cleaning of the threads to be done with proper dies.

1.13.8 The concrete foundation, surfaces shall be properly prepared by chipping, as required to bring the top of such foundation to the required level to provide the necessary roughness for bondage and to ensure enough bearing strength. All laitance and surface film shall be removed and cleaned and the packers placed with suitable mortar prior to erection of the equipment.

1.13.9 Packer plates should not only be blue matched with foundation but also with foundation frame, inter-packer contact surfaces between the packers and foundation frame etc. Blue matching shall be by Prussian blue match checks and required percentage contact shall be achieved by chipping and scrapping as per BHEL Engineers instructions.

1.13.10 The contractor shall ensure perfect matching of packer plates with foundation by dressing the foundation and between the packer plates and the base plate of structural column / equipment to the satisfaction of BHEL Engineer. Matching of packer shall be carried out by the Contractor at his cost.

1.13.11 Contractor shall carry out scrapping and blue matching of embedment plates / packers of rotating equipments so as to achieve prescribed percentage of contact. Chipping and bedding of concrete surfaces, finely dressing up to the extent required to obtain contact between packer and concrete, is also covered in the scope of the work. The fine dressing of concrete shall be with blue matching checks.

1.13.12 Supply, machining of permanent packer plates, shims for all equipments are in the scope of contractor.

1.13.13 Works such as minor rectification of foundation bolts, reaming of holes, drilling of dowels, matching of bolts and nuts, making new dowel pin etc. are covered in the scope of work.

1.13.14 The contractor shall arrange for grouting of foundation bolt holes of equipment and final grouting of equipment as per the drawings / specification as advised by the Engineer or BHEL after preparing the foundation surface for grouting. The contractor has to arrange, a representative from the supplier of special cement for witnessing the grouting and other works at their cost including any miscellaneous expenditure for this activity. BHEL will not pay any service and incidental charges for arranging the supplier representative. The contractor to take note of this aspect and quote accordingly.

1.13.15 Grouting/concreating of of equipments is included in the scope of contractor. All the materials required for grouting including special cements like CONBEXTRA- GP2 or its equivalent grade free flow cement as approved by BHEL/Customer and other materials like Portland cement, sand, gravel etc., are to be arranged by the contractor within the quoted rate. It shall be the responsibility of the contractor to obtain prior approval of BHEL, regarding suppliers, type of grouting cements before procurement of grouting cements.

1.13.16 Contractor shall arrange the required nos. of mixing machines and vibrators at their cost for carrying out the grouting operation. All the materials like cement and cleaning consumables shall also be arranged by the contractor at his cost.

1.13.17 The certificates of the grout are to be submitted BHEL. If necessary, test cubes are to be made and tested at site to ensure the quality of the grout as per relevant IS standards. In case grouting with Portland cement is approved, necessary cement, sand etc. to be arranged by the contractor including the fine aggregates.

1.13.18 Any additional quantity of grouting materials required for above and also for all other equipments to be arranged by the bidder within the quoted cost.

1.13.19 PROCEDURE FOR GROUTING:

1.13.20 Contractor has to carry out the grouting as per the work instructions for grouting available at site or the grouting is to be carried out as per supplier's recommendation / IS standard. Copy of these recommendations to be submitted to BHEL for records.

VOLUME - IA PART – I CHAPTER – XIV
SAFETY CLAUSE/ CONDTIONS

In addition to the clauses in Chapter IX of Special Conditions of Contract (Volume-1B of Book-II) the contractor shall comply with the following. (The clause mentioned in this chapter will prevail in case of contradiction between the clauses in this Chapter and that of Chapter IX of Special Conditions of Contract (Volume-1B of Book-II)).

1.14.1 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.

1.14.2 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

1.14.3 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.

1.14.4 TRAINING REQUIREMENTS

i. The Contractor shall provide mandatory Industrial Safety Training to all workmen. For the works where deployment of safety supervisor is not applicable, industrial safety training shall be provided by NPCIL.

ii. For all works having manpower less than or equal to 100 persons, the safety training shall be carried out at NPCIL's safety training centre.

iii. For all works having manpower more than 100, the Contractors shall establish their own safety training centre having adequate seating capacity and infrastructure for training.

iv. 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.

v. 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.

vi. 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.

vii. 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.

1.14.5 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.

1.14.6 PERSONAL PROTECTIVE EQUIPMENT

1.14.6.1 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.

1.14.6.2 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 3.5 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.

1.14.7 WORK PRACTICES

1.14.7.1 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.

1.14.7.2 WORK AT HEIGHT

a) For carrying out work at height of more than 3.5 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 table below 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 3.5 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.

1.14.7.3 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

1.14.7.4 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 signalman, 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.

1.14.7.5 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.

1.14.8 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.

1.14.9 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 provided 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.

1.14.10 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.

1.14.11 WORK SPECIFIC SAFETY MEASURES

1.14.11.1 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.

1.14.11.2 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.

1.14.11.3 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.

1.14.11.4 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 3.5 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 3.5 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) The planks used for any working platform should not project beyond the end supports to a distance exceeding four times the thickness of the planks used. The planks should be rigidly fixed at both ends to prevent sliding, slipping or tilting. The thickness of the planks should be adequate to take load of men and materials and should not collapse. Plywood or packing wood should not be used as planks.

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 3.5 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.

1.14.11.5 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.

1.14.11.6 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).

1.14.11.7 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.

1.14.11.8 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.

1.14.11.9 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.

1.14.11.10 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 goggle, 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.

1.14.11.11 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.

1.14.11.12 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.

1.14.11.13 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.

1.14.11.14 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.

1.14.11.15 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

1.14.11.16 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.

1.14.11.17 ENVIRONMENTAL SAFETY

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

1.14.12 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.

1.14.13 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.

1.14.14 HOUSEKEEPING

a) It should be recognised that a proper place for everything and everything in its place is maintained for a good housekeeping.

b) The material required for immediate use only should be brought to the designated workplace and stacked properly and labelled suitably.

c) 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.

d) 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.

e) 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.

f) 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.

g) Accumulation of water/oil spillages on the floor or any other workplace should be avoided.

h) Proper aisle space marking should be provided in all workplaces.

1.14.15 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.

1.14.16 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.

ANNEXURE -1

PENALTY STRUCTURE FOR NON-COMPLIANCE OF SAFETY REQUIREMENTS

Sl. No	Safety Parameters	Penalty structure for noncompliance of safety requirement
1.0	Safety Professional 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 *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.*
2.0	Safety Training ➢ Worker found without safety induction training or refresher training ➢ Worker found without safety training card	Rs 1000 per violation
3.0	➢ 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	➢ Not providing required PPEs to the workmen ➢ Not using PPEs or using PPEs in incorrect manner or using defective PPEs.	Rs 2000 per violation Rs 500 per violation

5.0	Work at Height ➢ Workers working at height without height pass. ➢ Working at height without Height work permit ➢ orking 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
	➢ 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	Electrical Safety ➢ 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.)	Rs 20,000 per violation

	➢ 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	
7.0	Material Handling ➢ 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	Welding, Gas cutting and other hot works ➢ 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	Safe storage of material ➢ 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> ➢ 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> ➢ 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> ➢ 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) Aerofobia _____

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. height wearing a safety belt : Pass/fail

(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 arrestor/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 - XV
NPCIL SECURITY RULES & MEDICAL MANAGEMENT

1.15.1 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.

1.15.1.1 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.

1.15.1.2 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.

1.15.1.3 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.

1.15.1.4 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.

1.15.1.5 PHOTOGRAPHY IN PROJECT PREMISES

Photography in Project Premises is strictly Prohibited.

1.15.2 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.

1.15.3 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.

1.15.4 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.

1.15.5 MEDICAL MANAGEMENT

1.15.5.1 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 injured /ill, while working, inside 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 arrangements within their quoted rates.

1.15.5.2 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 Facility/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.

1.15.5.3 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 – XVI HOUSEKEEPING

1.16.1 MAINTENANCE OF CLEAN SITE CONDITIONS AND HOUSEKEEPING

1.16.1.1 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.

1.16.1.2 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.

1.16.1.3 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.

1.16.1.4 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

1.16.1.5 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

1.16.2 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	

1.16.3 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

1.16.4 TRAINING REQUIREMENTS

a) Along with the induction safety training, the workmen should undergo housekeeping training along with safety training.

b) Housekeeping workers shall undergo training in usage of housekeeping equipments and tools such as vacuum cleaners.

c) 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.
-

1.16.5 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.

1.16.6 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.

1.16.7 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, he may get the work done at the risk and cost of the Contractor.
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.

1.16.8 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.

1.16.9 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

1.16.10 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.

1.16.11 PROVIDING WORK FORCE / STAFF:

The Contractor shall deploy adequate manpower as per clause 1.15.2 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.

1.16.12 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.

1.16.13 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.

1.16.14 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 – II CHAPTER 1

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

Sl No: 1

Clause 4.1.11 under 'Obligations of Contractor' in SCC is deleted.

Sl No: 2:

OCCUPATIONAL HEALTH, SAFETY & ENVIRONMENT MANAGEMENT/ QUALITY ASSURANCE PROGRAMME

The following clauses in Occupational Health, Safety & Environment Management / Quality Assurance Programme published in Chapter-IX of Special Conditions of Contract (Volume I Book-II) is revised as under.

Chapter IX Clause 9.1 is modified as below:

Contractor will comply with HSE (Health, Safety & Environment) requirements of BHEL as per the "HSE Plan for Site Operations by Subcontractor" (Document No. HSEP: 14 Rev01) enclosed.

Chapter IX Clause 9.1.1 to 9.1.25 stands deleted.

Chapter IX Clause 9.2 to 9.62 stands deleted.

Sl No: 3:

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.

Sl No: 4:

Earnest Money Deposit (EMD) clause 1.9 in General Conditions of Contract (GCC) (Volume I Book-II) is revised as under.

1.9 EARNEST MONEY DEPOSIT

1.9.1 Every tenderer shall submit the prescribed amount of Earnest Money Deposit (EMD) to BHEL PSSR, only in the following forms: -

i. Electronic Fund Transfer credited in BHEL account (before tender opening)

ii. Through Online EMD payment portal of BHEL with SBI (before tender opening) by following steps as below:-
    1. Visit www.onlinesbi.com -> Go to State Bank Collect (In the tab section)
    2. Click Check box to proceed for payment -> Click on Proceed
    3. Under State of Corporate/ Institution ->Select Tamilnadu
    4. Under Type of Corporate/ Institution -> Select PSU – Public Sector Undertaking ->Go
    5. Under PSU – Public Sector Undertaking Name -> Select BHEL PSSR CHENNAI and Submit
    6. Under Select Payment Category ->-> SCT TENDER EMD & TENDER FEES

iii. Banker's cheque or Pay order or Demand Draft in favour of 'Bharat Heavy Electricals Limited' (along with offer) and payable at Chennai.

iv. Fixed Deposit Receipt (FDR) issued by Scheduled Banks/ Public Financial Institutions as defined in the Companies Act (FDR should be in the name of the Contractor, a/c BHEL) along with the offer.

v. In case EMD amount is more than Rs. Two Lakhs, Tenderer has the option to submit Rs. Two lakhs in the forms described above in clause no. 1.9.1. (i) to (iv) and the remaining amount over and above Rs. Two Lakhs in the form of Bank Guarantee from Scheduled Bank (along with the Offer).

Note:

a) Proforma of Bank Guarantee (in lieu of Earnest Money)- Form WAM 23 is enclosed with this Tender.
b) The Bank Guarantee shall be valid for at least six months from the due date of tender submission mentioned in the Notice Inviting Tender.
c) Date of Expiry of Claim shall be as given in Proforma of Bank Guarantee (in lieu of Earnest Money)- Form WAM 23.

Bank Details for the purpose of Taking EMD

Name and Address of Beneficiary:	Bharat Heavy Electricals Ltd. Tek Towers, No. 11, Old Mahabalipuram Road, Okkiyam Thoraipakkam, Chennai - 600097
Name of Bank:	State Bank Of India
Bank Branch Address:	SBI Saidapet Branch, EVR Periyar Building, Nandanam, Anna Salai, Chennai - 600035
IFSC Code :	SBIN0000912
Account No. :	10610819499

Details for SFMS (Structured Financial Messaging System) transmission of BG

Bank and Branch	SBI TFCPC Branch
Branch Code	5056
IFSC Code	SBIN0005056

1.9.2 EMD shall not carry any interest.

1.9.3 EMD by the Tenderer will be forfeited as per NIT Conditions, if:

i. After opening the tender and within the offer validity period, the Tenderer revokes his tender or makes any modification in his tender which is not acceptable to BHEL.

ii. The Contractor fails to deposit the required Security deposit or commence the work within the period as per LOI/Contract.

1.9.4 EMD given by all unsuccessful tenderers will be refunded normally within 15 days of award of work.

1.9.5 EMD of successful tenderer will be retained as part of Security Deposit.

1.9.6 EMD by the tenderer shall be withheld in case any action on the tenderer is envisaged under the provisions of extant" Guidelines on Suspension of Business dealings with suppliers/contactors" and forfeited / released based on the action determined under these guidelines.

Sl No: 5

SECURITY DEPOSIT The SECURITY DEPOSIT (SD) clause 1.10 published in General Conditions of Contract (Volume I Book-II) is revised as under.

1.10 Security Deposit:

1.10.1 Upon acceptance of Tender, the successful Tenderer should deposit the required amount of Security Deposit for satisfactory completion of work, as given below:

1.10.2 The total amount of Security Deposit will be 5% of the contract value. EMD of the successful tenderer shall be converted and adjusted towards the required amount of Security Deposit.

1.10.3 The security Deposit should be furnished before start of the work by the contractor.

1.10.4 Modes of deposit:

1.10.4.1 The balance amount to make up the required Security Deposit of 2% of the contract value may be furnished in any one of the following forms

i. Cash (as permissible under the extant Income Tax Act)

ii. Local cheques of Scheduled Banks (subject to realization)/ Pay Order/ Demand Draft/ Electronic Fund Transfer in favour of BHEL

iii. Bank Guarantee from Scheduled Banks / Public Financial Institutions as defined in the Companies Act. The Bank Guarantee format for Security Deposit shall be in the prescribed formats.

iv. Fixed Deposit Receipt issued by Scheduled Banks/ Public Financial Institutions as defined in the Companies Act. The FDR should be in the name of the contractor, A/C BHEL, duly discharged on the back.

v. Securities available from Indian Post offices such as National Savings Certificates, Kisan Vikas Patras etc. (Certificates should be held in the name of Contractor furnishing the security and duly endorsed/ hypothecated/ pledged, as applicable, in favour of BHEL and discharged on the back)

(Note: 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)

1.10.5 At least 50% of the Security Deposit including the EMD should be deposited in any form as prescribed before start of the work and the balance 50% of the Security Deposit will be recovered by deducting 10% of the gross amount progressively from each running bills of the contractor till the total amount of the required Security Deposit is collected.

1.10.6 The recoveries made from running bills (cash deduction towards balance SD amount) will be released against submission of equivalent Bank Guarantee in the prescribed formats, but only once, before completion of work.

1.10.7 The Security Deposit shall not carry any interest.

1.10.8 If the value of work done at any time exceeds the contract value, the amount of Security Deposit shall be correspondingly enhanced and the excess Security Deposit due the enhancement shall be immediately deposited by the Contractor or recovered from payment/s due to the Contractor.

1.10.9 A) The validity of Bank Guarantees towards Security Deposit shall be initially upto the completion period as stipulated in the Letter of Intent/Award + 3 months, and the same shall be kept valid by proper renewal till the acceptance of Final Bills of the Contractor, by BHEL

B) Date of Expiry of Claim shall be as given in the prescribed formats for Bank Guarantee towards Security Deposit

1.10.10 BHEL reserves the right of forfeiture of Security Deposit in addition to other claims and penalties in the event of the Contractor's failure to fulfill any of the contractual obligations or in the event of termination of contract as per terms and conditions of contract. BHEL reserves the right to set off the Security Deposit against any claims of other contracts with BHEL.

1.10.11 Penalty for Delayed Remittance of Security Deposit

If the contractor fails to furnish SD before start of work, in line with 1.10.3 above, Simple Interest against delayed remittance of the Security Deposit shall be deducted from the sub-contractor at the rate of SBI PLR + 2% on the value of 50% SD of the contract, for the delayed period (i.e., period between start of work and date of remittance of Initial SD, i.e., atleast 50% of SD). In case, the delayed period has different SBI PLR rates, Simple Interest shall be calculated based on different rates by considering the corresponding time period. On similar lines Penalty shall be levied for delayed remittance of Additional Security Deposit (if applicable).

Note: - Bank details & SFMS details provided above in Sl. No. 04 Earnest Money Deposit) may be used for the purpose of arranging Bank Guarantees towards Security Deposit / Additional Security Deposit also.

Sl No: 6

Clause 2.7.2 and 2.7.3 in GCC regarding Rights of BHEL is revised as under:

2.7.2.

2.7.2.1 To terminate the contract or withdraw portion of work and get it done through other agency, at the risk and cost of the contractor after due notice of a period of 14 days' by BHEL in any of the following cases:

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. Termination of Contract on account of any other reason (s) attributable to Contractor.
v. Assignment, transfer, subletting of Contract without BHEL's written permission.
vi. Non-compliance to any contractual condition or any other default attributable to Contractor.

Risk & Cost Amount against Balance Work:

Risk & Cost amount against balance work shall be calculated as follows: Risk & Cost Amount= [(A-B) + (A x H/100)]

Where,

A= Value of Balance scope of Work (*) as per rates of new contract

B= Value of Balance scope of Work (*) as per rates of old contract being paid to the contractor at the time of termination of contract i.e. inclusive of PVC & ORC, if any.

H = Overhead Factor to be taken as 5

In case (A-B) is less than 0 (zero), value of (A-B) shall be taken as 0 (zero).

* Balance scope of work (in case of termination of contract):

Difference of Contract Quantities and Executed Quantities as on the date of issue of Letter for 'Termination of Contract', shall be taken as balance scope of Work for calculating risk & cost amount. Contract quantities are the quantities as per original contract. If, Contract has been amended, quantities as per amended Contract shall be considered as Contract Quantities.

Items for which total quantities to be executed have exceeded the Contract Quantities based on drawings issued to contractor from time to time till issue of Termination letter, then for these items total Quantities as per issued drawings would be deemed to be contract quantities.

Substitute/ extra items whose rates have already been approved would form part of contract quantities for this purpose. Substitute/ extra items which have been executed but rates have not been approved, would also form part of contract quantities for this purpose

and rates of such items shall be determined in line with contractual provisions.

However, increase in quantities on account of additional scope in new tender shall not be considered for this purpose.

NOTE: Incase portion of work is being withdrawn at risk & cost of contractor instead of termination of contract, contract quantities pertaining to portion of work withdrawn shall be considered as 'Balance scope of work' for calculating Risk & Cost amount.

LD against delay in executed work in case of Termination of Contract:

LD against delay in executed work shall be calculated in line with LD clause no. 2.7.9 of GCC, for the delay attributable to contractor. For limiting the maximum value of LD, contract value shall be taken as Executed Value of work till termination of contract.

Method for calculation of "LD against delay in executed work in case of termination of contract" is given below.

i). Let the time period from scheduled date of start of work till termination of contract excluding the period of Hold (if any) not attributable to contractor = T1

ii). Let the value of executed work till the time of termination of contract= X

iii). Let the Total Executable Value of work for which inputs/fronts were made available to contractor and were planned for execution till termination of contract = Y

iv). Delay in executed work attributable to contractor i.e. T2=[1-(X/Y)] x T1

v). LD shall be calculated in line with LD clause (clause 2.7.9) of the Contract for the delay attributable to contractor taking "X" as Contract Value and "T2" as period of delay attributable to contractor.

1.7.2.2 In case Contractor fails to deploy the resources as per requirement, BHEL can deploy own/hired/otherwise arranged resources at the risk and cost of the contractor 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.

2.7.3 **Recoveries arising out of Risk & Cost and LD or any other recoveries due from Contractor**

Following sequence shall be applicable for recoveries from contractor:

a) Dues available in the form of Bills payable to contractor, SD, BGs against the same contract.

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:

   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.

SL No: 7

In addition to clause 2.7.9 of General Conditions of Contract (GCC), a New clause 2.7.9.1 is added as below.

2.7.9.1 Penalty for Intermediate Milestones

2.7.9.1.1 M1 and M2 shall be intermediate Milestones for this work.

2.7.9.1.2 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.

2.7.9.1.3 Incase delay in achieving M1 milestone is solely attributable to the contractor,0.5% per week of executable contract value* limited to Maximum 2% of executable contract value will be withheld.

2.7.9.1.4 Incase delay in achieving M2 milestone is solely attributable to the contractor,0.5% per week of executable contract value* limited to maximum 3% of executable contract value will be withheld.

2.7.9.1.5 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 M2 milestone.

2.7.9.1.6 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.

2.7.9.1.7 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.

2.7.9.1.8 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.

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SL No: 8

OVERRUN COMPENSATION (ORC)

The **OVERRUN COMPENSATION (ORC)** clause 2.12 published in General Conditions of Contract (Volume I Book-II) is revised as under.

2.12 OVERRUN COMPENSATION (ORC)

2.12.1 **ORC during original contract period:** No ORC shall be applicable during the original contract period.

2.12.2 **ORC during extended period for the reasons solely attributable to contractor:** No ORC shall be applicable during the extended period granted for the reasons solely attributable to contractor and work executed during this period shall be paid as per original contract rates.

2.12.3 **ORC during extended period for the reasons not attributable to contractor:** ORC shall be payable as per following procedure:

2.12.3.1 For initial period of twelve months of extended period, ORC rate applicable over executed value shall be 5%. For every subsequent period of twelve

months, ORC rate shall be further increased by 5% over the previous rate. For example, ORC rates applicable for initial period of 12 months and subsequent period of 12 months are given below.

Sl. No.	Extended Period for the reasons attributable to BHEL	ORC rate applicable over executed value
1	First 12 months	5%
2	13th-24th month and so on	10.25% {[(1.05 x 1.05)-1] x 100}

This process of increasing ORC rate for each subsequent period of 12 months shall continue till applicability of ORC.

2.12.3.2 On completion of original contract period as well as on completion of each subsequent period of twelve months i.e. at the time of change in applicable ORC rate, Delay Analysis shall be carried out and percentage shortfall attributable to both BHEL & Contractor shall be calculated.

2.12.3.3 For the purpose of calculation of ORC, executed value of work in the month shall be divided in Part-1 and Part-2 in proportion of percentage shortfall attributable to BHEL and contractor respectively, based on the last delay analysis as worked out in 2.12.3.2.

ORC shall be payable only on Part-1 and no ORC shall be payable on Part-2. Value of Part-1 shall be further limited to the value of actual inputs provided by BHEL i.e. "Plan - Shortfall attributable to BHEL" for the month, as per Form-14 for calculation of ORC.

2.12.3.4 Payment of ORC amount shall be further regulated as follows:

(i) 50% of the ORC is allocated for deployment of matching resources (with weightages) agreed as per the joint programme drawn vide 2.11.4. ORC Payment against resources shall be calculated in proportion to percentage of resources actually deployed w.r.t. planned resources, as per Form-14.

(ii) 50% of ORC is allocated for achieving of planned progress agreed as per the joint programme drawn vide 2.11.4. ORC Payment shall be reduced in proportion to percentage shortfall attributable to contractor w.r.t.–"Plan - Shortfall attributable to BHEL" for the month, as per Form-14.

2.12.3.5 The maximum amount of ORC payable for the month shall be limited to Rs. 5,00,000/-.

2.12.3.6 In case, there is no shortfall attributable to contractor for the month and also contractor has deployed the resources as agreed in Form-14 but ORC amount payable for the month worked out as per procedure mentioned in clause 2.12.3.3, 2.12.3.4 and 2.12.3.5, is less than Rs.1,00,000/-, then ORC amount payable for the month shall be Rs.1,00,000/- otherwise ORC amount payable for the month shall remain same.

2.12.3.7 In case execution is on **HOLD** (Other than Force Majeure), ORC shall be payable as per following:

i). Contractor has not been permitted by BHEL to de-mobilize

a) ORC amount of Rs. 1,00,000/- per month shall be applicable during the period of HOLD provided resources as planned are deployed (not demobilized) during the period of hold.

b) Subsequent to lifting of HOLD, Period of HOLD shall not be excluded in calculation of period for deciding applicable ORC rate as per clause 2.12.3.1.

ii). Contractor has been permitted to demobilize and to remobilize after lifting of HOLD

a) No ORC shall be payable to contractor for the period of HOLD.

b) Subsequent to lifting of HOLD, Period of HOLD shall not be excluded in calculation of period for deciding applicable ORC rate as per clause 2.12.3.1.

2.12.3.8 In case **Force Majeure** is invoked:

i). No ORC shall be applicable during the period of Force Majeure.

ii). Subsequent to revocation of Force Majeure, period of Force Majeure shall be excluded in calculation of period for deciding applicable ORC rate as per clause 2.12.3.1.

2.12.4 Applicability of ORC: ORC shall not be applicable for following activities.

(i) Area cleaning, removal of temporary structures and return of scrap.

(ii) Punch list points / pending points liquidation pending due to reasons attributable to contractor

(iii) Submission of “As built Drawing”

(iv) Material Reconciliation

(v) Completion of Contract Closure formalities like HR Clearance/ No dues from various dept./ Statutory Authorities etc.

2.12.5 Total Over Run Compensation shall be limited to 10% of the cumulatively executed contract value till the month (excluding Taxes and Duties if payable extra). For this purpose, executed contract value excludes PVC, ORC and Extra/Supplementary Works.

Sl No: 9

Clauses 2.13.1, 2.13.6 & 2.13.7 in GCC on Interest Bearing Recoverable Advances,

9.1 Clauses 2.13.1,2.13.6 & 2.13.7 in GCC is revised as under:

9.1.1 Clause 2.13.1 in GCC is revised as "Normally no advance payment shall be payable to the contractor. Mobilization advance payment in exceptional circumstances shall be interest bearing and secured through a Bank Guarantee and shall be limited to a maximum of 5% of contract value. This 'Interest Bearing Recoverable Advance' shall be payable in not less than two installments with any of the installment not exceeding 60% of the total eligible advance".

9.1.2 Clause 2.13.6 in GCC is revised as "The rate of interest applicable for the above advances shall be the Base rate of State Bank of India prevailing at the time of disbursement of the advance + 6%, and such rate will remain fixed till the total advance amount is recovered".

9.1.3 Clause 2.13.7 in GCC is revised as "Unadjusted amount of advances paid shall not exceed 5% of the total contract value at any point of time. Recovery of advances shall be made progressively from each Running Bill such that the advance amounts paid along with the interest is fully recovered by the time the contractor's billing reaches 90% of contract value."

Sl. No: 10: Void

Sl No: 11

PRICE VARIATION COMPENSATION (PVC)

The PRICE VARIATION COMPENSATION (PVC) clause 2.17 published in General Conditions of Contract (Volume I Book-II) is revised as under.

2.17 PRICE VARIATION COMPENSATION

2.17.1 In order to take care of variation in cost of execution of work on either side, due to variation in the index of LABOUR, HIGH SPEED DIESEL OIL, WELDING ROD, CEMENT, STEEL, MATERIALS, Price Variation

Formula as described herein shall be applicable for works executed during contract period and for works executed during extended period (if any, subject to other conditions as described in this section).

2.17.2 **85%** component of executed Contract Value shall be considered for PVC calculations and remaining 15% shall be treated as fixed component. The basis for calculation of price variation in each category, their component, Base Index, shall be as under:

Sl. No.	CATEGORY	BASE INDEX	PERCENTAGE COMPONENT ('K')				
			CIVIL PACKAGES (See Note A/B/C)			MECHANICAL PACKAGES	Electrical, C&I, Material Management / Handling and other labour oriented packages
			A	**B****	**C**		
i)	LABOUR (ALL CATEGORIES)	'MONTHLY ALL-INDIA AVERAGE CONSUMER PRICE INDEX NUMBERS FOR INDUSTRIAL WORKERS' published by Labour Bureau, Ministry of Labour and Employment, Government of India. (Website: labourbureau.nic.in)	**40**	**25**	**30**	**65**	**80**
ii)	HIGH SPEED DIESEL OIL	Name of Commodity: HSD Commodity code: 1202000005 (**See Note E**)	**5**	**3**	**5**	**5**	**5**
iii)	WELDING ROD	Name of Commodity: MANUFACTURE OF BASIC METALS Commodity code:1314000000 (**See Note E**)				**15**	
iv)	CEMENT	Name of Commodity: ORDINARY PORTLAND CEMENT Commodity code: 1313050003 (**See Note E**)		**20**	**30**		
v)	STEEL (Structural and Reinforcement Steel)	Name of Commodity: MILD STEEL: LONG PRODUCTS Commodity code: 1314040000 (**See Note E**)		**25**			
vi)	ALL OTHER MATERIALS (Other than Cement & Steel)	Name of Commodity: ALL COMMODITIES Commodity code: 1000000000 (**See Note E**)	**40**	**12**	**20**		

Note: A) Cement & Steel: Free Issue (BHEL Scope)
B) Cement & Steel: In Contractor Scope
C) Cement in Contractor Scope, and Steel is Free Issue (BHEL Scope)
D) For Composite packages (i.e. Civil + Mechanical + Electrical and / or CI or Civil + Mechanical or Mechanical + Electrical and / or CI), the Component ('K') for various categories shall be as per respective packages as above

E) As per the 'MONTHLY WHOLE SALE PRICE INDEX' for the respective Commodity and Type, published by Office of Economic Adviser, Ministry of Commerce and Industry, Government of India. (Website: http://www.eaindustry.nic.in/download_data_0405.asp). Revisions in the index or commodity will be re adjusted accordingly.

2.17.3 **Void**

2.17.4 Payment / recovery due to variation in index shall be determined on the basis of the following notional formula in respect of the identified component ('K') viz LABOUR, HIGH SPEED DIESEL OIL, WELDING ROD, CEMENT, STEEL, MATERIALS.

$$P = K \times R \times \frac{(X_N - Xo)}{Xo}$$

Where

P = Amount to be paid/recovered due to variation in the Index for Labour, High Speed Diesel Oil, Welding Rod, Cement, Steel and Materials

K = Percentage component ('K') applicable for Labour, High Speed Diesel Oil, Welding Rod, Cement, Steel and Materials

R = Value of work done for the billing month (Excluding Taxes and Duties if payable extra)

XN = Revised Index for Labour, High Speed Diesel Oil, Welding Rod, Cement, Steel and Materials for the billing month under consideration

Xo = Index for Labour, High Speed Diesel Oil, Welding Rod, Cement, Steel and Materials as on the Base date.

2.17.5 **Base date shall be calendar month of actual commencement of work at site.**

2.17.6 PVC shall not be payable for the ORC amount, Supplementary / Additional Items, Extra works. However, PVC will be payable for items executed under quantity variation of BOQ items under originally awarded contract.

2.17.7 The contractor shall furnish necessary monthly bulletins in support of the requisite indices from the relevant websites along with his Bills.

2.17.8 The contractor will be required to raise the bills for price variation payments on a monthly basis along with the running bills irrespective of the fact whether any increase/decrease in the index for relevant categories has taken place or not. In case there is delay in publication of bulletins (final figure), the provisional values as published can be considered for payments and arrears shall be paid/recovered on getting the final values.

2.17.9 PVC shall be applicable for works executed during contract period and for works executed during extended period, if any, and for the portion of work delayed/backlog for the reasons not attributable to the contractor.

However, the total Quantum of Price Variation Amount payable/recoverable shall be regulated as follows:

i) For the portion of shortfall/backlog not attributable to contractor, PVC shall be worked out on the basis of indices applicable for the respective month in which work is done. Base index shall be applicable as defined in clause 2.17.5

ii) In case of Force Majeure, the PVC shall be regulated as per (a) or (b) below.

a) Force Majeure is invoked before "Base Date" / "revised base date" (as explained below) OR immediately after "base date" / "revised base date" in continuation (i.e. during the period when PVC is not applicable):

vii. Base date shall be revised: Revised Base date = Previous base date + duration of Force Majeure.

No PVC will be applicable for the work done till revised base date.

viii. PVC will be applicable for the work done after "base date"/" revised date" as the case may be (during extended period when delay is not attributable to contractor). PVC shall be worked out on the basis of indices applicable for the respective month in which work is done with base index as on "base date"/ "revised base date" as the case may be.

b) Force Majeure is invoked after "base date"/ "revised base date" as the case may be (during extended period when delay is not attributable to contractor).

2. PVC shall be applicable for the work done after revocation of Force Majeure.

3. PVC for the work done after revocation of Force Majeure shall be worked out on the basis of indices applicable for the respective month on which work is done excluding the effect

of change in indices during total period of Force Majeure(s) invoked after "base date" / "revised base date" as the case may be. Base index shall be taken as on "base date" / "revised base date" as the case may be.

The total amount of PVC shall not exceed 15% of the cumulatively executed contract value. Executed Contract value for this purpose is exclusive of PVC, ORC, Supplementary / Additional items and Extra works except items due to quantity variation

Sl No: 12

Clauses 2.21 in GCC regarding Arbitration is amended as below

2.21 ARBITRATION & CONCILIATION

2.21.1 ARBITRATION:

2.21.1.1 Except as provided elsewhere in this Contract, in case Parties are unable to reach amicable settlement (whether by Conciliation to be conducted as provided in Clause 2.21.2 herein below or otherwise) in respect of any dispute or difference; arising out of the formation, breach, termination, validity or execution of the Contract; or, the respective rights and liabilities of the Parties; or, in relation to interpretation of any provision of the Contract; or. in any manner touching upon the Contract (hereinafter referred to as the 'Dispute'), then, either Party may, commence arbitration in respect of such Dispute by issuance of a notice in terms of section 21 of the Arbitration & Conciliation Act, 1996 (hereinafter referred to as the 'Notice'). The Notice shall contain the particulars of all claims to be referred to arbitration in sufficient detail and shall also indicate the monetary amount of such claim. The arbitration shall be conducted by a sole arbitrator to be appointed by the Head of the BHEL Power Sector Region issuing the Contract within 60 days of receipt of the complete Notice. The language of arbitration shall be English.

The Arbitrator shall pass a reasoned award.

Subject as aforesaid, the provisions of Arbitration and Conciliation Act 1996 (India) or statutory modifications or re-enactments thereof and the rules made thereunder as in force from time to time shall apply to the arbitration proceedings under this clause. The seat of arbitration shall be **Chennai** (the place from where the contract is Issued). The Contract shall be governed by and be construed as per provisions of

the laws of India. Subject to this provision 2.21.1.1 regarding ARBITRATION, the principal civil court exercising ordinary civil jurisdiction over the area where the seat of arbitration is located shall have exclusive jurisdiction over any DISPUTE to the exclusion of any other court.

2.21.1.2 In case of Contract with Public Sector Enterprise (PSE) or a Government Department, the following shall be applicable:
In the event of any dispute or difference relating to the interpretation and application of the provisions of commercial contract(s) between Central Public Sector Enterprises (CPSEs)/ Port Trusts inter se and also between CPSEs and Government Departments/Organizations (excluding disputes concerning Railways, Income Tax, Customs & Excise Departments), such dispute or difference shall be taken up by either party for resolution through AMRCD (Administrative Mechanism for Resolution of CPSEs Disputes) as mentioned in DPE OM No. 4(1)/2013-DPE(GM)/FTS-1835 dated 22-05-2018 as amended from time to time.

2.21.1.3 The cost of arbitration shall initially be borne equally by the Parties subject to the final allocation thereof as per the award/order passed by the Arbitrator.

2.21.1.4 Notwithstanding the existence of any dispute or differences and/or reference for the arbitration, the Contractor shall proceed with and continue without hindrance the performance of its obligations under this Contract with due diligence and expedition in a professional manner unless the dispute inter-alia relates to cancellation, termination or short-closure of the Contract by BHEL.

2.21.2 CONCILIATION:

If at any time (whether before, during or after the arbitral or judicial proceedings), any Disputes (which term shall mean and include any dispute, difference, question or disagreement arising in connection with construction, meaning, operation, effect, interpretation or breach of the agreement, contract), which the Parties are unable to settle mutually, arise inter-se the Parties, the same may, be referred by either party to Conciliation to be conducted through Independent Experts Committee (IEC) to be appointed by competent authority of BHEL from the BHEL Panel of Conciliators.

Notes:

1. No serving or a retired employee of BHEL/Administrative Ministry of BHEL shall be included in the BHEL Panel of Conciliators.
2. Any other person(s) can be appointed as Conciliator(s) who is/are mutually agreeable to both the parties from outside the BHEL Panel of Conciliators.

   The proceedings of Conciliation shall broadly be governed by Part-III of the Arbitration and Conciliation Act 1996 or any statutory modification thereof and as provided in Procedure 2.3 enclosed in Vol 1A Part II Chapter 4. The Procedure 2.3 together with its Formats will be treated as if the same is part and parcel hereof and shall be as effectual as if set out herein in this GCC.

   The Contractor hereby agrees that BHEL may make any amendments or modifications to the provisions stipulated in the Procedure 2.3 enclosed in Vol 1A Part II Chapter 5 from time to time and confirms that it shall be bound by such amended or modified provisions of the Procedure 2.3 with effect from the date as intimated by BHEL to it.

2.21.3 No Interest payable to Contractor

Notwithstanding anything to the contrary contained in any other document comprising in the Contract, no interest shall be payable by BHEL to Contractor on any moneys or balances including but not limited to the Security Deposit, EMD, Retention Money, RA Bills or the Final Bill, or any amount withheld and/or appropriated by BHEL etc., which becomes or as the case may be, is adjudged to be due from BHEL to Contractor whether under the Contract or otherwise.

Sl No: 13

The chapter Reverse auction procedure published in 'Forms and Procedures' of Volume I Book-II stands deleted. Revised Reverse Auction Guidelines 2020 available in the website http://www.bhel.com shall be applicable**.**

Sl No: 14:

Existing format on Monthly Performance Evaluation of Contractor, as available in Form No F-14 of Volume ID Forms and procedure stands Deleted. Form No.- F-14 (Rev 01) is enclosed.

Sl No: 15:

Existing format on Monthly Performance Evaluation of Contractor, as available in Form No F-15 of Volume ID Forms and procedure stands Deleted. Form No.- F-15 (Rev 02) is enclosed.

Sl No: 16

Clause 2.22 in GCC regarding Retention Amount is revised as under:

2.22 Performance security Deposit

2.22.1 After award of work, before commencement of work at site Vendor shall submit 5% of the contract value towards Performance Security Deposit, in the form of (a) or (b) below. In addition, Performance Security deposit on PVC will be recovered at the rate of 5% from every running bill.

(a) CASH (DD/Online payment), 5% of the contract Value towards Performance security deposit, before commencing the contract.

(or)

(b) Recovery 5% from Each Running Bill towards Performance security deposit.

(Note: Subcontractor has to choose either Option (a) or (b) before issue of Detailed LOI).

2.22.2 **Refund of Performance Security Deposit**:

a) 50% of Performance Security Deposit shall be released along with the final bill.

b) Balance 50% will be released after completion of Performance Guarantee Period (i.e., after expiry of Guarantee period), provided all the defects noticed during the guarantee period have been rectified to the satisfaction of BHEL Site Engineer/ BHEL Construction Manager, and after deducting all expenses/other amounts due to BHEL under the contract/ other contracts entered into by BHEL with them. This portion of Performance Security Deposit, amount can be released on commencement of the Guarantee Period, on submission of equivalent Bank Guarantee.

Sl No: 17

Existing format for Integrity Pact, as available in Volume ID Forms and procedure stands Deleted. Refer revised format for Integrity Pact provided in Annexure – 7 of Notice Inviting Tender (NIT).

Sl No: 18

Existing format for BANK GUARANTEE FOR SECURITY DEPOSIT, as available in Form No. F-11 (Rev 00) of Volume ID Forms and procedures stands deleted. Refer

Proforma of Bank Guarantee (in lieu of Security Deposit)-Form WAM 22 provided in Chapter-10, Part-II of Volume-IA Technical Conditions of Contract.

Sl No: 19

Clause 2.15.5 of GCC in Extra Works is revised as under:

2.15.5: After eligibility of extra works is established and finally accepted by BHEL engineer / designer, payment will be released on competent authority's approval at the following rate.

MAN-HOUR RATE FOR ELIGIBLE EXTRA WORKS:

Single composite average labour man-hour rate, including overtime if any, supervision, use of tools and tackles and other site expenses and incidentals, consumables for carrying out any major rework / repairs / rectification / modification / fabrication as certified by site as may arise during the course of erection, testing, commissioning or extra works arising out of transit, storage and erection damages, payment, if found due will be at Rs 108/- per man hour.

Sl No: 20

Following paragraph has been added in clause 2.7.1 under clause 2.7 "Rights of BHEL" of GCC (Rev. 01).

"In case of inadequate manpower deployed by the contractor, BHEL reserves the right to deploy additional manpower through any other agency for expediting activities in the interest of the project. Supplied manpower shall be put on job by the contractor and payments and other statutory compliances related to manpower shall be the contractor's responsibility. In case of contractor's failure to fulfil his obligations in respect of such manpower, BHEL reserves the right to take necessary action as per contract conditions."

VOLUME-IA PART – II CHAPTER 2

CHECKLIST FOR EVALUATION OF SUBCONTRACTORS

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

[To be filled and submitted by the contractor along with supporting documents]

Contractor:	BHEL	W.O.Number	400442
Package:	TSS Package		
Item:	Main TG Package of Unit-3	BOQ/WD No	Schedule A, B, C, D, E, F

PART 1: SUBCONTRACTOR DETAILS			
Registered Company Name:			
Registered Address:			
Phone:		E-Mail:	
Fax:		Website:	
Details of 'scope of work to be subcontracted':			
Main TG Package of Unit 3 including cross over & integral piping.			
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 [*Supporting documents are to be submitted]*

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: • 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: • 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 *(e.g Ultrasonic Examination/Helium Leak testing etc. as applicable)*	
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 – II CHAPTER 3 to CHAPTER 8

In the next 111 pages as below:

CHAPTER	Details	No. of sheets
CHAPTER 3	HSE plan for site operations by subcontractor	82
CHAPTER 4	Proforma of Bank Guarantee (in lieu of Earnest Money)- Form WAM 23	03
CHAPTER 5	Proforma of Bank Guarantee (in lieu of Security Deposit)- Form WAM 22	03
CHAPTER 6	Format for Form no.: F-14 (Rev 01); Monthly Plan and Review with Contractors Chapter-8 06	06
CHAPTER 7	Format for Form no.: F-15 (Rev 02); Monthly Performance Evaluation of contractor Chapter-9 06	06
CHAPTER 8	Procedure for conduct of Conciliation	11

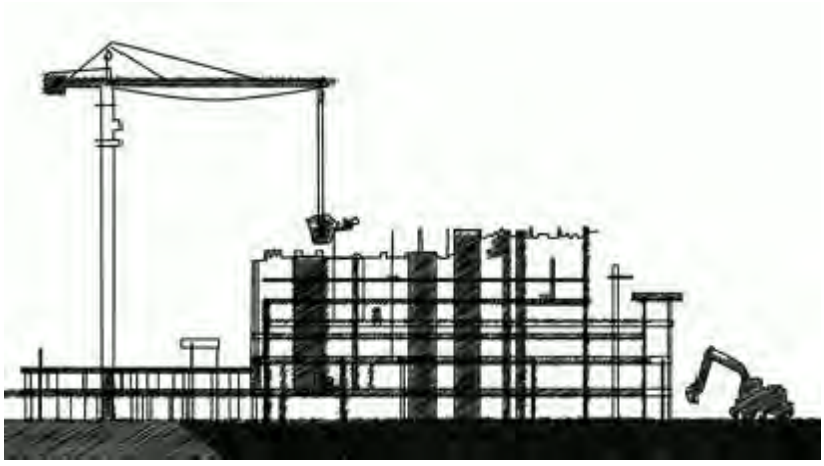
HEALTH, SAFETY and ENVIRONMENT PLAN

for

SITE OPERATIONS

by

SUB-CONTRACTORS



POWER SECTOR

HSE PLAN FOR SITE OPRATIONS BY BHEL'S SUBCONTRACTORS

AT A GLANCE

BEFORE START

SIGNING OF MOU
Agree to comply to HSE requirement- Statutory and BHEL's

PLAN

HSE ORGANISATION	
Manpower • 1 (one) safety officer for every 500 workers or part thereof • 1(one) safety-steward/ supervisor for every 100 workers **Qualification** As per Cl. 7.1	**HSE Roles and responsibilities** • Site In-charge- As per clause 7.2.1 • Safety officer- As per clause 7.2.2

HSE Planning
for Man, Machinery/Equipment/Tools & Tackles

PROVIDE

HSE INFRASTUCTURE	
• PPEs • Drinking Water • Washing Facilities • Latrines and Urinals • Provision of shelter for rest • Medical facilities	• Canteen facilities • Labour Colony • Emergency Vehicle • Pest Control • Scrapyard • Illumination

TRAIN

HSE TRAINING , AWARENESS & PROMOTION	
Training • Induction training • Height work and other critical areas • Tool Box talk & Pep Talk	**Awareness & Promotion** • Signage • Poster • Banner • Competition • Awards

COMMUNICATE

HSE COMMUNICATION	
Incident Reporting • Accident- Fatal & Major • Property damage • Near Miss	**Event Reporting** • Celebrations • Training • Medical camp

EXECUTE SAFELY

OPERATIONAL CONTROL PROCEDURES

PERMIT TO WORK

Height work (above 2 metres), Hot Work, Heavy Lifting, Confined Space, Radiography, excavation (More than 4 metres)

SAFETY DURING WORK EXECUTION	
• Welding • Rigging • Cylinder- storage & Movement • Demolition work • T&Ps • Chemical Handling • Electrical works	• Fire • Scaffolding • Height work • Working Platform • Excavation • Ladder • Lifting • Hoisting appliance
HOUSE KEEPING	
WASTE MANGEMENT	
TRAFFIC MANAGEMENT	
ENVIRONMENTAL CONTROL	
EMERGENCY PREPAREDNESS AND RESPONSE PLAN	

CHECKS

HSE AUDITS & INSPECTION	
• Daily Checks • Inspection of PPEs • Inspection of T& Ps • Inspection of Cranes & Winches	• Inspection of Height work • Inspection of Welding and Gas cutting • Inspection of elevators etc.

HSE PERFORMANCE EVALUATION PARAMETERS

NON CONFORMANCE

PENALTY for NON CONFORMANCE

Refer Clause 16

Incremental penalty

For repeated violation by the same person, the penalty would be double of the previous penalty

For repeated fatal incident in the same Unit incremental penalty to be imposed. The subcontractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same subcontractor for the same package in the same unit.

REVISION HISTORY SHEET

Date	Revision No.	Details of Changes	Reason	Prepared	Reviewed	Approved
12.08.2014	00	First Issue	First Issue	S. B. Jayant, Dy Manager-FQA & Safety	A. K. Sinha, GM-FQA & Safety	Anuj Bhatnagar, ED-FQA & Safety
20.01.2020	01	Formats added: **HSEP:14-F30 – Monthly HSE Planning & Review** (Page 11, Clause 8.0 - updated) HSEP:14-F13E-Excavation Inspection Format (part of F30)) HSEP:14-F32B – Job Safety Analysis Format (part of F30) **HSEP:14-F31A – Daily HSE Reporting** (Page 18, Clause 10.3 – added) **HSEP:14-F33 – HSE Performance Evaluation** (Page 31, Clause 13 – revised)	IOM No. **PSHQHSE/MONREP/02** Dated 08-Jan-2020	Rohit Kumar	Santosh Nair, GM (MSX & HSE)	

1.0 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.

1.3 Although every effort has been made to make the procedures and guidelines in line with statutory requirements, in case of any discrepancy relevant statutory guidelines must be followed.

1.4 In case the customer has any specific requirement, the same is to be fulfilled.

2.0 SCOPE

The document is applicable for BHEL's Subcontractors at all installation / servicing activities of BHEL Power Sector as per the relevant contractual obligations.

3.0 OBJECTIVES AND TARGETS

The HSE Plan reflects that BHEL places high priority upon the Occupational Health, Safety and Environment at workplaces.

- Ensure the Health and Safety of all persons at work site is not adversely affected by the work.
- Ensure protection of environment of the work site.
- Comply at all times with the relevant statutory and contractual HSE requirements.
- Provide trained, experienced and competent personnel. Ensure medically fit personnel only are engaged at work.
- Provide and maintain plant, places and systems of work that are safe and without risk to health and the environment.
- Provide all personnel with adequate information, instruction, training and supervision on the safety aspect of their work.
- Effectively control, co-ordinate and monitor the activities of all personnel on the Project sites including subcontractors in respects of HSE.
- Establish effective communication on HSE matters with all relevant parties involved in the Project works.
- Ensure that all work planning takes into account all persons that may be affected by the work.
- Ensure fitness testing of all T&Ps/Lifting appliances like cranes, chain pulley blocks etc. are to be certified by competent person.
- Ensure timely provision of resources to facilitate effective implementation of HSE requirements.
- Ensure continual improvements in HSE performance
- Ensure conservation of resources and reduction of wastage.
- Capture the data of all incidents including near misses, process deviation etc. Investigate and analyze the same to find out the root cause.
- Ensure timely implementation of correction, corrective action and preventive action.

HSE TARGETS

EXPLOSION	**ZERO**
FATALITY	**ZERO**
LOST TIME INJURY	**ZERO**
FIRE	**ZERO**
VEHICLE INCIDENTS	**ZERO**
ENVIRONMENTAL INCIDENTS	**ZERO**

4.0 BHEL POWER SECTOR HEALTH, SAFETY & ENVIRONMENT POLICY

Health, Safety & Environment Policy of BHEL

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

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

sd/-

CMD, BHEL

5.0 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_____shall ensure that safe work practices as per the HSE plan. Spirit and content therein shall be reached to 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.

Signed by authorized representative of M/s ----------

Name :

Place & Date:

6.0 TERMS AND DEFINITIONS

6.1 DEFINITIONS

6.1.1 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.

6.1.2 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".

6.1.3 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 labours. 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.

6.1.4 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.

6.1.5 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.

6.1.6 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.

6.1.7 TYPE OF INCIDENTS & THEIR REPORTING:

The three categories of Incident are as follows:

Non-Reportable Cases:
An incident, where the injured person is given medical help and discharged for work without counting any lost time.

Reportable Cases:
In this case the injured person is disable for 48 hours or more and is not able to perform his duty.

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.

6.1.8 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:

$$\frac{\text{Number of Reportable LTI}}{\text{Total Man Hours Worked}} \times 1{,}000{,}000$$

6.1.9 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:

$$\frac{\text{Days lost due to LTI}}{\text{Total Man Hours Worked}} \times 1{,}000{,}000$$

6.1.10 INCIDENCE RATE

Incidence Rate is the Number of LTI per one thousand manpower deployed. Mathematically, the formula reads as:

$$\frac{\text{Number of LTI}}{\text{Average number of manpower deployed}} \times 1000$$

7.0 HSE ORGANISATION

Number of safety officers:
The subcontractor must deploy one safety officer for every 500 workers or part thereof in each package. In addition, there must be one safety-steward/safety-supervisor for every 100 workers.

Deployment: The subcontractor should deploy sufficient safety officers and safety-steward/Safety-supervisor, as per requirement given above, since initial stage and add more in proportion to the added strength in work force. Any delay in deployment will attract a penalty of Rs.30,000/- per man month for the delayed period.

7.1 QUALIFICATION FOR HSE PERSONNEL

Sl.no	Designation	Qualification	Experience
1	Safety officer (Construction Agency)	Degree or Diploma in Engineering with full time diploma in Industrial Safety with construction safety as one of the subjects	Minimum two years for degree holder and five years for diploma holder in the field of Construction of power plant/ major industries

2	Safety-Steward/ Safety-Supervisor	Degree or diploma in any discipline with full time diploma in Industrial Safety with construction safety as one of the subjects	Minimum two years

7.2 RESPONSIBILITIES

7.2.1 SITE IN -CHARGE OF SUBCONTRACTOR

- Shall sign Memorandum of Understanding (MoU) for compliance to BHEL's HSE Plan for Site Operations as per clause 5.0
- Shall engage qualified safety officer(s) and steward (s) as per clause 7.0
- Shall adhere to the rules and regulations mentioned in this code, practice very strictly in his area of work in consultation with his concerned engineer and the safety coordinator.
- Shall screen all workmen for health and competence requirement before engaging for the job and periodically thereafter as required.
- Shall not engage any employee below 18 years.
- Shall arrange for all necessary PPEs like safety helmets, belts, full body harness, shoes, face shield, hand gloves etc. before starting the job. Shall ensure that no working men/women carry excessive weight more than stipulated in Factory Rule Regulation R57.
- Shall ensure that all T&Ps engaged are tested for fitness and have valid certificates from competent person.
- Shall ensure that provisions stipulated in contract Labour Regulation Act 1970, Chapter V C.9, canteen, rest rooms/washing facilities to contracted employees at site.
- Shall adhere to the instructions laid down in Operation Control Procedures (OCPs) available with the site management.
- Shall ensure that person working above 2.0 meter should use Safety Harness tied to a life line/stable structure.
- Shall ensure that materials are not thrown from height. Cautions to be exercised to prevent fall of material from height.
- Shall report all incidents (Fatal/Major/Minor/Near Miss) to the Site engineer /HSE officer of BHEL.
- Shall ensure that Horseplay is strictly forbidden.
- Shall ensure that adequate illumination is arranged during night work.
- Shall ensure that all personnel working under subcontractor are working safely and do not create any Hazard to self and to others.
- Shall ensure display of adequate signage/posters on HSE.
- Shall ensure that mobile phone is not used by workers while working.
- Shall ensure conductance of HSE audit, mockdrill, medical camps, induction training and training on HSE at site.
- Shall ensure full co-operation during HQ/External /Customer HSE audits.

- Shall ensure submission of look-ahead plan for procurement of HSE equipment's and PPEs as per work schedule.
- Shall ensure good housekeeping.
- Shall ensure adequate valid fire extinguishers are provided at the work site.
- Shall ensure availability of sufficient number of toilets /restrooms and adequate drinking water at work site and labour colony.
- Shall ensure adequate emergency preparedness.
- Shall be member of site HSE committee and attend all meetings of the committee
- Power source for hand lamps shall be maximum of 24 v.
- Temporary fencing should be done for open edges if Hand – railings and Toe-guards are not available.

7.2.2 HEALTH, SAFETY AND ENVIRONMENT OFFICER OF SUBCONTRACTOR

- Carry out safety inspection of Work Area, Work Method, Men, Machine & Material, P&M and other tools and tackles.
- Facilitate inclusion of safety elements into Work Method Statement.
- Highlight the requirements of safety through Tool-box / other meetings.
- Help concerned HOS to prepare Job Specific instructions for critical jobs.
- Conduct investigation of all incident/dangerous occurrences & recommend appropriate safety measures.
- Advice & co-ordinate for implementation of HSE permit systems, OCPs & MPs.
- Convene HSE meeting & minute the proceeding for circulation & follow-up action.
- Plan procurement of PPE & Safety devices and inspect their healthiness.
- Report to PS Region/HQ on all matters pertaining to status of safety and promotional program at site level.
- Facilitate administration of First Aid
- Facilitate screening of workmen and safety induction.
- Conduct fire Drill and facilitate emergency preparedness
- Design campaigns, competitions & other special emphasis programs to promote safety in the workplace.
- Apprise PS– Region on safety related problems.
- Notify site personnel non-conformance to safety norms observed during site visits / site inspections.
- 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.
- To decline acceptance of such PPE / safety equipment that do not conform to specified requirements.
- Encourage raising Near Miss Report on safety along with, improvement initiatives on safety.
- Shall work as interface between various agencies such customer, package-in-charges, subcontractors on HSE matters

8.0 PLANNING BY SUBCONTRACTOR

Monthly planning and review of HSE activities shall be carried out by subcontractor as per format No. HSEP:14-F30 jointly along with BHEL.

8.1 MOBILISATION OF MACHINERY/EQUIPMENT/TOOLS BY SUBCONTRACTOR

- 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.

- The machinery and equipment to be embraced for this purpose shall include but not limited to the following:

  - Mobile cranes.
  - Side Booms.
  - Forklifts.
  - Grinding machine.
  - Drilling machine.
  - Air compressors.
  - Welding machine.
  - Generator sets.
  - Dump Trucks.
  - Excavators.
  - Dozers
  - Grit Blasting Equipment.
  - Hand tools.

- 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.

8.2 MOBILISATION OF MANPOWER BY SUBCONTRACTOR

- The subcontractor shall arrange induction and regular health check of their employees as per schedule VII of BOCW rules by a registered medical practitioner.
- 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.
- 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.
- Appropriate accommodation to be arranged for all workmen in hygienic condition.

8.3 PROVISION OF PPEs

- Personnel Protective Equipment (PPEs), in adequate numbers, will be made available at site & their regular use by all concerned will be ensured
- The following matrix recommends usage of minimum PPEs against the respective job.

Sl. No	Type of work	PPEs
1	Concrete and asphalt mixing	Nose mask, hand glove, apron and gum boot
2	Welders/Grinders/ Gas cutters	Welding/face screen, apron, hand gloves, nose mask and ear muffs if noise level exceeds 90dB. Helmet fitted with welding shield is preferred for welders
3	Stone/ concrete breakers	Ear muffs, safety goggles, hand gloves
4	Electrical Work	Rubber hand glove, Electrical Resistance shoes
5	Insulation Work	Respiratory mask, Hand gloves, safety goggles
6	Work at height	Double lanyard full body harness, Fall arrestor (specific cases)
7	Grit/Sand blasting	Blast suit, blast helmet, respirator, leather gloves
8	Painting	Plastic gloves, Respirators (particularly for spray painting)
9	Radiography	As per BARC guidelines

- The PPEs shall conform to the relevant standards as below and bear ISI mark.

Relevant is-codes for personal protection

IS: 2925 – 1984	Industrial Safety Helmets.
IS: 4770 – 1968	Rubber gloves for electrical purposes.
IS: 6994 – 1973 (Part-I)	Industrial Safety Gloves (Leather &Cotton Gloves).
IS: 1989 – 1986 (Part-I-II)	Leather safety boots and shoes.
IS: 5557 – 1969	Industrial and Safety rubber knee boots.
IS: 6519 – 1971	Code of practice for selections care and repair of Safety footwear.
IS: 11226 – 1985	Leather Safety footwear having direct molding sole.
IS: 5983 – 1978	Eye protectors.
IS: 9167 – 1979	Ear protectors.
IS: 1179-1967	Eye & Face protection during welding
IS: 3521 – 1983	Industrial Safety Belts and Harness
IS:8519 -1977	Guide for selection of industrial Safety equipment for body protection
IS:9473-2002,14166-1994,14746-1999	Respiratory Protective Devices

The list is not exhaustive. The safety officer may demand additional PPEs based on specific requirement.

- 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
- Besides the PPEs mentioned above, the persons shall use helmet and safety shoe. The visitors shall use Helmet and any other PPEs as deemed appropriate for the area of work.

Colour scheme for Helmets:

1. Workmen: Yellow
2. Safety staff: Green or white with green band
3. Electrician: Red
4. Others including visitors: White

- All the PPEs shall be checked for its quality before issue and the same shall be periodically checked. The users shall be advised to check the PPEs themselves for any defect before putting on. The defective ones shall be repaired/ replaced.
- The issuing agency shall maintain register for issue and receipt of PPEs.
- The Helmets shall have logo or name (abbreviation of agency name permitted) affixed or printed on the front.
- The body harnesses shall be serial numbered.

8.4 ARRANGEMENT OF INFRASTRUCTURE

8.4.1 DRINKING WATER

- Drinking water shall be provided and maintained at suitable places at different elevations.
- Container should be labeled as " Drinking Water"
- Cleaning of the storage tank shall be ensured atleast once in 3 months indicating date of cleaning and next due date.
- Potability of water should be tested as per IS10500 at least once in a year.

8.4.2 WASHING FACILITIES

- In every workplace, adequate and suitable facilities for washing shall be provided and maintained.
- 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.
- 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.

8.4.3 LATRINES AND URINALS

- Latrines and urinals shall be provided in every work place.
- Urinals shall also be provided at different elevations.
- They shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times, by appointing designated person.
- Separate facilities shall be provided for the use of male and female worker if any.

8.4.4 PROVISION OF SHELTER DURING REST

Proper Shed & Shelter shall be provided for rest during break

8.4.5 MEDICAL FACILITIES

8.4.5.1 MEDICAL CENTRE (As per Schedule V, X and XI of BOCW central Rules, 1998)

- A medical centre shall be ensured/identified at site with basic facilities for handling medical emergencies. The medical center can be jointly developed on proportionate sharing basis with permission from BHEL
- A qualified medical professional, not less than MBBS, shall be deployed at the medical centre
- The medical centre shall be equipped with one ambulance, with trained driver and oxygen cylinder.
- Medical waste shall be disposed as per prevailing legislation (Bio-Medical Waste –Management and Handling Rules, 1998)

8.4.5.2 FIRST AIDER

- Ensure availability of Qualified First-aider throughout the working hours.
- Every injury shall be treated, recorded and reported.
- Refresher course on first aid shall be conducted as necessary.
- List of Qualified first aiders and their contact numbers should be displayed at conspicuous places.

8.4.5.3 FIRST AID BOX (as per schedule III of BOCW)

- 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.
- 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.
- 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.
- The first aid box shall be distinctly marked with a Green Cross on white background.
- Details of contents of first aid box is given in Annexure No. 01
- Monthly inspection of First Aid Box shall be carried out by the owner as per format no. HSEP:14-F01
- The subcontractor should conduct periodical first –aid classes to keep his supervisor and Engineers properly trained for attending to any emergency.

8.4.5.4 HEALTH CHECK UP (As per schedule VII and Form XI)

The persons engaged at the site shall undergo health checkup as per the format no. HSEP:14-F02 before induction. The persons engaged in the following works shall undergo health checkup at least once in a year:

a. Height workers
b. Drivers/crane operators/riggers

c. Confined space workers
d. Shot/sand blaster
e. Welding and NDE personnel

8.4.6 PROVISION OF CANTEEN FACILITY

- Canteen facilities shall be provided for the workmen of the project inside the project site.
- Proper cleaning and hygienic condition shall be maintained.
- Proper care should be taken to prevent biological contamination.
- Adequate drinking water should be available at canteen.
- Fire extinguisher shall be provided inside canteen.
- Regular health check-up and medication to the canteen workers shall be ensured.

8.4.7 PROVISION OF ACCOMODATION/LABOUR COLONY

- The subcontractor shall arrange for the accommodation of workmen at nearby localities or by making a labour colony.
- Regular housekeeping of the labour colony shall be ensured.
- Proper sanitation and hygienic conditions to be maintained.
- Drinking water and electricity to be provided at the labour colony.
- Bathing/ washing bay
- Room ventilation and electrification.

8.4.8 PROVISION OF EMERGENCY VEHICLE

- Dedicated emergency vehicle shall be made available at workplace by each subcontractor to handle any emergency

8.4.9 PEST CONTROL

Regular pest control should be carried out at all offices, mainly laboratories, canteen, labour colony and stores.

8.4.10 SCRAPYARD

- In consultation with customer, scrapyard shall be developed to store metal scrap, wooden scrap, waste, hazardous waste.
- Scrap/Waste shall be segregated as Bio-degradable and non-bio-degradable and stored separately.

8.4.11 ILLUMINATION

- 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.

- Adequate and suitable light shall be provided at all work places & their approaches including passage ways as per IS: 3646 (Part-II). Some recommended values are given below:

S. No.	Location	Illumination (Lux)
A.	**Construction Area**	
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 rough measurements etc.	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

- Lamp (hand held) shall not be powered by mains supply but either by 24V or dry cells.
- Lamps shall be protected by suitable guards where necessary to prevent danger, in case of breakage of lamp.
- Emergency lighting provision for night work shall be made to minimise danger in case of main supply failure.

If the subcontractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instructions issued by the authorized BHEL official, BHEL shall have the right to take corrective steps at the risk and cost of the subcontractor

9.0 HSE TRAINING& AWARENESS

9.1 HSE INDUCTION TRAINING

All persons entering into project site shall be given HSE induction training by the HSE officer of BHEL /subcontractor before being assigned to work.

In-house induction training subjects shall include but not limited to:

- Briefing of the Project details.
- Safety objectives and targets.
- Site HSE rules.
- Site HSE hazards and aspects.
- First aid facility.
- Emergency Contact No.
- Incident reporting.
- Fire prevention and emergency response.
- Rules to be followed in the labour colony (if applicable)

- 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.)
- They must arrive fully dressed in safety wear & gear to attend the induction.
- Any one failing to conform to this safety wear& gear requirement shall not qualify to attend.
- On completing attending subcontractor's in-house HSE induction, each employee shall sign an induction training form (format no. HSEP:14-F03) to declare that he had understood the content and shall abide to follow and comply with safe work practices. They may only then be qualified to be issued with a personal I.D. card, for access to the work site.

9.2 HSE TOOLBOX TALK

- HSE tool Box talk shall be conducted by frontline foreman/supervisor of subcontractor to specific work groups prior to the start of work. The agenda shall consist of the followings:
    - 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.
- Record of Tool box talk shall be maintained as per format no. HSEP:14-F04
- Tool box talk to be conducted at least once a week for the specific work.

9.3 TRAINING ON HEIGHT WORK

Training on height work shall be imparted to all workers working at height by in-house/external faculty at least twice in a year. The training shall include following topics:

- Use of PPEs
- Use of fall arrester, retractable fall arrester, life line, safety nets etc.
- Safe climbing through monkey ladders.
- Inspection of PPEs.
- Medical fitness requirements.
- Mock drill on rescue at height.
- Dos & Don'ts during height work.

9.4 HSE TRAINING DURING PROJECT EXECUTION

- Other HSE training shall be arranged by BHEL/ subcontractor as per the need of the project execution and recommendation of HSE committee of site.
- The topics of the HSE training shall be as follows but not limited to:
    - Hazards identification and risk analysis (HIRA)
    - Work Permit System
    - Incident investigation and reporting
    - Fire fighting
    - First aid
    - Fire-warden training
    - EMS and OHSMS
    - T & Ps fitness and operation

- Electrical safety
- Welding, NDE & Radiological safety
- Storage, preservation & material handling.

- A matrix shall be maintained to keep an up-to-date record of attendance of training sessions carried out.

9.5 HSE PROMOTION-SIGNAGE, POSTERS, COMPETITION, AWARDS ETC

9.5.1 Display of HSE posters and banners

- Site shall arrange appropriate posters, banners, slogans in local/Hindi/English languages at work place

9.5.2 Display of HSE signage

- Appropriate HSE signage shall be displayed at the work area to aware workmen and passersby about the work going on and do's and don'ts to be followed

9.5.3 Competition on HSE and award

- Site will arrange different competition (slogan, poster, essay etc.) on HSE time to time (Safety day, BHEL day, World Environment Day etc.) and winners will be suitably awarded.

9.5.4 HSE awareness programme

- Subcontractor shall arrange HSE awareness programme periodically on different topics including medical awareness for all personnel working at site

10.0 HSE COMMUNICATION

10.1 INCIDENT REPORTING

- The subcontractor shall submit report of all incidents, fires and property damage etc to the Engineer immediately after such occurrence, but in any case not later than 24 hours of the occurrence. Such reports shall be furnished in the manner prescribed by BHEL. (Refer HSE procedure for incident investigation, analysis and reporting for details)
- In addition, periodic reports on safety shall also be submitted by the subcontractor to BHEL from time to time as prescribed by the Engineer. Compiled monthly reports of all kinds of incidents, fire and property damage to be submitted to BHEL safety officer as per prescribed formats.
- HSE incidents of site shall be reported to BHEL site Management as per Procedure for Incident Investigation and Reporting in format no. HSEP:14-F15. Corrective action shall be immediately implemented at the work place and compliance shall be verified by BHEL HSE officer and until then, work shall be put on hold by Construction Manager.

10.2 HSE EVENT REPORTING

- 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
- Celebration of important days like National Safety Day, World Environment Day etc. shall also be reported as mentioned above.

10.3 DAILY HSE ACTIVITY REPORTING

Daily HSE activities shall be reported by subcontractor to BHEL as per Format No. HSEP:14-F31A

11.0 OPERATIONAL CONTROL

All applicable OCPs (Operational control procedures) will be followed by subcontractor as per BHEL instructions. This will be done as part of normal scope of work. List of such OCPs is given below. In case any other OCP is found to be applicable during the execution of work at site, then subcontractor will follow this as well, within quoted rate. These OCPs (applicable ones) will be made available to subcontractor during work execution at site. However for reference purpose, these are kept with Safety Officer of BHEL at the Power Sector Regional HQ, or available in downloadable format in the website, which may be refereed by subcontractor, if they so desire.

LIST OF OCPs

Safe handling of chemicals	Safety in use of cranes	Hydraulic test
Electrical safety	Storage and handling of gas cylinders	Spray insulation
Energy conservation	Manual arc welding	Trial run of rotary equipment
Safe welding and gas cutting operation	Safe use of helmets	Stress relieving
Fire safety	Good house keeping	Material preservation
Safety in use of hand tools	Working at height	Cable laying/tray work
First aid	Safe excavation	Transformer charging
Food safety at canteen	Safe filling of hydrogen in cylinder	Electrical maintenance
Illumination	Vehicle maintenance	Safe handling of battery system
Handling and erection of heavy metals	Safe radiography	Computer operation
Safe acid cleaning	Waste disposal	Storage in open yard
Safe alkali boil out	Working at night	For sanitary maintenance
Safe oil flushing	Blasting	Batching
Steam blowing	DG set	Piling rig operation
Safe working in confined area	Handling & storage of mineral wool	Gas distribution test
Safe operation of passenger lift, material hoists & cages	Drilling, reaming and grinding(machining)	Cleaning of hotwell / deaerator
Electro-resistance heating	Compressor operation	O&M of control of AC plant & system
Air compressor	Passivation	Safe Loading of Unit
Safe EDTA Cleaning	Safe Chemical cleaning of Pre boiler system	Safe Boiler Light up
Safe Rolling and Synchronization		

11.1 HSE ACTIVITIES

HSE activities shall be conducted at site based on the HSEMSM developed by Power Sector and issued to site by Regions.
While planning for any activity the following documents shall be referred for infrastructural requirements to establish control measures:

1) HSE Procedure for Register of OHS Hazards and Risks
2) HSE Procedure for Register of Environmental Aspects and Impacts
3) HSE Procedure for Register of Regulations

4) Operational Control Procedures
5) HSE Procedure for Emergency Preparedness and Response Plan
6) Contract documents

11.2 WORK PERMIT SYSTEM

- The following activities shall come under Work Permit System
  a. Height working above 2 metres
  b. Hot working at height
  c. Confined space
  d. Radiography
  e. Excavation more than 4 meter depth
  f. Heavy lifting above 50 ton
  Refer Annexure 05 for Work permit formats.
- "HSE Procedure for Work Permit System" shall be followed while implementing permit system. Where customer is having separate Work Permit System the same shall be followed.
- Permit applicant shall apply for work permit of particular work activity at particular location before starting of the work with Job Hazard Analysis.
- Permit signatory shall check that all the control measures necessary for the activity are in place and issue the permit to the permit holder.
- Permit holder shall implement and maintain all control measures during the period of permit .He will close the permit after completion of the work. The closed permit shall be archived in HSE Department of site.

11.3 SAFETY DURING WORK EXECUTION

Respective OCPS are to be followed and adherence to the same would be contractually binding

11.3.1 WELDING SAFETY

All safety precautions shall be taken for welding and cutting operations as per IS-818. All safety precautions shall be taken for foundation and other excavation marks as per IS-3764.

11.3.2 RIGGING

Rigging equipment shall not be loaded in excess of its recommended safe working load. Rigging equipment, when not in use, shall be removed from the original work area so as not to present a hazard to employees.

11.3.3 CYLINDERS STORAGE AND MOVEMENT

All gas cylinders shall be stored in upright position. Suitable trolley shall be used. There shall be flash-back arrestors conforming to IS-11006 at both cylinder and burner ends. Damaged tube and regulators must be immediately replaced. No of cylinders shall not exceed the specified quantity as per OCP
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.

When cylinders are transported by powered vehicle they shall be secured in a vertical position.

11.3.4 DEMOLITION WORK

Before any demolition work is commenced and also during the process of the work the following shall be ensured:

- All roads and open areas adjacent to the work site shall either be closed or suitably protected.
- 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.
- 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.

11.3.5 T&Ps

All T&Ps/ MMEs should be of reputed brand/appropriate quality & must have valid test/calibration certificates bearing endorsement from competent authority of BHEL..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.

11.3.6 CHEMICAL HANDLING

Displaying safe handling procedures for all chemicals such as lube oil, acid, alkali, sealing compounds etc , at work place.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.

11.3.7 ELECTRICAL SAFETY

- Providing adequate no. of 24 V sources and ensure that no hand lamps are operating at voltage level above 24 Volts.
- Fulfilling safety requirements at all power tapping points.
- High/ Low pressure welders to be identified with separate colour clothings. No welders will be deployed without passing appropriate tests and holding valid welding certificates. Approved welding procedure should be displayed at work place.
- The subcontractor shall not use any hand lamp energized by Electric power with supply voltage of more than 24 volts in confined spaces like inside water boxes, turbine casings, condensers etc.
- All portable electric tools used by the subcontractor shall have safe plugging system to source of power and be appropriately earthed. Only electricians licensed by appropriate statutory authority shall be employed by the subcontractor to carry out all types of electrical works. Details of earth resource ad their test date to be given to BHEL safety officer as per the prescribed formats of BHEL
- The subcontractor shall use only properly insulated and armored cables which conform to the requirement of Indian Electricity Act and Rules for all wiring, electrical applications at site.

- BHEL reserves the right to replace any unsafe electrical installations, wiring, cabling etc. at the cost of the subcontractor.
- All electrical appliances used in the work shall be in good working condition and shall be properly earthed.
- No maintenance work shall be carried out on live equipment.
- The subcontractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installations.
- Area wise Electrical safety inspection is to be carried out on monthly basis as per "Electrical Safety Inspection checklist' and the report is to be submitted to BHEL safety officer
- 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
- The subcontractor shall carefully follow the safety requirement of BHEL/ the purchaser with the regard to voltages used in critical areas.

11.3.8 FIRE SAFETY

- Providing appropriate fire fighting equipment at designated work place and nominate a fire officer/warden adequately trained for his job.
- Subcontractor shall provide enough fire protecting equipment of the types and numbers at his office, stores, temporary structure in labor colony etc. Such fire protection equipment shall be easy and kept open at all times.
- 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.
- 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.
- 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.
- Emergency contacts nos must be displayed at prominent locations
- 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.

11.3.9 SCAFFOLDING

- Suitable scaffolds shall be provided for workman for all works that cannot safely be done from the ground, or from solid construction except in the case of short duration of work which can be done safely from ladders.
- When a ladder is used, it shall be of rigid construction made of steel. The steps shall have a minimum width of 45 cm and a maximum rise of 30 cm. Suitable handholds of good quality wood or steel shall be provided and the ladder shall be given an inclination not steeper then ¼ horizontal and 1 vertical.
- Scaffolding or staging more than 3.6 m above the ground floor, swung or suspended from an overhead support or erected with stationery support shall have a guard rail properly bolted, braced or otherwise secured, at least 90 cm above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from saver, from swaying, from the building or structure.

11.3.10 **WORK AT HEIGHT**:

- Guardrails and toe-board/barricades and sound platform conforming to IS:4912-1978 should be provided.

- Wherever necessary, life-line (pp or metallic) and fall arrestor along with Polyamide rope or Retractable lifeline should be provided.
- Safety Net as per IS:11057:1984 should be used extensively for prevention/ arrest of men and materials falling from height. The safety nets shall be fire resistant, duly tested and shall be of ISI marked and the nets shall be located as per site requirements to arrest or to reduce the consequences of a possible fall of persons working at different heights.
- 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.
- Use of Rebar steel for making Jhoola and monkey-ladder (Rods welded to vertical or inclined structural members), temporary platform etc. must be avoided.
- Monkey Ladder should be properly made and fitted with cages.
- Jhoola should be made with angles and flats and tested like any lifting tools before use.
- Lanyard must be anchored always and in case of double lanyard, each should be anchored separately.
- In case of pipe-rack, persons should not walk on pipes and walk on platforms only.
- In case of roof work, walking ladder/ platform should be provided along with lifeline and/ or fall arrestor.
- Empty drums must not be used.
- For chimney or structure painting, both hanging platform and men should be anchored separately to a firm structure along with separate fall arrestor. Rope ladder should be discouraged.

11.3.11 WORKING PLATFORM

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 as described above. Every opening in the floor or a building or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 90 cm.

11.3.12 EXCAVATION

Wherever there are open excavation in ground, they shall be fenced off by suitable railing and danger signals installed at night so as to prevent persons slipping into the excavations.

11.3.13 LADDER SAFETY

Safe means of access shall be provided to all working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 m in the length while the width between side rails in rung ladder shall in no case be less than app. 29.2 cm for ladder upto and including 3 m in length. For longer ladders this width shall be increased at least ¼'' for each additional foot of length.

A sketch of the ladders and scaffolds proposed to be used shall be prepared and approval of the Engineer obtained prior to Construction.

11.3.14 LIFTING SAFETY

- It will be the responsibility of the subcontractor to ensure safe lifting of the equipment, taking due precaution to avoid any incident and damage to other equipment and personnel.

- All requisite tests and inspection of handling equipment, tools & tackle shall be periodically done by the subcontractor by engaging only the Competent Persons as per law.
- Defective equipment or uncertified shall be removed from service.
- Any equipment shall not be loaded in excess of its recommended safe working load.

11.3.15 HOISTING APPLIANCE

- Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safe guards.
- Hoisting appliance should be provided with such means as will reduce to the minimum the risk of any part of a suspended load becoming incidentally displaced.
- When workers employed on electrical installations which are already energized, insulating mats, wearing apparel, such as gloves, sleeves and boots as may be necessary should be provided.
- The worker should not wear any rings, watches and carry keys or other materials which are good conductor of electricity.

11.4 ENVIRONMENTAL CONTROL

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. 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.

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).

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

All subcontractors shall be responsible for the cleanliness of their own areas.

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.
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, keeping good relation with local populace etc.
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.

11.5 HOUSEKEEPING

- Keeping the work area 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 has to be done by

subcontractor within quoted rate, on daily basis by an identified group. 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 contractor's bill. Such decisions of BHEL shall be binding on the subcontractor

- Proper housekeeping to be maintained at work place and the following are to be taken care of on daily basis.
- All surplus earth and debris are removed/disposed off from the working areas to identified locations.
- Unused/Surplus cables, steel items and steel scrap lying scattered at different places/elevation within the working areas are removed to identified locations.
- All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from workplace to identified locations. 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 location.
- Access and egress (stair case, gangways, ladders etc.) path should be free from all scrap and other hindrances.
- Workmen shall be educated through tool box talk about the importance of housekeeping and encourage not to litter.
- Labour 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.
- Fabricated steel structures, pipes & piping materials shall be stacked properly.
- 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.
- Utmost care shall be taken to ensure over all cleanliness and proper upkeep of the working areas

11.6 WASTE MANAGEMENT

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.

11.6.1 BINS AT WORK PLACE

- Sufficient rubbish bins shall be provided close to workplaces.
- Bins should be painted yellow and numbered.
- Sufficient nos. of drip trays shall be provided to collect oil and grease.
- Sufficient qty. of broomsticks with handle shall be provided.
- Adequate strength of employees should be deployed to ensure daily monitoring and service for waste management.

11.6.2 STORAGE AND COLLECTION

- Different types of rubbish/waste should be collected and stored separately.
- Paper, oily rags, smoking material, flammable, metal pieces should be collected in separate bins with close fitting lids.
- Rubbish should not be left or allowed to accumulate on construction and other work places.
- Do not burn construction rubbish near working site.

11.6.3 SEGREGATION

- Earmark the scrap area for different types of waste.
- Store wastes away from building.
- Oil spill absorbed by non-combustible absorbent should be kept in separate bin.
- Clinical and first aid waste stored and incinerated separately.

11.6.4 DISPOSAL

- Sufficient containers and scrap disposal area should be allocated.
- All scrap bin and containers should be conveniently located.
- Provide self-closing containers for flammable/spontaneously combustible material.
- Keep drainage channels free from choking.
- Make schedule for collection and disposal of waste.

11.6.5 WARNING AND SIGNS

- Appropriate sign to be displayed at scrap storage area
- No toxic, corrosive or flammable substance to be discarded into public sewage system.
- Waste disposal shall be in accordance with best practice.
- Comply with all the requirements of Pollution Control Board (PCB) for storage and disposal of hazardous waste.

11.7 TRAFFIC MANAGEMENT SYSTEM

11.7.1 SAFE WORKPLACE TRANSPORT SYSTEM

- 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.
- 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.
- For internal traffic, lines marked on roads / access routes and between buildings shall clearly indicate where vehicles are to pass.
- Temporary obstacles shall be brought to the attention of drivers by warning signs or hazard cones.
- Speed limits shall be clearly displayed. Speed ramps preceded by a warning signs or marker are necessary.
- 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.
- Safest route shall be provided between places where vehicles have to call or deliver.
- Avoid vulnerable areas/items such as fuel or chemicals tanks or pipes, open or unprotected edges and structures likely to collapse

- Safe areas shall be provided for loading and unloading.
- Avoid sharp or blind bends. If this is not possible hazards should be indicated e.g. blind corner.
- Ensure road crossings are minimum and clearly signed.
- Entrance and gateways shall be wide enough to accommodate a second vehicle without causing obstruction.
- Set sensible speed limits which are clearly sign posted.
- Where necessary ramps should be used to retard speed. This shall be preceded by a warning sign or mark on the road.
- Forklift trucks shall not pass over road hump unless of a type capable of doing so.
- Overhead electric cable, pipes containing flammable hazardous chemical shall be shielded by using goal posts height gauge posts or barriers.
- 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.

11.7.2 TRAFFIC ROUTE FOR PEDESTRIANS

- Where traffic routes are used by both pedestrians and vehicles road shall be wide enough to allow vehicles and pedestrians safely.
- 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.
- Where pedestrian and vehicle routes cross, appropriate crossing shall be provided.
- Where crowd is likely to use roadway e.g. at the end of shift, stop vehicles from using them at such times.
- Provide high visibility clothing for people permitted in delivery area.

11.7.3 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:

- A high level of stability.
- A safe means of access/egress.
- Suitable and effective service and parking brakes.
- Windscreens with wipers and external mirrors giving optimum all round visibility.
- Provision of horn, vehicle lights, reflectors, reversing lights, reversing alarms.
- Provision of seat belts.
- Guards on dangerous parts.
- Driver protection - to prevent injury from overturning and from falling objects/materials.
- Driver protection from adverse weather.
- No vehicle shall be parked below HT/LT power lines.
- Valid Pollution Under Control certification for all vehicles

11.7.4 DAILY CHECK BY DRIVER

- There should also be daily safety checks containing below mentioned points by the driver before the vehicle is used.
  - Brakes.
  - Tires.
  - Steering.
  - Mirrors.
  - Windscreen waters.
  - Wipers.
  - Warning signals.
  - Specific safety system i.e. control interlocks
- Management should ensure that drivers carry out these checks.

11.7.5 TRANSPORTATION OF PERSONNEL AND MATERIALS BY VEHICLES

- 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.
- 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.
- All overhangs shall be made clearly visible and restricted to acceptable limits
- Load shall be checked before moving off and after traveling a suitable distance.
- 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.
- Warning signs shall be displayed during transportation of material.
  All vehicles used by BHEL shall be in worthy condition and in conformance to the Land Transport requirement.

11.7.6 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.

11.8 EMERGENCY PREPAREDNESS AND RESPONSE

- Emergency preparedness and response capability of site shall be developed as per Emergency Preparedness and Response plan issued by Regional HQ
- Availability of adequate number of first aiders and fire warden shall be ensured with BHEL and its subcontractors
- 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.
- Assembly point shall be earmarked and access to the same from different location shall be shown
- Fire exit shall be identified and pathway shall be clear for emergency escape.

- Appropriate type and number of fire extinguisher shall be deployed as per Fire extinguisher deployment plan and validity shall be ensured periodically through inspection
- 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.
- First aid center shall be developed at site with trained medical personnel and ambulance
- Emergency contact numbers (format given in EPRP) of the site shall be displayed at prominent locations.
- Tie up with fire brigade shall be done in case customer is not having fire station.
- Tie up with hospital shall be done in case customer is not having hospital.
- Disaster Management group shall be formed at site
- Mock drill shall be arranged at regular intervals. Monthly report of the above to be given to BHEL safety Officer as per prescribed BHEL formats
- Mock drill shall be conducted on different emergencies periodically to find out gaps in emergency preparedness and taking necessary corrective action

12.0 HSE INSPECTION

Inspection on HSE for different activities being carried out at site shall be done to ensure compliance to HSEMS 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 etc. 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.

12.1 DAILY HSE CHECKS

Both the Site Supervisors and safety 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:

- Personal Safety wears & gear compliance.
- Complying with site safety rules and permit-to-work (PTW).
- Positions and postures of workers.
- 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.

12.2 INSPECTION OF PPE

- PPEs shall be inspected by HSE officer at random once in a week as per format no. HSEP:14-F06 for its compliance to standard and compliance to use and any adverse observation shall be recorded in the PPE register.
- The applicable PPEs for carrying out particular activities are listed below.

12.3 INSPECTION OF T&Ps

- A master list of T&Ps shall be maintained by each subcontractor.
- All T&Ps being used at site shall be inspected by HSE officer once in a month as per format no. HSEP:14-F07 for its healthiness and maintenance.
- 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.
- The validity of T&P shall be monitored as per "Status of T&Ps" format no. HSEP:14-F08

12.4 INSPECTION OF CRANES AND WINCHES

- 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.
- Cranes and Winches shall be inspected by HSE officer once in a month as per format no. HSEP:14-F09 for healthiness, maintenance and validity of third party inspection.
- The date of third party inspection and next due date shall be painted on cranes and winches.
- The operators/drivers shall be authorized by sub-contractor based on their competency and experience and shall carry the I-card.
- 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.

12.5 INSPECTION ON HEIGHT WORKING

- Inspection on height working shall be conducted daily by supervisors before start of work to ensure safe working condition including provision of
    - Fall arrestor
    - Lifelines
    - Safety nets
    - Fencing and barricading
    - Warning signage
    - Covering of opening
    - Proper scaffolding with access and egress.
    - Illumination
- Inspection on height working shall be conducted once in a week by HSE officer as per format no. HSEP:14-F10.
- Medical fitness of height worker shall be ensured.
- Height working shall not be allowed during adverse weather.

12.6 INSPECTION ON WELDING AND GAS CUTTING OPERATION

- Supervisor shall ensure that no flammable items are available in near vicinity during welding and gas cutting activity.
- Gas cylinders shall be kept upright.
- Use of Flash back arrestor shall be ensured at both ends.

- Inspection during welding and gas cutting operations shall be carried out by HSE officer once a month as per format no. HSEP:14-F11.
- Use of fire blanket to be ensured to avoid falling of splatters during welding or gas cutting operation at height.
- Availability of fire extinguisher at vicinity shall be ensured.

12.7 INSPECTION ON ELECTRICAL INSTALLATION / APPLIANCES

- Ensure proper earthing in electrical installation
- Use ELCB at electrical booth
- Electrical installation shall be properly covered at top where required
- Use appropriate PPEs while working
- Use portable electrical light < 24 V in confined space and potentially wet area.
- Monthly inspection shall be carried out as per format no. HSEP:14-F12.

12.8 INSPECTION OF ELEVATOR

- Elevators shall be inspected by concerned supervisors once in a week as per format no. HSEP:14-F13.
- All elevators shall be inspected by competent person and validity shall be ensured.
- The date of third party inspection and next due date shall be painted on elevator.

12.9 INSPECTION OF EXCAVATION

Excavation activities shall be inspected as per Format HSEP:14-F13A

13.0 HSE PERFORMANCE

- Contractor shall be assessed on monthly basis for HSE Compliance by BHEL Safety In-charge at site.
  The HSE compliance shall be based on Online HSE Evaluation System of BHEL as per Format No. HSEP:14-F33.
- BHEL shall reserve the right to use this assessment for evaluating bidder's capacity for future tenders
- Suitable HSE reward system shall be developed at site level to promote HSE compliance amongst workmen by the subcontractor.
  To decide HSE reward, performance towards HSE shall be evaluated for workmen and it shall be awarded regularly in public gathering.
- 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.

14.0 HSE PENALTIES

- As per contractual provision HSE penalties shall be imposed on subcontractors for non- compliance on HSE requirement as per format no. HSEP:14-F14. The list in the format is only indicative. For any other violation, not listed in the format, the minimum penalty amount is to be decided as per BOCW act.
- 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.
- The penalty amount shall be recovered by Site Finance department from subcontractors from the RA/Final bill.

15.0 OTHER REQUIREMENTS

- In case of any delay in completion of a job due to mishaps attributable to lapses by the subcontractor, BHEL shall have the right to recover cost of such delay from the payments due to the subcontractor, after notifying the subcontractor suitably.
- 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 at the risk and cost of the subcontractor after giving a notice of not less than 7 days indicating the steps that would be taken by BHEL.
- 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.
- 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.
- 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.
- 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.
- The subcontractor shall notify BHEL of his intention to bring to site any equipment or material which may create hazard.
- 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.

- 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.

16. NON COMPLIANCE

NONCONFORMITY OF SAFETY RULES AND SAFETY APPLIANCES WILL BE VIEWED SERIOUSLY AND BHEL HAS RIGHT TO IMPOSE FINES ON THE SUBCONTRACTOR AS UNDER FOR EVERY INSTANCE OF VIOLATION NOTICED:

SN	Violation of Safety Norms	Fine (in Rs)
01	Not Wearing Safety Helmet	200/- *
02.	Not wearing Safety Belt or not anchoring life line	500/-*
03	Not wearing safety shoe	200/-*
04	Not keeping gas cylinders vertically	200/-
05	Not using flash back arrestors	100/-
06	Not wearing gloves	50/- *
07.	Grinding Without Goggles	50/- *
08.	Not using 24 V Supply For Internal Work	500/-
09.	Electrical Plugs Not used for hand Machine	100/-
10.	Not Slinging properly	200/-
11.	Using Damaged Sling	200/-
12.	Lifting Cylinders Without Cage	500/-
13.	Not Using Proper Welding Cable With Lot of Joints And Not Insulated Property.	200/-
14.	Not Removing Small Scrap From Platforms	500/-
15.	Gas Cutting Without Taking Proper Precaution or Not Using Sheet Below Gas Cutting	500/-
16.	Not Maintaining Electric Winches Which are Operated Dangerously	500/-
17.	Improper Earthing Of Electrical T&P	500/-
18	No or improper barricading	500/-
19.	Activity carried out without Safety work permit (Height work, Lifting activity, Hot work-each person/case)	1000/-
20.	Incident Resulting in Partial Loss in Earning Capacity	25,000/- per victim
21.	Fatal Incident Resulting in total loss in Earning Capacity	1,00,000/- per victim for first instance #

- Legend:-

  *: per head. For repeated violation by the same person, the penalty would be double of the previous penalty. Date of "Repeated violation" will be counted from subsequent days.

  #: or as deducted by customer, whichever is higher. For repeated fatal incident in the same Unit incremental penalty to be imposed. The subcontractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same subcontractor for the same package in the same unit.

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. The amount will be deducted from running bills of the subcontractor. The amount collected above will be utilized for giving award to the employees who could avoid incident by following safety rules. Also the amount will be spent for purchasing the safety appliances and supporting the safety activity at site.

17.0 HSE AUDIT/INSPECTION

- Regular HSE Audit/inspection shall be carried out by Subcontractor as per Site HSE audit calendar.
- HSE checklist **(Annexure 02)** shall be used for carrying out audit/inspection and report shall be submitted to BHEL site management
- All non-conformities and observations on HSE identified during internal or external HSE audit shall be disposed off by site in a time bound manner and reported back the implementation status
- Corrective action and Preventive action on HSE issues raised by certification body issued by Regional HQs shall be implemented by site and reported to Site management.

18.0 MONTHLY HSE REVIEW MEETING

- Site shall hold HSE review meeting every month to discuss and resolve HSE issues of site and improve HSE performance. It will also discuss the incidents occurred since previous meeting,its root cause and Corrective action and Preventive action. The agenda is given below:
  - Implementation of earlier MOM
  - HSE performance
  - HSE inspection
  - HSE audit and CAPA
  - HSE training
  - Health check-up camp
  - HSE planning for the erection and commissioning and installation activities in the coming month
  - HSE reward and promotional activities
- The meeting shall be chaired by Construction Manager, convened by HSE coordinator and attended by all HOS, Site Incharge of Subcontractors and HSE officer of Subcontractors.
- MOM on the discussion will be circulated to the concerned for implementation.

19.0 FORMATS USED (Details available in Annexure-04)

SL. No.	Format Name	Format No.	Rev No.
01	Inspection of First Aid Box	HSEP:14-F01	00
02	Health Check Up	HSEP:14-F02	00
03	HSE Induction Training	HSEP:14-F03	00
04	Tool Box Talk	HSEP:14-F04	00
05	Monthly Site HSE Report	As specified by BHEL	00
06	Inspection of PPE	HSEP:14-F06	00

07	Inspection of T&Ps	HSEP:14-F07	00
08	Status of T&Ps	HSEP:14-F08	00
09	Inspection of Cranes and Winches	HSEP:14-F09	00
10	Inspection on Height Working	HSEP:14-F10	00
11	Inspection on Welding & Gas Cutting	HSEP:14-F11	00
12	Inspection on Electrical Installation	HSEP:14-F12	00
13	Inspection on Elevator	HSEP:14-F13	00
14	HSE Penalty	HSEP:14-F14	00
15	Accident /incident / property damage /fire incident report	HSEP:14-F15	00

20.0 ANNEXURES

ANNEXURE 01

As per Contract Labour (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 labour 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 Labour 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 labour 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 labour 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 02

HSE AUDIT/INSPECTION CHECKLIST CUM COMPLIANCE REPORT

PROJECT:_____ SUBCONTRACTOR:_____

DATE : _____ OWNER :_____

INSPECTION BY:_____

Note : write 'NA' wherever the items is not applicable

Item	Yes	No	Remarks	Action
HOUSEKEEPING				
Waste containers provided and used				
Passageways and walkways clear				
General neatness of working area				
Other				
PERSONNELPROTECTIVEEQUIPTMENTS				
Goggles; shields				
Face protection				
Hearing protection				
Respiratory masks etc.				
Safety belts				
Other				
EXCAVATIONS / OPENINGS				
Openings properly covered or barricaded				
Excavations shored				
Excavations barricaded				
Overnight lighting provided				
Other				
WELDING, CUTTING				
Gas cylinders chained upright				
Cable and hoses not obstructing				
Fire extinguisher (s) accessible				
Others				
SCAFFOLDING				
Fully decked platforms				
Guard and intermediate rails in place				
Toe boards in place				
Adequate shoring				
Adequate access				
Others				
LADDER				
Extension side rails 1 m above				
Top of landing				
Properly secured				

Angle + 70^0 from horizontal				
Other				
HOISTS, CRANES AND DERRICKS				
Condition of cables and sheaf OK				
Condition of slings, chains, hooks OK				
Inspection & maintenance log maintained				
Outriggers used				
Signals observed and understood				
Qualified operators				
Others				
MACHINERY, TOOLS & EQUIPMENT				
Proper instruction				
Safety devices				
Proper cords				
Inspection and maintenance				
Other				
VEHICLE AND TRAFFIC				
Rules and regulations observed				
Inspection and maintenance				
Licensed drivers				
Other				
TEMPORARY FACILITIES				
Emergency instructions posted				
Fire extinguishers provided				
Fire-aid equipment available				
General neatness				
Others				
FIRE PREVENTION				
Personnel instructed				
Fire extinguishers checked				
No smoking in prohibited areas.				
Hydrants				
Clearance				
Others				
ELECTRICAL				
Proper wiring				
ELCB's provided				
Ground fault circuit interrupters				
Protection against damage				
Prevention of tripping hazards				
Other				
HANDLING & STORAGE OF MATERIALS				
Properly stored or stacked				
Passageways clear				
Other				
FLAMMABLE GASES AND LIQUIDS				
Containers clearly identified				
Proper storage				
Fire extinguisher nearby				

Other				
WORKING AT HEIGHT				
Safety nets				
Safety belts				
Safety helmets				
Anchoring of safety belt to the life line rope				
ENVIRONMENT				
Lubricant waste/engine oils properly dispose.				
Waste from Canteen, offices, sanitation etc. disposed properly.				
Disposal of surplus earth, stripping materials, expired batteries, oily rags and combustible materials done properly.				
HEALTH CHECKS				
Hygienic conditions at labor camps O.K.				
Availability of first-aid facilities				
Proper sanitation at site, office & labor camps.				
Arrangement of medical facilities.				
Measures for dealing with illness.				
Availability of potable drinking water for workmen & staff.				
Provision of crèches for children.				

ANNEXURE 03

REFERENCES

- Contract documents
- Relevant legislations
- HSEMSM
- Relevant Indian standards as listed below (illustrative only):

SL NO	CODE NAME	TITLE
(1)	IS : 818-1888 (Reaffirmed 2003)	Code of Practice for safety and health requirements in Electric and Gas Welding and Cutting operations.
(2)	IS: 1179-1967 (Reaffirmed 2003)	Specification for Equipment for Eye & Face protection during welding.
(3)	IS : 1989 (Part 2):1986 (Reaffirmed 1997)	Specification for Leather Safety Boots & Shoes
(4)	IS:2925 – 1984 (Reaffirmed 2010)	Specification for Industrial Safety Helmets
(5)	IS:3521 : 1999 (Reaffirmed 2002)	Industrial Safety Belts & Harnesses-Specification
(6)	IS:3646(Part II) – 1966 (Reaffirmed 2003)	Code of Practice for Interior Illumination
(7)	IS:3696 (Part I) – 1987 (Reaffirmed 2002)	Safety Code for Scaffolds and Ladders
(8)	IS: 3696(Part 2) : 1991 (Reaffirmed 2002)	Scaffolds and Ladders-Code of Safety
(9)	IS:3786 – 1983 (Reaffirmed 2002)	Method for Computation of Frequency and Severity Rates for Industrial Injuries and Classification of Industrial Incidents
(10)	IS:4770 : 1991 (Reaffirmed 2006)	Rubber Gloves – Electricals purposes-Specification
(11)	IS:4912 : 1978 (Reaffirmed 2002)	Safety Requirements for Floor and Wall Openings, Railings and Toe Boards
(12)	IS: 5983 – 1980 (Reaffirmed 2002)	Specification for Eye-Protectors
(13)	IS:6519 – 1971 (Reaffirmed 1997)	Code of Practice for Selection, Care and Repair of Safety Footwear
(14)	IS:9167:1979	Specification for Ear-Protectors
(15)	IS:6994(Part I)-1973 (Re affirmed 1996)	Specification for Industrial Safety Gloves Leather and Cotton Gloves
(16)	IS:8519 – 1977 (Reaffirmed 1983)	Guide for Selection of Industrial Safety Equipment for Body Protection.
(17)	IS 11006 : 2011	Flash Back(Flame Arrestor) Specification

(18)	IS:8520 – 1977 (Reaffirmed 2002)	Guide for Selection of Industrial Safety Equipment for Eye, Face and Ear Protection.
(19)	IS:9473:2002	Respiratory Protective Devices-Filtering Half Masks to protect against Particles-Specification.
(20)	IS:9944:1992 (Reaffirmed 2003)	Natural and Man-made Fiber Rope Slings-Recommendations on Safe working loads.
(21)	IS:11057 – 1884 (Reaffirmed 2001)	Specification for Industrial Safety Nets
(22)	IS:12254:1993 (Reaffirmed 2002)	Polyvinyl Chloride (PVC) Industrial Boots-Specification
(23)	IS:13367(Part 1):1992 (Reaffirmed 20030	Safe Use of Cranes-Code of Practice
(24)	IS:14166:1994 (Reaffirmed 2002)	Respiratory Protective Devices-Full Face Masks Specification
(25)	IS:14746 : 1999 (Reaffirmed 2003)	Respiratory Protective Devices-Half Masks and Quarter Masks - Specification
(26)	IS : 15397 :2003 (Reaffirmed 2008)	Portable Extinguisher Mechanical Foam Type(Stored Pressure)-Specification
(27)	IS: 19011:2002	Guidelines for Quality and/or Environmental Management Systems Auditing

ANNEXURE 04 : SAFETY FORMATS
&
ANNEXURE 05 : WORK PERMIT FORMATS

	POWER SECTOR	FORMAT NO: HSEP:14-F01 REV NO.: 00 PAGE NO. 01 OF 02
	INSPECTION OF FIRST AID BOX	

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection :	

Number of employees on the site: -_____

Sl.No.	**Item**	**No. Available**	**Remarks**
1	No. of small sterilized dressings		
2	No of medium sized sterilized dressings		
3	No of large sized sterilized dressings.		
4	No of large sized sterilized burn dressings		
5	No of (15 grams) packets sterilized cotton wool		
6	No of pieces of sterilized eye pads in separate sealed packets.		
7	No of roller bandages 10 cm wide.		
8	No of roller bandages 5 cm wide.		
9	Whether tourniquet available		
10	Whether supply of Suitable splints available.		
11	No of packets of safety pins.		
12	Whether kidney tray available		
13	Whether sufficient number of eye wash bottles, filled with distilled water or suitable liquid, clearly indicated by a distinctive sign which shall be visible at all times, available.		
14	Whether 4%-xylocaine eye drops, and boric acid eye drops and soda by carbonate eye drops available.		
15	Whether (60ml) bottle containing a two percent alcoholic solution of iodine available		
16	Whether (two hundred ml) bottle of mercurochrome (2 per cent) solution in water available.		

Sl.No.	Item	No. Available	Remarks
17	Whether 120ml bottle containing Sal volatile having the dose and mode of administration indicated on the label, available.		
18	Whether roll of adhesive plaster (6 cmX1 meter) available		
19	No of rolls of adhesive plaster (2 cmX1 meter)		
20	Whether snake bite lancet available.		
21	Whether (30 grams) bottle of potassium permanganate crystals available.		
22	Whether a pair scissors available		
23	Whether copy of the First-Aid leaflet issued by the Director-General, Factory Advice service and labour Institutes, Government of India available.		
24	Whether bottle containing 100 tablets (each of 5 grains) of aspirin available		
25	Whether Ointment for burns available		
26	Whether bottle of a suitable surgical anti-septic solution available		

Signature of Subcontractor's Site I/C:

	POWER SECTOR	FORMAT NO: HSEP:14-F02 REV NO.: 00 PAGE NO. 1 OF 02
	HEALTH CHECK UP	

Name of Site :	
Name of Sub-Contractor :	
Name of Employee :	

NAME:

History Of Past Illness	H/O Epilepsy
	H/O Drug Allergy
	H/O Diabetics/ Hypertension
	H/O Unconsciousness
Personal History	

EXAMINATION		**OBSERVATION**	
General Physical Examination			
Height	:		
Weight	:		
BMI	:		
Built And nourishment	:		
Pallor	:		
Temperature	:		
Chest Expansion	:	Inspiration	Expansion
Lymph Node Enlargement	:		
Ear, Nose, Throat	:		
Ear	:		
Nose	:		
Throat	:		

EXAMINATION		OBSERVATION	
Cardiovascular System Examination :			
Inspection	:		
Palpation	:	Pulse	BP
Auscultation (Heart Sounds)	:		
Respiratory System	:		
Inspection	:	Respiratory Rate	
Palpation:	:		
Percussion	:		
Auscultation (Breath Sounds)	:		
Examination of Abdomen	:		
Inspection	:		
Palpation	:		
Auscultation (Bowel Sounds)	:		
Any Other	:		
Clinical Impression			

Signature of the examining doctor

	POWER SECTOR **HSE INDUCTION TRAINING**	FORMAT NO: HSEP:14-F03 REV NO.: 00 PAGE NO. 01 OF 01

Name of Site :	
Name of Sub-Contractor :	
Date :	
Name of Training Co-ordinator	

Sl No.	**Name**	**Designation**	**Organisation**	**Signature**

Signature of Training co-ordinator :

	POWER SECTOR	FORMAT NO: HSEP:14-F04 REV NO.: 00 PAGE NO. 01 OF 01
	TOOL-BOX TALK	

Name of Site :	
Sub-Contractors Name :	
Date :	

Topic	**Name of person delivered Tool Box Talk**	**No. of Participants attended**	**Remarks**

Signature of Site I/C of Subcontractor :

	POWER SECTOR **PERSONAL PROTECTIVE EQUIPMENTS**	FORMAT NO: HSEP:14-F06 REV NO.: 00 PAGE NO. 01 OF 01

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection :	

Item	**Issued this Month**	**Nos. Issued up to the Month**	**Percentage of usage at site**
Safety Helmet			
Safety Shoes			
Full Body Harness			
Fall Arrestor			
Safety Nets			
Other PPEs.			

Signature of Site I/C of Subcontractor :

	POWER SECTOR **INSPECTION OF T&Ps**	FORMAT NO: HSEP:14-F07 REV NO.: 00 PAGE NO. 01 OF 01

Name of Site :	
Name of Sub-Contractor :	
Date of Inspection :	

Sl.No.	Description	Remarks	
1.0	Name of equipment		
2.0	Basic Information of equipment		
2.1	Specification		
2.2	Sr. No. of equipment		
2.3	Make		
2.4	Year of manufacture		
3.0	Major repairs / overhauls(Furnish details of work carried out)		Date(s) of major repair/overhaul
3.1			
3.2			
3.3	Repairs carried out at site		
4.0	Any performance test conducted	Yes/No	
5.0	Document Submitted	Yes/No	
6.0	Manufacturer's test / guarantee certificate	Available/ Not available	
7.0	Performance test	Done/ Not Done	
8.0	Acceptance Norms		
9.0	Committee Observations		
10.0	Date of next review (if accepted)		

Signature-Site Safety Officer (BHEL)	**Signature-Subcontractor/ Subcontractor's Safety Officer**

	POWER SECTOR **STATUS OF T&Ps**	FORMAT NO: HSEP:14-F08 REV NO.: 00 PAGE NO. 01 OF 01

Name of Site	
Name of Sub-Contractor	
Date of Inspection	

Item	**Nos. Deployed**	**Identification No.**	**Nos. Tested by competent person**	**Validity of Test Certificate**
Winches				
Chain Blocks				
Wire Rope Slings				
Man Cages				
D-Shackles				
Air Compressors				
Crawler Cranes				
Mobile Cranes				
Hydra Cranes				
Others				

Signature of Site I/C of subcontractor:

	POWER SECTOR **INSPECTION OF CRANES AND WINCHES**	FORMAT NO: HSEP:14-F09 REV NO.: 00 PAGE NO. 01 OF 03

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection:	

Crane Reg. No (Make/Model) _____

Name of Driver/Operator _____

Sl.no.	Description	Observation	Measures
1	Valid Driving license		
2	Hook & Hook Latch		
3	Over Hoist limit switch		
4	Boom limit switch		
5	Boom Angle Indicator		
6	Boom limit cutoff switch		
7	Condition of Boom		
8	Condition of ropes		
9	Number of load lines		
10	Size and condition of the slings		
11	Stability of the cranes		
12	Soil Condition		
13	Swing Break And Lock		
14	Proper Break And Lock		
15	Hoist Break And Lock		
16	Boom Break And Lock		
17	Main Clutch		
18	Leakage in Hydraulic Cylinders		
19	Out riggers filly extendable		
20	Tyre pressure		
21	Condition of Battery And Lamps		

Sl.no.	Description	Observation	Measures
22	Guards of moving and rotating parts		
23	Load chart provided		
24	Number and position of pedant ropes		
25	Reverse Horn		
26	Load Test Details		
27	Operator's fitness		
28	Pollution under control certificate		
29	Fire extinguisher of appropriate type.		
30	Training of the operator		

WINCH

Sl. No.	Description	YES	NO	NA	Remarks
1	Has the copy of Third Party Inspection certificate been provided in winch machine shed?				
2	Is winch machine operator experienced enough to operate the winch machine?				
3	Is the winch machine operated by someone other than the winch machine operator?				
4	Is there guard provided in all moving parts like wheel and motor's shaft?				
5	Will it protect against unforeseen operational contingencies?				
6	Are brakes, clutch and locking arrangement working properly?				
7	Has it been ensured that the guard does not constitute a hazard by itself?				
8	Are the cranks and the connecting rods protected by guardrails?				
9	Is there provision for fully covered shed with wooden plank roof?				

Sl. No.	Description	YES	NO	NA	Remarks
10	Is wire rope free from any kind of damage or wear and tear?				
11	Is split pin provided for the protection of clutch and brake locking arrangement?				
12	Is pulley inspected by competent person and certified before use?				
13	Is pulley free from any wear and tear visually?				
14	Is winch rope barricaded with clipsheet for the protection of rope and person?				
15	Is the wire rope lubricated by cardium oil?				
16	Is there any friction in wire rope which may damage the wire rope rather than the rolling parts?				
17	Is there any oil leakage in the hydraulic system of the winch machine?				
18	Has it been ensured that the guard will not cause discomfort or inconvenience to operator?				
	Total Number of NO:				
	Total Number of NA:				
	% Compliance :				

Signature of Site I/C of subcontractor :

	POWER SECTOR	FORMAT NO: HSEP:14-F10 REV NO.: 00 PAGE NO. 01 OF 02
	INSPECTION OF HEIGHT WORKING	

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection:	

Sl. No.	**Descriptions**	**Observation (Yes/No)**	**Remarks**
1	All the workers have been explained safe work method?		
2	An established communication system has been established and explained to the workers.		
3	Adequate illumination has been ensured.		
4	Work area inspected prior to the start of the work.		
5	Area below the work place barricaded, particularly below hot work.		
6	Workers provided with bags /box to carry bolts, nuts and hand tools		
7	Arrangement for fastening hand tools made.		
8	All work platforms ensured to be of adequate strength and ergonomically suitable.		
9	Fabricated makeshift arrangements are checked for quality and type of material welding, anchoring etc.		
10.	Work at more than one elevation at the same segment is restricted.		
	ACCESS/EGRESS		
1	Walkways provided with handrail, mid-rail and toe guard?		
2	All checkered plates, gratings properly welded/ bolted?		
3	Are ladders inspected and they are in good condition?		
4	Are ladders spliced?		
5	Are ladders properly secured to prevent slipping, sliding or falling?		
6	Do side rails extend 36” above top landing?		
7	Are built up ladders constructed of sound materials?		

Sl. No.	Descriptions	Observation (Yes/No)	Remarks
8	Are rugs and cleats not over 12” on center?		
9	Metal ladders not used around electrical hazards.		
10	Proper maintenance and storage.		
11	Ladders placed at right slope.		
12	Ladders / staircases welded/ bolted properly.		
13	Any obstruction in the stairs.		
14	Are landing provided with handrails, knee rails, toe boards etc.?		
15	Whether ramp is provided with proper slope.		
16	Proper hand rails / guards provided in ramps.		
	Housekeeping		
1	Walkways, aisles & all overhead workplaces cleared of loose material.		
2	Flammable materials, if any, are cleared.		
3	All the de shuttering materials are removed after de shuttering is done.		
4	Platforms and walkways free from oil/grease or other slippery material.		
5	Collected scrap are brought down or lowered down and not dropped from height.		
	PPE And Safety Devices		
1	Use of safety helmet, safety belts ensured for all workers		
2	Anchoring points provided at all places of work.		
3	Common lifeline provided wherever linear movement at height is required.		
4	Safety nets are use wherever required.		
5	Proper fall arrest system is deployed at critical workplaces.		
6	Crawler boards/Safety system or works on fragile roof are used.		

Signature of Site I/C of subcontractor :

	POWER SECTOR **INSPECTION OF WELDING AND GAS CUTTING**	FORMAT NO: HSEP:14-F11 REV NO.: 00 PAGE NO. 1 OF 02

Name of Site	
Name of Sub-Contractor	
Inspected by	
Date of Inspection	

Welding				
Sl.no.	Description	Yes	No	Remarks
1	Is electric connection given through 30 mA ELCB/RCCB to welding m/c?			
2	Is electric cable fitted properly in junction box on m/c?			
3	Is electrical cable free from joints?			
4	Are the joints attached firmly & insulated with tape?			
5	Is double earthing given to body of m/c?			
6	Is the physical condition of the m/c good?			
7	Is ON/OFF switch connected to the m/c is working and in good condition?			
8	Are indication lamps on m/c working?			
9	Is the electrode holder in good condition?			
10	Are the cables of the welding m/c lugged & tight properly?			
11	Are return lead connected properly (Rod, Angle, Channels shall not be used)			
	Total No of NO			
	Total No of YES			

	POWER SECTOR **INSPECTION OF WELDING AND GAS CUTTING**	FORMAT NO: HSEP:14-F11 REV NO.: 00 PAGE NO. 2 OF 02

Gas Cutting				
Sl. no	Description	Yes	No	Remarks
1	Are Cylinders kept on trolleys?			
2	Physical condition of Gas cylinders Good?			
3	Is there Oil/Grease on valve of the cylinder?			
4	Are pressure regulators in good condition?			
5	Condition of hose pipe OK?			
6	Are hose pipe clamped with hose clip?			
7	Is flash back arrestor & NRV fitted on torch both for O2 and LPG cylinder?			
8	Is nozzle of the torch cleaned?			
	Total Number of NO			
	Total No of YES			
	% Compliance			

Signature of Site I/C of subcontractor :

	POWER SECTOR **INSPECTION OF ELECTRICAL INSTALLATION**	FORMAT NO: HSEP:14-F12 REV NO.: 00 PAGE NO. 01 OF 02

Name of Site	
Name of Sub-Contractor	
Inspected by	
Date of Inspection:	

Sr. No.	**Contents**	**Yes/No**	**Remarks**
A	**Cable**		
1.	Whether the condition of cable is checked?		
2.	Are cables received from other sites checked for insulation resistance before putting them into use?		
3.	Are all main cables taken either underground / overhead?		
4.	Are welding cables routed properly above the ground?		
5.	Are welding and electrical cables overlapping?		
6.	Is any improper joining of cables/wires prevailing at site?		
B	**DBs/SDBs**		
1.	Is earth conductor continued up to DB / SDB?		
2.	Whether DBs and extension boards are protected from rain / water?		
3.	Is there any overloading of DBs / SDBs?		
4.	Are correct / proper fuses & CBs provided at main boards and sub-boards?		
5.	Is energized wiring in junction boxes, CB panels & similar places covered all times?		
C	**ELCB**		
1.	Whether the connections are routed through ELCB?		
2.	Is ELCB sensitivity maintained at 30 mA?		

Sr. No.	Contents	Yes/No	Remarks
3.	Are the ELCB numbered and tested periodically & test results recorded in a logbook countersigned by a competent person?		
D	**Grounding**		
1.	Is natural earthing ensured at the source of power (main DB at Generator or Transformer)?		
2.	Whether the continuity and tightness of the earth conductor are checked?		
3.	Mention the gauge of the earth conductor used at the site.		
4.	Mention the value of Earth Resistance.		
E	**Electrically operated Machines or Accessories**.		
1.	Whether the plug top is provided everywhere.		
2.	Are all metal parts of electrical equipment and light fittings / accessories grounded?		
3.	Is there any shed or cover for welding machines?		
4.	Are halogen lamps fixed at proper places?		
5.	Are portable power tools maintained as per norms?		
6.	Any other information:		

Signature of Site I/C of subcontractor :

	POWER SECTOR **INSPECTION OF ELEVATOR**	FORMAT NO: HSEP:14-F13 REV NO.: 00 PAGE NO. 01 OF 01

Name of Site	
Name of Sub-Contractor	
Inspected by	
Date of Inspection	

Sr. No.	**Description**	**Remarks**	
1.0	Name of equipment		
2.0	Basic Information of equipment		
2.1	Specification		
2.2	Sr. No. of equipment		
2.3	Make		
2.4	Year of manufacture		
3.0	Major repairs/overhauls(Furnish details of work carried out)		Date(s) of major repair/overhaul
3.1			
3.2			
3.3	Repairs carried out at site		
4.0	Any performance test conducted	Yes/No	
5.0	Document Submitted	Yes/No	
6.0	Manufacturer's test / guarantee certificate	Available/ Not available	
7.0	Performance test	Done/ Not Done	
8.0	Acceptance Norms		
9.0	Committee Observations		
10.0	Date of next review (if accepted)		

Signature-Subcontractor/ Subcontractor's Safety Officer	**Signature-Site Safety Officer (BHEL)**

	POWER SECTOR **Inspection of Excavation**	FORMAT NO: **HSEP:14-F13E** REV NO.: 00 PAGE NO. 01 OF 01

Name of Site :	
Name of Sub-Contractor :	
Inspected by :	
Date of Inspection :	

Sl.no.	Description	Yes	No	Remarks
1	Precautions taken for Underground Electrical Cable			
2	Precautions taken for Under / Above ground sewer/ Drinking Water Line			
3	Precautions taken for Underground Telecommunication Line			
4	Precautions taken for Underground Product/Utility Line			
5	Precautions taken for Underground Fire Water Line			
6	Shoring / Shuttering / Sheet piling done to prevent collapse of excavation walls. Strength of Excavation wall ensured at all times			
7	Slope Cutting / Angle Maintained			
8	Hard Barricading & Edge Protection provided			
9	Separate Safe Access for Man and Vehicle			
10	Lighting arrangement			
11	Banksman Provided			
12	Required basic PPEs provided			
13	Excavated soil / Construction Material / equipment kept away from the edge.			
14	First aid in attendance.			
15	Other:			
	Total No of YES			

Signature-Subcontractor/ Subcontractor's Safety Officer **Signature-Site Safety Officer (BHEL)**

Sub: MEMO for Penalty for non-compliances in Safety

Following lapse (tick marked) was observed and penalty is imposed as stated at the bottom of this memo. It is requested that such occurrences be please avoided in future.

Safety Area

SN	Violation of Safety Norms	Fine (in Rs)
01	Not Wearing Safety Helmet	200/- *
02.	Not wearing Safety Belt or not anchoring life line	500/-*
03	Not wearing safety shoe	200/-*
04	Not keeping gas cylinders vertically	200/-
05	Not using flash back arrestors	100/-
06	Not wearing gloves	50/- *
07.	Grinding Without Goggles	50/- *
08.	Not using 24 V Supply For Internal Work	500/-
09.	Electrical Plugs Not used for hand Machine	100/-
10.	Not Slinging properly	200/-
11.	Using Damaged Sling	200/-
12.	Lifting Cylinders Without Cage	500/-
13.	Not Using Proper Welding Cable With Lot of Joints And Not Insulated Property.	200/-
14.	Not Removing Small Scrap From Platforms	500/-
15.	Gas Cutting Without Taking Proper Precaution or Not Using Sheet Below Gas Cutting	500/-
16.	Not Maintaining Electric Winches Which are Operated Dangerously	500/-
17.	Improper Earthing Of Electrical T&P	500/-
18	No or improper barricading	500/-
19.	Activity carried out without Safety work permit (Height work, Lifting activity, Hot work-each person/case)	1000/-
20.	Incident Resulting in Partial Loss in Earning Capacity	25,000/- per victim
21.	Fatal Incident Resulting in total loss in Earning Capacity	1,00,000/- per victim for first instance #

Legend: -

*: per head. For repeated violation by the same person, the penalty would be double of the previous penalty. Date of "Repeated violation" will be counted from subsequent days.

#: or as deducted by customer, whichever is higher. For repeated fatal incident in the same Unit incremental penalty to be imposed. The subcontractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same subcontractor for the same package in the same unit.

Details (if any) related to non- compliance (Name of persons, Nature of deficiency, etc.)

_____

Penalty imposed:

1, Rate as per above chart_____

2. No. of Persons/ machine/ event/ labour _____

3. Total Penalty= 1. X 2. =_____

Signature:

Witnessed by: (Sub- Contractor representative) (BHEL Personnel)

Name_____ Name_____

Distribution: 1 Copy: to Sub- contractor,
1 Copy to Site Construction Manager (BHEL)

बी एच ई एल BHEL	**POWER SECTOR- HQ** **Incident Report** (To be submitted within 24 hours of time of incident)	FORMAT NO: HSEP:14-F15 REV NO.: 00 PAGE NO. 01 OF 01

Type of incident: Fatal/Major/ Minor/Fire/Property Damage/Near-miss

1	NAME OF SITE		3	ACTIVITY AREA	
2	SCOPE OF WORK		4	NAME OF CONTRACTOR	
			5	NAME & DESIGNATION OF BHEL ACTIVITY I/C	
6	DATE & TIME OF ACCIDENT		7	DATE RESUMED	
8	NO. OF WORK-DAYS LOST BY VICTIM (If duty not resumed, give estimated figure)				
9	NO. OF MANHOURS LOST BY OTHERS				
10	PERSONAL DETAILS OF INJURED AND / OR DETAILS OF MATERIALS / EQUIPMENT / PROPERTY DAMAGED				

NAME				NAME OF MATERIAL / EQUIPMENT / PROPERTY	
PERIOD OF EMPLOYMENT					
AGE	YRS	SEX	MALE/ FEMALE	ESTIMATED COST	ACTUAL COST
MARITAL STATUS		SINGLE / MARRIED			
OCCUPATION				NATURE OF DAMAGE	
PART OF BODY INJURED					
NATURE OF INJURY					
AGENCY (OBJECT / EQUIPMENT / SUBSTANCE) MOST RESPONSIBLE FOR CAUSING ACCIDENT / INJURY / DAMAGE					
12	PERSON (NAME & DESIGNATION) WITH MOST CONTROL OVER AGENCY (OBJECT / EQUIPMENT / SUBSTANCE) CAUSING ACCIDENT INJURY / DAMAGE				
13	DESCRIBE CLEARLY HOW THE ACCIDENT OCCURRED (USE ADDITIONAL SHEET, IF REQUIRED				
ANALYSIS					
14	WHAT ACTS AND / OR CONDITIONS CONTRIBUTED MOST DIRECTLY TO THIS ACCIDENT				
15	WHAT ARE THE BASIC REASON FOR THE EXISTENCE OF THESE ACTS AND / OR CONDITION ?				
16	WHAT CORRECTIVE ACTIONS HAVE BEEN TAKEN TO PREVENT ACCIDENT RECURRENCE ?				
	DATE :			SIGNATURE OF SITE HSE COORDINATOR	
17	COMMENTS OF HEAD / SOX				
	DATE:			SIGNATURE OF HEAD/SOX	

	POWER SECTOR **Format for Monthly HSE Planning & Review**	FORMAT NO: **HSEP:14-F30** REV NO.: 00 PAGE NO. 01 OF 3

Note: This is a template and can be modified in consultation with BHEL			
Name of the Site		**Name of the Subcontractor**	
Scope of Work		**Date**	
PART- A: PLAN OF HSE ACTIVITIES FOR THE MONTH OF……			**PART-B: REVIEW ON ……**
SN.	**Description of HSE Activity & Formats**	**Plan & Targets for the month**	**Review**
1	Availability of First Aid Box at Required Places and Inspection thereof as per Format: F01	Areas 1. … …	
2	Health check-up as per Format: F02	Health check-up for Nos 1. New inductees 2. Drivers & Operators 3. Workers in following high risk areas: a. …	
3	Induction training of newly joined workers as per Format: F03	Minimum No. of workers:	
4	Toolbox talks (TBT) conducted before start of work as per Format: F04	Locations of TBTs & No. of workers **1.** …	
5	PPE usage and issue as per Format: F06		
6	Inspection of T&Ps as per Format: F07	List of T&Ps to be inspected 1.	
7	Identification & Inspection Status of T&Ps as per Format: F08		
8	Inspection of Cranes & Winches as per Format: F09	List of Cranes & Winches & Nos. 1. …	
9	Inspection of Height Working as per Format: F10	Areas: 1. …	
10	Inspection of Welding & Gas Cutting operations as per Format: F11	Areas: 1. …	
11	Inspection of Electrical Installations as per Format: F12	Locations: 1. …	
12	Inspection of Elevators (as applicable) as per Format: F13	Locations: 1. …	
13	Inspection of Excavation as per Format: F13E	**Locations:** **1. …**	

SN.	Description of HSE Activity & Formats	Plan & Targets for the month	Review
14	Job Safety Analysis as per Format F32B	**Activities:** **1. …**	
15	Regular Job Specific Training (Re-training) for workers involved in hazardous activities	Topics/ Hazards & No. of workers **1.** …	
16	Mass housekeeping (HK) drive in work areas	Areas **1.** …	
17	Vertigo Test of Height workers	Minimum No. of workers:	
18	Deployment of qualified HSE Officers as per contract	Location(s) & Nos. **1.** …	
19	Deployment of qualified HSE Stewards as per contract	Location(s) & Nos. **1.** …	
20	Deployment of Safety tools & Equipment (Safety Nets, Lifelines, Fall arrestors, Man-cages, flashback arrestors, scaffolding etc.)	Tool/ Equipment & Location **1.** …	
21	Safety Walks by site in charge of agency (4 -Weekly once)	Dates:	
22	Safety walks by departmental head (8-Weekly twice)	Dates:	
23	Availability/ deployment of Safety posters/ placards/ signage at strategic locations	Locations: Nos. **1.** …	
24	Provision of clean drinking water sources for workers	Locations: Nos. **1.** …	
25	Provision of toilets for workers (separate for male & female workers)	Locations: Nos. **1.** …	
26	Rest sheds for workers during lunchtime, rain, dust storm etc.	Locations: Nos. **1.** …	
27	Availability of following in Labor colony	**1. Clean drinking water** **2. Toilets** **3. Cleanliness & Hygiene** **4. Grass cutting,** **5. Fogging** **6. Electrical Inspection …**	

SN.	Description of HSE Activity & Formats	Plan & Targets for the month	Review
28	Availability of dust/ waste bins at various locations	Locations: **1.** …	
29	Availability of Ambulance (individual/ joint) in each shift	Ambulance No.	
30	Availability of emergency vehicle in each shift	Emergency vehicle	
31	Deployment/ Availability of tested Fire Extinguishers	Locations & Nos. **1.** …	
32	Tree plantation	Locations & Nos. **1.** …	
33	Waste disposal & Scrap Bins	Locations **1.** …	
34	Illumination checks	Locations **1.** …	
35	Safety award function: 1. Display of good practices Award presentation	Minimum 1 per month	
36	**Submission of Daily Reports as per Format No.F31A**	**Daily Reports (Night & Day Shifts)**	

PLAN		**REVIEW**	
Agency Name: Sign: Date:	**BHEL** Name: Sign: Date:	**Agency** Name: Sign: Date:	**BHEL** Name: Sign: Date:

	POWER SECTOR	FORMAT NO: **HSEP:14-F31** A REV NO.: 00 PAGE NO. 01 OF 1
	Format for Daily HSE Reporting	

Note: Following format to be submitted (preferably) in excel/ soft copy by subcontractor daily at the end of each shift. Any photographs/ records to be attached

Site									**Subcontractor**																		
Year							**Month**													**Day**							
SHIFT	Submitted By	Work Area(s)	Staff	Man-Power	Safety Officers	Safety Stewards	Tool Box (Topics and No. of Participants)	Induction Training (No. of Participants)	Vertigo Test (Numbers Tested)	On-the-Job Training (Topic & participants)	Work Permits	Job Safety Analyses conducted	Height Work Inspection	Other Hazardous Activities Inspection	T&P Inspection (Names & Nos. Inspected)	Safety Walk (Designation, Areas)	HSE Meeting	Safety Reward (Details)	Housekeeping/ Dust Suppression/ Tree Plantation Activities (Locations/Details)	Lost time Accident	Restricted Work Case	Medical Treatment Case	First Aid Case	Near miss	Property Damage/ Fire	Non-Compliances Submitted by BHEL	Complied by Agency	Any other Remarks/ Inputs
Day																											
Night															NA		NA	NA	NA								

	POWER SECTOR **Job Safety Analysis Format**	FORMAT NO: **HSEP:14-F32B** REV NO.: 00 PAGE NO. 01 OF 1

Name of the Site	
Name of the Subcontractor	
Activity, Area	

HAZARDS	**PRECAUTIONS**

(Name)	**Submitted By (Agency HSE)**		**Reviewed By (BHEL Execution)**		**Approved By (BHEL HSE)**	
(Sign)						
(Date)						

SL	Parameter for Measurement	M/ O	Wt	Supporting Documents
1a	Induction training for new workers conducted through audio-visual medium & documented ?	M	1	Induction Training Records
1b	Tool box talk conducted regularly as per plan, and documented?	M	1	Toolbox Talk Records
1c	Contractor in charge and safety in charge attended safety meetings?	M	2	Minutes of Meeting
1d	Whether observations in safety meetings are complied before next meeting?	M	2	-do-
1e	Preparation and submission of Monthly HSE report within stipulated time	M	1	Report submission date
1f	Preparation and submission of Incident/near-miss report and RCA Report (as applicable) within stipulated time	M	1	Incident/ Near Miss Records
1g	Carrying out Inspections and submission of Inspection reports within stipulated time	M	1	Inspection Records
1h	Regular Job Specific Training ensured for High Risk Workers (through audio-visual medium) as per plan	M	1	Training & Attendance Records
2a	Whether the contractor is registered under BOCW	M	2	BOCW Registration Certificate
2b	Availability of Qualified safety officer (1 for every 500 labour)	M	2	Safety Officer qualification & experience records
2c	Availability of Qualified safety supervisor (1 for every 100 labour)	M	2	Safety Officer qualification & experience records
2d	All the workers are provided and using safety helmets and safety shoes/gum boots	M	2	PPE Issue Records, Inspection/ non-conformity records
2e	Housekeeping done on regular basis and scrap removal at site	M	1	Housekeeping records, Inspection/ non-conformity records
2f	Usage of Goggles/Face shields and Hand gloves for gas cutter and grinders		1	PPE Issue Records, Inspection/ non-conformity records
2g	Wall openings & floor openings are guarded?		1	Inspection/ non-conformity records
2h	Adequate illumination provided in all working area?		1	Inspection/ non-conformity records
2i	Safety posters, sign boards and emergency contact numbers in all prominent location are displayed?		1	Inspection/ non-conformity records
2j	Availability of automatic reverse horns, Main horn, hook latches for Vehicles, mobile cranes, Hydras		1	Inspection/ non-conformity records
2k	Ban of carrying mobile phones to work place is implemented for workers		1	Inspection/ non-conformity records
2l	Availability of Tags & Inspection Certificates for Cranes of all capacities		1	Master T&P List with internal & external test details
2l.2	Availability of Tags & Inspection Certificates for Winches of all capacities		1	Master T&P List with internal & external test details
2l.3	Availability of Tags & Inspection Certificates, color coding for Chain pulley blocks		1	Master T&P List with internal & external test details
2l.4	Availability of Tags & Inspection Certificates for Vehicles - Trailers, Dozers, Dumpers, Excavators. Mixers etc.		1	Master T&P List with internal & external test details
2l.5	Availability of Tags & Inspection Certificates for Welding machines, grinders, Drilling machines, etc.		1	Master T&P List with internal & external test details
2l.6	Availability of Tags & Inspection Certificates, colour coding for Wire rope slings etc.		1	Master T&P List with internal & external test details
2l.7	Availability of Tags & Inspection Certificates for Batching plants		1	Master T&P List with internal & external test details

SL	Parameter for Measurement	M/ O	Wt	Supporting Documents
2m.1	Use of Lifting Permit as per requirement		1	Permit Records
2m.2	Use of Height Permit as per requirement		1	Permit Records
2m.3	Use of Hot Work Permit as per requirement		1	Permit Records
2m.4	Use of Excavation permit as per requirement		1	Permit Records
2m.5	Use of Confined space work permit as per requirement		1	Permit Records
2m.6	Use of Grating removal and safety net removal permit as per requirement		1	Permit Records
2m.7	Use of Lockout-Tag out permit as per requirement		1	Permit Records
2m.8	Use of Radiography permit as per requirement		1	Permit Records
2m.9	Use of Night/ Holiday Work Permit as per requirement		1	Permit Records
2m.10	Use of Any other Applicable Permit as per requirement		1	Permit Records
3a	Material safety data sheet(MSDS) available for all chemicals and displayed in usage and storage area?		1	Inspection/ non-conformity records
3b	Spillages of oil/concrete and other chemical is controlled and cleaned by proper method in case of spill?		1	Inspection/ non-conformity records
3c	Availability of adequate number of urinals in workplace and in elevations and maintained	M	1	
3d	Availability of rest rooms for workers at site	M	1	
3e	Availability of Drinking water facility at work spot		1	
3f	Hygienic Labour colony is provided for workers.		1	
4a	Is heavy/complex critical lifting permit obtained for heavy, complex materials before handling/erection activity?		1	Work Permit records
4b	Whether area below lifting activities barricaded		1	Inspection/ non-conformity records
4c	Availability of experienced rigging foreman		1	Experience details of rigging foreman
4d	Is agency is following proper storage and handling procedure as per manufacturer standard for all hazardous material?		1	Procedure for storage & handling
4e	Are oxygen and acetylene cylinders are transported to work place from storage area in trolleys		1	
5a	Whether all deep excavation has been protected by barrier		1	Inspection/ non-conformity records
5b	Sloping/benching & shoring provided for excavation as per requirement?		1	-do-
5c	Proper access and egress provided for excavations?		1	-do-
5d	Blasting is done in controlled manner?		2	-do-
6a	Whether Electrical booth is equipped with Co_2 fire extinguishers and fire buckets filled with sand?		2	Inspection/ non-conformity records
6b	Availability of Illumination lamp in electric booth?		1	-do-
6c	whether Caution Boards have been displayed?		1	-do-
6d	Usage of Metal Plug top for all hand power tools ?		1	-do-
6e	Usage of Insulated welding cables.		1	-do-
6f	Electrical Booth/Distribution Board to be covered by proper Canopy.		1	-do-
6g	Availability of functional & individual 30ma ELCB / RCCB and MCB for protection and conducting periodical check-up?		1	-do-
6h	Double earthing for panel boards and all machinery & proper earth pit with regular inspection available?		1	-do-
6i	Whether Electrician is qualified and experienced		1	Qualification & Experience records of electrician
6j	Availability and usage of Rubber hand gloves by electrician?		1	Inspection/ non-conformity records

SL	Parameter for Measurement	M/ O	Wt	Supporting Documents
7a	Whether Scaffolding pipes made with steel or aluminum, are being used and checked periodically by experienced/ certified scaffolder?		2	Inspection/ non-conformity records
7b	8mm Stainless Steel wire rope with plastic cladding is provided for life line (Vertical / Horizontal) during height work?		2	-do-
7c	Availability of emergency lighting in case of power failure		1	-do-
7d	Whether all the openings are covered with Safety Nets made of fire proof Nylon?		1	-do-
7e	Whether MS pipe rails around staircases & platforms in usage are provided with top, middle rails and toe guard ?		1	-do-
7f	Whether Ladder with vertical life line /Fall arrestor is available to climb?		1	-do-
7g	Whether all workers deployed for working at height have been issued height pass after undergoing vertigo test?		1	Height Pass records
7h	Whether all workers deployed for height work / climbing ladder are provided and using Double lanyard safety belt?		1	PPE Issue records, inspection/ non-conformity reports
7i	Is all hand tools/Small material used by height workers is tied firmly to prevent fall?		1	-do-
8a	Flash back arrestors for all gas cutting sets is available on Torch side and cylinder side		1	Inspection/ non-conformity records
8b	Oxygen/Acetylene/LPG cylinders not in use have caps in place and stored separately?		1	-do-
8c	Availability of Face screen, Hand gloves, and Apron, for welders		1	-do-
8d	Protection from falling hot molten metal during metal cutting / welding at height by providing GI sheet below the cutting area especially in fire prone areas		1	-do-
9a	Pre-employment medical check-up done for all workers and submitted?		1	Medical check records
9b	Availability of first aid center, with MBBS doctor(Own or Sharing basis)	**M**	2	Attendance records
9c	Availability of Ambulance facility 24 hours (Own or sharing basis)	**M**	2	-do-
9d	Is First aid trained personnel's are available and their names are displayed at site?	**M**	1	-do-
9e	Availability of Emergency vehicle at site		1	
9f	Periodical medical check-up is conducted for all the workers and submitted?		1	Medical check records
9g	Availability of sufficient number of first aid box as per standard list and maintaining record		1	Inspection records
10a	Availability of Fire extinguishers, buckets at all vulnerable points		2	Fire extinguisher records
10b	Periodic fire mock drill conducted?		1	Fire, Mock drill records
10c	Are all flammable materials are stored separately?		1	
10d	Periodic grass cutting is done in material storage area?		1	
10e	Availability of 24V DC lighting in confined space work area		1	
10f	Availability of exhaust fan in confined space work area		1	

Note:

- **M: Mandatory; O: Optional**. Points other than mandatory can be excluded with appropriate justification (scope etc.) by BHEL
- Additionally: 30 Marks for each Fatal Accident and 10 mark for each major accident shall be deducted.

SAFETY WORK CLEARANCE	Permit no.
Project:	Emergency Contact Nos:
Subcontractor:	

BURNING/WELDING /HOT WORK PERMIT

Area :_____ Date:_____ Time:_____

Name of Site Engineer (Permit Requesting Authority):_____ Sign:_____

Name of Work Performing Contractor: _____

Name of Package In charge:_____ Sign:_____ Date:_____

Description of Work: _____

_____

Work Execution Date:_____ Time Valid from:_____ to _____

The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.

The following precautions are to be taken:

No.	Item	Yes	Not required
1.	Proper Access/Exit available		
2.	Proper ventilation and /or lighting provided.		
3.	Proper and safe scaffolding, platform, ladder provided.		
4.	Welding machine located in a clean and dry area.		
5.	Welding machine grounded at the equipment and proper leakage current protection device (ELCB) provided for welding machine.		
6.	Emergency STOP buttons are in working condition. Welder /Helper knows how to operate it.		
7.	Welding machine input/output cables, welding holder and weld return clamp (Holder) are insulated and in good condition.		
8.	Welder & Fitter trained to connect ground/work return clamps (Holder) to work place prior to energization of welding machine.		
9.	Gas cylinders are stacked vertically and not below the welding / cutting area. Regulator key is available with cylinder.		
10.	Pressure gauges/Flash back arrestor provided and in working condition.		
11.	Personal Protective equipment Minimum applicable: safety helmet, safety goggles, welding helmet, safety shoes, leather gloves, long sleeve and nose mask -provided		
12.	In case of pits, water removed from the pit and wood/rubber insulation provided.		
13.	Safety signboards are in place.		
14.	Adequate and Suitable nos. of fire fighting extinguisher provided.		
15.	Nearby combustible material removed. Housekeeping done.		
16.	Other		

Name of Contractor Safety Officer:_____ Sign:_____ Date:_____ Time: _____

Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):

Name:_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Safety Representative:_____ Sign: _____

I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.

Name of Work Performing Authority:_____ Sign:_____ Date:_____ Time:_____

Permit Cancellation:

I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition.

Name of Work performing Authority:_____ Sign:_____ Date:_____ Time:_____

Name of Site Engr. (Permit Requesting Authority):_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Site Engr. (Permit Issuing Authority):_____ Sign:_____ Date:_____ Time: _____

(This permit is valid only for the date it is issued)

Original at BHEL site **Second Copy – BHEL SAFETY** **Third Copy : Contractor**

SAFETY WORK CLEARANCE	Permit no.
Project:	Emergency Contact Nos:
Subcontractor:	

LIFTING ACTIVITY PERMIT

Area :_____ Date:_____ Time:_____

Name of Site Engineer (Permit Requesting Authority):_____ Sign: Name of Work

Performing Contractor: _____

Name of Package In charge:_____ Sign:_____ Date:_____

Description of Work: _____

_____

Work Execution Date:_____ Time Valid from:_____ to _____

The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.

The following precautions are to be taken:

No.	Item	Yes	Not required
1.	Crane used for lifting activity tested, certified and approved for rated lifting		
2.	All lifting tackles, gears/appliances are tested and certified for lifting works.		
3.	Crane operator is trained and competent for lifting operation.		
4.	Lifting sling/ belt is protected against sharp edge of the jobs to be lifted.		
5.	Access and exit marked and without obstruction.		
6.	Lifting arrangement adequate.		
7.	Unwanted rubbish material removed from work platform.		
8.	Minimum 2 guidelines have been provided for balancing and guiding jobs to be lifted.		
9.	Periphery area of crane booms as well as lifting job is barricaded and unauthorized/no-entry sign board posted.		
10.	Rigger and signal man is trained and competent for lifting work.		
11.	No lifting activity to be carried out during lightening, heavy wind/rain.		
12.	If scaffolding to be used during lift, scaffolding with valid tag available for use.		
13.	Double lanyards safety harness/belt checked an in working condition.		
14.	Safety shoes (non-slip), helmet with chin strap available with employees.		
15.	Others.		

Name of Contractor Safety Officer:_____ Sign:_____ Date:_____ Time: _____

Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):

Name:_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Safety Representative:_____ Sign: _____

I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.

Name of Work Performing Authority:_____ Sign:_____ Date:_____ Time:_____

Permit Cancellation:

I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition.

Name of Work performing Authority:_____ Sign:_____ Date:_____ Time:_____

Name of Site Engr. (Permit Requesting Authority):_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Site Engr. (Permit Issuing Authority):_____ Sign:_____ Date:_____ Time: _____

(This permit is valid only for the date it is issued)

Original at BHEL site **Second Copy – BHEL SAFETY** **Third Copy : Contractor**

SAFETY WORK CLEARANCE	Permit no.
Project:	Emergency Contact Nos:
Subcontractor:	

WORKING AT HEIGHT PERMIT

Area :_____ Date:_____ Time:_____

Name of Site Engineer (Permit Requesting Authority):_____ Sign: Name of Work

Performing Contractor: _____

Name of Package In charge:_____ Sign:_____ Date:_____

Description of Work: _____

_____

Work Execution Date:_____ Time Valid from:_____ to _____

The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.

The following precautions are to be taken:

No.	Item	Yes	Not required
1.	All workers on job are medically fit for working at height (Person should not have vertigo)		
2.	Scaffolding with valid tag available for use		
3.	Safety harness with life line support/ fall arrester are checked and in working condition		
4.	Safety shoes (non-slip), Helmet with chin strip available with employees		
5.	Safety nets are provided as per design and provided 25 ft. below working area & extending 8 ft beyond.		
6.	Horizontal life lines are provided to cater to design specification of 2300kg per person.		
7.	Ladders have been inspected and provided as per BHEL standard/contract.		
8.	All lifting / tightening tools, hand tools/equipment checked and in good condition		
9.	Access and exit marked and without obstruction.		
10.	Lighting arrangement adequate.		
11.	Unwanted and rubbish material removed from working platform.		
12.	Electrical cable, welding Hose/Compressed air hose properly secured and lay down without obstruction.		
13.	Signboards provided on working platforms		
14.	Hazards in the vicinity are identified and communicated to the worker.		
15.	Other		

Name of Contractor Safety Officer:_____ Sign:_____ Date:_____ Time: _____

Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):

Name:_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Safety Representative:_____ Sign: _____

I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.

Name of Work Performing Authority:_____ Sign:_____ Date:_____ Time:_____

Permit Cancellation:

I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition.

Name of Work performing Authority:_____ Sign:_____ Date:_____ Time:_____

Name of Site Engr. (Permit Requesting Authority):_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Site Engr. (Permit Issuing Authority):_____ Sign:_____ Date:_____ Time: _____

(This permit is valid only for the date it is issued)

Original at BHEL site **Second Copy – BHEL SAFETY** **Third Copy : Contractor**


बी एच ई एल
BHEL

Form WAM 23

PROFORMA OF BANK GUARANTEE (in lieu of EARNEST MONEY if permissible under Works Policy)

(On non-Judicial paper of appropriate value)
(Para 4.7.6 of Works Accounts Manual)

Bank Guarantee No……
Date……

To
(Employer's Name and Address)
……..

Dear Sirs,

In accordance with the terms and conditions of Invitation for Bids/Notice Inviting Tender No……[1] (Tender Conditions), M/s. ……[2] having its registered office at ……[3] (hereinafter referred to as the 'Tenderer'), is submitting its bid for the work of……[4] invited by Bharat Heavy Electricals Limited (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns) incorporated under the Companies Act, 1956 and having its registered office at *BHEL House, Siri Fort, Asiad, New Delhi – 110049* through its unit at *Bharat Heavy Electricals Limited, Power Sector Southern Region, Tek Towers, No.11, Old Mahabalipuram Road, Okkiyam Thoraipakkam, Chennai – 600097.*

The Tender Conditions provide that the Tenderer shall pay a sum of Rs ……[5] as Earnest Money Deposit in the form therein mentioned. The form of payment of Earnest Money Deposit includes Bank Guarantee executed by a Scheduled Bank.

In lieu of the stipulations contained in the aforesaid Tender Conditions that an irrevocable and unconditional Bank Guarantee against Earnest Money Deposit for an amount of .....[6] is required to be submitted by the Tenderer as a condition precedent for participation in the said Tender and the Tenderer having approached us for giving the said Guarantee,

we, the .....(Name & address of the Bank) ..... having our Head Office at ……..(hereinafter referred to as the Bank) being the Guarantor under this Guarantee, hereby irrevocably and unconditionally undertake to forthwith and immediately pay to the Employer without any demur, merely on your first demand any sum or sums of Rs.....[6] (in words Rupees.....) without any reservation, protest, and recourse and without the beneficiary needing to prove or demonstrate reasons for its such demand.

Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. _____.[6]

We undertake to pay to the Employer any money so demanded notwithstanding any dispute or disputes raised by the Tenderer in any suit or proceeding pending before any Court or Tribunal, Arbitrator or any other authority, our liability under this present being absolute and unequivocal.

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

We …….. Bank further agree that the Employer shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Tender or to extend the time of submission of from time to time or to postpone

for any time or from time to time any of the powers exercisable by the Employer against the said Tenderer and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Tenderer or for any forbearance, act or omission on the part of the Employer or any indulgence by the Employer to the said Tenderer or by any such matter or thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving us.

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

This Guarantee shall be irrevocable and shall remain in force upto and including…….[7] and shall be extended from time to time for such period as may be desired by the Employer.

This Guarantee shall not be determined or affected by liquidation or winding up, dissolution or change of constitution or insolvency of the Tenderer but shall in all respects and for all purposes be binding and operative until payment of all money payable to the Employer in terms hereof. However, unless a demand or claim under this Guarantee is made on us in writing on or before the ……[8] we shall be discharged from all liabilities under this Guarantee.

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

a) The liability of the Bank under this Guarantee shall not exceed……[6]
b) This Guarantee shall be valid up to ……[7]
c) Unless the Bank is served a written claim or demand on or before _____[8] all rights under this guarantee shall be forfeited and the Bank shall be relieved and discharged from all liabilities under this guarantee irrespective of whether or not the original bank guarantee is returned to the Bank

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

For and on behalf of
(Name of the Bank)

(Signature of Authorised signatory)

Date…….
Place of Issue…….

[1] Details of the Invitation to Bid/Notice Inviting Tender (Tender Ref. No. Eg. - BHEL PSSR SCT XXXX)
[2] Name of Tenderer
[3] REGISTERED Office Address of the Tenderer
[4] Details of the Work i.e Tender Description
[5] EMD Amount as mentioned in Notice Inviting Tender
[6] BG Amount in words and Figures (BG Amount shall be Minimum of EMD amount less Rs. 2 Lakhs)
[7] Validity Date
[8] Date of Expiry of Claim Period (Claim Period shall be minimum of 3 Months after the validity date of Bank Guarantee)

Note:
1. The BG should be on Non-Judicial Stamp paper/e-stamp paper of appropriate value as per Stamp Act prevailing in the State(s) where the BG is submitted or is to be acted upon or the rate prevailing in the State where the BG was executed, whichever is higher. The Stamp Paper/e-stamp paper shall be purchased in the name of Vendor/Contractor/Supplier /Bank issuing the guarantee.

2. In Case of Bank Guarantees submitted by Foreign Vendors-
   a. From Nationalized/Public Sector / Private Sector/ Foreign Banks (BG issued by Branches in India) can be accepted subject to the condition that the Bank Guarantee should be enforceable in the town/city or at nearest branch where the Unit is located i.e. Demand can be presented at the Branch located in the town/city or at nearest branch where the Unit is located.
   b. From Foreign Banks (wherein Foreign Vendors intend to provide BG from local branch of the Vendor Country's Bank)
      b.1 In such cases, in the Tender Enquiry/ Contract itself, it may be clearly specified that Bank Guarantee issued by any of the Consortium Banks only will be accepted by BHEL. As such, Foreign Vendor needs to make necessary arrangements for issuance of Counter- Guarantee by Foreign Bank in favour of the Indian Bank's (BHEL's Consortium Bank) branch in India. It is advisable that all charges for issuance of Bank Guarantee/ counter- Guarantee should be borne by the Foreign Vendor. The tender stipulation should clearly specify these requirements.
      b.2 In case, Foreign Vendors intend to provide BG from Overseas Branch of our Consortium Bank (e.g. if a BG is to be issued by SBI Frankfurt), the same is acceptable. However, the procedure at sl.no. b.1 will required to be followed.
      b.3 The BG issued may preferably be subject to Uniform Rules for Demand Guarantees (URDG) 758 (as amended from time to time).

PROFORMA OF BANK GUARANTEE (in lieu of SECURITY DEPOSIT)
(On non-Judicial paper of appropriate value)
(Para 4.7.6 of Works Accounts Manual)

Bank Guarantee No……
Date……

To
(Employer's Name and Address)
……..

In consideration of Bharat Heavy Electricals Limited (hereinafter referred to as the 'Employer' which expression shall unless repugnant to the context or meaning thereof, include its successors and permitted assigns) incorporated under the Companies Act, 1956 and having its registered office at *BHEL House, Siri Fort, Asiad, New Delhi – 110049* through its unit at *Bharat Heavy Electricals Limited, Power Sector Southern Region, Tek Towers, No.11, Old Mahabalipuram Road, Okkiyam Thoraipakkam, Chennai - 600097* having agreed to exempt _____[1] (Name of the Vendor / Contractor / Supplier) with its registered office at_____[2] (hereinafter called the said "Contractor" which term includes supplier), from demand under the terms and conditions of the Contract arising vide Letter of Intent (LOI) reference No._____ dated _____[3] valued at Rs. _____[4] (Rupees _____ only)[4] (hereinafter called the said Contract), of Security Deposit for the due fulfilment by the said Contractor of the terms and conditions contained in the said Contract, on production of a Bank Guarantee for Rs. _____[5] (Rupees _____ only),

We, the .....(Name & address of the Bank) ..... having our Head Office at ……..(hereinafter referred to as the Bank), at the request of _____ [Contractor(s)], being the Guarantor under this Guarantee, do hereby irrevocably and unconditionally undertake to forthwith and immediately pay to the Employer, an amount not exceeding Rs._____ without any demur, immediately on demand from the Employer and without any reservation, protest, and recourse and without the Employer needing to prove or demonstrate reasons for its such demand

Any such demand made on the bank, shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. _____[5].

We undertake to pay to the Employer any money so demanded notwithstanding any dispute or disputes raised by the Contractor(s) in any suit or proceeding pending before any Court or Tribunal or Arbitrator or any other authority, our liability under this present being absolute and unequivocal.

The payment so made by us under this guarantee shall be a valid discharge of our liability for payment hereunder and the Contractor(s) shall have no claim against us for making such payment.

We, further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract and that it shall continue to be enforceable till all the dues of the Employer under or by virtue of the said Contract have been fully paid and its claims satisfied & the Employer certifies that the terms and conditions of the said Contract have been fully and properly carried out by the said contractor(s) or acceptance of the final bill or discharge of this guarantee by the Employer, whichever is earlier. This guarantee shall initially remain in force upto and including _____[6] and shall be extended from time to time for such period as may

be desired by the Employer. Unless a demand or claim under this guarantee is made on us in writing on or before the _____[7], we shall be discharged from all the liability under this guarantee thereafter.

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

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

This Guarantee shall not be determined or affected by liquidation or winding up, dissolution or change of constitution or insolvency of the Contractor but shall in all respects and for all purposes be binding and operative until payment of all money payable to the Employer in terms thereof. This guarantee will not be discharged due to the change in the constitution of the Bank or the Contractor(s).

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

a) The liability of the Bank under this Guarantee shall not exceed……[5]

b) This Guarantee shall be valid up to ……[6]

c) Unless the Bank is served a written claim or demand on or before _____[7] all rights under this guarantee shall be forfeited and the Bank shall be relieved and discharged from all liabilities under this guarantee irrespective of whether or not the original bank guarantee is returned to the Bank.

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

Date _____ Day of _____

for_____ (indicate the name of the Bank)

(Signature of Authorised signatory)

[1] NAME OF VENDOR /CONTRACTOR / SUPPLIER
[2] REGISTERED OFFICE ADDRESS OF THE VENDOR /CONTRACTOR / SUPPLIER.
[3] LETTER OF INTENT(LOI) REFERENCE NO. WITH DATE
[4] CONTRACT VALUE (AS MENTIONED IN LOI)
[5] BG AMOUNT IN FIGURES AND WORDS
[6] VALIDITY DATE
[7] DATE OF EXPIRY OF CLAIM PERIOD (CLAIM PERIOD SHALL BE MINIMUM OF 3 MONTHS AFTER VALIDITY DATE)

Note:

1. The BG should be on Non-Judicial Stamp paper/e-stamp paper of appropriate value as per Stamp Act prevailing in the State(s) where the BG is submitted or is to be acted upon or the rate prevailing in the State where the BG was executed, whichever is higher. The Stamp Paper/e-stamp paper shall be purchased in the name of Vendor/Contractor/Supplier /Bank issuing the guarantee.
2. In Case of Bank Guarantees submitted by Foreign Vendors-
   a. From Nationalized/Public Sector / Private Sector/ Foreign Banks (BG issued by Branches in India) can be accepted subject to the condition that the Bank Guarantee should be enforceable in the town/city or at nearest branch where the Unit is located i.e. Demand can be presented at the Branch located in the town/city or at nearest branch where the Unit is located.
   b. From Foreign Banks (wherein Foreign Vendors intend to provide BG from local branch of the Vendor Country's Bank)
      b.1 In such cases, in the Tender Enquiry/ Contract itself, it may be clearly specified that Bank Guarantee issued by any of the Consortium Banks only will be accepted by BHEL. As such, Foreign Vendor needs to make necessary arrangements for issuance of Counter- Guarantee by Foreign Bank in favour of the Indian Bank's (BHEL's Consortium Bank) branch in India. It is advisable that all charges for issuance of Bank Guarantee/ counter- Guarantee should be borne by the Foreign Vendor. The tender stipulation should clearly specify these requirements.

      b.2 In case, Foreign Vendors intend to provide BG from Overseas Branch of our Consortium Bank (e.g. if a BG is to be issued by SBI Frankfurt), the same is acceptable. However, the procedure at sl.no. b.1 will required to be followed.
      b.3 The BG issued may preferably be subject to Uniform Rules for Demand Guarantees (URDG) 758 (as amended from time to time).

PSSR	MONTHLY PLAN & REVIEW WITH CONTRACTOR	Page **1** of **6**

Name of Project		Contract No.	
Name of Work		Name of Contractor	

PART- A: PLAN/ REVIEW OF WORK FOR THE MONTH OF …….. Date of Plan/ Review……

SN.	Description of Work	Unit of Measur-ement	Unit Rate	Planned (QTY Planned for the month as per Part –C of last month)		Cumulative Shortfall attributable to contractor upto last month (Refer Note 1)		Achieved		Shortfall attributable to BHEL w.r.t Plan (as per Col. 3 of Part-D)		Cumulative Shortfall attributable to Contractor upto & including this month		REMARKS (Reasons for Shortfall attributable to Contractor. Supporting documents to be kept as record.)
(a)	(b)	(c)	(d)	A		B		C		D		E=A+B-C-D		
				Phy.	Financial	Phy	Financial	Phy.	Financial	Phy.	Financial	Phy.	Financial	
	Value of Other Items not mentioned above but planned to be executed in this month													
Total					ΣA		ΣB		ΣC		ΣD		ΣE	

BHEL
(Sign with name, designation and date)

CONTRACTOR
(Sign with name, designation and date)

Name of Project		Contract No.	
Name of Work		Name of Contractor	

PART- A: Contd…….

Note 1: **In addition to the work planned as per Col. 'A', Contractor shall also make full efforts to minimize the 'Cumulative shortfall attributable to contractor upto the month' as mentioned in Col. 'B' by enhancing its resources, so as to achieve the completion of activities as per agreed schedule. In case contractor is not able to execute the entire shortfall, then BHEL 'Engineer in-charge', shall decide the priority of work to be executed and it shall be binding on the contractor.**

Note 2: Percentage Shortfall attributable to contractor w.r.t. **"**Plan - Shortfall attributable to BHEL**"** for the month = [(ΣE-ΣB)/(ΣA-ΣD)]x100
In case, (ΣE-ΣB) is negative, then it shall be treated as zero percent."

Note 3: Form 14 should include all items being planned in the current month, and all items against which shortfall was attributable to contractor till previous month. However, for practical reason, if it is not possible to mention some of the items in Form-14 being planned to be executed in this month, then also value of such items shall necessarily be included in calculation of Total Value.

Note 4: In case reason for shortfall attributable to contractor is w.r.t. T&P and Manpower, it should be in conformity with Part B1 and B2.

BHEL
(Sign with name, designation and date)

CONTRACTOR
(Sign with name, designation and date)

Name of Project		Contract No.	
Name of Work		Name of Contractor	

PART – B-1: PLAN/REVIEW OF DEPLOYMENT OF MAJOR T&Ps FOR THE MONTH OF ……..…….. Date of Plan/ Review……

CONTRACTOR'S SCOPE: -

SN.	PLAN				DEPLOYMENT STATUS			
	Major T&P to be deployed as per work planned for the month	QTY	Deployment Period (in days)	Weightage assigned to planned T&P (in fraction such that ΣC =1)	Actual Deployed Quantity	Actual Deployment Period (in days)	Weighted T&P Deployed	REMARKS (Works affected due to non-deployment of T&Ps)
		A	B	C	D	E	F=(C x D x E) / (A x B)	

Note: In case, E>B, it shall be considered as E=B. Similarly, in case D>A, it shall be considered as D=A.
Percentage of T&P Deployed = ΣF x 100

BHEL SCOPE: -

SN.	PLAN			DEPLOYMENT STATUS		
	Major T&P to be deployed as per work planned for the month	QTY	Deployment Period (in days)	Actual Deployed Quantity	Actual Deployment Period (in days)	REMARKS (Works affected due to non-deployment of T&Ps)

BHEL
(Sign with name, designation and date)

CONTRACTOR
(Sign with name, designation and date)

Name of Project		Contract No.	
Name of Work		Name of Contractor	

PART – B-2: PLAN/ REVIEW OF DEPLOYMENT OF MANPOWER FOR THE MONTH OF ……..…….. Date of Plan/ Review……

CONTRACTOR'S SCOPE: -

SN.	Area of Work	Category of Labour	No. of Labour required as per category	Deployment Period (in days)	No. of Labour actually deployed	Actual Deployment Period (in days)	REMARKS (Works affected due to non-availability of labour)
			A	B	C	D	

Percentage of Manpower Deployed=100 x Σ(CxD)/Σ(AxB)

BHEL
(Sign with name, designation and date)

CONTRACTOR
(Sign with name, designation and date)

PSSR	MONTHLY PLAN & REVIEW WITH CONTRACTOR	Page **5** of **6**

Name of Project		Contract No.	
Name of Work		Name of Contractor	

PART – C: PLAN(PHYSICAL) FOR THE NEXT MONTH i.e. ……..…….. Date of Plan ……

SN.	Description of work	Original Planned Quantity	Planned Quantity (excluding shortfalls attributable to contractor till date)	Unit of Measu-rement	T&Ps Required				Manpower Required		REMARKS (Reasons for difference in Original Planned Quantity w.r.t. Planned quantity to be given)
					Contractor Scope		BHEL Scope		Category of Labour	No. of Labour required as per Category	
					Major T&P to be deployed as per work planned for the month	Quantity	Major T&P to be deployed as per work planned for the month	Quantity			

Note 1: Planned quantity should be based on available/ expected fronts/ inputs in the next month

Note 2: "Original Planned Quantity" shall be as per latest jointly agreed programme between BHEL and Contractor before commencement of work or at the time of latest Time Extension, as the case may be.

BHEL
(Sign with name, designation and date)

CONTRACTOR
(Sign with name, designation and date)

Name of Project		Contract No.	
Name of Work		Name of Contractor	

PART – D: REASONS FOR SHORTFALL ATTRIBUTABLE TO BHEL IN RESPECT OF PLAN FOR THE MONTH……

SN.	Description of Work (from Part-A)	Quantities Affected		Reasons for Shortfall attributable to BHEL	Agency responsible for reasons for Shortfall	Remarks (Supporting Documents in respect of agency responsible)
		(Physical Quantity)	Unit of Measu-rement			
1	2	3	4	5	6	7

Note1: Reasons for shortfall shall include non-availability of fronts/ drawings/ materials/ T&P (BHEL Scope)/ clearances etc. and other hindrances for which contractor is not responsible.

Note2: Agency responsible may be BHEL Site/ MUs/ Design Centre/ BHEL Customer/ other Contractors etc.

BHEL
(Sign with name, designation and date)

Project		**Vendor**			**Package/Unit**	
Sl. No.	Parameter for Measurement	Classification	Max Score	Score Obtained	Measurement Key/Scheduled date	Supporting Documents
#1.01	Cumulative number of days in the month, the nominated Quality Officer or his authorised nominee was not available	QUALITY	1.5		Quality Officer or his authorised nominee should be available for all the days of working at site	Daily Log Book entry/Incident Registers/letter references
#1.02	Number of instances of non- compliance wrt FQP, Standard Drawings, Specifications, E&C Manuals etc.	QUALITY	1.5		No deviation from FQP, Standard Drawings, Specifications, E&C Manuals etc. is allowed without BHEL Engineer's approval.	Daily Log Book entry/Incident Registers/letter references
#1.03	Percentage submission of test certificates for batches of welding electrodes, cement, sand, aggregate, consumable, Paints etc. as applicable for this month OR In case of MM & MH package, monthly checks for Storage/Preservation of material.	QUALITY	1		Submission of 100% Test certificates for materials as per FQP is mandatory. MM & MH package: Storage/Preservation as per manual/procedure.	Daily Log Book entry/Incident Registers/letter references
#1.04	Number of incidences of improper storage & preservation (not in accordance to the guidelines of BHEL MUs or approved FQP) of materials, consumables (viz. gases, welding electrodes & fluxes, fuel etc.) & bought-out items (paints, fasteners etc.) under the custody of the contractor	QUALITY	1		Total number of non-compliances	Daily Log Book entry/Incident Registers/letter references
#1.05	Rework/ Rejection instances in a month necessitated due to deviation from Standard Drawings /Specifications /Manuals /E&C procedures /FQPs or due to Poor Workmanship by contractor	QUALITY	2		Reworks/ Rejection should be as minimum as possible. Total number of reworks/ rejections due to reasons attributable to contractor.	Daily Log Book entry/Incident Registers/letter references
#1.06	Delay in preparation & submission of signed protocols / log sheets / site register / NDT test reports as per approved FQP/ Qualified Welder List along with photocopies of Welder ID cards / Welder Performance Evaluation records etc. in the month OR in case of MM / MH package reconciliation statement / verification report.	QUALITY	1		Within 2 days of measurements taken or within first 3 working days of next month, as advised by BHEL Engineer	Daily Log Book entry/Incident Registers/letter references
#1.07	Number of instances for Major equipment/product failure due to negligence/improper work/poor workmanship by contractor	QUALITY	1		No such event should happen	Daily Log Book entry/Incident Registers/letter references
#1.08	Total number of complaints received in the month on the quality of finish / aesthetics	QUALITY	1		Total number of non-compliances	Daily Log Book entry/Incident Registers/letter references

Name and Signature of BHEL Package In-charge

Name and Signature of Contractor

Project		**Vendor**			**Package/Unit**	
Sl. No.	Parameter for Measurement	Classification	Max Score	Score Obtained	Measurement Key/Scheduled date	Supporting Documents
#2.01	Cumulative number of days of delay in submission of Plan FOR THE MONTH supported by deployment plan of Major T&Ps and Manpower (as per Form F-14) and relevant construction/layout drawings - like A4 plan / elevation views of plan status for structures / pressure parts/Civil Works, Piping isometrics for piping, Layout / PID / System reference sketch, Unloading / storage plans etc.as applicable.	PERFORMANCE	5		Number of days delayed from second working day of the month	Daily Log Book entry/Incident Registers/letter references
#2.02	Percentage of timely submission of Daily Reports for Progress of work, Resources, Consumables etc.	PERFORMANCE	1.5		Percentage of timely submission of daily reports/ Scheduled date is successive next day for each day	Daily Log Book entry/Incident Registers/letter references
#2.03	Number of days delayed for submission of FQP log sheets / protocols / Monthly Progress Reports for the work executed during the month under measurement	PERFORMANCE	1.5		Number of days delayed/Scheduled date is first 2 working days of next month	Daily Log Book entry/Incident Registers/letter references
#2.04	Percentage Shortfall attributable to contractor w.r.t. “Plan - Shortfall attributable to BHEL” for the month as per Form-14	PERFORMANCE	35		As per Part-A of Form-14	Progress review formats
#2.05	Number of days delayed in submission of Running bills with complete supporting documents (including updated reconciliation statement of BHEL issued material) for the month	PERFORMANCE	2		Number of days delayed / Scheduled date is 7th day of next month	Daily Log Book entry/Incident Registers/letter references
#2.06	Number of times the Top Management of contractor did not respond to critical issues of site, for the month	PERFORMANCE	1		Total number of instances	Daily Log Book entry/Incident Registers/letter references
#2.07	Cumulative number of days in the month the works were stopped / refused on interpretation of contract clauses/scope due to tendency of taking undue advantage by interpreting contract clauses in their favour	PERFORMANCE	2		Cumulative number of days lost	Daily Log Book entry/Incident Registers/letter references
#2.08	Number of times rework was refused by contractor	PERFORMANCE	1		Total number of non-compliances	Daily Log Book entry/Incident Registers/letter references

Project		**Vendor**			**Package/Unit**	
Sl. No.	Parameter for Measurement	Classification	Max Score	Score Obtained	Measurement Key/Scheduled date	Supporting Documents
#2.09	Cumulative number of days in the month recording / logging was not done in daily log / history register / hindrance register / soft form in a PC maintained at BHEL Site Office	PERFORMANCE	1		Cumulative number of days recording or logging was not done / all days of the month	Daily Log Book entry/Incident Registers/letter references
#3.01	Percentage of Manpower Deployed w.r.t. Plan for the month as per Form-14.	RESOURCES	7		As per Part-B2 of Form-14	Daily Log Book entry/Incident Registers/letter references
#3.02	Percentage of T&P Deployed w.r.t. Plan for the month as per Form-14.	RESOURCES	7		As per Part-B1 of Form-14	Daily Log Book entry/Incident Registers/letter references
#3.03	Cumulative number of major instances in the month hampering / affecting progress of work due to breakdown or non-availability of major T&P and MME for the work, under the scope of Contractor	RESOURCES	3		Cumulative number of instances	Daily Log Book entry/Incident Registers/letter references
#3.04	Cumulative number of major instances in the month hampering / affecting progress of work due to non-availability of Consumables/ use of improper consumables under the scope of contractor	RESOURCES	3		Cumulative number of instances	Daily Log Book entry/Incident Registers/letter references
#4.01	Number of non-compliances during the month for Statutory requirements like validity of Labour Licence, Insurance Policy, Labour Insurance, PF, BOCW Compliance etc. and any other applicable laws/ Regulation, Electrical Licence, T&P fitness certificate, Contractors' All Risk Policy etc. as applicable	SITE INFRASTRUCTURE & SERVICE	1		Total number of non-compliances	Daily Log Book entry/Incident Registers/letter references
#4.02	Cumulative number of days in a month poor illumination is reported at storage area, erection area, pre-assembly area and other designated areas by BHEL site.	SITE INFRASTRUCTURE & SERVICE	0.5		Total number of non-compliances/random checks	Daily Log Book entry/Incident Registers/letter references
#4.03	Cumulative number of days of non-availability of well-maintained toilets facilities for workers (separate for men and women) and non-availability of potable drinking water stations for workers in specified areas.	SITE INFRASTRUCTURE & SERVICE	1		Total number of non-compliances/random checks	Daily Log Book entry/Incident Registers/letter references

Project		**Vendor**			**Package/Unit**	
Sl. No.	Parameter for Measurement	Classification	Max Score	Score Obtained	Measurement Key/Scheduled date	Supporting Documents
#4.04	Total number of instances in the month, Housekeeping NOT attended to in spite of instructions by BHEL -i.e. removal / disposal of surplus earth / debris / scrap / unused / surplus cable drums / other electrical items / surplus steel items / packing materials, thrown out scrap like weld butts, cotton waste etc. from the working area to identified locations	SITE INFRASTRUCTURE & SERVICE	2		Total number of non-compliances/random checks	Daily Log Book entry/Incident Registers/letter references
#4.05	Total number of instances in a month, Site Office with reasonably good facilities including enough nos. of computers and printers etc. for use by office and supporting staff was not made available/maintained.	SITE INFRASTRUCTURE & SERVICE	0.5		No discrepancy during regular or surprise visits	Photograph and report of the Engineer
#5.01	Number of days delayed in making labour payments for the last month	SITE FINANCE	2		Number of days delayed / Scheduled date is 7th day of next month	Daily Log Book entry/Incident Registers/letter references
#5.02	Number of complaints from labour/ sub supplier/ sub-contractor for non-receipt of payments from contractor	SITE FINANCE	1.5		Total number of complaints or reporting	Daily Log Book entry/Incident Registers/letter references
#5.03	Number of times the site operations were hampered for want of funds at the disposal of site-in-charge.	SITE FINANCE	1.5		Total number of non-compliances	Daily Log Book entry/Incident Registers/letter references
#6.01	Cumulative number of days in a month the nominated Safety Officer was not available	HSE & SA	1		Safety Officer should be available for all the days	Daily Log Book entry/Incident Registers/letter references
#6.02	Shortfall in number of weekly safety meetings in the month conducted or attended by the Safety Officer	HSE & SA	0.5		Safety meetings to be held every week	Copy of Minutes of meeting
#6.03	Level of compliance w.r.t decisions taken in previous Safety meetings	HSE & SA	0.5		Number of consolidated issues discussed in Safety meetings	Copy of Minutes of meeting, Non-compliance intimation documents from BHEL site
#6.04	Delay in submission of monthly report on safety (including electrical safety for equipment & personnel etc.) in the prescribed form	HSE & SA	1		Number of days delayed/Scheduled date is third working day of next month	Daily Log Book entry/Incident Registers/letter references
#6.05	Number of days taken for lodging FIRs from date of occurrence/notice of incident of theft / accident etc.	HSE & SA	0.5		Number of days delayed/Scheduled date is within 24 Hrs of occurrence/notice of incidence	Copy of FIR lodged by Contractor

Project		**Vendor**			**Package/Unit**	
Sl. No.	Parameter for Measurement	Classification	Max Score	Score Obtained	Measurement Key/Scheduled date	Supporting Documents
#6.06	Number of times written(email, letters etc.) warning issued for non-availability/ use of improper Fall protection and rescue arrangement as lifeline, fall arrestors, safety net, hand-railings, covered floors, man-basket, rescue basket & kit etc. by the contractor	HSE & SA	2		Total number of non-compliances	Daily Log Book entry/Incident Registers/letter references
#6.07	Number of times punitive fines imposed for unsafe practices as per contract like non-availability/use of PPEs as safety shoes, helmets, goggles, gloves, lifeline, safety belts etc.	HSE & SA	1		Total number of non-compliances	Non-compliance intimation documents from BHEL site
#6.08	Percentage compliance to Emergency preparedness and response plan: Portable Fire-extinguishers, Buckets, Fire-wardens, display of emergency numbers, mock-drills, Hazard Identification and Risk Assessment(HIRA) etc.	HSE & SA	1		Compliance should be 100% as per HSE Plan or as finalized in Safety Meetings	Non-compliance intimation documents from BHEL site
#6.09	Number of times the agency has defaulted on display of safety posters / safety slogans / safety barriers/emergency numbers etc. in identified areas	HSE & SA	0.5		Total number of instances	Non-compliance intimation documents from BHEL site
#6.10	Non compliances observed during HSE and Safety Audit	HSE & SA	0.5		Total number of non-compliances	Non-compliance intimation documents from BHEL site, Audit Reports
#6.11	Cumulative number of days in the month, non-availability of First Aid Kit, First Aider & Emergency Vehicles/Ambulance.	HSE & SA	0.5		Cumulative number of days	Non-compliance intimation documents from BHEL site
#6.12	Number of days taken for submission of Root Cause analysis (RCA) for the accident from the cut-off date intimated by BHEL for submission of RCA	HSE & SA	0.5		Number of days delayed/Scheduled date is cut-off date intimated by BHEL	Daily Log Book entry/Incident Registers/letter references
#6.13	Non conductance of training (induction, job specific, height work etc.), tool box meeting and health check-up as per Contract requirements	HSE & SA	0.5		Number of incidences of non-conductance during the month	Daily Log Book entry/Incident Registers/letter references
		Total	100			

Name and Signature of BHEL Package In-charge

Name and Signature of Contractor

Project		**Vendor**			**Package/Unit**	
Sl. No.	Parameter for Measurement	Classification	Max Score	Score Obtained	Measurement Key/Scheduled date	Supporting Documents
Less Deduction in Score Due to Major Accidents (Fatal, Permanent Disability or bodily injury by which person injured is prevented to resume to work within 48 hours or more after accident,, Major Damage to Equipment etc.) attributable to the contractor @ 3 points/ accident						
Less Deduction in Score Due to Minor Accidents attributable to the contractor @ 1 point/ accident						
Less Deduction in Score Due to not Maintaining of Labour Colony (if applicable) as per BHEL HSE policy @2 points in a month on verification any day						
				Final Score		

Performance Score Summary for the Month	Total Score	Score Obtained
QUALITY	10	
PERFORMANCE	50	
RESOURCES	20	
SITE INFRASTRUCTURE & SERVICE	5	
SITE FINANCE	5	
HSE & SA	10	
OTHERS (deductions if any)	0	
TOTAL	**100**	

Note:

1) It is only indicative and shall be as per the online format issued by BHEL time to time.
2) No request will be entertained after specified date of current month w.r.t. changes requested in the scores of immediate previous month.

Name and Signature of BHEL Package In-charge

Name and Signature of Contractor

Procedure-2.3

PROCEDURE FOR CONDUCT OF CONCILIATION PROCEEDINGS

1. The proceedings of Conciliation shall broadly be governed by Part-III of the Arbitration and Conciliation Act 1996 or any statutory modification thereof and as provided herein:

2. The party desirous of resorting to Conciliation shall send an invitation/notice in writing to the other party to conciliate specifying all points of Disputes with details of the amount claimed. The party concerned shall not raise any new issue thereafter. Parties shall also not claim any interest on claims/counter-claims from the date of notice invoking Conciliation till the conclusion of the Conciliation proceedings. If BHEL is to initiate Conciliation, then, the invitation to Conciliate shall be extended to the concerned Stakeholder in **Format 7** hereto. Where the stakeholder is to initiate the Conciliation, the notice for initiation of Conciliation shall be sent in **Format-8** hereto.

3. The party receiving the invitation/notice for Conciliation shall within 30 days of receipt of the notice of Conciliation intimate its consent for Conciliation along with its counter-claims, if any.

4. The Conciliation in a matter involving claim or counter-claim (whichever is higher) up to Rs 5 crores shall be carried out by sole Conciliator nominated by BHEL while in a matter involving claim or counter-claim (whichever is higher) of more than Rs 5 crores Conciliation shall be carried out by 3 Conciliators nominated by BHEL. The appointment of Conciliator(s) shall be completed and communicated by the concerned Department/Group of BHEL Unit/Division/Region/Business Group to the other party and the Conciliator(s) within 30 days from the date of acceptance of the invitation to conciliate by the concerned party in the **Format-9**. The details of the Claim, and counter-claim, if any, shall be intimated to the Conciliator(s) simultaneously in **Format-5**.

5. The Parties shall be represented by only their duly authorized in-house executives/officers and neither Party shall be represented by a Lawyer.

6. The first meeting of the IEC shall be convened by the IEC by sending appropriate communication/notice to both the parties as soon as possible but not later than 30 days from the date of his/their appointment. The hearings in the Conciliation proceeding shall ordinarily be concluded within two (2) months and, in exceptional cases where parties have expressed willingness to settle the matter or there exists possibility of settlement in the matter, the proceedings may be extended by the IEC by a maximum of further 2 months with the consent of the Parties subject to cogent reasons being recorded in writing.

7. The IEC shall thereafter formulate recommendations for settlement of the Disputes supported by reasons at the earliest but in any case within 15 days from the date of conclusion of the last hearing. The recommendations so formulated along with the reasons shall be furnished by the IEC to both the Parties at the earliest but in any case within 1 month from the date of conclusion of the last hearing.

8. Response/modifications/suggestions of the Parties on the recommendations of the IEC are to be submitted to the IEC within time limit stipulated by the IEC but not more than 15 days from the date of receipt of the recommendations from the IEC.

9. In the event, upon consideration, further review of the recommendations is considered necessary, whether by BHEL or by the other Party, then, the matter can be remitted back to the IEC with request to reconsider the same in light of the issues projected by either/both the Parties and to submit its recommendations thereon within the following 15 days from the date of remitting of the case by either of the Parties.

10. Upon the recommendations by the Parties, with or without modifications, as considered necessary, the IEC shall be called upon to draw up the Draft Settlement Agreement in terms of the recommendations.

11. When a consensus can be arrived at between the parties only in regard to any one or some of the issues referred for Conciliation the draft Settlement Agreement shall be accordingly formulated in regard to the said Issue(s), and the said Settlement Agreement, if signed, by the parties, shall be valid only for the said issues. As regards the balance issues not settled, the parties may seek to resolve them further as per terms and conditions provided in the contract.

12. In case no settlement can be reached between the parties, the IEC shall by a written declaration, pronounce that the Conciliation between the parties has failed and is accordingly terminated.

13. Unless the Conciliation proceedings are terminated in terms of para 22 (b), (c) & (d) herein below, the IEC shall forward his/its recommendations as to possible terms of settlement within one (1) month from the date of last hearing. The date of first hearing of Conciliation shall be the starting date for calculating the period of 2 months.

14. In case of 3 members IEC, 2 members of IEC present will constitute a valid quorum for IEC and meeting can take place to proceed in the matter after

seeking consent from the member who is not available. If necessary, videoconferencing may be arranged for facilitating participation of the members. However, the IEC recommendations will be signed by all members. Where there is more than one (1) Conciliator, as a general rule they shall act jointly. In the event of differences between the Members of IEC, the decision/recommendations of the majority of the Members of IEC shall prevail and be construed as the recommendation of the IEC.

15. The Draft Settlement Agreement prepared by the IEC in terms of the consensus arrived at during the Conciliation proceedings between the Parties shall be given by the IEC to both the parties for putting up for approval of their respective Competent Authority.

16. Before submitting the draft settlement agreement to BHEL's Competent Authority viz. the Board Level Committee on Alternative Dispute Resolution (BLCADR) for approval, concurrence of the other party's Competent Authority to the draft settlement agreement shall be obtained by the other party and informed to BHEL within 15 days of receipt of the final draft settlement agreement by it. Upon approval by the Competent Authority, the Settlement Agreement would thereafter be signed by the authorized representatives of both the Parties and authenticated by the members of the IEC.

17. In case the Draft Settlement Agreement is rejected by the Competent Authority of BHEL or the other Party, the Conciliation proceedings would stand terminated.

18. A Settlement Agreement shall contain a statement to the effect that each of the person(s) signing thereto (i) is fully authorized by the respective Party(ies) he/she represents, (ii) has fully understood the contents of the same and (iii) is signing on the same out of complete freewill and consent, without any pressure, undue influence.

19. The Settlement Agreement shall thereafter have the same legal status and effect as an arbitration award on agreed terms on the substance of the dispute rendered by an arbitral tribunal passed under section 30 of the Arbitration and Conciliation Act, 1996.

20. Acceptance of the Draft Settlement Agreement/recommendations of the Conciliator and/or signing of the Settlement Agreement by BHEL shall however, be subject to withdrawal/closure of any arbitral and/or judicial proceedings initiated by the concerned Party in regard to such settled issues.

21. Unless otherwise provided for in the agreement, contract or the Memorandum of Understanding, as the case may be, in the event of likelihood of prolonged

absence of the Conciliator or any member of IEC, for any reason/incapacity, the Competent Authority/Head of Unit/Division/Region/Business Group of BHEL may substitute the Conciliator or such member at any stage of the proceedings. Upon appointment of the substitute Conciliator(s), such reconstituted IEC may, with the consent of the Parties, proceed with further Conciliation into the matter either de-novo or from the stage already reached by the previous IEC before the substitution.

22. The proceedings of Conciliation under this Scheme may be terminated as follows:

a. On the date of signing of the Settlement agreement by the Parties; or,

b. By a written declaration of the IEC, after consultation with the parties, to the effect that further efforts at conciliation are no longer justified, on the date of the declaration; or,

c. By a written declaration of the Parties addressed to the IEC to the effect that the Conciliation proceedings are terminated, on the date of the declaration; or,

d. By a written declaration of a Party to the other Party and the IEC, if appointed, to the effect that the Conciliation proceedings are terminated, on the date of the declaration; or,

e. On rejection of the Draft Settlement Agreement by the Competent Authority of BHEL or the other Party.

23. The Conciliator(s) shall be entitled to following fees and facilities:

Sl No	**Particulars**	**Amount**
1	Sitting fees	Each Member shall be paid a Lump Sum fee of Rs 75,000/- for the whole case payable in terms of paragraph No. 27 herein below.
2	Towards drafting of settlement agreement	In cases involving claim and/or counter-claim of up to Rs 5crores. Rs 50,000/- (Sole Conciliator) In cases involving claim and/or counter-claim of exceeding Rs 5 crores but less than Rs 10 crores. Rs 75,000 (per Conciliator)

Sl No	Particulars	Amount
		In cases involving claim and/or counter-claim of more than Rs 10 crores. Rs 1,00,000/- (per Conciliator) Note: The aforesaid fees for the drafting of the Settlement Agreement shall be paid on the, Signing of the Settlement Agreement after approval of the Competent Authority or Rejection of the proposed Settlement Agreement by the Competent Authority of BHEL.
3	Secretarial expenses	Rs 10,000/- (one time) for the whole case for Conciliation by a Sole Member IEC. Where Conciliation is by multi member Conciliators –Rs 30,000/- (one time)- to be paid to the IEC
4	Travel and transportation and stay at outstation Retired Senior Officials of other Public Sector Undertakings (pay scale wise equivalent to or more than E-8 level of BHEL)	As per entitlement of the equivalent officer (pay scale wise) in BHEL.
	Others	As per the extant entitlement of whole time Functional Directors in BHEL. Ordinarily, the IEC Member(s) would be entitled to travel by air Economy Class.
5	Venue for meeting	Unless otherwise agreed in the agreement, contract or the Memorandum of Understanding, as the case may be, the venue/seat of proceedings shall be the location of the concerned Unit / Division / Region /

Sl No	Particulars	Amount
		Business Group of BHEL. Without prejudice to the seat/venue of the Conciliation being at the location of concerned BHEL Unit / Division / Region / Business Group, the IEC after consulting the Parties may decide to hold the proceedings at any other place/venue to facilitate the proceedings. Unless, Parties agree to conduct Conciliation at BHEL premises, the venue is to be arranged by either Party alternately.

24. The parties will bear their own costs including cost of presenting their cases/evidence/witness(es)/expert(s) on their behalf. The parties agree to rely upon documentary evidence in support of their claims and not to bring any oral evidence in IEC proceedings.

25. If any witness(es) or expert(s) is/are, with the consent of the parties, called upon to appear at the instance of the IEC in connection with the matter, then, the costs towards such witness(es)/expert(s) shall be determined by the IEC with the consent of the Parties and the cost so determined shall be borne equally by the Parties.

26. The other expenditures/costs in connection with the Conciliation proceedings as well as the IEC's fees and expenses shall be shared by the Parties equally.

27. Out of the lump sum fees of Rs 75,000/- for Sitting Fees, 50% shall be payable after the first meeting of the IEC and the remaining 50% of the Sitting Fees shall be payable only after termination of the conciliation proceedings in terms of para 22 hereinabove.

28. The travelling, transportation and stay at outstation shall be arranged by concerned Unit as per entitlements as per Serial No. 4 of the Table at para 23 above, and in case such arrangements are not made by the BHEL Unit, the same shall be reimbursed to the IEC on actuals limited to their entitlement as per Serial No. 4 of the Table at Para 23 above against supporting documents. The IEC Member(s) shall submit necessary invoice for claiming the fees/reimbursements.

29. The Parties shall keep confidential all matters relating to the conciliation proceedings. Confidentiality shall extend also to the settlement agreement,

except where its disclosure is necessary for purposes of its implementation and enforcement or as required by or under a law or as per directions of a Court/Governmental authority/ regulatory body, as the case may be.

30. The Parties shall not rely upon or introduce as evidence in any further arbitral or judicial proceedings, whether or not such proceedings relate to the Disputes that is the subject of the Conciliation proceedings:

a. Views expressed or suggestions made by the other party in respect of a possible settlement of the Disputes;

b. admissions made by the other party in the course of the Conciliator proceedings;

c. proposals made by the Conciliator;

d. The fact that the other Party had indicated his willingness to accept a proposal for settlement made by the Conciliator.

31. The Parties shall not present the Conciliator(s) as witness in any Alternative Dispute Resolution or Judicial proceedings in respect of a Disputes that is/was the subject of that particular Conciliation proceeding.

32. None of the Conciliators shall act as an arbitrator or as a representative or counsel of a Party in any arbitral or judicial proceeding in respect of a Disputes that is/was the subject of that particular Conciliation proceeding.

33. The Parties shall not initiate, during the Conciliation proceedings, any arbitral or judicial proceedings in respect of a Disputes that is the subject matter of the Conciliation proceedings except that a Party may initiate arbitral or judicial proceedings where, in his opinion, such proceedings are necessary for preserving his rights including for preventing expiry of period of limitation. Unless terminated as per the provisions of this Scheme, the Conciliation proceedings shall continue notwithstanding the commencement of the arbitral or judicial proceedings and the arbitral or judicial proceedings shall be primarily for the purpose of preserving rights including preventing expiry of period of limitation.

34. The official language of Conciliation proceedings under this Scheme shall be English unless the Parties agree to some other language.

FORMAT-5

STATEMENT OF CLAIMS/COUNTER CLAIMS TO BE SUBMITTED TO THE IEC BY BOTH THE PARTIES

1. Chronology of the Disputes

2. Brief of the Contract/MoU/Agreement/LOI/LOA

3. Brief history of the Disputes:

4. Issues:

5. Details of Clam(s)/Counter Claim(s):

SI. No.	**Description of claim(s)/Counter Claim**	**Amount (in INR)Or currency applicable in the contract**	**Relevant contract clause**

6. Basis/Ground of claim(s)/counter claim(s) (along with relevant clause of contract)

Note– *The Statement of Claims/ Counter Claims may ideally be restricted to maximum limit of 20 pages. Relevant documents may be compiled and submitted along with the statement of Claims/ Counter Claims. The statement of Claims/ Counter Claims is to be submitted to all IEC members and to the other party by post as well as by email.*

FORMAT-7

FORMAT FOR NOTICE INVOKING CONCILIATION CLAUSE BY BHEL FOR REFERRING THE DISPUTES TO CONCILIATION THROUGH IEC

To,

M/s. (Stakeholder's name)

Subject: **NOTICE FOR INVOCATION OF THE CONCILIATION CLAUSE OF THE CONTRACT BY BHEL**

Ref: Contract No/MoU/Agreement/LOI/LOA& date _____.

Dear Sir/Madam,

As you are aware, with reference to above referred Contract/MoU/Agreement/LOI/LOA, certain disputes have arisen, which, in-spite of several rounds of mutual discussions and various correspondences have remained unresolved. The brief particulars of our claims which arise out of the above- referred Contract/MoU/Agreement/LOI/LOA are reproduced hereunder:

Sl. No.	Claim description	Amount involved

As you are aware, there is a provision in the captioned Contract/MoU/Agreement/LOI/ LOA for referring disputes to conciliation.

In terms of Clause ---------of Procedure i.e., Annexure ------ to the Contract/MoU /Agreement / LOI / LOA, we hereby seek your consent to refer the matter to Conciliation by Independent Experts Committee to be appointed by BHEL. You are invited to provide your consent in writing to proceed with conciliation into the above mentioned disputes within a period of 30 days from the date of this letter along with details of counter-claims, if any, which you might have with regard to the subject Contract/ MoU/ Agreement/ LOI/ LOA.

Please note that upon receipt of your consent in writing within 30 days of the date of receipt of this letter by you, BHEL shall appoint suitable person(s) from the BHEL Panel of Conciliators.

This letter is being issued without prejudice to our rights and contentions available under the contract and law.

Thanking you
Yours faithfully

Representative of BHEL

Note: The Format may be suitably modified, as required, based on facts and circumstances of the case.

FORMAT-8

FORMAT FOR NOTICE INVOKING CONCILIATION CLAUSE BY A STAKEHOLDER FOR REFERRING THE DISPUTES TO CONCILIATION THROUGH IEC

To,
BHEL (Head of the Unit/Division/Region/Business Group)

Subject: **NOTICE FOR INVOCATION OF THE CONCILIATION CLAUSE OF THE CONTRACT BY A STAKEHOLDER**

Ref: Contract No/MoU/Agreement/LOI/LOA& date _____.

Dear Sir/Madam,

As you are aware, with reference to above referred Contract/MoU/Agreement/LOI/LOA, certain disputes have arisen, which, in-spite of several rounds of mutual discussions and various correspondences have remained unresolved. The brief particulars of our claims which have arisen out of the above-referred Contract/MoU/Agreement/LOI/LOA are enumerated hereunder:

Sl. No.	Claim description	Amount involved

As you are aware, there is a provision in the captioned Contract/MoU/Agreement/LOI/ LOA for referring inter-se disputes of the Parties to conciliation.

We wish to refer the above-said disputes to Conciliation as per the said Clause of the captioned Contract/MoU/Agreement/LOI/ LOA. In terms of Clause ---------of Procedure i.e., Annexure ------ to the Contract/MoU /Agreement / LOI / LOA, we hereby invite BHEL to provide its consent in writing to proceed with conciliation into the above mentioned disputes within a period of 30 days from the date of this letter along with details of counter-claims, if any, which it might have with regard to the subject Contract/ MoU/ Agreement/ LOI/ LOA and to appoint suitable person(s) as Conciliator(s) from the BHEL Panel of Conciliators.

This letter is being issued without prejudice to our rights and contentions available under the contract and law.

Thanking you
Yours faithfully

Representative of the Stakeholder

Note: The Format may be suitably modified, as required, based on facts and circumstances of the case.

FORMAT-9

FORMAT FOR INTIMATION TO THE STAKEHOLDER ABOUT APPOINTMENT OF CONCILIATOR/IEC

To,

M/s. (Stakeholder's name)

Subject: **INTIMATION BY BHEL TO THE STAKEHOLDER AND CONCILIATOR(S) ABOUT APPOINTMENT OF CONCILIATOR/IEC**

Ref: Contract No/MoU/Agreement/LOI/LOA& date _____.

Sir,

This is with reference to letter dated ---------- regarding reference of the disputes arising in connection with the subject Contract No /MoU/Agreement/LOI/LOA to conciliation and appointment of Conciliator(s).

In pursuance of the said letter, the said disputes are assigned to conciliation and the following persons are nominated as Conciliator(s) for conciliating and assisting the Parties to amicably resolve the disputes in terms of the Arbitration & Conciliation Act, 1996 and the Procedure ---- to the subject Contract ...../MoU/Agreement/LOI/LOA, if possible.

Name and contact details of Conciliator(s)

a) .....

b) .....

c) .....

You are requested to submit the Statement of Claims or Counter-Claims (strike off whichever is inapplicable) before the Conciliator(s) in Format 5 (enclosed herewith) as per the time limit as prescribed by the Conciliator(s).

Yours faithfully,

Representative of BHEL

CC: To Conciliator(s)… for Kind Information please.
Encl: As above

Note: The Format may be suitably modified, as required, based on facts and circumstances of the case.