TENDER SPECIFICATION

BHEL: PSSR: SCT: 2137

TECHNICAL CONDITONS OF THE CONTRACT

FOR

Balance works of Erection, alignment, welding, NDT, fixing of pipe supports, flushing and hydro testing as per requirement of Secondary cycle piping system and all associated Piping for Unit-3

AT
KUDANKULAM NUCLEAR POWER PROJECT, TAMILNADU

BHARAT HEAVY ELECTRICALS LIMITED

(A Government of India Undertaking)

Power Sector – Southern Region

BHEL Integrated Office Complex, TNEB **Road**

Pallikaranai, Chennai -600100

VOLUME – IA

PART I & II

TECHNICAL CONDITIONS OF CONTRACT (TCC)

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PROJECT INFORMATION

1.1.1 INTRODUCTION

Kudankulam Nuclear Power Project (KKNPP) site is a coastal site on the shores of Gulf of Mannar located on the South-Eastern tip of India near Kanyakumari. The nearest Railway Stations are one at Kanyakumari, and the other at Valliyoor which is about 27 Kms away, both having broad gauge railway track. There is a Major District Road (MDR) from Kanyakumari to Tiruchendur passing through Kudankulam village at a distance of 2-3 Kms from the site. The MDR joins National Highway No.44 at about 8 Kms north of Kanyakumari. Site is accessible by road from Nagercoil and from Kanyakumari. It is suggested that Bidder shall necessarily acquaint himself by a visit to the site and with the conditions prevailing at site before submission of the bid. The information given here in under is for general guidance and shall not be contractually binding on BHEL/Owner. All relevant site data /information as may be necessary shall have to be obtained /collected by the Bidder.

1.1.2 PROJECT INFORMATION

1.1	PROJECT TITLE	:	KUDANKULAM NUCLEAR POWER PROJECT UNIT 3 & 4
1.2	PLANT CAPACITY	:	2X 1000 MWe
1.3	TYPE OF PROJECT	:	GREEN FIELD
1.4	OWNER	:	NUCLEAR POWER CORPORATION OF INDIA LIMITED
1.5	PLANT LOCATION	:	KUDANKULAM PO, RADHAPURAM TALUK, TIRUNELVELI DISTRICT, TAMILNADU – 627106
1.6	NEAREST TOWN	:	NAGERCOIL (41KM)
1.7	NEAREST RAILWAY STATION	:	KANYAKUMARI (35KM)
1.8	NEAREST AIRPORT	:	TUTICORIN (131KM)

VOLUME - IA PART – I CHAPTER – II

SCOPE OF WORK & TECHNICAL SPECIFICATION

CONTENT

SCOPE OF WORK AND TECHNICAL SPECIFICATION

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

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

1. BROAD SCOPE OF WORK

Balance works of Erection, alignment, welding, NDT, fixing of pipe supports, flushing, hydro testing as per requirement of Secondary cycle piping system and all associated Piping including handling at site stores / storage yard, transporting to site at UNIT 3 KUDANKULAM NUCLEAR POWER PROJECT.

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

2. GENERAL

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

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

1. Study, Preparation and Submission of detailed work schedule such as level 3 and level 4 to meet the specific targets and agreed milestones as per contract. All work schedules and networks shall be prepared & submitted based on actual quantum of work indicating resources required by the contractor to achieve the agreed targets.
2. The contractor personnel shall be conversant with Russian codes and standards. Contractor quality personnel shall be assessed by BHEL & 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 BHEL 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 BHEL Engineer within the days specified by the BHEL engineer from the date of completion. All the activities of the contractor shall be confined to areas authorized by the NPCIL Engineer-in-charge. The contractor shall be liable for any and all damage caused by him to the NPCIL Corporation's premises.

5. Fabrication, erection, welding, inspection, NDE and hydro/Pneumatic testing of CS/SS/Titanium pipes, supports and valves issued as free issue materials by NPCIL, supply of all welding consumables (except welding electrode, filler wire), machining of items from FIM, Stub/O-let drilling, IBR clearance for Auxiliary steam piping. The scope includes testing of valves at Valve Testing Facility and fabrication and erection of temporary loops for flushing of pipelines.

   Note: Temporary structures shall be provided by BHEL on returnable basis. Required welding electrodes and consumables for erection of temporary structures is in the scope of the contractor. Arranging required scaffolding is in the scope of contractor.

6. Receipt of free issue materials from NPCIL's stores or at the delivery point, uncrate, inspection and preparation of incoming material inspection report (IMIR), reporting deficiency if any to NPCIL, shifting from NPCIL's store to BHEL/contractors store, storage, preservation, material management, shifting from BHEL/contractor's storage to erection site, handling of materials during erection/construction and inspection before erection of items including return of empty crating of FIM to NPCIL's store.
7. Supply of materials under contractor scope, inspection and preparation of incoming material inspection report (IMIR), storage, preservation, material management, shifting to erection site, handling of materials during erection/construction. For executing the work on contractor's/BHEL supplied material, the supply of welding electrodes, filler wires, and welding consumables are in the scope of contractor, whereas for executing the work on free issue material from NPCIL, welding electrodes and filler wire will be issued as FIM and only supply of welding consumables will be in the scope of contractor.
8. Preparation of work procedures and QAP, qualification of welding procedure and welders.
9. Preparation of reports for the works carried out and digitalization of RT films.
10. Preparation of CCC and material accounting and submission to BHEL & NPCIL for acceptance.
11. All reports shall be entered in Construction management software provided by NPCIL/BHEL for material supply, erection activities, protocols, measurements & billing. Agency shall provide

minimum 2 computers & printers with latest configuration (along with one operator per PC) for data entry, reporting of daily progress, billing, updating details in online system with in the quoted rates.

12. Deployment of qualified manpower, supervisory staff and training & qualification of personnel and arrangement of Plant and Machinery, tools & tackles, scaffoldings, ladders, platforms etc.
13. Housekeeping, dewatering preservation including supply of preservative consumables.
14. Preparation and submission of detailed work schedule to meet the specified targets using latest project management tools and facilities.
15. **The balance works of Unit#3 Secondary Cycle Piping includes completion of works already undertaken by other agency in UNIT#3. The contractor is responsible for completing the remaining balance of works required for completion of the job/system.**

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 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 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 BHEL/NPCIL ENC of the work. In the instance where

contractor is unable to achieve the required technical parameters, he must apply to the BHEL/NPCIL ENC with full justification for the regularization of nonconformance. 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. Inadequacy in detailing in Engineer's drawing shall be brought to the notice of the BHEL/NPCIL Engineer within 3 (Three) days of receipt of drawings by the Contractor.
9. 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.
10. Design Concession Request (DCR) shall be raised for non-generic deviation and non-conformances and it has to be regularized as per Quality management system.

4. KKS code:

In KKNPP 3&4 all the Structures, Systems and Components (SSC's) are identified by a Unique non language based coding system known as KRAFTWERK KENNEZEICHEN SYSTEM (KKS). All the working documentations, drawings, technical specifications and other technical related documents issued to the contractor from time to time shall refer to these KKS codes. Complete list of KKS codes is available with Engineer In-charge which shall be made available to the Contractor on demand at the time of start of the work. The list of KKS codes of all the systems and structures which are part of this tender is given in **Annexure-II** to this section. Under the KKS coding system, apart from system and structures identification, each component/equipment in a system is identified by a certain

code. It is the responsibility of the contractor to train his personnel in understanding the KKS codes. The non-familiarity or ignorance of KKS coding system will not relieve the contractor from his responsibility of successfully performing the said work.

5. BUILDING AND SYSTEM DESCRIPTION:

5.1 Building description:

The erection of 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), Reactor building (UJA,UKA), and 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.

5.2 System and equipment description:

The piping system covered under this tender document are related to secondary cycle systems and its associated systems.

Secondary cycle systems mainly consists of Steam Systems, Condensate Systems, Feed Water Systems and Supporting Systems.

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

6. RECEIPT OF MATERIAL, SHIFTING, STORAGE:

6.1 Receipt and shifting of materials:

1. The scope of material shifting covers identification of material, preparation of CIV, clearance from EIC and its submission to BHEL/NPCIL's stores, receipt, handling, loading on to the truck/trailer, shifting of materials from BHEL/NPCIL's stores to contractor's store or erection site, unloading the material at contractor's store or erection site, uncrating, checking the completeness of items/physical damage (if any), preparation and submission of incoming material inspection report (IMIR) and its clearance from EIC, further shifting of materials from contractor's store to erection site and disposal of the crating/packing material at the designated place of the NPCIL's stores, returning of un-erected materials to NPCIL's stores. This work also includes arranging all the necessary tools and tackles, truck/trailer, plant and machinery, man power and consumables.

2. Receipt of free issue materials from NPCIL's stores or at the delivery point, uncrate, inspection and preparation of incoming material inspection report (IMIR), reporting deficiency if any to NPCIL.
3. Shifting and handling of materials from NPCIL's store to BHEL/contractors store/yard for prefabrication, painting works or for any other work involved. **Appr. distance between NPCIL to BHEL yard/stores is 6kms.**
4. Shifting and handling of materials from BHEL yard/stores/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. **Appr. distance between BHEL yard/stores to erection site is 6kms.**
5. 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. The contractor shall make note of such items and draw the items from NPCIL stores on requisition. The free issue material will be issued against contractor issue voucher (CIV) at BHEL/NPCIL stores. The contractor shall prepare Contractor Issue Voucher (CIV) either using BHEL/NPCIL certified software's like IPMIS, IBA-CMM or manually using CIV book which shall be issued to contractor during the execution of work. Contractor shall establish facility for software based material management system for free issue materials, compatible with the BHEL/NPCIL's software. The CIV should contain all the details of the requested material and the same shall be submitted to department of stores through EIC. It is the responsibility of the contractor to collect the requested material from the designated location of the BHEL/NPCIL stores once the materials is issued.
6. The Contractor shall draw the FIM from the NPCIL's stores located within the plant premises or in the vicinity of the plant premises.
7. The Contractor shall be responsible for shifting of all the items / general equipment / material, piping materials from the NPCIL's store / Contractor's store / shop to the place of work/ installation. In no case the equipment/piping material will be delivered by NPCIL at the actual place of erection.
8. After receiving the materials contractor shall carry out uncrating, visual inspection to check for any damage, inspecting the contents for deficiency if any, checking for the completeness, preparation of Incoming material inspection report (IMIR), shifting up to erection site, handling and

storage. Further shifting to the erection point, shifting of materials from contractor's store to erection site and disposal of the crating /packing material at the designated place of the NPCIL's stores will be the responsibility of the contractor. The FIM shall be issued in a lot, in packed/as received condition. No piecemeal issue/delivery shall be permitted.

9. 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.
10. 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.
11. 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.
12. Disposal of crating/packing materials to NPCIL store is in the scope of Contractor.

6.2 Storage of materials:

1. Attention is drawn to the fact that the environment at KK site is corrosive and therefore proper storage and its periodic monitoring by contractor has to be done at no extra cost. Contractor shall make storage 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 NPCIL. It is the responsibility of the contractor to maintain complete record of the list of materials at stores, maintain log books and entry/exit records for the material movement in and out of the contractor's warehouse/ store. All such records which are required for material accounting and billing shall be prepared, recorded and maintained by the contractor either manually or by using licensed software's with prior approval of ENC. BHEL/NPCIL approved committee has every right to audit Contractor stores, records and his logbooks time to time during the execution of work, for which Contractor shall ensure and provide all such information and facilities on demand.

6.3 Identification, marking and segregation of material:

1. In NPCIL stores, all the equipments and pipelines are identified by their KKS codes and Item no's. It is the responsibility of the contractor to get the details of KKS codes, package no's, Item no's for such materials from NPCIL. 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.

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.

- Painting of piping, structures, supports (Shifting of material from NPCIL to BHEL yard for painting work is in the scope of the contractor. Painting will be carried out by BHEL)
- Equipment installation with support structures and inspection
- Installation and inspection of supports for large diameter piping.
- Erection of pre-fabricated large diameter piping spools (100 NB and above) and supporting them.
- Erection and field welding of the remaining piping (small diameter) and installation of their supports.
- Inspection, Testing and flushing of piping Circuits

8. INTERFACING WITH OTHER AGENCIES AND TERMINAL POINTS:

8.1 Interfacing:

1. The civil construction work is under progress by other agencies, hence required co-operation shall be established by the mechanical contractor for smooth progress of work. Construction of civil works shall be continuing in other part of the same building where equipment and piping are being erected. Also other mechanical/electrical agencies related to ventilation, material handling equipments, common services, cable laying, ducting etc may also work in the same area. Hence for carrying out the above activities the co-ordination with other contractors/agencies working in that area for erection of ducting, cable tray, etc., will be required. This is to avoid unnecessary cutting and re-welding of ducting, cable trays, their supports, etc., for

taking fabricated pipe spools in the required locations. Contractor shall not consider this type of parallel working as disturbance or hindrance to erection work.

2. All mechanical erection work covered under this specification shall be planned and executed as combined nature of civil, mechanical, electrical and instrumentation work. The civil construction and mechanical erection works shall be done in a sequential/combined manner. The work front for civil and mechanical contractor shall be available or released on completion of specified activities by each contractor on every activity and both contractors shall ensure that their part of work is completed in time. 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 the contractor/BHEL as well as supplied by Russian Federation (Free issue Materials), the dimensional mismatches between the connecting components shall be suitably fabricated and joined by the contractor.

8.2 Terminal points:

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 equipments/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. at such terminal points, shall be carried out by the contractor.
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.

9. PREPARATION OF WORK PROCEDURES:

1. The contractor shall prepare and submit work procedures for fabrication, erection, inspection and testing all the piping, painting and structural works in his scope to EIC for approval. The procedures shall be prepared in line with the general Industry practice, Working Documents, acceptable

codes and standards and to the requirements of Equipment Manufacturer/Designer. The procedures shall clearly define all the details pertaining to the type of testing, process of testing, the methodology adopted, special requirements, sequence of steps, fabrication requirements, assembly requirements, alignment process, quantum of testing, testing tools & consumables required, calibration requirements, testing parameters, sampling requirements, interpretation of results, defect rectification methodology.

2. 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 the EIC. Any other procedure deemed necessary for work shall be submitted to EIC 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. **Joint Codification: Contractor has to prepare joint codification of the issued drawings before taking up the fit up work for the approval of M/s NPCIL. Details like inch dia, inch meter, sqm etc. shall be worked out prepared as per the format of M/s NPCIL. Dedicated person(s) shall be assigned for the work.**

   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, joint codifications & 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.

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 NPCIL on account of delay by the contract or on account of supervision front, shall be deducted from the contractor.

11. 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 and fabrication, cold bending of small diameter pipes, carrying out NDE, hydro/pneumatic testing of pipelines, making arrangements for flushing and performing flushing operation and digitization of RT films, machining of FIM, orfice fixing, flange assembly. Scope includes cleaning, de-preservation of pipe internal and external surfaces using rotary brush, compressed air and manual wiping.

11.1 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 the BHEL/contractor.
3. Rigging procedures and erection schemes for all the heavy lifts shall be prepared by contractor and got approved by EIC before starting work.
4. Secondary Cycle Pipe lines shall be erected at various locations and elevations of UMA, UMV, UGZ and 2USF and associated Pipe lines shall be erected inside the buildings as indoor pipe lines in various floors including below ground and above ground floors of buildings/structures and associated buildings within plant site of KK 3.
5. 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. Threaded pipe nipples wherever required will be fabricated by machining by the contractor.
6. Pipelines shall be erected and joined by welding or flange connections or threaded connections in accordance with the working documentation and tender specification. Pipeline shall be made with the minimum feasible number of joints. The contractor shall pre-fabricate sub-assemblies of piping etc. to the maximum extent feasible.
7. 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.
8. 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.

9. For any cutting and edge preparation of small bore & big bore pipelines required to suit the layout of piping is part of scope.
10. Adherence to safety guidelines, security guidelines, various work permit system and compliance of all statutory requirements of the project.
11. Removal of caps and other closures from all equipment nozzles supplied with temporary caps is included in contractor's scope of work. This shall be considered as part of edge preparation and job shall be done without any extra charges. 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.
12. 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.
13. Preparation of reports, documents required at various stages of the work.
14. 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.
15. 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.

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

In addition to the requirements given in clause no 11.1, 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 NPCIL.
5. Welding of pipelines will be measured in Inch-dia for CS, SS and Titanium pipelines. Different sizes of the pipeline in OD and corresponding Inch-dia per joint that will be considered for measurement of welding of pipelines.

11.3 Erection of CS, SS, Ti pipelines:

In addition to the general requirements given in clause no 11.1, 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 the specifications.

Note: Temporary structures shall be provided by BHEL on returnable basis. Required welding electrodes and consumables for erection of temporary structures is in the scope of the contractor. Arranging required scaffolding is in the scope of contractor.

11.4 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. In that case an under taking towards owning full responsibility for achieving the desired quality shall be given by the contractor.
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.

11.5 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/contractor. 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 ЕА-400/10У, ЕА-400/10Т filler wire Сб -04Х19Н11М3
c. For different steels (carbon + corrosion-resistant) – electrodes ЕА-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/contractor, 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.

11.6 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).

11.7 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.

11.8 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 14days.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.

11.9 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 11.1, 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.

11.10 Assembly of flanged joints:

In addition to the general requirements given in clause no 11.1, 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.

11.11 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, manpower, P&M, including consumables like rubber, gaskets, cleaning kits 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

11.12 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.

11.13 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 BHEL shall install the EP with anchor fasteners. Necessary drilling of holes in concrete wall / floor / ceiling and fixing Hilti anchors shall be carried out by BHEL.
3. Supply of Hilti make anchor fasteners is in the scope of BHEL.
4. 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.
5. 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.

   Note: Temporary structures shall be provided by BHEL on returnable basis. Required welding electrodes and consumables for erection of temporary structures is in the scope of the contractor. Arranging required scaffolding is in the scope of contractor.

Broadly the supports are divided into three types.

6. Type I: Spring Type Supports:
   a. Single/Double spring hanger support: It consists of single/Double spring coil which supports the gravity loads of piping systems and is suspended by turn buckles attachment with concrete or steel structure.
   b. Spring with base support: It consists single-spring coil which supports the gravity loads of piping systems from below
   c. The pre assembly work involves pre-compression and locking of spring unit height to set value of drawing, assembly, installation of spreader beam, pipe clamps, lock pad plates, saddles, turn buckles, and other ancillaries item, welding of pad plate, fabrication of support structures and its welding with embedded parts(EPs) in concrete or metal structures.
7. Type II: Rigid Hanger Supports:

In this type of support the piping is suspended by hanger rods rod attachment with concrete or steel structure. The erection work involves installation of spreader beam, pipe clamps, lock pad plates,

saddles, turn buckles, and other ancillaries item, welding of pad plate and tie rod, fabrication of support structures and its welding with embedded parts(EPs) in concrete or metal structures.

8. Type III: Fixed/sliding/guide sliding/damper supports:

In these types of supports the piping is supported by saddle, mounted on supporting structure. The erection work involves installation of pipe clamps, lock pad plates, saddles, and other ancillary's item, welding of pad plate, fabrication of support structures and it's welding with embedded parts (EPs) in concrete or metal structures.

11.14 Stub/o-let drilling:

Stub/O-let drilling involves study of drawings, identification of pipe spools and O- lets/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.

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

11.15 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.

11.16 Indian boiler regulatory (IBR) clearance for aux steam supply lines:

The main scope of work of the contractor is to qualify the erected pipeline and obtain IBR clearance approval from Tamil Nadu boiler Inspectorate for KKNPP 3&4 for auxiliary steam lines inside the turbine building. Contractor scope of work includes but not limited to:

1. Submission of action plan to BHEL & NPCIL identifying the list of documents to be submitted to the Boiler Inspectorate for obtaining IBR clearance.
2. Compilation and submission of all documents of auxiliary steam piping system (LBG) of KK 3&4 in UMA buildings such as pipeline passport documents, design data, test certificates of pipes, pipe fittings, valves, & supports to IBR.
3. Preparation of drawings for obtaining the approval.

4. Verification of erected pipeline with supports, weld joints at field with drawings and preparation of reports for submission to IBR.
5. Deployment of IBR qualified welder for welding of auxiliary steam piping system.
6. Completion of NDE of weld joints and submission of reports to IBR for approval.
7. Arrangement of stage wise inspection and final approval from IBR authorities.
8. Obtaining permission and intimation for performance of hydro test from IBR authorities.
9. All arrangements and coordination for the inspection and witnessing of the hydro testing by the Boiler Inspector.
10. Carrying out additional tests to qualify the piping as per the IBR requirement.
11. Performing hydro test of auxiliary steam line, in presence of boiler inspector.
12. Getting the approval for charging the Auxiliary steam line from the chief inspectorate of Boiler (Tamil Nadu) as per IBR after submission of as built drawings and final test reports.
13. BHEL & NPCIL shall be intimated in advance regarding any field inspection to be carried out by Boiler Inspectorate. Contractor shall abide by all instructions, procedures, Act issued by BHEL/NPCIL, State/Central Government or any other statutory body for the purpose of execution of this work.

Note: Obtaining IBR clearance shall be part of scope of piping work and no additional payment will be made.

11.17 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. Therefore, such pipelines are not listed on pipeline list but are included in contractor's scope of work. 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.

11.18 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.

Secondary cycle 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 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 BHEL/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.

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.

11.19 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.

   The above list is only indicative. The actual list, formats, annexure etc to be part of CRR shall be prepared by the contractor and to be submitted for the approval of EIC.

3. Testing requirements:

a. Arrangement of all required manpower, components, high pressure positive displacement pump for pressurization, compressor, hoses, other hardware, pressure gauges, 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 BHEL/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. 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

11.20 Flushing of pipelines

After completion of erection and hydro test of pipelines, contractor shall carry out water/steam/air/ 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. Steam supply for flushing is in NPCIL scope. Temporary piping loop erected for steam flushing shall be subjected to hydrotest in location.

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

11.21 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.

11.22 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 NPCIL for acceptance. This work also includes arranging all necessary P&M, manpower, tools, tackles & consumables completion of work as per tender specification.

12. MISCELLANEOUS WORKS:

12.1 Manpower assistance for repair, preservation and pre-handing over checks 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 & BHEL/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 items, the first preservation shall be carried out by contractor within the part of scope of erection. Subsequently the items 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 (L8.5):

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 which payment for scaffolding shall be through separate BOQ item with acceptance of EIC. Scaffolding for the above 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 erection / dismantling of scaffolding and its hiring charges shall be measured separately in respective BOQ..

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.

The hire charges for the scaffolding for the above specific works will be measured in m3xday in such a way that the number of days for rent will be considered from the next day of completion of erection & clearance by NPCIL safety department & up to date clearance (inclusive) from EIC for dismantling. The scaffolding base in m2 & height in meter erected shall be considered for the measurement of volume. Inclined supports, lateral support bracing etc projected beyond base size shall not be considered in measurement for payment. Material required for scaffolding viz. pipes, clamps, base plate, platform, ladders, shifting etc shall be provided by contractor. However if during the course of use of scaffoldings (after getting clearance by NPCIL safety department) if the same is found unsafe or without inspection tags or found with missing scaffold members/approach ladders etc , the rental charges will not be paid for such time duration till the deficiencies are corrected and clearance is obtained.

12.2 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.

Calculation of weld volume for butt/groove welds.

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.

13. QUALITY ASSURANCE & TESTING:

13.1 General requirements

1. The work under this contract/package covers secondary cycle systems and associated systems, 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. Notwithstanding 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. Contractor shall prepare QAP for all the erection activities at site and submit for approval of NPCIL. The operational control includes inspection of technology compliance in the course of preparation of details, fit-up, heating, welding process etc
4. 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.
5. 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.
6. 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.
7. 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.
8. Along with the main control methods some complementary control methods are also possible (styloscope method, hardness measurement, etching etc.).
9. 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.
10. The inspection requirements will be indicated in detail in the working drawing and specifications.
11. Contractor shall not undertake any pre-fabrication job outside the Project area unless otherwise it is permitted by the EIC. All items fabricated outside the Project and all materials to be supplied by the Contractor are subject to EIC's Quality Surveillance.

12. 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.
13. 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.
14. NPCIL/BHEL shall carry out audit in all phases of the work i.e. procurement, pre- fabrication, erection, inspection, examination and testing.
15. 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.

14. 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.

15. 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:

15.1 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.

15.2 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.

15.3 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.

15.4 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.

15.5 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.

16. 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.

16.1 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.

16.2 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.

17. 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.

18. RECORDS AND REPORTS:

18.1 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.

18.2 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. Piping erection, NDT and testing progress reports
b. General statement of activities
c. Welders performance & qualification records
d. 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.

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

19.1 Completion of work:

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

19.2 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. Test Certificate from manufacturers for all the materials supplied by the contractor.
15. Reports generated during manufacturing, fabrication, erection and testing.
16. Inspection/test report/investigation, field tests, concreting reports etc.
17. Drawings/ documents/ reports relevant to the works.
18. 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.

19.3 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.

MATERAIL ACCOUNTING & PERMISSIBLE WASTAGE

S.No.	Particulars	Unit	Rate at which Material will be issued	Maximum invisible wastage (Non-Returnable) (%)	Maximums permissible wastage (Returnable in case of Free issue) (%)
1	CS pipes, pipe blocks, fittings , accessories and welding consumables	MT	0	2	4
2	SS & Ti pipes, pipe blocks, fittings, Accessories and welding consumables.	MT	0	1	4
3	Pipe Supports & its associated structural Components.	MT	0	3	7

Note: The percentage can vary as per the cutting plan approved by NPCIL Engineer-in-Charge

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	Fast acting steam dump system with discharge into the turbine condenser (FSDV – C)
BRU-A	Fast acting steam dump system with discharge into atmosphere (FSDV – A)
BRU-D	Fast acting steam dump system with discharge into De-aerator (FSDV – D)
CCC	Construction Completion Certificate
CCR	Central Control Room
CCV	Contractor's Credit Voucher
CCW	Condenser Cooling Water
CEA	Central Electricity Authority
CEP	Condensate Extraction Pump
CIV	Contractor's Issue Voucher
CRR	Circuit Release Report
C&MM	Contracts and Material Management
CoManas	Corporate Management System
CS	Carbon Steel
DCN/ECN/FCN	Design Change Notice/ Engineering Change Notice /Field Change Notice
DD	Detailed Drawing
DM	Demineralized Water
DPR	Detailed Project Report
DPT	Dye Penetrant Testing
DBA	Design Basis Accidents
DC	Direct Current
DFT	Dry Film Thickness
DN	Nominal Dia
EIC / ENC	Engineer In-charge
EP	Embedded part
EPGS	Electronic Part of the Governing System
EDFWP	Electric Drive of the Feed Water Pump

EOT	Electric Overhead Travelling
FAR	Flange Alignment Report
FIM	Free Issue Material
FME	Foreign Material Exclusion
FS	Flow Sheets
GCC	General Conditions of Contract
GSC	Gland steam condenser
GAN	GOSTATOMNADZOR – Russian Regulatory Board
GOST	Russian National Standard
GA	General Arrangement
GTAW	Gas Tungsten Arc Welding
HDPE	High Density Poly Ethylene
HPC/HPR	High Pressure Cylinder/High Pressure Rotor
HPH	High Pressure Heater
HTS	Hydro Technical Structure
HV	High Voltage
I & C	Instrumentation and Control
ID	Inner Dia
IR	Insulation Resistance
IBA	Integrated Business Application
IBR	Indian Boiler Regulatory
IGC	Inter Granular Corrosion
IPMIS	Integrated Project Management & Information System
IMIR	Incoming Material Inspection Report
JIT	Joint Inspection Team
JHA	Job Hazard Analysis
LPC/LPR	Low Pressure Cylinder/Low Pressure Rotor
LPH	Low Pressure Heater
KKNPP	Kudankulam Nuclear Power Project
KKS	KRAFTWERK KENNEZEICHEN SYSTEM (Codification system followed by Russian for identification of buildings, equipments, structures materials and systems etc. in nuclear power plant)
KLT	Kerosene Leak Test
KV	Kilo-Volt
MDR	Major District Road
MIV	Material Issue Voucher
MCV	Material Credit Voucher
MSR	Moisture Separator Reheater
MT	Metric Tonne

MWe	Megawatt electrical
NDE/NDT	Non Destructive Examination/Testing
NPCIL	Nuclear Power Corporation of India Limited
NTD	Normative technical documentation (Russian standards)
NRV	Non Return Valve
OBE	Operation Beyond Earthquake
OD	Outer Dia
ODC	Over Dimensional Consignment
OMTI	Fire-resistant Oil
P & ID	Process and Instrument diagrams.
PSAR	Preliminary safety analysis reports
PPE	Personnel Protective Equipment
PQR	Procedure Qualification Record
P&M	Plant and machinery
QA	Quality Assurance
QAP	Quality Assurance Plan
RA bill	Running Account bill
RT	Radiographic Testing
RTD	Resistance Temperature Detector
SCC	Special Conditions of Contract
SCPP	Secondary Cycle Piping
SMAW	Shielded Metal Arc Welding
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
LBW10-20,60-90	Turbine sealing steam system (including valve stems)
LBW30-50	TDFP sealing steam system (including valve stems)
LC.	Condensate systems

KKS Code	System Designation
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 Pumps HX Casing
LCP	Turbine hall demineralized water system
LCR	TDFP turbine condensate system
LCS	Re-heater heating steam condensate system
LCT	MS/SR moisture separator condensate system
LCW	Sealing and cooling steam drains system
LCX	Feeding pipeline of NRV with servomotor
LD.	Condensate polishing systems (UDP)
LDB	Autonomous dematerializing plant system
LDF	Turbine condensate deironing and polishing demineralization system (UDP)
LDN	Component cooling water chemistry control system
LDP	Spent resins from UDP regeneration and flushing system
LDR	UDP washing and regeneration water system
LF.	Common installations for steam, water, gas cycles
LFN	Secondary working fluid correction treatment system
LST	Balancing piping of moisture separator re-heater for separate
MA.	Steam turbine plant
MAA	HP cylinder system
MAC	LP cylinder system
MAG	Turbine condensers system

KKS Code	System Designation
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 feed water systems
QUB	Automated chemical monitoring system for steam systems
QUC	Automated chemical monitoring system for condensate systems
QUD	Sampling system for the auxiliary steam generation
QUG	Automated chemical monitoring system for unit demineralizing plant systems
QUH	Sampling system for secondary cycle and condensate polishing plant
SC.	Stationary process air systems

KKS Code	System Designation
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 essential loads
PUE	System for drain water pumping out from pump houses of essential loads

KKS Code	System Designation
PUK	System for washout of PAA system revolving screens
PUJ	System for washout of trashrack tray of median purification of PAA main system
PUP	System for washout of trash rack tray of median purification and PEA system revolving screens
PUQ	Tunnel discharge water drain system
PUV	Oil supply system of pump houses
PUN	Sea water supply system to Chlorination plant
PUL	Fish diversion ejector power supply system
PUS	Cooling system of fish pump
PUM	Airlift power supply system
PUT	Fish protection facility service rooms drainage
PUX	System of air supply to the instruments measuring the pressure differential and water levels in intake structure.
GML	Drainage water pumping out from main pumping house
SCD	Compressed air system
UMA	Turbine Building
UMV	T & G Oil Building
UMW	TB emergency oil discharge tank
1UGZ	Process tunnel to tanks 1UGB, 2UGB, UGC
2UGZ	Process channel to tank 1UGS
UQA	Main pump house
UQC	Essential load pump house
UQD	Pressure pipelines of main cooling water structure
UQE	Discharge pipelines of main cooling water structure
UQG	Inlet portal of discharge pipeline
UQN	Discharge channel
UQR	Chiller building
UQU	Discharge Pipeline

KKS Code	System Designation
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 etc
+12.3 m	Exhaust fans for vapor evacuation etc
+16.8 m	MKW filters etc
+22.1 m	MKW Damper tanks (on Platform at +24.5 m)

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

3. UMW-Turbine building emergency oil discharge structure :

The Emergency Oil discharge tank (UMW) is a rectangular underground concrete structure with metal casing. The tank is located at the basement location of -5.000 m outside to the south of UMA building. The dimensions of the tank are 8.8 m x

4.8 m x 4.55 m. The main purpose of the structure is to facilitate for the storage or discharge of oil under emergency conditions from UMV building. The tank is provided with hatches and breather for the discharge of oil vapours to atmosphere. The details of elevations and equipment

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

4. 2UGZ- Process tunnel:

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

5. 1UGZ- Process tunnel:

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

6. 2USF –Nitrogen receivers structure:

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

7. UQA -Main pump house:

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

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

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

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

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

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

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

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

8. UQC -Essential load pump house:

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

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

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

Sewage water biological cleaning station of the controlled access area 0 UGW includes the structures of Pump house with receiving tank (01UGW), Auxiliary- production building (02 UGW), Sand-trap (03UGW), Receiving tank (04UGW), Bio-filter (GQD06BB001, GQD06BB002), Stabilizer (05UGW001,

05UGW002), Sediment tank (06UGW001-06UGW004), Cleaned wastes container (07UGW), Contact tank (08UGW001, 08UGW002), Sand bed (09UGW), Sludge beds (01UGT), Gas release tube (11 UGW) and Pump house of the cleaned wastewater (03UGT).

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

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

ANNEXURE – IV

SYSTEMS DESCRIPTION

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)

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 31ºC 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.

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

VOLUME-IA PART – I CHAPTER – III

FACILITIES & CONSUMABLES IN THE SCOPE OF CONTRACTOR / BHEL

(SCOPE MATRIX)

Sl.No	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
1.3.1	**PART I**			
1.3.1.1	**ESTABLISHMENT**			
1.3.1.1.1	**FOR CONSTRUCTION PURPOSE:**			
1.3.1.1.1.1	Open space for office	Yes		Free
1.3.1.1.1.2	Open space for storage	Yes		Free
1.3.1.1.1.3	Construction of bidder‘s office, canteen and storage building including supply of materials and other services		Yes	
1.3.1.1.1.4	Bidder‘s all office equipment, office / store / canteen/Consumables.		Yes	
1.3.1.1.1.5	Canteen facilities for the bidder‘s staff, supervisors and engineers etc		Yes	
1.3.1.1.1.6	Firefighting 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		(One point at unit 3)
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 At the construction site /area		Yes	
1.3.1.4.2	For construction work (Execution of the lighting work / arrangements) At office storage area At the preassembly area At the construction site /area		Yes	
1.3.1.5	**COMMUNICATION FACILITIES for site operations of the bidder**			
1.3.1.5.1	Telephone, Fax, internet, internet, email etc (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 equipment’s required for compressor & compressed air system including pipes, valves, storage systems etc		Yes	
1.3.1.6.2	Installation of above system and operation & maintenance of the same		Yes	
1.3.1.6.3	Supply of the all the consumables for the above system during the contract period		Yes	

Sl.No	Description	Scope to be taken care by		Remarks
		BHEL	Bidder	
1.3.2	**PART II**			
1.3.2.1	**ERECTION FACILITIES**			
1.3.2.1.1	Engineering works for construction	Yes		In consultation with BHEL
1.3.2.1.2	Providing the erection drawings/ documents for all the equipment covered under this scope	Yes		
1.3.2.1.3	Drawings for construction methods		Yes	
1.3.2.1.4	Joint codifications, As-built drawings – wherever deviations observed and executed and also based on the decisions taken at site- example – routing of small bore pipes		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 including consumables like rubber, gaskets, cleaning kits etc.
1.3.2.1.7	Closed fabrication shed (only empty shed on shareable basis), if required	Yes		Equipment for fabrication are in the scope of contractor.
1.3.2.1.8	Preparation of site erection schedules and other input requirements		Yes	In consultation with BHEL
1.3.2.1.9	Review of performance and revision of site erection schedules in order to achieve the end dates and other commitments		Yes	
1.3.2.1.10	Weekly erection schedules based on Sl No 1.3.2.1.8		Yes	
1.3.2.1.11	Daily erection / work plan based on Sl No 1.3.2.1.10		Yes	
1.3.2.1.12	Preparation of preassembly bay		Yes	

1.3.2.1.13	Periodic visit of the senior official of the bidder to site to review the progress so that works are completed as per schedule. It is suggested this review by the senior official of the bidder should be done once in every two months.		Yes	

1.3.3 LAND FOR SITE OFFICE

1.3.3.1 Minimum open space as made available by customer will be provided at free of charges to the contractor, for construction of temporary office shed, storage area, storage shed, work shop and RT source storage pits etc. inside the plant area. All the arrangements will be subject to the approval of Engineer prior to setting up of such facility.

1.3.3.2 The contractor's office shall be semi-permanent structure and built with standard construction materials. No make shift structures are permitted. The facilities to be built by the contractor shall be aesthetically pleasing and shall match with the general surrounding of KKNPP site.

1.3.3.3 Location and area requirement for office / storage sheds shall be discussed and mutually agreed to.

1.3.4 ELECTRICITY:

1.3.4.1 Construction power will be provided to the contractor – one point at each unit 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) TANGEDCO fixed electricity charges present rate is Rs 350 per KVA per Month
d) 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.

1.3.4.2 Contractor to maintain log sheet with BHEL engineering in charge signature for weekly/ monthly power consumption and healthiness of ELCB.

1.3.4.3 Provision of distribution of electrical power from the given points to the required places with proper distribution boards, approved cables and cable laying including supply of all materials like cables, switch boards, pipes etc., observing the safety rules laid down by electrical authority of the State/ BHEL / their customer with appropriate statutory requirements shall be the responsibility of the tenderer / contractor.

1.3.4.4 BHEL is not responsible for any loss or damage to the contractor 's equipment as a result of variations in voltage / frequency or interruptions in power supply.

1.3.4.5 Necessary "Capacitor Banks" to improve the Power factor to a minimum of 0.9 shall be provided by the contractor at their cost. Penalty if any levied by customer on this account will be recovered from contractor's bills.

1.3.4.6 As there are bound to be interruptions in regular power supply, power cut/load shedding in any construction sites, contractor should make their own arrangement for alternative source of power supply through deployment of adequate number of DG sets at their cost during the power breakdown /failure to get urgent and important work to go on without interruptions. No separate payment shall be made for this contingency.

1.3.4.7 All electrical installations/works shall be carried out by qualified electricians under supervision GOVT approved electrical contractor as per IE Guide lines and Safety procedure of NPCIL. The same shall be maintained properly and regular periodic maintenance shall be carried out to ensure healthiness of electrical system.

1.3.4.8 All cabling and installations shall be subject to the approval of the Engineer/Safety Engineer and shall comply in all respects to the appropriate statutory requirements given in the following.

i. Indian Electricity Act 1910 (as amended/latest)

ii. Electricity Supply Act 1910 (as amended/latest)

iii. Indian Electricity Rules 1956 (as amended/latest)

iv. TNEB regulations (latest)

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

1.3.4.9 **DOMESTIC POWER SUPPLY FOR LABOUR CAMP**

i. TNEB/TANGEDCO established LT Power distribution arrangement in the labour camp area.

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

1.3.5 CONSTRUCTION WATER

1.3.5.1 BHEL/NPCIL will not be able to supply water at plant site to the contractor. The Contractor shall make his own arrangements to meet the desired quality and quantity of construction water demand at his own cost from 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 of KKNPP.

1.3.7 LIGHTING FACILITY

1.3.7.1 Adequate lighting facility and illumination level in line of Rule - 11 of Atomic Energy (Factories) Rules 1996 for buildings and outside area such as flood light, hand lights and area lighting shall be provided by the contractor at his own cost at the site of erection, at the storage of his materials and equipment and at temporary access roads within the working area. The contractor shall obtain the approval of the Engineer for the lighting arrangement prior to installation. The lighting

fixtures used shall be of good quality with all its systems and control gears working in good condition.

1.3.7.2 The lighting network to be established during the construction phase shall be of semi - permanent nature using pre-fabricated channels, conduiting or cleating of cables etc. Hanging or indiscriminate looping of lighting cables is not acceptable and Engineer reserves the right to disconnect any lighting network carried out in an unsafe and untidy manner. Any recommendations given by the Engineer in this regard to improve the safety and aesthetic appearance of the electrical installations shall be binding on the Contractor.

1.3.7.3 All the electrical safety requirements stipulated at site from time to time shall be adhered and complied in order to ensure complete electrical safety of all installations as well as operation, control and protection etc.,

1.3.7.4 Contractors are encouraged to explore the possibility of using renewable and green energy sources such as solar energy and LED lighting in their premises at site and labor camp.

1.3.8 LAND FOR STAFF AND LABOUR CAMP

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

In respect of any land allotted to the Contractor for purposes of or in connection with the Contract, the Contractor shall be a licensee subject to the following and such other terms and conditions as may be imposed by 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 and printers of latest configuration (along with one operator per PC) to be arranged by contractor for data entry in construction management software, online material management, reporting of daily progress, billing and other similar activities, within the quoted rate.

ii. Computers shall have latest configuration preferably of Windows 10 OS, i5 processor, 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:

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

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

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

1.3.11 WATER FOR LABOUR CAMP

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

1.3.12 CONSUMABLES:

i. 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 for pipe supports, metal structures, platforms and permanent supports the supply of welding electrodes, filler wires, and welding consumables are in the scope of contractor.

iii. For executing the work on all BHEL supplied material like Pipes, fittings, Valves, strainers etc the supply of welding electrodes, filler wires, and welding consumables are in the scope of contractor.

iv. 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.

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, supply of Ammonia for hydro testing of pipelines 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 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 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 towads non compliance of above and dual benifit to contractor of any govt anounced scheme will be passed to the contractor .

1.3.15 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.

1.3.16 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 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.

Indicative List of Plant And Machinery To Be Deployed		
S.no	**Description of Equipment**	**Qty (nos.)**
	Welding	
1	Welding machine	25
2	High frequency TIG welding machine	10
3	Pipe chamfering machine	As required
4	Pipe bending machine	As required
5	Grinding Machine	25
6	Mother oven	3
7	Portable oven	25
8	Transfer oven/Holding Oven	3
9	De humidifier	As required
10	Gas cutting set	5
11	Fitter tool kit	25
12	Engraving machine	As required
	NDT	
13	RT source with camera	2
14	X-ray machine	1
15	UT machine	2
16	RT film Digitization equipment	As required
17	PMI machine	1
	Facilities	
18	DG set	As required
	MHE and load carrier	
19	Mobile crane (20/23 T)	1
20	Hydra (12-16 T)	2
21	Electric winch 10T	As required
22	Trailer 40 Feet	As required (min.1)
23	Tata Ace HT/ Tata 407	1
	Rigging	
24	Hydraulic jacks	As required
25	Chain pulley block/Rachet lever hoist (Upto 20 T)	As required
26	Wire rope slings	As required
27	Web sling	As required

Indicative List of Plant And Machinery To Be Deployed		
S.no	**Description of Equipment**	**Qty (nos.)**
28	D- shackle	As required
29	Bow shackle	As required
30	Eye bolt	As required
31	Manila rope	As required
32	Skid roller	As required
	Machines	
33	Hand Drilling machine	As required
34	Insitu boss drilling machine	2
35	Air Compressor 400 cfm	As required
36	Torque wrench	As required
37	Hydraulic torque wrench	As required
38	Induction heater for bolt tightening	1
39	Drilling machine	As required
40	Power hacksaw	1
	Testing and Measurements	
41	Total station	As required
42	Dumpy level	As required
43	Pressure gauges	As required
44	Electric hydro test pump up to 250Kgf/cm2	4
45	Fill pump	As required
46	Theodolite	As required
47	Vernier calipers	As required
48	Boroscope for FME Inspection	As required
49	Weld gauges	As required
50	Profile gauge	As required
51	Hardness gauge	1
	Miscellaneous	
52	Vacuum cleaner	As required
53	Pump Required for filling and flushing	1
54	Hot Air blower	1
55	24V transformer	3
56	Dewatering pumps 10HP	1
57	Dewatering pumps 5HP	2
58	Tapset, Dieset and Reamers	As required
59	Scaffolding set	As required
60	Plotter and printers	As required
61	Water tanker	As required
62	Lux Meter	1
63	Sound Meter	1

Indicative List of Plant And Machinery To Be Deployed		
S.no	**Description of Equipment**	**Qty (nos.)**
64	Exhaust fan	As required
65	Air Blower	As required
66	Fire extinguishers	As required
67	PPEs	As required

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 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. 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.

NOTE:

i. Allocation will be made on mutually agreed plan and review of progress.

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

1.5.2 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.

1.5.2.1 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.

1.5.2.2 Closed fabrication shed if required. Only empty shed will be provided by BHEL. Any partition, structures/handling arrangement required for Closed fabrication shed shall be carried out by the contractor at his cost. Equipment for fabrication are in the scope of contractor.

1.5.3 All the erection facilities mentioned in clause **1.5.2** 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.

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

1.5.5 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

1.5.6 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.

1.5.7 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.

1.5.8 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.

1.5.9 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.

1.5.10 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.

VOLUME-IA PART-I CHAPTER- VI

TIME SCHEDULE

1.6.1 TIME SCHEDULE

1.6.1.1 The entire work of Erection, alignment, welding, NDT, fixing of pipe supports, flushing, hydro testing as per requirement of Secondary cycle piping system and all associated Piping including handling at site stores / storage yard, transporting to site at KKNPP UNIT 3 shall be completed within 14 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)
		Unit 3
1	Start of work	1st Month
2	Hydrotest of Aux. Steam Piping (LBG-IBR)	9th Month
3	Flushing of Condensate system	11th Month
4	Flushing of Feed water system	13th Month
5	Completion of Contractual Obligations	14th 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	Hydrotest of Aux. Steam Piping (LBG-IBR)	9th Month	**M1**
2	Flushing of Feed water system	11th Month	**M2**

1.6.6 PENALTY FOR INTERMEDIATE MILESTONES

i. M1 shall be intermediate Milestone for this work.

ii. In case of slippage of these identified Intermediate Milestones, Delay Analysis shall be carried out on achievement of each of these Intermediate Milestones in reference to Form 14.

iii. In case delay in achieving each M1 milestone is solely attributable to the contractor,0.5% per week of executable contract value* limited to maximum 2% of executable contract value will be withheld.

iv. In case delay in achieving each M2 milestone is solely attributable to the contractor,0.5% per week of executable contract value* limited to maximum 3% of executable contract value will be withheld.

v. Amount already withheld, if any, against slippage of M1 milestone, shall be released only if there is no delay attributable to contractor in achievement of M2 milestone.

vi. Amount required to be withheld on account of slippage of identified intermediate milestone(s) shall be withheld out of respective milestone payment and balance amount (if any) shall be withheld @10% of RA Bill amount from subsequent RA bills.

vii. Final deduction towards LD (if applicable), on account of delay attributable to contractor shall be based on final delay analysis on completion / closure of contract. Withheld amount, if any due to slippage of intermediate milestones shall be adjusted against LD or released as the case may be.

viii. In case of termination of contract due to any reason attributable to contractor before completion of work, the amount already withheld against slippage of intermediate milestones shall not be released and be converted in to recovery.

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

1.6.7 CONTRACT PERIOD

The contract period for completion of entire work under scope shall be 14 **months** from the "COMMENCEMENT OF CONTRACT PERIOD" as specified earlier for completion of the entire work under this package.

1.6.8 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

1.6.9 Secured Advance: Not Applicable.

1.6.10 Advance for Mobilization: Not Applicable.

1.6.11 Terms of Payment

BOQ item no	The following percentage of quoted rates of BOQ items will be paid on submission of respective reports along with RA bill after completion of relevant activities of the work on prorata basis.				
	Stage	1	2	3	4
	Work	70%	20%	5%	5%
F1.5, F1.6,F2,F3.3, F4, F5, F6.1, F6.3	Welding (CS/SS/Ti)	Welding Inspection Report		CCC	Material Accounting Statement.
F7.1,F7.2	Preparation of weld edge	Welding Report	Welding Inspection Report	CCC	Material Accounting Statement.
F8	Erection of (CS/SS/Ti)	Erection Report	Hydro test Report	CCC	Material Accounting Statement.
F11	Cold bending	Bending Inspection Report	NDT Report	CCC	Material Accounting Statement.
F12.1,F12.2,F12.3	Assembly of flanged joints	Flange Alignment Report	Hydro test Report	CCC	Material Accounting Statement.
F13.1 , F13.2, F13.3	Valves (VTF)	Valve Testing Report		CCC	Material Accounting Statement.
F14.1, F14.2, F14.3	Valves (Erection)	Erection Report	Welding Inspection Report / Flange	CCC	Material Accounting Statement.

BOQ item no	The following percentage of quoted rates of BOQ items will be paid on submission of respective reports along with RA bill after completion of relevant activities of the work on prorata basis.				
	Stage	**1**	**2**	**3**	**4**
	Work	**70%**	**20%**	**5%**	**5%**
			Alignment Report		
F15.1, F15.2	Supports	Erection Report	Hydro test Report	CCC	Material Accounting Statement.
F18	Stub/O-let drilling	Drilling Report	FME Inspection Report	CCC	Material Accounting Statement.
F19, F20, F21, F22	NDT (CS/SS/Ti)	NDT Report	Hydro test Report	CCC	Material Accounting Statement.
F23	Testing (CS/SS/Ti)	Hydro test Report	Draining & De-watering Report	CCC	Material Accounting Statement.
F29.6	Fabrication & Erection of piping for flushing	Erection Report	Flushing Report	Normalisation Report	Material Accounting Statement.
F29.8	Flushing of Piping system (steam/water/Air)	Flushing Report	Normalisation Report (25%)		CCC
F31	Digitalization of RT films	Soft copy of films		CCC	Material Accounting Statement.
L8.1.1, L8.1.2,L8.1.3	Man power assistance during repair works	Muster card (100%)			
L8.2.1,L8.2.2,L8.2.3	Man power assistance during re-preservation	Muster card (100%)			

<table>
<tr><td rowspan="3">BOQ item no</td><td colspan="5">The following percentage of quoted rates of BOQ items will be paid on submission of respective reports along with RA bill after completion of relevant activities of the work on prorata basis.</td></tr>
<tr><td>Stage</td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>Work</td><td>70%</td><td>20%</td><td>5%</td><td>5%</td></tr>
<tr><td>L8.4.1 , L8.4.2, L8.4.3</td><td>Manpower assistance during System pre-handing over checks.</td><td colspan="4">Muster card (100%)</td></tr>
<tr><td>L8.5.1</td><td>Erection and dismantling of Scaffolding</td><td colspan="4">Erection Report (50%), Dismantling report (50%)</td></tr>
<tr><td>L8.5.2</td><td>Hire charge for scaffolding</td><td colspan="4">Clearance report (100%)</td></tr>
<tr><td>L9.1, L9.2, L9.3</td><td>Insitu Modification works</td><td colspan="4">Clearance report (100%)</td></tr>
<tr><td>L.10.1, L.10.2</td><td>Shifting & handling of materials</td><td colspan="2">Incoming Material Inspection Report</td><td>Store documentation</td><td>Material Accounting Statement.</td></tr>
</table>

NOTE: Refer Part II Chapter 1 of this Technical Conditions of Contract for Corrections/ Revisions in Special Conditions of Contract, General Conditions of Contract and Forms & Procedures.

VOLUME-IA PART – I CHAPTER – VIII

TAXES AND DUTIES

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 favor 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 (BOQ)

Please refer to Volume II, Price Bid, Part-C for detailed BOQ.

NOTE TO BOQ:

1.9.1 The Price bid contains the consolidated list of BOQ with brief description of items. The quantity indicated in the BOQ / Price bid is approximate only and is liable for variation. Payment will be as per actual quantity executed as certified by BHEL Engineer.

1.9.2 Before filling the Rates in the Price bid, the bidder shall go through the detailed specification of all items of BOQ as well as Scope of Work as specified in relevant Clause of this document.

1.9.3 Bidders shall refer Volume II, Price Bid, Part –A for Instructions.

1.9.4 Bidders shall quote "Total Amount" in the format enclosed as a separate Excel File in e-Procurement portal for the subject tender and upload the same under "Packet details - > Tender covers -> Finance '(Cover Type Description – Price Bid) and same shall be taken into account for evaluation and awarding and hence, shall be complete in all respect for the full scope of work defined in specification and in accordance with terms & conditions of the tender.. Any other entry elsewhere in the price bid shall be treated as Null and Void. Quoting of rates in any other form/formats will not be entertained.

1.9.5 The above mentioned "Total amount" is for the entire Bill of Quantity (BOQ) given in Part -C of the Price Bid.

1.9.6 BHEL has pre-fixed the weightages for the amount of individual items of Bill of Quantity with respect to the "Total Amount" in Part-C.

1.9.7 Based on the pre-fixed weightages, the amount for the individual items of the Bill of Quantity shall be arrived at. This amount shall be rounded off to the nearest rupee.

1.9.8 Based on the quantities of individual item and the amount arrived in Sl.No.: 1.9.7 above, unit rate of individual items shall be derived. This unit rate shall be rounded off to four decimal places.

1.9.9 Bidders to note that this is an item rate contract. Payment shall be made for the actual quantities of work executed at the unit rate arrived at as per Sl.No. 1.9.8 above.

Note: BOQ ref no L8.1.1, L8.1.2, L8.1.3, L8.2.1, L8.2.2, L8.2.3, L8.4.1, L8.4.2, L8.4.3 Items were Manpower assistance is to be provided. Bidder to ensure minimum rates of remuneration to the various categories of workmen to be deployed as mentioned under VOLUME-IA PART – I CHAPTER – III Clause 1.3.15 "Fair Wages".

VOLUME-IA PART – I CHAPTER – X

GENERAL

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

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

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

i) Security Deposit
ii) Unqualified Acceptance for LOI, Detailed LOI / Work Order.
iii) Rs.100/- Stamp Paper for preparation of Contract Agreement.

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

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

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.

10.3.1 BOCW Act & BOCW Welfare Cess Act

10.3.1.1 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.

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

10.3.1.3 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.

10.3.1.4 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.

10.3.1.5 Contractor shall make remittance of the BOCW cess as per the 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, fees paid towards registration of Beneficiaries and Contribution of Beneficiaries remitted.

10.3.1.6 Non-compliance to Provisions of the BOCW Act & BOCW Welfare Cess Act is not acceptable. In case of any non-compliance, BHEL reserves the right to withhold any sum as it deems fit. Only upon total compliance 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

10.4 PROVIDENT FUND

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

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

10.5 **OTHER STATUTORY REQUIREMENTS**

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

10.5.2 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.

10.5.3 The Contractor should ensure compliance of Sec 21 of Contract Labour (R&A) Act 1970 regarding responsibility for payment of Wages. In case of “Non-compliance of Sec 21 or non-payment of wages” to the workmen before the expiry of wage period by the contractor, BHEL will reserve its right to pay the workmen under the orders of Appropriate authority and recover the expenses incurred plus applicable overheads from the dues payable to the contractor.

10.5.4 The Contractor shall submit copies of Final Settlement statement of disbursal of retrenchment benefits on retrenchment of each workmen 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 Act 1948 (if applicable) to BHEL along with the Final Bill.

10.5.5 In case of any dispute pending before the appropriate authority under ID Act 1948, WC Act 1923 or ESI Act 1948 and PF Act 1952, BHEL reserve the right to hold such amounts from the final bills of the Contractor which will be released on submission of proof of settlement of issues from the appropriate authority under the act.

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

10.6 DEPLOYMENT OF SKILLED / SEMI-SKILLED TRADESMEN

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

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

10.7 Site Visit by the Bidder

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

10.7.1 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.

10.7.2 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.

10.7.3 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.

10.7.4 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.

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

10.7.6 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.

10.7.7 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.

10.7.8 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.

10.7.9 The contractor shall carry out additional tests, if any, which the Engineer feels necessary because of site conditions and also to meet system specification.

10.7.10 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.

10.7.11 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.

10.7.12 Wherever Construction sequences are furnished by BHEL, the contractor shall follow the same sequence. Contractor shall execute the supply and works as per sequence prescribed by BHEL at site engineer. No claims for extra payment from the contractor will be entertained on the grounds of deviation from the methods of execution of similar job in any other site or for any reasons whatsoever.

10.7.13 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.

10.7.14 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.

10.7.15 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.

10.7.16 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.

10.7.17 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.

10.7.18 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.

10.7.19 The contractor must obtain the signature and permission of the security personnel of the customer / BHEL for bringing any of their materials inside the site premises. Without the Entry Gate Pass these materials will not be allowed to be taken outside. Surplus materials including

steel item brought at site by the contractors with proper documentation and Gate pass, shall be allowed to taken out of the project premises after completion of relevant works, on certification by BHEL in charge.

10.7.20 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 and recover the expenses incurred plus applicable overheads from the dues payable to the contractor, if there is any failure on the part of contractor in this respect.

10.7.21 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.

10.7.22 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.

10.7.23 No member of the already erected structure / buildings, other component and auxiliaries should be removed / modified without specific approval of BHEL engineer.

10.7.24 Contractors shall ensure that all their Staff / Employees are exposed to periodical training programme conducted by qualified agencies/ personnel on latest ISO 9001 Standards.

10.7.25 Sometimes, it may be required to re-schedule the activities to enable other agencies to commence/ continue the work so as to keep the overall project schedule.

10.7.26 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.

10.7.27 Crane operators deployed by the contractor shall be tested by BHEL before he is allowed to operate the cranes.

10.7.28 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.

10.7.29 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.

10.7.30 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.

10.7.31 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.

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

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

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

10.7.35 RECORDS TO BE MAINTAINED AT SITE:

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

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

(i) Hindrance Register

(ii) Site Order Book.

(iii) Test Check of measurements.

(iv) Steel & Cement Supply and Consumption Daily Register

(v) Records of Test reports of Field tests.

(vi) Records of manufacture's test certificates.

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

10.8 SITE INSPECTION

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

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

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

10.8.4 Field Quality Assurance (FQA) Formats: -

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

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

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

10.9 DOCUMENTATION

10.9.1 The following information shall be furnished by the bidder within two weeks of award of contract for purchaser's approval:

a) Bar chart covering planned activities at site
b) Detailed organization chart
c) Details of T&P available with contractors with documents proofs.

10.9.2 The following information shall be furnished by the bidder after testing and inspection:
Test certificates of various tests conducted at site. All inspection and test certificates shall be signed by BHEL representative also.

10.10 RECORDS TO BE MAINTAINED AT SITE:

10.10.1 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.

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

a. Hindrance Register.
b. Site Order Book.
c. Test Check of measurements.
d. Supply and Consumption Daily Register of Cement and Steel
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.

VOLUME-IA PART-I CHAPTER – XI

PROGRESS OF WORK

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

1.11.1 Refer forms F -14 to F-18 of volume I D (Forms & Procedure) of volume -I Book-II. Plan and review will be done as per the formats. These should be submitted on monthly basis with duly signed by BHEL and Contractor.

1.11.2 Contractor is required to draw mutually agreed monthly erection programs in consultation with BHEL well in advance. Contractor shall ensure achievement of agreed program and shall also timely arrange additional resources considered necessary at no extra cost to BHEL.

1.11.3 Progress review meetings will be held at site during which actual progress during the week vis-a-vis scheduled program shall be discussed for actions to be taken for achieving targets. Contractor shall also present the program for subsequent week. The contractor shall constantly update / revise his work program to meet the overall requirement. All quality problems shall also be discussed during above review meetings. Necessary preventive and corrective action shall be discussed and decided upon in such review meetings and shall be implemented by the contractor in time bound manner so as to eliminate the cause of non-conformities.

1.11.4 Tenderers have to furnish a list of Tools and Plants including cranes, Tractor / Trailers etc., which they propose to deploy for this work.

1.11.5 The contractor shall submit daily, weekly and monthly progress reports, manpower reports, materials reports, consumables (gases / electrodes) report, cranes availability report and other reports as per Performa considered necessary by the Engineer. The periodicity of the reports will be decided by BHEL Engineer at site.

1.11.6 The contractor shall submit weekly / fortnightly / monthly statement report regarding consumption of all consumables for cost analysis purposes.

1.11.7 The contractor shall submit a report of any damage, shortage, discrepancy etc., every week detailing in this regard.

1.11.8 The manpower reports shall clearly indicate the manpower deployed, category wise specifying also the activities in which they are engaged.

1.11.9 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 Loading of material at BHEL / Customer stores and storage yard, transport to site, unloading at site / working area of equipment placement on respective foundation / location, fabrication yard, pre-assembly bay or at working area are in the scope of work of contractor. Required cranes, tractors, trailer or trucks / slings / tools and tackles / labour including operators Fuel lubricants etc for loading & unloading of materials will be in the scope of contractor.

1.12.2 The storage yard is located in more than one location within the Main Plant Boundary.

1.12.3 Shifting and handling of materials from NPCIL's store to BHEL/contractors store/yard for prefabrication, painting works or for any other work involved. **Appr. distance between NPCIL to BHEL yard/stores is 6kms.**

1.12.4 Shifting and handling of materials from BHEL yard/stores/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. **Appr. distance between BHEL yard/stores to erection site is 6kms.**

1.12.5 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.

1.12.6 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. Materials shifting to site shall be planned in such a way that those materials required for 1-2 weeks shall only be shifted and stored near site erection area. Edge protection of pipes shall be ensured with end cap at every stage of work.

1.12.7 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.

1.12.8 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.

1.12.9 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.

1.12.10 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.

1.12.11 The contractor shall provide any fixtures, concrete blocks & wooden sleepers, which are required for temporary supporting of the components at site.

1.12.12 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

SAFETY

1.13.0 SAFETY CLAUSE/CONDITIONS:

1.13.1 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.

1.13.2 SAFETY ORGANIZATION OF THE CONTRACTOR:

The following minimum requirement shall be fulfilled:

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

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

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

1.13.3 QUALIFICATION OF SAFETY PROFESSIONAL SHALL BE AS FOLLOWS:

- **SAFETY OFFICER:**

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

- **SAFETY SUPERVISOR:**

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

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

1.13.4 TRAINING REQUIREMENTS

i. The Contractor shall provide mandatory Industrial Safety Training to all workmen.

ii. The Contractors shall establish their own safety training centre having adequate seating capacity and infrastructure for training.

iii. Induction safety training shall be provided to all personnel of the Contractors within the first three days of entry into plant site, failing which the workmen shall not get plant entry pass for further extended period.

iv. After the induction safety training, the workmen should undergo refresher training once in every six months. Safety training card in prescribed format shall be issued to all workmen after completion of training.

v. The duration of the training shall be minimum four hours. The typical syllabus for the training is as follows:

a) Hazards at construction sites. Use of personal protective equipment and their practical demonstration. Mock drill to ensure proper use of PPEs. Need for preventing accidents.

b) Aims and Objectives of safety, pep talk, and housekeeping. Safety Work Permit and Authorization to work on system equipment. Height Pass training and briefing about hazard prompt list.

c) DOs and DON'Ts on construction activities. Briefing about location of First aid/Fire station/Safety Section and their telephone numbers. Good safety practices of NPCIL projects.

d) Films on construction safety and feedback.

vi. The safety supervisors and the safety engineers will have to undergo refresher safety training in safety supervision and accident prevention techniques conducted by National safety Council or other recognized institutions once in a year.

1.13.5 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.

1.13.6 PERSONAL PROTECTIVE EQUIPMENT

1.13.6.1 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.

1.13.6.2 PERSONAL PROTECTIVE EQUIPMENT (PPE)

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

b) All the PPEs in use should be as per relevant IS standards as referred in the AERB safety guidelines on 'PPE'(AERB/SG/IS-3).

c) All persons employed at the construction site should use safety helmets. Safety helmet should be with BIS mark and should have its headband with back support and chin strap.

d) Workers employed on mixing asphaltic materials, cement and lime mortars should use protective goggles, protective foot wears, hand gloves and respirators as required.

e) Persons engaged in welding and gas-cutting works should use suitable welding face shields. The persons who assist the welders should use suitable goggles. Protective goggles should be worn while chipping and grinding.

f) Stonebreakers should use protective goggles. They should be seated at sufficiently safe distances from one another.

g) Safety goggles should be of shatterproof type and with zero power.

h) Persons engaged in or assisting in shot blasting operations and cleaning the blasting chamber should use suitable gauntlets, overalls, shatterproof and dust-proof goggles and self-contained breathing apparatus set.

i) All persons working at heights more than 2.5 m above ground or floor and exposed to risk of falling down should use full body harness safety belts, unless otherwise protected by cages, guard railings, etc. In places where the use of safety belts is not feasible, suitable net of adequate strength fastened to substantial supports should be used.

j) When workers are employed in sewers and inside manholes that are in use, it should be ensured that the manholes are opened and are adequately ventilated at least for an hour. After it has been well ventilated, the atmosphere inside the space should be checked for the presence of any toxic gas or oxygen deficiency by a competent person and recorded in the register before the workers are allowed to get into the manholes. A pilot team should enter the area donning self-contained breathing apparatus (SCBA). The manholes opened should be cordoned off with suitable railing and provided with warning signals or caution boards to prevent accidents. There should be proper illumination in the night. Depending upon the work situation, the facility should provide PPE including the SCBA as recommended by Head, industrial safety.

1.13.7 WORK PRACTICES

1.13.7.1 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.

1.13.7.2 WORK AT HEIGHT

a) For carrying out work at height of more than 2.5 meters above floor/ground level, height pass should be provided for all the workers involved in the work as per procedure, which includes ascertaining medical fitness by Registered Medical Practitioner and worker's physical test etc. If any worker is found working at height without required height pass, penalty as per Sr. No.5 of Annexure -1 shall be imposed.

b) Height work permit shall be obtained for all the works carried out on temporary staging, platforms etc. above a height of 2.5 meters from stable floor or ground floor. All implements used for height work such as scaffold, access stairs/ladders, platform, railings etc should be certified by concerned Engineer prior to its use and to the effect that they should have a display card as "Safe for use". Wood, bamboo or other combustible materials shall not be used for making staging/scaffolds.

c) The minimum 1m width of working platforms shall be maintained. All scaffolds or staging shall have guard rails, mid rails and toe boards. Safe means of access by means of portable or fixed ladders, stairways or ramps shall be provided for all workplaces at height. Cross bracings or frames of scaffold shall not be permitted as means of access.

d) Safety nets, fall arrestor system, lifelines and other such additional safety measures commensurate with the location and nature of work shall also be provided. Full body safety harness with double lanyard shall only be allowed for work at height.

1.13.7.3 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 CO_2) 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

1.13.7.4 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.

1.13.7.5 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.

1.13.8 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.

1.13.9 FIRE PROTECTION AND FIREFIGHTING ARRANGEMENTS

a) In accordance with the nature of material used during the execution of the job, suitable fire protection and firefighting arrangements, shall be ensured by the Contractor.

b) Based on the fire load, sufficient numbers of portable fire extinguishers shall be made available at worksites.

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

1.13.10 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.

1.13.11 WORK SPECIFIC SAFETY MEASURES

1.13.11.1 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.

1.13.11.2 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.

1.13.11.3 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.

1.13.11.4 SAFE MEANS OF ACCESS/PLATFORMS

a) Adequate safe means of access and exit should be provided for all work places, at all elevations.

b) Suitable scaffolds should be provided for workmen for all works that cannot be done safely from the ground, or from solid platform except such short duration work that can be done safely from ladders. Bamboo/wooden scaffolding should not be permitted.

c) Where the platform for working is more than 2.5 m above ground, the width of the platform should be minimum 1 m.

d) Ladder should be of rigid construction having sufficient strength for the intended loads. Wooden/bamboo/rope ladders should not be permitted. All ladders should be maintained in good condition. The ladders should be fixed to the ground or rigid platforms. An additional person should be engaged for holding the ladder, if ladder is not securely fixed. Ladder shall be extended from floor to at least one meter above the platform.

e) A portable ladder should be given an inclination not steeper than 1 in 4 (1 horizontal and 4 vertical). Ladders should not be used for climbing while carrying materials in hands. While climbing both the hands should be free.

f) Any working platform on scaffolding or staging more than 2.5 m above the ground or floor should have a guard rail attached, bolted, braced at least 1 m high above the floor or platform of such scaffolding or staging along with mid-rail.

g) Only metal platforms are allowed for any working platform The platform should be rigidly fixed at both ends to prevent sliding, slipping or tilting.

h) The guardrail should extend along the entire exposed length of the scaffolding with only such opening as may be necessary for the delivery of materials. Standard railing should have posts not more than 2 m apart and an intermediate rail halfway between the floor or platform of the scaffolding and the top rail. Such scaffolding or staging should be so fastened as to prevent it from swaying from the building or structure. Scaffolding and ladder should conform to IS 3696 (Part 1): 1987 and (Part II): 1996.

i) Working platforms of scaffolds should have toe boards at least 15 cm in height to prevent materials from falling down.

j) A sketch of the scaffolding proposed to be used should be prepared and approval by the engineer-in-charge obtained prior to start of erection of scaffolding. All scaffolds should be examined by engineer in-charge before use.

k) Working platform, gangways and stairways should be so constructed that they should not sag unduly or unequally and if the height of the platform or gangway or stairway is more than 2.5 m above ground level or floor level. They should have adequate width for easy movement of persons and materials and should be suitably guarded.

l) No single portable ladder should be used for access to a height of more than 4.5 m. For ladders up to 3m in length the width between styles (side bars)/width in the ladder should in no case be less than 300 mm. For longer ladders this width should be increased by at least 20 mm for each additional meter of length. Step/rungs spacing should be uniform and should not exceed 300 mm. Portable ladder should be used only for access to work place. In case work place is higher than 4.5 meters, pre-fabricated steel staircase should be used.

1.13.11.5 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.

1.13.11.6 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).

1.13.11.7 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.

1.13.11.8 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.

1.13.11.9 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.

1.13.11.10 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.

1.13.11.11 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.

1.13.11.12 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.

1.13.11.13 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.

1.13.11.14 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.

1.13.11.15 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

1.13.11.16 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.

1.13.11.17 ENVIRONMENTAL SAFETY

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

1.13.12 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.

1.13.13 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.

1.13.14 HOUSEKEEPING

a) The Contractor shall at all times keep his work spot, site office and surroundings clean and tidy from rubbish, scrap, surplus materials and unwanted tools and equipment.

b) Welding and other electrical cables shall be so routed as to allow safe traffic by all concerned.

c) No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or the public. The Engineer-In-Charge may require the Contractor to remove any materials which are considered to be of danger or cause inconvenience to the public. If necessary, the Engineer-In-Charge may cause them to be removed at the Contractor's cost.

d) At the completion of the work, the Contractor shall have removed from the work premises all scaffoldings, surplus materials, rubbish and all huts and sanitary arrangements used/installed for his workmen on the site.

e) The Engineer-In-Charge has the right to stop work if the Contractor fails to improve upon the housekeeping after having been notified.

f) It should be recognised that a proper place for everything and everything in its place is maintained for a good housekeeping.

g) The material required for immediate use only should be brought to the designated workplace and stacked properly and labelled suitably.

h) All work spots, site office and surroundings should all times be kept clean and free from debris, scrap, concrete muck, surplus materials and unwanted tools and equipment. A day-to-day collection and disposal of scraps/debris should be done safely at designated place.

i) Electrical cables, leads and hoses should be so routed as to allow safe traffic by all concerned. Cable should be preferably supported on the brackets fixed along the wall to maintain safe access.

Wherever routing on the floor cannot be avoided, care should be taken to ensure mechanical protection of these cables and safe access is not disturbed.

j) No material on any work place should be so stacked or placed or disposed off as to cause danger, inconvenience or damage to any person or environment.

k) All unused scaffoldings, surplus/scrap materials and equipment/ systems like temporary electrical panels etc. should not be allowed to accumulate and shall be removed from the premises at the earliest.

l) Accumulation of water/oil spillages on the floor or any other workplace should be avoided.

m) Proper aisle space marking should be provided in all workplaces.

1.13.15 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.

1.13.16 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	<u>Electrical Safety</u> ➢ Use of unsafe/damaged /nonstandard electrical equipment/ appliances ➢ Drawing power supply from power socket without plug ➢ Drawing power without or bypassing ➢ ELCB ➢ Faulty/inadequate earthing ➢ Unsafe cable joints ➢ Use of non-standard power distribution boards, extension ➢ boards ➢ Not carrying out periodic inspection of electrical system/equipment (without inspection stickers on PDBs, extension boards, power tools etc.) ➢ Not providing fire extinguisher & rubber mat near PDBs. ➢ Using polycarbonate switches, plugs and sockets instead of metal clad sockets and plugs ➢ Non-deployment of electrician	Rs 20,000 per violation
7.0	<u>Material Handling</u> ➢ 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	Fire protection and Fire fighting arrangements ➢ 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	Transportation of man and material ➢ 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	Housekeeping ➢ Non compliance of Housekeeping requirements. ➢ Urinating/defecating in non designated places ➢ Spitting in workplaces. ➢ Smoking in workplaces ➢ Writing graffiti in workplaces	Rs 1500 per violation

	➢ Temporary sheds in unauthorized places	

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 – XIV

NPCIL SECURITY RULES & MEDICAL MANAGEMENT

1.14.1 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.

1.14.1.1 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.

1.14.1.2 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.

1.14.1.3 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.

1.14.1.4 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.

1.14.1.5 Photography in Project Premises

Photography in Project Premises is strictly Prohibited.

1.14.2 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.

1.14.3 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.

1.14.4 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.

1.14.5 MEDICAL MANAGEMENT

FIRST AID CENTRE & AMBULANCE FACILITY

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

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

MEDICAL FACILITIES

a) Medical facilities conforming to the provisions of the Atomic Energy (Factories) Rules, 1996 should be provided at all work sites.
b) Well maintained first aid boxes should be kept at each location of the work by the contractor and availability of the personnel trained in first aid should be ensured.
c) The facility management/contractor shall make arrangements for the first aid and medical services for the injured or ill persons for prompt attention or aid.
d) The arrangement can be made by the contractor or an agreement can be in vogue with the facility.
e) Display of emergency contact numbers of important persons and hospitals and route map of site shall be maintained at designated places.
f) It should be ensured by the occupier that occupational health monitoring of contract workers is carried out as per provisions of the Factories Act 1948 as per the latest amendment and the stipulations/directions given by Atomic Energy Regulatory Board from time to time.

1.14.5.1 MEDICAL MANAGEMENT OF SERIOUS INJURIES

a) In case of serious injuries, the injured should be shifted to the nearest first-aid centre at site immediately. The opinion of medical officer/ certifying surgeon should be sought immediately for medical management.

b) After providing the first aid treatment the injured should be shifted to designated medical facility of the site/hospital for further medical assistance, in an ambulance along with a nursing attendant.

c) The doctor at the medical facility of the site/hospital attending the case shall assess the extent of injuries and render immediate medical aid. If the situation warrants trauma/special care the injured shall be shifted to the referral hospital, having all the requisite facilities for specialised treatment in ambulance along with a medical attendant.

d) A list of such referral hospitals for specialised medical management facilities for the injured persons should be available with the project management/Head, industrial safety and Head, medical services of the site for ready reference.

VOLUME - IA PART- I CHAPTER - XV

HOUSE KEEPING

1.15.1 MAINTENANCE OF CLEAN SITE CONDITIONS AND HOUSEKEEPING

1.15.1.1 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.

1.15.1.2 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.

1.15.1.3 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.

1.15.1.4 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

1.15.1.5 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.

1.15.2 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	

1.15.3 QUALIFICATION OF HOUSEKEEPING SUPERVISOR SHALL BE AS FOLLOWS:

a) Housekeeping In charge:

Any Degree / Diploma in engineering with two years project/ Industrial experience

b) Housekeeping Supervisor:

+2 with one-year Project/ Industrial experience or Any diploma

1.15.4 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.

1.15.5 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.

1.15.6 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.

1.15.7 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.

f) Contractor shall keep supervisor and supporting staff exclusively for housekeeping of own works.

g) Contractor shall submit the minimum manpower deployment schedule on monthly basis based on the approved housekeeping plan/ schedule for the approval of the ENC.

1.15.8 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.

1.15.9 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

1.15.10 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.

1.15.11 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.

1.15.12 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.

1.15.13 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.

1.15.14 DISPOSAL OF WASTE AND DEBRIS

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

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

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

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

VOLUME-IA PART-I CHAPTER- XVI

WEIGHT SCHEDULE

.TENTATIVE WEIGHT SCHEDULE FOR SECONDARY CYCLE PACKAGE (FIM BY NPCIL) FOR UNIT 3			
S.No.	**Particulars**	**UOM**	**QTY FOR ONE UNITS**
1.	Pipes, pipe blocks, fittings, accessories	MT	925
2.	Valves	MT	150
3.	Pipe Supports & its associated structural components.	MT	304

Note:

1. The weight indicated above is approximate and there may be a variation in weight of items.
2. The weight mentioned above is tentative balance placement weight. In addition to this tonnage, the contractor is responsible for completing the remaining balance of work that has already been undertaken.

This section provides list of Free Issue Materials (FIM BY NPCIL) to be issued to the contractor for erection. The list contains the following groups in sequence	
S.No	**Description**
1	List of Pipelines in MT system wise
2	List of Valves in Nos. System wise
3	List of Supports in MT. System wise

List of Pipelines in MT System wise as FIM in SECONDARY CYCLE PACKAGE FOR UNIT 3				
S.NO	**System KKS code**	**Material**	**Building**	**Weight in MT**
1	GHA	CS	UMA	3
2	PAB90	CS	UMA	16
3	PAS	CS	UMA	10
4	LBG	CS	UMA	122
5	LCM	CS	UMA	5
6	MAL	CS	UMA	11
7	O-system (LBG)	CS	UMA	9
8	O-system (LCM)	CS	UMA	4
9	LDN	CS	UMA	1
10	LFN	CS	UMA	0.02
11	PGB	CS	UMA/UMV	128
12	LBA	CS	UMA	50
13	LBB	CS	UMA	10
14	LBQ	CS	UMA	5
15	LBS	CS	UMA	10
16	LCN	CS	UMA	0
17	LCS	CS	UMA	10
18	LCT	CS	UMA	2
19	LST	CS	UMA	0
20	O	CS	UMA/UMV	45
21	QJB30	CS	UMA	1
22	QJB50	CS	UMA	0.3
23	QJC10	CS	UMA	0.1
24	SCB10	CS	UMA	0.5
25	PAB	CS	UMA	150
26	LCB	CS	UMA	3
27	LCC	CS	UMA	1

List of Pipelines in MT System wise as FIM in SECONDARY CYCLE PACKAGE FOR UNIT 3				
S.NO	**System KKS code**	**Material**	**Building**	**Weight in MT**
28	LCE	CS	UMA	12
29	LCH	CS	UMA	20
30	LCJ	CS	UMA	4
31	LCO	CS	UMA	0.4
32	LCX	CS	UMA	6
33	LDB	CS	UMA	0.3
34	LDF	CS	UMA	20
35	LDP	CS	UMA	0.4
36	LDR	CS	UMA	1
37	LCA	CS	UMA	50
38	LAA	CS	UMA	6
39	LAB	CS	UMA	100
40	LAC	CS	UMA	2
41	LAD	CS	UMA	2
42	LAH	CS	UMA	8
43	LAJ	CS	UMA	0.02
44	LCG	CS	UMA	0.1
45	LCR	CS	UMA	5
46	LBG	SS	UMA	1
47	LCM	SS	UMA	2
48	O-system (LCM)	SS	UMA	0.001
49	LCP	SS	UMA	6
50	LDN	SS	UMA	0.08
51	LFN	SS	UMA	2
52	PGB	SS	UMA	0.3
53	JEA50	SS	UMA	0.3
54	LCN	SS	UMA	6

List of Pipelines in MT System wise as FIM in SECONDARY CYCLE PACKAGE FOR UNIT 3				
S.NO	**System KKS code**	**Material**	**Building**	**Weight in MT**
55	LCS	SS	UMA	0.1
56	QUB	SS	UMA	0.2
57	PAB	SS	UMA	13
58	LCB	SS	UMA	0
59	LCE	SS	UMA	1
60	LCJ	SS	UMA	0.001
61	LCX	SS	UMA	0.0002
62	LDB	SS	UMA	5
63	LDF	SS	UMA	26
64	LDP	SS	UMA	4
65	LDR	SS	UMA	18
66	QUC	SS	UMA	2
67	QUG	SS	UMA	1
68	QUH	SS	UMA	0.2
69	LCA	SS	UMA	0.03
70	LAA	SS	UMA	0.1
71	LAB	SS	UMA	2
72	LAC	SS	UMA	0.4
73	LAH	SS	UMA	0.3
74	LAJ	SS	UMA	0.2
75	QUA	SS	UMA	0.1
Total Wt of CS pipeline (MT)				**834**
Total Wt of SS pipeline (MT)				**91**
Total Qty per in MT				**925**

List of Valves in Nos. System wise as FIM in in SECONDARY CYCLE PACKAGE FOR UNIT 3			
System KKS code	**Material**	**Building**	**Nos.**
GHA	CS	UMA	35
JEA	SS	UMA	11
LAA	CS	UMA	7
LAB	CS	UMA	181
LAC	CS	UMA	34
LAD	CS	UMA	84
LAH	CS	UMA	16
LAJ	CS	UMA	3
LBA	CS	UMA	14
LBB	CS	UMA	1
LBG	CS/CS	UMA	143
LBS	CS	UMA	2
LCA	CS/SS	UMA	100
LCB	CS	UMA	39
LCC	CS	UMA	7
LCE	CS	UMA	42
LCH	CS	UMA	25
LCJ	CS	UMA	12
LCM	CS	UMA	45
LCN	SS	UMA	23
LCP	SS	UMA	30
LCR	CS	UMA	5
LCS	CS	UMA	50
LCT	CS	UMA	25
LCX	CS	UMA	16
LDB	SS	UMA	15

List of Valves in Nos. System wise as FIM in in SECONDARY CYCLE PACKAGE FOR UNIT 3			
System KKS code	**Material**	**Building**	**Nos.**
LDF	CS/SS	UMA	177
LDN	CS/SS	UMA	12
LDP	CS	UMA	50
LDR	SS	UMA	37
LFN	SS	UMA	62
MAL	CS	UMA	57
PAS	CS	UMA	20
PGB	CS/SS	UMA/UMV	120
QJB	CS	UMA	40
QJC	CS	UMA	5
QUA	SS	UMA	8
QUB	SS	UMA	12
QUC	SS	UMA	56
QUG	SS	UMA	9
QUH	SS	UMA	8
SCB	CS	UMA	1
XAV	SS	UMA	100
Total Valves (Nos)			**1739**
Total Tentative weight (MT)			**150**

List of Supports in MT (system wise) as FIM in in SECONDARY CYCLE PACKAGE FOR UNIT 3			
Sr. No.	**KKS Code system**	**Quantity**	**Total Approx. weight**
		Nos.	**MT**
1	LCA	600	60
2	LCB	88	2
3	LCC	22	0.1
4	QUG	11	1.6
5	QUC	2500	16
6	LCX	121	0.5
7	LCE	138	2.5
8	LCH	50	3
9	LCO	129	1.3
10	LDB	25	0.5
11	LDF	200	12
12	LDP	25	0.5
13	LDR	121	10
14	QUH	144	0.8
15	LCJ	50	3
16	LBG	461	28
17	LCM	1600	8
18	MAL	188	1.3
19	O-system LBG	60	1.5
20	QJB	50	0.3
21	QJC	25	0.2
22	SCB10	27	0.1
23	PAB	30	45
24	LAA	88	3
25	LAB	400	30

List of Supports in MT (system wise) as FIM in in SECONDARY CYCLE PACKAGE FOR UNIT 3			
Sr. No.	**KKS Code system**	**Quantity**	**Total Approx. weight**
		Nos.	**MT**
26	LAC	215	1.5
27	LAD	130	1.5
28	LAH	130	4
29	LAJ	27	0.3
30	LCR	50	1
31	QUA	100	1
32	GHA	390	1.5
33	PAB 90	24	2
34	PAS	100	10
35	LCP	200	5
36	LDN	12	1.5
37	LFN	10	0.5
38	PGB	400	5
39	JEA50	40	0.6
40	LBA	150	15
41	LBB	22	3.5
42	LBQ	20	2.5
43	LBS	30	7
44	LCN	70	2
45	LCS	100	1.5
46	LCT	50	2
47	LST	8	0.3
48	O	75	2
49	QUB	276	2.5
	Total Qty for unit 3	**9782**	**304**