Annexure-1

Tender Enquiry Fabrication and Supply of Factory Finished Fabricated Structures of Main Power House and Common Control Room at 1x800 MW DCRTPP Yamuna Nagar Project, Haryana

Sl No.	PO/WO Details	PO/WO Date	Total Quantity	Details of supply of Structure (Per Month Quantity in MT)												TOTAL QTY for 12 months	Details of end Customer 1) Name of Customer 2) E-Mail Id of Contact Person 3) Phone No (If Available)
				MM/YY ...../.....	MM/YY ...../.....	MM/YY ...../.....	MM/YY ...../.....	MM/YY ...../.....	MM/YY ...../.....	MM/YY ...../.....	MM/YY ...../.....	MM/YY ...../.....	MM/YY ...../.....	MM/YY ...../.....	MM/YY ...../.....		
1																	
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4																	
5																	
6																	
7																	
8																	
9																	
10																	
TOTAL																	

Details with respect to the Fabrication and Supply of the Heaviest component by the Vendor

Sl No	Description	Details
1	Weight of the Heaviest Component Supplied by Vendor (MT)	
2	Dimensions of the heaviest Component	
3	Date of Manufacturing of the heaviest Component	
4	WO/PO/Drawing Reference for the above.	

Annexure 1A

DECLARATION

With reference to BHEL CPC TENDER Enquiry for Fabrication and Supply of Factory Finished Fabricated Structures of Main Power House and Common Control Room at 1x800 MW DCRTPP Yamuna Nagar Project, Haryana Project.

a) Bidder shall declare the total number of executable orders in hand and the cumulative tonnage of fabrication to be manufactured under these orders.

PO/WO Ref. Number	Order Quantity (in MT)	Contract Period (in month)	Balance Order Quantity to be executed (in MT)	Balance Contract Period (in month)

Based on above, average Monthly Output (in MT) required to execute the above-mentioned orders _____ MT/month.

b) Facilities/Equipments restricting or deciding the monthly capacity of the works.

Name of Equipment	Remarks

c) Monthly Capacity of works - _____MT / Month

We, hereby declare that above mentioned details are correct and verifiable. BHEL reserves the right to seek the supporting documents and carryout physical assessment of this works for establishing the claims made above. In case of inconsistency or falsification, appropriate action, as stipulated anywhere in the tender/contract may be taken in line with the provisions of the contract.

Seal and Sign of authorized person of Bidder

6.00.00 **PURCHASE AND SERVICE**

6.01.00 The major items/equipment/components to be manufactured in the shop of the contractor i.e. in-house items and those procured from sub-vendors/sub-manufacturer/sub-contractors i.e. bought out items (BOIs).shall be listed out by the contractor in their bid proposal.

6.02.00 An indicative list of major bought out items (not exhaustive) and services for civil works is enclosed at Annexure- III for which the, contractor shall submit the requisite details/lists of manufacturer's in. their bid proposal. The list of manufacturers/ sub-vendors for all the BOIs envisaged in contract including shall be included in the .bid proposal by the contractor which shall be discussed I reviewed by the OWNER during post bid discussions and the list of proposed manufacturers / sub-vendors for each of the BOIs shall be agreed/ approved. If any item is left out or gets included during detailed engineering, the contractor shall propose the manufacturer's / sub-vendor's details for review / approval of OWNER, prior to initiating the procurement of such materials.

6.03.00 Where the manufacturers are placed in details required ("DR") category, the details of the manufacturers / sub-vendors placed in the "DR" category shall be submitted to the OWNER for approval in the prescribed OWNER format no. QA-01-QAI-P-04/F1-RO (main supplier's evaluation report) and format no. QA-01-QAl-P-04/F2-RO (sub supplier questionnaire) within the period agreed at the time of post bid discussions. The contractor's proposal shall include vendor's site facilities, expertise, facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-Contractors proposed- The formats for furnishing above details shall be given to the Contractor at post bid discussion stage. Monthly progress reports on sub-contractor detail submission I approval shall be furnished on format no. QS-01-QAI-P-02/F1. Such manufacturers / sub-vendors approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.

6.04.00 To facilitate advance planning of material testing/ approval of bought out items, well before the start of activity as per L-2 network, representative samples shall be procured by the contractor from approved sub-vendors and submitted to the engineer for his approval before bulk procurement at least two months prior to start of works. In case of manufacturers test certificate (MTC) is submitted for acceptance, it shall be dearly traceable and correlated with the consignment received at site. MTC of all bought out items shall essentially contain all the test parameters / characteristics specified in the technical specifications / standards / codes. In case the manufacturer's test certificate does not mention these details, sample from each lot shall be tested for these properties at the third party lab acceptable to OWNER. Approval of material / sample by the engineer shall not relieve the contractor of his responsibility, for their conformance to the specification, as well as the requisite performance and quality of material.

6.05.00 Structural steel supply if in the scope of the contractor shall be procured from main steel producers like SAIL, TISCO, IISCO, RINL, ESSAR Steel, Ispat Industries, JSW Steel, Lloyds Steel, Jindal Steel & Power. In case of non-availability of some of the sections with main steel producers the contractor may propose to procure the sections from the re-rollers of the main steel

producers, the name of such re-rollers: will have to be cleared by corporate quality assurance of OWNER. for which details such as" BIS approval, main steel producer's approval past experience for production of sections of specified material, details of machines plants testing, facilities etc., Confirmation that the process control and manufacturing of steel sections by re-rollers shall be same as that of main steel producers, that billets for re-rolling will be sourced from main steel producers only shall be furnished with regards to re-roller.

6.06.00 Even after clearance of re-rollers, induction of billets with identified and correlated Mill test certificates (TC's) in the process of re-rolling, sampling of steel, quality checks thereof and stamping of final product for further identification and correlation with TC's prior to dispatch shall be the responsibility of the contractor and these shall be performed in presence of the authorized representative of the main Contractor.

6.07.00 Reinforcement steel supply if in the scope of the contractor shall be procured from main steel producers tike SAIL, TISCO, IISCO, RINL, Essar Steel, lspat Industries, JSW Steel, Lloyds Steel, Jindal Steel &. Power, Jai Balaji Industries Ltd, Durgapur (for 8-40mm reinforcement steel) and mill test certificates (TC) is to be obtained and submitted to OWNER for co-relation. In case any size /diameter specified is not available with main steel producers and are proposed to be supplied from the conversion agent of the main steel producer the name of such conversion agent / re-roller shall have to be approved by OWNER for which details such as BIS approval, Main steel producer's approval, Past experience for production of sections of specified material, details of machines, plants testing facilities etc., and confirmation that the process control and manufacturing of steel sections by re-rollers is the same as that of main steel producers, that billets for re-rolling are sourced from main steel producers only shall be furnished with regards to re-roller.

7.00.00 MANUFACTURING QUALITY PLAN AND FIELD QUALITY PLAN

7.01.00 All materials/components and equipment covered under the scope of work, shall be procured by the contractor for the purpose of the contract, after obtaining the written approval of the OWNER, which are to be manufactured at shop/ factory of the vendor/sub vendor shah be covered under a comprehensive quality assurance programme. The contractor's purchase specifications and inquiries shall call for Manufacturing Quality Plans (MQP) to be submitted by the sub-contractor/ sub- supplier/ sub-vendor- The MQP called for from the sub-contractor shall detail out for all the components and equipment, various tests / inspection, to be carried out as per the requirements of this specification and standards mentioned therein, quality practices and procedures followed by contractor's I sub-contractor's / sub-supplier's quality control organization, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. Such quality plans of the vendors I sub-vendors shall be submitted to the OWNER for approval in the prescribed .format no. QS-01-QA1-P-09/F1-R1 for MQP and such approved quality plans shall form a part of the purchase order/contract between the contractor and-sub-contractor. The quality, plans shall be submitted on electronic form e.g. CD or E-.mail in addition to hard copy for review and approval of OWNER. After approval the same shall be submitted in compiled form on CD in addition to hard copy.

ANNEXURE - III

	Project : **Package :** **Supplier :** **Bidder No. :**		**Stage : :**		**LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL**			**DOC. NO.:** **REV. NO.:** **DATE :** **PAGE : OF**		
					SUB-SYSTEM:					
S. N.	**Item**	**QP/ Insp. Cat.**	**QP No.**	**QP Sub. Schedule**	**QP approval schedule**	**Proposed sub-supplier**	**Place**	**Sub-suppliers approval status / category**	**Sub-supplier Details submission schedule**	**Remarks**

LEGENDS

1. SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY the Owner)

A – For these items proposed vendor is acceptable to the Owner. To be indicated with letter "A" in the list alongwith the condition of approval, if any.

DR – For these items "Details required" for the Owner review. To be identified with letter "DR" in the list.

NOTED – For these items vendors are approved by Main Supplier and accepted by the Owner without specific vendor approval from the Owner. To be identified with "NOTED.'

2. QP/INSPN CATEGORY:

CAT-I: For these items the Quality Plans are approved by the Owner and the final acceptance will be on physical inspection witness by the Owner.

CAT-II: For these items the Quality Plans approved by the Owner. However no physical inspection shall be done by the Owner. The final acceptance by the Owner shall be on the basis review of documents as per approved QP.

CAT-III: For these items Main Supplier approves the Quality Plans. The final acceptance by the Owner shall be on the basis certificate of conformance by the main supplier.

UNITS/WORKS: Place of manufacturing Place of Main Supplier of multi units/works.

i) any other equipment including special tools & tackles and services required for satisfactory completion of the project and operation & maintenance of the same on total turnkey basis;

j) training of Owner's personnel nominated by the Owner during erection, testing & commissioning, operation and maintenance of power plant equipment.

k) furnishing of all relevant technical data and assist HPGCL for obtaining statutory clearances.

l) any other activity not listed above but required for safe and successful operation of the plant shall be deemed to have been included in the Contractor's scope.

11.3 The Contractor shall, unless specifically excluded in the Contract, perform all such works and/or supply all such items and materials not specifically mentioned in the Contract but that can be reasonably inferred from the Contract as being required for attaining completion and performance of the facilities and Final Taking Over of the plant as if such work and/or items and materials were expressly mentioned in the Contract.

11.4 The detailed Scope of Work to be performed against the contract shall be as per Chapter-1, Volume-II of this Bid document attached hereinafter.

12.0 ASSIGNMENT AND SUBLETTING OF PART OF CONTRACT

12.1 The contractor may, after informing the Owner and getting his written approval, assign or sub-let any part of the contract other than for main equipment, for minor details or for any part of the plant for which makes are identified in the contract. Suppliers of the equipment not identified in the contract or any change in the identified supplier shall be subject to approval by the Owner. The experience list of equipment vendors under consideration by the contractor for this contract shall be furnished to the Owner/ for approval prior to procurement of all such items/equipment. Such assignments/subletting shall not relieve the contractor from any obligation, duty or responsibility under the contract. Any assignment as above without prior written approval of Owner shall be void.

12.2 The bidder shall not be allowed to change its associate(s) mentioned in the DJU submitted by the bidder. However if, in the opinion of the owner, any unavoidable circumstances warrants such change, the owner at its sole discretion may permit the bidder to change the associate on such terms and conditions as decided by the owner. The decision of the owner shall be final and binding in this regard.

12.3 For components/equipment procured by the contractor for the purposes of the contract, after obtaining the written approval of the Owner, the contractor's purchase specifications and enquiries shall call for quality plans to be submitted by the suppliers along with their proposals. The quality plans called for from the vendors shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organization, the relevant reference documents/standards used, acceptance level, inspection, documentation raised etc.

12.4 Contractor shall have to obtain specific approval from the Owner to sublet civil works as well as unloading, storage and erection works of this project.

The contractor shall be responsible for the acts, defaults and neglects of all Sub-contractors and all agents, servants or workmen of any of them as fully as if they were the acts, defaults or neglects of the contractor under the terms of this contract.

The contractor shall continue to be responsible for all contractual obligations under the contract including by its vendors, sub-vendors, associates, etc with regard to Statutory Compliances, undertakings for confidentiality, other obligations making the Owner liable during and after the contract. The contractor shall submit all statutory clearances including payment of dues to workers including PF, royalty etc. before release of final payments.

12.5 The contractor shall not without the prior written consent of the Owner assign to any Person any benefit of or obligation under the contract in whole or in part. The contractor shall provide to the Owner unpriced copies of all contracts between sub-contractors and themselves. The contractor shall ensure that all such sub-contracts are made in writing.

12.6 The sub-contractor shall cause all warranties provided to the contractor under any sub-contract to be assignable to the Owner or its designee and shall assign to the Owner the benefit of all unexpired sub-contract warranties (excluding performance or schedule guarantees for which liquidated damages are provided as a remedy) upon the expiration of the warranty period, or earlier, at the Owner request, provided the contractor shall continue to be responsible for all contractual obligations under the contract.

13.0 PATENT RIGHTS AND ROYALTIES

Royalties and fees for patents covering materials, articles, apparatus, devices, equipment or processes used in the works shall be deemed to have been included in the contract Price. The contractor shall satisfy all demands that may be made at any time for such royalties or fees; and he alone shall be liable for any damages or claims for patent infringements and shall keep the Owner indemnified in that regard. The contractor shall, at his own cost and expense, defend all suits or proceedings that may be instituted for alleged infringement of any patents involved in the works, and in case of an award of damages, the contractor shall pay for such award. In the event of any suit or other proceedings instituted against the Owner, the same shall be defended at the cost and expenses of the contractor who shall also satisfy/comply with decree, order or award made against the Owner. Final payment to the contractor by the Owner will not be made while any such suit or claim remains unsettled. In the event any apparatus or equipment of any part thereof furnished by the contractor, is in such suit or proceedings held to constitute infringement, and its use is prohibited, then contractor shall, at his option, and at his own expense, either procure for the Owner, the right to continue use of said apparatus, equipment or part thereof, replace it with non-infringing apparatus or equipment or modify it, so it becomes non-infringing as acceptable to Owner.

If any proceedings are brought or any claim is made against the Owner arising out of the matters referred to in GCC, the Owner shall promptly give the Contractor a notice thereof, and the Contractor may at its own expense and in the Owner's name conduct such proceedings or claim and any negotiations for the settlement of any such proceedings or claim. If the Contractor fails to notify

CHAPTER – 9

STEEL STRUCTURE

GENERAL

Design of structural steel work shall include generally but not be limited to the steel constructions listed below:

Steel building structure and open structures: This shall include beams, columns, bracings, supporting structures for floors, roof slabs, cladding etc.
Crane, gantry girder, monorails etc.
Coal bunkers.
Coal conveyor galleries and trestles.
Large diameter oil tanks.
Large diameter pipe line for cooling water.
Single steel flue for R.C.C. Chimney.
Galvanised latticed structures for switchyard.
Pipe and cable racks.
Platforms and walkways.
Ladders, staircases, handrails etc.

9.1 FRAMING

All buildings/structures shall be either "rigid frame" or "simple space frame" or a combination of two.

Lateral forces shall be resisted by stiff jointed moment connections in rigid frame design. The column bases shall generally be fixed to concrete foundation pedestal by providing moment resistant base detail.

The power house building design shall be a combination of rigid frame in transverse direction and simple frame in longitudinal direction.

If RCC floor / roof is assumed to act as diaphragm transmitting lateral loads to braced bays, it shall be provided with shear connectors. However, whenever large / more number of cut-outs are provided in the floor slab, horizontal floor bracings shall be provided below slab to transfer horizontal force to columns without considering diaphragm action from slab. Grating / chequered plate floor shall neither be considered to provide lateral support to the top flange of supporting beams nor to provide a shear diaphragm. Adequate lateral support and horizontal bracing shall be provided as required in such cases.

Floors for vibrating machines of all kind together with supporting framework shall be adequately braced in both horizontal and vertical planes. Floors or structure supporting mechanical equipment shall be designed to minimize vibration, avoid resonance and maintain alignment and level.

Pipe rack shall consist of rigid main frame/braced frame in transverse direction spaced longitudinally as required. In longitudinal direction, pipe rack shall be divided into sections of suitable length with an anchor bay. The main transverse frames shall be connected with longitudinal beams, which will transmit horizontal forces to braced anchor bays. The pipe and cable rack bridge structure shall be adequately rigid to carry the forces from pipelines at

anchor points without undue deflection so that pipelines are really anchored at the anchor points.

9.2 DESIGN CONCEPTS

All buildings / structures shall be framed structure. Basic consideration for structural framing shall be stability, rigidity, building usage, ease of fabrication / erection and overall economy. Additional bracings / moment connections shall be used to assure stability of structures. Structure shall be designed such that the surfaces of all parts shall be accessible for inspection, cleaning, painting and maintenance

Individual members of the frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion, etc. Criticality of erection / maintenance loads shall also be checked separately in combination with other simultaneously occurring loads for possible design loadings.

The different load combinations shall be taken as per IS:875 (Part-5) and other relevant IS Codes.

a. Wind and seismic forces shall not be considered to act simultaneously.

b. For the design of main plant structures during seismic condition, the deaerator feed water tank shall be considered full upto operating level. However, for other load combinations, deaerator feed water tank in flooded condition shall be considered.

c. In the analysis of main plant building & bunker building, the stresses arising due to temperature must be considered.

d. 'Lifted load' of crane shall not be considered during seismic condition.

e. In case two cranes are provided and tandem operation is not envisaged, the load shall be taken as one crane fully loaded and second crane without lifted load but standing idle adjacent to first crane.

f. In case two cranes are provided and tandem operation is envisaged for some bays, then the load shall be taken as both the cranes fully loaded and standing side for these bays. For other bays, load shall be taken as one crane fully loaded and second crane without lifted load but standing idle adjacent to first crane.

g. Permissible stresses for different load combinations shall be taken as per relevant IS codes.

h. Frictional force between the pipes and supporting structure in longitudinal direction need not be considered along with seismic or wind forces.

The design of steel structures shall be done by Limit state method. Design shall be as per provision of IS:800 (latest) and other relevant IS standards. For design of coal bins and hopper IS:9178 (Part I to III) shall be followed.

Roof decking sheets shall be designed as per IS:801 to carry the self load, dead load due to RCC slab and finishes and imposed load. The deflection of metal deck shall be limited as per BS:5950.

Permissible stresses for different members shall be allowed to exceed upto 33.33% only under normal loads along with wind and seismic conditions. The members which are designed primarily to resist wind load such as bracing members ,no increase in permissible stress will be permitted. However, permissible stresses in bolts and welds shall be allowed to exceed up to 25 % only under wind and seismic conditions.

For design which requires the use of the minimum column load (such as, uplift on anchor bolts, column axial tension, etc.) The following criteria shall be used in determining minimum load: Use 90% of the column dead load, No live load is used, Uplift forces from vertical bracing are included where applicable and Wind uplift on the roof is included where applicable.

Base plates shall be placed on foundation pedestal with grouting. For large base plates necessary grout holes shall be provided. All anchor bolts for fastening steel columns on foundation shall be embedded in foundation during concreting itself. No anchor pockets in foundation shall be allowed. Design of base plates shall be based on design pressure on foundation which shall not exceed the following:

Pedestal in concrete grade M20	5.0 N / sq.mm
Pedestal in concrete grade M25	6.25 N / sq.mm
Pedestal in concrete grade M30	7.5 N / sq.mm

The total horizontal shear force at the base of column is transferred to the column pedestals through friction between the base plate and the grout. A coefficient of friction of 0.30 shall be used in conjunction with the minimum column load as defined above. If the horizontal shear force exceeds the frictional resistance force or if the column is subjected to a net uplift load, the total force shall then be transmitted through shear bars / shear keys welded to the base plate. Anchor bolts are not assumed to resist any horizontal shear force. Necessary recesses shall be kept in the foundation concrete for shear lugs.

Crane gantry girders shall be single web plate girders of welded construction with bearing and intermediate stiffeners. Crane girder shall be designed as simply supported and of single span length. Chequered plate shall be used for gantry girder walkway flooring. For lifting / monorails beams ISMB sections shall be preferred and the bottom flange of all beams shall be checked separately for distortion and reinforced suitably if required

9.3 PERMISSIBLE DEFLECTIONS

The permissible deflections of various steel members under normal loading conditions shall be as specified below. For calculation of deflections in structures and individual members dynamic effects shall not be considered, unless specified otherwise. Also, no increase in deflection limits shall be allowed when wind or seismic load are acting concurrent with normal loading conditions.

9.3.1 Vertical Deflection

a) For beams supporting dynamic equipment : Span / 500
b) For beams supporting floors / masonry : Span / 325
c) For beams supporting pipes : Span / 400
d) For roofing and cladding components : Span / 325
e) For gratings and chequered plates : Span / 200 subject to a maximum of 6 mm

f) Coal/ Ash conveyor gallery bridges : Span / 450
g) For beams directly supporting drive machinery : Span / 500

For crane gantries or any member subjected to working loads, the maximum deflection under dead load and live load excluding impact shall not exceed the following values:

a) For manually operated cranes & monorails : Span / 500
b) For electric overhead cranes

i) Up to 50 t capacity : Span / 750
ii) Over 50 t capacity : Span / 1000

c) The vertical deflection of metal deck sheet for floor / roof shall be limited to : Span / 250.

9.3.2 Horizontal deflections

The permissible horizontal deflections shall be as per following unless specified otherwise:

a)	Single storey building (without crane load)	:	Height / 325
b)	Multistoried building (without crane load)	:	Height / 500
c)	Pipe rack columns	:	Height / 325
d)	Crane gantry girder due to surge	:	Height/200
e)	Building main columns at crane rail level due to action of crane surge load only	:	Height / 2500 limited to maximum of 10 mm
f)	Open gantry columns at crane rail level due to action of crane surge load only	:	Height/4000 limited to maximum of 10 mm
h)	Coal handling trestles	:	Height / 1000

Provisions of IS: 800 and relevant IS Code shall be followed for limiting deflections of structural elements not listed above.

9.4 MINIMUM THICKNESS OF STRUCTURAL STEEL ELEMENTS

The minimum thickness of various components of a structure and hot rolled sections shall be as follows. The minimum thickness of rolled shapes shall mean flange thickness regardless of web thickness. Structural steel members exposed to significantly corrosive environment shall be increased suitably in thickness or suitably protected otherwise as per good practice and sound engineering judgement in each instance.

a)	Trusses, purlins, girts and bracing	6mm
b)	Columns and beams	8mm
c)	Guessets	8mm
d)	Stiffeners	8mm
e)	Base plates	12mm & above
e)	Chequered plates	8 mm o/p & above
f)	Grating flats	5 mm

Minimum thickness of structural members other than gratings directly exposed to weather and inaccessible for painting and maintenance shall be 8 mm.

9.5 MINIMUM SIZES

The flange width of purlins supporting light weight concrete slab shall not be less than 65 mm and for those supporting roof sheeting and wall cladding it shall not be less than 50 mm. Width of steel rolled section connected to other member shall be at least 50 mm. The depth of beams for platform of all structures shall not be less than 125 mm.

9.6 SLENDERNESS AND DEPTH RATIO

The slenderness ration of main members in tension, compression or bending shall be in accordance with IS:800.

The following limiting ratios of depth to span shall considered as a general guide.

a)	Truss	1 / 10
b)	Rolled beams and girders for ordinary floors and rafters	1 / 24
c)	Supporting floor beams for vibrating machinery /equipment	1 / 15
d)	Roof purlins and girts	1 / 45
e)	Gable columns	1 / 30

9.7 JOINTS / CONNECTIONS IN STEEL STRUCTURES

Steel structures shall be detailed and connection and joints provided as per the provisions of IS:800, IS:9595, IS:1367, IS:9178 and IS:816 and as per following requirements:

9.7.1 a. Welding shall be used for shop fabrication and joints. For siteconnections,welding or high strength friction grip (HSFG) type bolts shall be used, except in few cases for shear connections of lighter members or removable beam connections where bolted (class 4.6) joints may be adopted e.g. purlins, side girts etc. Minimum two bolts of diameter not less than 16 mm per connection shall be used.

b. For high strength friction grip bolt connections IS:4000 shall be followed. High strength friction grip bolts shall be of property class 8.8 or 10.9 and shall conform to IS: 3757 and shall not be less than 20 mm in diameter unless designated otherwise

c. Connection of vertical bracings with connection members and diagonals of truss members shall be designed for full tensile capacity of the bracings unless actual loads are indicated on the drawings.

d. Size of fillet weld for flange to web connection for built up section shall be as follows:

   i) For box section weld size shall be designed for 60% of full shear capacity or actual shear whichever is more. Where filet weld is not possible, full penetration but weld shall be provided.

   ii) For built-up I section or rolled section with cover plates, weld size shall be designed for 80% of full shear capacity or actual shear, (if indicated in drawings) whichever is more. However, weld size shall not be less 0.5 times the web thickness. Weld shall be double fillet.

   iii) All welds shall be continuous unless otherwise specifically approved. The minimum size of the fillet weld shall be 6 mm.

e. Shear connections shall be designed for 75% of section strength for rolled sections and 80% of section strength of built-up section or rolled section with cover plates. However, if actual shear load is more than above, the connection shall be designed for actual load.

f. Moment connection between beam and column shall be designed for 100% of moment capacity of the beam section. This can be achieved either by direct butt welding of the top flange of beam with column flange or by providing top moment plate with suitable notch for additional weld length.

g. All bolts and nuts shall have property class compatible to each other. For bolts carrying dynamic or fluctuating loads and those in direct tension shall be provided with an additional double coil helical spring washer conforming to IS:6755. The threaded portion of the bolt shall project through the nut at least by one thread.

h. Where a steel beam or member is to be connected on RCC structure, it shall be connected using an insert plate and preferably through shear connection.

i. All butt welds shall be full penetration butt welds.

j. For crane girders, welding between web and flange plates shall be carried out by submerged arc welding process. The connection between top flange and web of crane girder shall be full penetration butt weld. Bottom flange, connection with web can be fillet weld or butt weld as directed by Purchaser. Bearing edges of crane girders shall be machine finished.

k. Connection of base plate and associated stiffeners with the columns shall be designed considering the total load transferred through welds. However, minimum weld size (double fillet) shall not be less than 0.6

times the thickness of stiffeners. The connections of gusset plates to column and girders shall be made to include provisions for eccentricity in connection.

l. Splicing shall be carried out with welding/ HSFG Connection (Grade 8.8 and 10.9 bolts)

All work shall be full strength. Field splicing shall be done with web and flange cover plates for full strength. In exceptional cases, the field splicing shall be designed for 50% of load carried by the cover plates and remaining 50% load through full penetration butt weld. Shop splicing for all sections other than rolled shall be carried out by full penetration butt welds with no cover plates. Splicing for all rolled sections shall be carried out using web and flange cover plates.

9.7.2 All bolted connections shall have bolts of minimum 16 mm dia. The connections of stairs and handrailing shall be made with 20 mm diameter threaded fasteners conforming to IS:1363. Erection bolts shall be black bolts of minimum 12 mm dia.

9.7.3 Efficiency of site welds to be considered shall be as follows:

a) Butt weld above 25 m from ground : 50%
b) Others : 80%

9.8 REQUIREMENTS FOR SPECIFIC STRUCTURES

9.8.1 Large Diameter Oil Tanks

Design, fabrication and erection of the cylindrical welded storage tank shall follow the provisions of IS:803. The stresses in the tank shall be computed on the assumption that tank is filled with water. Tension in each course shall be computed at 30 cm above the centreline of lower horizontal joint of the course under consideration.

Wind and internal vacuum loads shall be considered together to check the stability of tank.

Joint efficiency factor shall be taken as 0.85 for butt joints to determine the minimum thickness of shell plates provided all the vertical and horizontal butt welds are spot radiographed. Where welds are not inspected by radiography joint efficiency factor of 0.7 shall be used. However it is recommended that all butt welded joints shall be radiographed.

Minimum thickness of shell plate shall be as given in clause 6.3.3.2 of IS:803 to which corrosion allowance shall be added. Maximum thickness of shell plate shall not exceed 40 mm. Width of shell plate shall not be less than 1500 mm.

Bottom plate uniformly resting on the substructure shall have a minimum thickness of 6 mm for tank upto 10 m in diameter and 8 mm for higher diameter. Bottom plate shall project at least 25 mm allround beyond the outer edge of weld attaching the bottom to the shell plate.

For large diameter oil tanks supported cone roof shall be provided. Arrangement of columns and rafters shall in general be as per fig 9 and 10 of

IS:803. Roof plates shall have a minimum thickness of 6 mm and shall not be attached to the supporting member. A curb angle shall be provided at the top of the shell in line with clause 6.3.6.2 of IS:803. Roof plates shall be attached to the curb angle with a continuous fillet weld on the top side only. Minimum slope of roof shall be 1 in 16.

Rafter clips for the outer row of rafters shall be welded to the shell. Columns shall not be rigidly attached to the bottom plates guide. Clips shall be welded to the tank bottom to prevent lateral movement.

Roof supporting columns shall be made from structural shapes or pipe or built up section. Suitable base frames or reinforcing pads shall be provided at the column base to distribute loads coming on the tank bottom.

Appurtenances and mountings covered under section 7 of IS:803 shall be provided in addition to any other appurtenance which the BIDDER considers essential for the safe and smooth operation of the fuel oil storage and oil handling system.

After erection and inspection of the tank, the tanks shall be tested as per clause 12 of IS:803. Leakage, if any noticed shall be repaired to the satisfaction of the OWNER and the tank retested to satisfy acceptance criteria.

9.8.2 Large Diameter Steel Pipes

Design, installation and testing of the pipe shall be, in general, conforming to latest edition of "Steel pipe - A guide for design and installation" – AWWA Manual M11 – published by American Water Works Association. Pipes shall be as per IS:3589, fabricated from steel plates conforming to IS:2062. Piping shall be designed for pump shut-off pressure or 1.5 times the maximum pump head whichever is higher. Thickness of the pipe shall also be adequate to withstand full vacuum in the pipe. Also, the pipes shall be hydro-tested at a pressure of 1.5 times the design pressure. Thickness of the pipes shall be calculated as per requirement of AWWA M11 and / or ASME B31.1. Underground large diameter piping shall be laid with minimum earth cushion of 1500 mm. A surcharge of 2 t/sq.m in addition to backfill shall also be considered. The pipes shall be given an internal coating with epoxy paint 250 micron. Where pipes are not encased wrapping as per IS:10221 shall be provided outside. Underground large diameter piping shall be given sand bedding conforming to requirements of IS:5822. The minimum thickness of sand bed under bottom of pipe shall be 100 mm. At locations of the change of flow direction thrust blocks shall be provided as per requirement of hydraulic transient analysis. Double kinetic type air-cum- vacuum valves shall be provided at locations as per requirement of hydraulic transient analysis. The complete piping system shall be line tested before commissioning of the system. All site joints shall be inspected by radiography

9.9 PAINTING

a. All steel structures shall receive two primer coats and two finish coats of painting. First coat of primer shall be given in shop after fabrication before dispatch to erection site after surface preparation as described below. The second coat of primer shall be applied after erection and final alignment of the erected structures. Two finish coats shall also be applied after erection.

b. Steel surface which is to paint, shall be cleaned of dust and grease and the heavier layers of rust shall be removed by chipping prior to actual surface preparation. The surface shall be cleaned to grade ST-2 as per SIS05-5900 or as per IS:1477(Part-1). Primer paint shall be redoxide zinc cromate confirming to IS:2074. Dry film thickness of each coat shall be 25 microns.

Finish paint shall be as follows:-

Structure	Prime coat (Micron)	Intermediate coat (Micron)	Top coat (Micron)	Total Dft (Micron)
Station building, Boiler structure, Mill & bunker bay structure, ESP structure, Misc Covered structure	Inorganic zinc silicate 1x75		HB epoxy polyamide (pigmented) 1x75	150
DM plant	Inorganic zinc silicate 1x75	HB MIO Epoxy 1x~~75~~ 125	Aromatic poly-Urethane acid resistant 1x50	~~200~~ 250
Coal handling and ash handling structures	Inorganic zinc silicate 1x75	HB MIO Epoxy 1x~~75~~ 125	HB epoxy polyamide (pigmented) 1x75	~~225~~ 275
Pipe and cable rack and misc open structure	Inorganic zinc silicate 1x75		Aliphatic poly-urethane (UV resistant) 1x50	125

FGD structures in addition ((**Add**. as per PBR Sr. No 771, Dt. 27.06.23)

All paints shall be of approved brand and shade as per the OWNER's requirement.

c. Joints to be site welded shall have no paint applied within 100 mm of welding zone.

Similarly where Friction grip fasteners are to be used no painting shall be provided. On completion of the joint the surfaces shall receive the paint as specified.

d. Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly.

Surfaces inaccessible after erection including top surfaces of floor beams supporting gratings or chequered plate shall receive one additional coat of finish paint over and above number of coats specified before erection. Portion of steel member embedded / to be encased in concrete shall not be painted.

Painting shall not be done in frosty or foggy weather or when humidity is such as to cause condensation on the surfaces to be painted.

9.10 CODES AND STANDARDS

All steel materials shall comply with the following IS:-

i)	IS:801	-	Cold formed light gauge steel structural member.
ii)	IS:2062	-	Grade – A, Structural Steel for plate thickness upto 20mm
iii)	IS:2062	-	Grade – B (Killed), Structural Steel for plate thickness above 20mm
iv)	IS:2062	-	Grade – C, for crane gantry girder in turbine hall.
v)	IS:806	-	Steel tubes in general building construction.

b. Electrodes

The arc welding electrodes shall conform to the relevant IS; and shall be of heavily coated type having uniform thickness. With each container of electrodes, the manufacturer shall furnish instructions giving recommended voltage and amperage (polarity in case of D.C. supply) for which the electrodes are suitable. All electrodes shall comply with the following IS:

i)	IS: 814	-	Covered electrodes for metal arc welding structural steel
ii)	IS:815	-	Classification and coding of covered electrodes for metal arc welding of mild steel and low alloy high tensile steel.
iii)	IS:7280	-	Base wire electrode for submerged arc welding.

c. Bolts and nuts

All bolts and nuts shall conform to the requirements of IS:1367 - Technical Supply Conditions for Threaded Fasteners. Materials for bolts and nuts shall comply with the following IS codes. Mild steel for bolts and nuts tested to following IS shall have a tensile strength of not less than 44 Kg/mm2; and minimum elongation of 23 per cent on a gauge length of 5.6 ÖA, where 'A' is the cross sectional area of the test specimen :

i)	IS:1367	-	Technical supply conditions for threaded fasteners.
ii)	IS:1608	-	Method for tensile testing of steel other than sheet, strip, wire and tube.
iii)	High tensile steel material shall have the mechanical properties as per IS:1367 or as approved by the Engineer.		

d. Washers

Washers shall be made of steel conforming to the following IS:

i)	IS:1977	-	Structural steel (Ordinary Quality) St-39-0
ii)	IS:2062	-	Steel for general structural purpose

iii) IS:6623 - High Strength Structural Nuts
iv) IS:6649 - Hardened and tampered washers for high strength structural bolts & nuts.

9.11 FABRICATION OF STRUCTURAL STEEL WORK

9.11.1 The details of fabrication, shop testing and delivery to site of structural steel work including supply of all consumable stores, bolts, nuts, washers, electrodes and other materials as required including field connections are indicated below to be performed by the contractor:

a. Preparation & submission of complete detailed fabrication drawings and erection marking drawings as required including design calculations.

b. Furnish all materials, labour, tools & plant and all consumables required for fabrication and supply of all necessary bolts, nuts, washers, tie rods and welding electrodes for field connections.

c. Furnish shop painting of all fabricated steelwork as specified.

d. Suitably mark, bundle and pack for transport all fabricated materials.

e. Prepare and furnish detailed bill of materials, dispatch lists (including bought out items) as required for fabrication of structural steelwork.

f. Load and transport all fabricated steelwork to site with field connection materials.

g. Maintain a fully equipped fabrication shop at site for modification and repairs as required.

No work under this specification will be provided by any agency other than the Contractor, unless specifically mentioned otherwise elsewhere in the contract.

9.11.2 Conformity with designs

The contractor shall design all connections, supply and fabricate all steelwork and furnish all connection materials in accordance with the approved drawings. The method of painting, marking, packing and delivery of all fabricated materials shall be as approved by the Engineer.

9.11.3 Materials to be used

Standard structural steel sections shall be used instead of fabricated steel sections as far as possible.

All steel materials required for the work shall be supplied by the contractor.

9.12 STORAGE OF MATERIALS

a. All materials shall be stored to prevent deterioration ensuring the preservation of their quality and fitness for the work. Any material which has deteriorated or has been damaged shall be removed from the

contractor's yard immediately. The contractor shall maintain upto date account in respect of receipt, use and balance of all sizes and sections of steel and other materials. In case the fabrication is carried out in contractor's fabrication shop outside the plant site where other fabrication works are also carried out, all materials shall be stacked separately with easily identifiable marks.

b. The steel used for fabrication shall be stored in separate stacks off the ground section-wise and lengthwise so that they can be easily inspected, measured and accounted for at any time. If required by the Engineer, the materials should be stored under cover and suitably painted for protection against weather.

c. The electrodes for electric are welding shall be stored in properly designed racks, separating different types of electrodes in distinctly marked compartments. The electrodes shall be kept in a dry and warm condition [if necessary by resorting to heating].

d. Bolts, nuts, washers and other fastening materials shall be stored on racks off the ground with a coating of suitable protective oil. These shall be stored in separate gunny bags or compartments according to diameter, length and quality.

e. Paints shall be stored under cover in airtight containers. Paints supplied in sealed containers shall be used up as soon as possible once the container is opened.

9.13 INSPECTION OF FABRICATION WORK

As far as possible, all inspections by the Engineer shall be made at the contractor's fabrication shop. The contractor shall co-operate with the Engineer in permitting access for inspection to all places where work is being done and in providing free of cost all necessary help in respect of tools & plant, instrument, labour and materials required to carry out the inspection. The inspection shall be so scheduled as to provide the minimum interruption to the work of the contractor. Materials or workmanship not in reasonable conformance with the provisions of this specification would be rejected at any time during the progress of the work.

The dimensions, forms, weights and tolerances of all rolled shapes, bolts, nuts, studs, washers etc. and other members used in the fabrication shall, wherever applicable, conform to the requirements of the latest relevant IS.

9.14 FABRICATION DRAWINGS

The sequence of submission of fabrication drawings for approval shall match with the approved fabrication and erection schedule. It should be ensured that the correctness of general arrangement for centerline dimensions and levels, section sizes, and adequacy of connections including splice joints as to the number of bolts, weld length, size of gusset/end plates are maintained. The approval of the drawing however shall not relieve the contractor of his sole responsibility in carrying out the work correctly and fulfilling the complete requirements of spec.

The fabrication drawings shall include but not be limited to the following:

i) Assembly drawings giving exact sizes of the sections to be used and identification marks of the various sections.

ii) Dimensional drawings of base plates, foundation bolt location etc.

iii) Details of all connections with supporting calculations.

iv) Any other drawings or calculations that may be required for the clarification of the works.

The fabrication drawings shall give all the necessary information for the fabrication, erection and painting of the steelwork in accordance with the provisions of this specification. Fabrication drawings shall be made in accordance with the best modern practice and with due regard to sequence, speed and economy in fabrication and erection. Fabrication drawings shall give complete information necessary for fabrication of various components of the steelwork, including the location, type, size and extent of welds. These shall also clearly distinguish between fabrication and field bolts and welds and specify the class of bolts and nuts. The drawings shall be drawn to a scale large enough to convey all the necessary information adequately. Notes on the fabrication drawings shall indicate those joints or groups of joints in which it is particularly important that the welding sequence; and technique of welding shall be carefully controlled to minimize the locked -up stresses and distortion. Welding symbols used shall be in accordance with the requirements of IS:813; and shall be consistent throughout. Weld lengths called for on the drawings shall mean the net effective length.

9.15 WORKMANSHIP

a. All workmanship shall be equal to the best practice in modern structural shops, and shall conform to the provisions of IS:800 and other relevant Indian standards or equivalent.

b. Rolled materials before being laid off or worked, must be clean, free from sharp kinks, bends or twists and straight within the tolerances allowed by IS:1852. If straightening is necessary, it shall be done by mechanical means or by the application of a limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 600 Deg. C.

c. Cutting shall be effected by shearing, cropping or sawing. Use of a mechanically controlled gas cutting torch is permitted for mild steel only. Gas cutting of high tensile steel is permitted provided special care is taken to leave sufficient metal to be removed by machining, so that all metal that has been hardened by flame is removed. Gas cutting without a mechanically controlled torch shall be permitted if special care is taken and done under expert hand.

To determine the effective size of members cut by gas, 3 mm shall be deducted from each cut edge. Gas cut edges, subjected to substantial stress or which have weld metal deposited on them, shall be reasonably free from gouges. Occasional notches or gauges not more than 4 mm deep will be permitted. Gouges greater than 4 mm that remain from cutting, shall be removed by grinding. All re-entrant corners shall be shaped notch-free to a radius of at least 12 mm. Shearing, cropping and

gas cutting shall be clean, reasonably square and free from any distortion.

d. Finishing of sheared or cropped edges of plates or shapes of edges gas-cut with mechanically controlled torch shall not be required, unless specifically required by design and called for on the drawings, included in a stipulation for edge preparation for welding or as may be required after the inspection of the cut surface. Surface cut with hand-flame shall generally be ground, unless specifically instructed.

e. The erection clearance for cleated ends of members connecting steel to steel shall preferably be not greater than 2 mm at each end. The erection clearance at ends of beams without web cleats shall be not more than 3 mm at each end, but where, for practical reasons, greater clearance is necessary, suitably designed cleatings shall be provided.

f. Bolted construction:

i) Holes through more than one thickness of material for members, such as compound stanchions and girder flanges, shall be drilled after the members are assembled and tightly clamped or bolted together. Punching shall be permitted before assembly, if the thickness of the material is not greater than the nominal diameter of bolt plus 3 mm subject to a maximum thickness of 16 mm provided that the holes are punched 3 mm less in diameter than the required size; and reamed after assembly to the full diameter.

Holes for black bolts shall be not more than 1.5 mm or 2 mm (depending on whether the diameter of the bolt is less or more than or equal to 25 mm) larger in diameter than the nominal diameter of the black bolt passing through them.

Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to a tolerance grade of H8 to IS:919. Parts to be connected shall be firmly held together by tacking welds or clamps and the holes drilled through all thicknesses in one operation and subsequently reamed to size. Holes not drilled through all thicknesses in one operation shall be drilled to a smaller size and reamed out after assembly. Holes for bolts shall not be formed by gas cutting process.

ii) Drifting to enlarge unmatching holes shall not generally be permitted. In case drifting is permitted to a slight extent during assembly, it shall not distort the metal or enlarge the holes. Holes to be enlarged to admit the bolts shall be reamed. Poor matching of holes shall be cause for rejection. The component parts shall be so assembled that they are neither twisted not otherwise damaged, and shall be so prepared that the specified cambers, if any, are maintained.

Bolted construction shall be permitted only in case of field connections if called for on the drawings and is subjected to the limitation of particular connection as may be specified.

Washers shall be tapered or otherwise suitably shaped, where necessary, to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project out through the nut at

least one thread. In all cases, the bolt shall be provided with a washer of sufficient thickness under the nut to avoid any threaded portion of the bolt being within the thickness of the parts bolted together. In addition to the normal washer, one spring washer or lock-nut shall be provided for each bolt for connections subjected to vibrating forces or otherwise as indicated on the drawings.

g. Welded Construction

i) Welding shall be in accordance with relevant IS. Welding shall be done by experienced and good welders qualified by tests in accordance with IS:817. Surfaces to be welded shall be free from loose scale, slag, rust, grease, paint and any other foreign material except that mill scale which withstands vigorous wire brushing may remain. Joint surfaces shall be free from fins and tears. Preparation of edges by gas-cutting shall, wherever practicable, be done by a mechanically guided torch.

ii) Parts to be fillet welded shall be brought in as close contact as practicable and in no event shall be separated by more than 4 mm. If the separation is 1.5 mm or greater, the size of the fillet welds shall be increased by the amount of the separation. The fit of joints at contact surfaces which are not completely sealed by welds, shall be close enough to exclude water after painting. Abutting parts to be butt-welded shall be carefully aligned. Misalignments greater than 3 mm shall be corrected; and in making the correction, the parts shall not be drawn into a sharper slope than two degrees (2 Deg.). The work shall be positioned for flat welding whenever practicable.

iii) In assembling and joining parts of a structure or of built-up members, the procedure and sequence of welding shall be such as will avoid needless distortion and minimize shrinkage stresses. Where it is impossible to avoid high residual stresses in the closing welds of a rigid assembly, such closing welds shall be made in compression elements.

In the fabrication of cover-plated beams and built-up members, all shop splices in each component part shall be made before such component part is welded to other parts of the member. Long girders or girder sections shall be made by shop splicing not more than 3 sub-sections, each made in accordance with this paragraph. Welded assemblies shall be stress relieved by heat treating in accordance with the provisions of the relevant IS.

iv) All complete penetration groove welds made by manual welding, except when produced with the aid of backing material not more than 8 mm thick with root opening not less than one-half the thickness of the thinner part joined, shall have the root of the initial layer gouged out on the back side before welding is started from that side, and shall be so welded as to secure sound metal and complete fusion throughout the entire cross- section. Groove welds made with the use of the backing of the same material as the base metal shall have the weld metal thoroughly fused with the backing material. Backing strips need not be removed. If required, they may be removed by gouging or gas cutting after welding is completed, provided no injury is done to the base metal and weld metal and the weld metal surface is left flush or slightly convex with full throat thickness.

Groove welds shall be terminated at the ends of joint in a manner ensuring soundness. Where possible, this should be done by use of extension bars or run-off plates which need not be removed upon weld completion. To get the best and consistent quality of welding, automatic submerged arc process shall be preferred. The technique of welding employed, the appearance and quality of welds made, and the methods of correcting defective work shall conform to the relevant IS.

v) If welding is to be undertaken at low temperature, adequate precautions as recommended in relevant IS shall be taken. When the parent material is more than 40 mm thick, the temperature of the area mentioned above shall be in no case be less than 20oC, all requirements regarding preheating of the parent material shall be in accordance with the relevant IS.

vi) Where required, intermediate layers of multiple-layer welds shall be peened with light blows from a power hammer, using a round-nose tool. Peening shall be done after the weld is cooled to a temperature warm to the hand. Care shall be exercised to prevent scaling or flaking of weld & base metal from over peening.

vii) The equipment shall be capable of producing proper current so that the operator may produce satisfactory welds. The welding machine shall be of type and capacity as recommended by the electrode manufacturer.

viii) Column splices and butt joints of compression members for stress transmission shall be accurately machined and close-butted over the whole section with a clearance not exceeding 0.2 mm locally at any place. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc., after welding together, should be accurately machined so that the parts connected butt over the entire surfaces of contact. Care should be taken that those connecting angles or channels are fixed with such accuracy that they are not reduced in thickness by machining by more than 2 mm.

ix) Bases and caps fabricated out of steel plates, except when cut from material with true surface, shall be accurately machined over the bearing surface and shall be in effective contact with the end of the stanchion. A bearing face which is to be grouted direct to a foundation need not be machined if such face is true and parallel to the upper face. To facilitate grouting, holes shall be provided, where necessary, in stanchion bases for the escape of air. The ends of lacing bars shall be neat and free from burrs. Rolled section or built-up steel separators or diaphragms shall be required for all double beams except where encased in concrete, in which case, pipe separators shall be used. Provision shall be made for all necessary steel bearing plates to take up reaction of beams & columns and the required stiffeners & gussets whether or not specified. Bearing plates and stiffener connections shall not be permitted to encroach on the designed architectural clearances.

x) All shop connections shall be welded as specified. Certain shop connections, may be changed to field connections if desired by the Engineer for convenience of erection; and the contractor shall make the desired changes. The steelwork shall be temporarily shop-erected complete so that accuracy of fit may be checked before dispatch. The parts shall be shop-erected with a sufficient number of parallel drifts to

bring and keep the parts in place. In case of parts drilled or punched using steel jigs to make all similar parts interchangeable, the steelwork shall be shop erected facilitating the check of interchangeability.

9.16 TESTING, ACCEPTANCE CRITERIA AND DELIVERY

a. The contractor shall carry out testing as per IS. The contractor shall get the specimen tested in a laboratory approved by the Engineer and test results shall be submitted to the Engineer in triplicate within 3 days after completion of the test. All electrodes shall be procured with test certificates. The correct grade and size of electrodes not deteriorated in storage shall only be used. The testing of welding shall be performed as under with quantum of minimum non-destructive tests to be conducted during fabrication and after erection as below:

VISUAL EXAMINATION

All welds shall be 100% visually inspected to check the following:

Presence of undercuts
Surface cracks in both welds and base metals.
Unfilled craters
Improper weld profile and size
Excessive reinforcement in weld
Surface porosity

Before inspection, the surface of weld metal shall be cleaned of all slag, spatter matter, scales etc. by using wire brush or chisel.

DYE PENETRATION TEST (DPT)

This test shall be carried out for all important fillet welds and groove welds to check the following:
Surface cracks
Surface porosities

Dye Penetration Test shall be carried out in accordance with IS: 3658 or equivalent American National Standard ASTME165.

5% of the total length, dye-penetration test shall be carried out to the root and final run for fillet welds.

10% of the total length, dye-penetration test shall be carried out to the root run after back gouging for butt welds.

ULTRASONIC TESTING

All butt weld shall be tested for 100% length by ultrasonic test to detect the following:
Cracks
Lack of fusion
Slag inclusions
Gas porosity

Ultrasonic testing shall be carried out in accordance with IS: 3664, IS: 4904 or equivalent American National Standard ANSI / AWS D1-92 Chapter 6: Part C.

Before Ultrasonic test is carried out, any surface irregularity like undercuts, sharp ridges etc. shall be rectified. Material surface to be used for scanning by probes must allow free movement of probes. For this purpose, surface shall be prepared to make it suitable for carrying out ultrasonic examination.
All butt-welds in beams, girders & columns will be of full penetration. Butt welds shall be radiographically or ultrasonically tested as per IS: 822 and standard practice.

Plates above 25 mm thickness shall be subject to ultrasonic test as per ASTM-A435 or equivalent to check the presence of lamination

RADIOGRAPHIC TESTING(X – RAY AND GAMMA – RAY EXAMINATION)

Generally, splicing shall not be provided in tension flange of bunker girder. For structures supporting bunkers and deaerator, 100% length of all butt welds shall be tested. For other structures, this test shall be limited to 2% of length of welds of each element of butt joints for welds made by manual or semi-automatic welding and 1% of length of weld if made by automatic welding machines. The location and extent of weld to be tested by this method shall be decided by OWNER to detect the following defects:

gas porosity
slag inclusions
lack of penetration
lack of fusion
cracks

When radiograph is not possible due to inaccessibility to the satisfaction of ENGINEER In-Charge, ultrasonic test shall be carried out after grinding the surface.

Radiographic testing shall be conducted in accordance with IS 1182, IS 2595, IS 3657 or equivalent American National Standard ANSI / AWSD1.1- 92.
Any surface irregularity like undercuts, craters, pits, etc. shall be removed before conducting radiographic test. The length of weld to be tested shall not be more than 0.75 x focal distance. The width of the radiographic film shall be width of the welded joint plus 20 mm on either side of the weld.

CONTRACTOR shall provide testing equipment for conducting non-destructive tests for confirming the integrity of welding wherever necessary as directed by the OWNER..

In cases, the test results shows deficiency, the Engineer shall have option to reject or instruct any remedial measures to be carried out by the contractor.

b. All bolts, nuts and washers shall conform to the relevant IS. If desired by the Engineer, representative samples of these materials should be tested

in an approved laboratory and in accordance with the procedures described in relevant IS. All paints and primers shall be of standard quality and shall conform to the provisions of the relevant IS. The tolerances on the dimensions of individual rolled steel components shall be as per IS:1852. The tolerances on straightness, length etc. of various fabricated components (such as beams and girders, columns, crane gantry girder etc.) of the steel structures subjected to dynamic loading (like wind, seismic etc.) and thin walled construction (like box girders) shall be as per IS:7215.

c. Should any structure or part of a structure be found not to complying to the provisions of the specification, the same shall be liable to rejection. No structure or part of the structure, once rejected, shall be offered again for test, except in cases where the Engineer considers the defects rectifiable. The Engineer may, at his discretion, check the test results obtained at the contractor's works by independent tests at an approved laboratory and should the items, so tested, be found to be unsatisfactory.

When all tests to be performed in the contractor's shop have been successfully carried out, the steelwork will be accepted forthwith; upon receipt of which, the items shall be shop painted, packed and dispatched. No item should be delivered unless an acceptance certificate for the same has been issued. The satisfactory completion of these tests or the issue of the certificates shall not bind the Purchaser to accept the work, should it, on further tests before or after erection, be found not in compliance with spec.

d. The contractor should deliver the fabricated structural steel materials to site with all necessary field connection materials in a sequence permitting an efficient and economical performance of the erection work. The Purchaser may prescribe or control the sequence of delivery of materials, at his own discretion. Each separate piece of fabricated steelwork shall be distinctly marked on all surfaces before delivery in accordance with the markings shown on approved erection drawings and shall bear such other marks as will further facilitate identification and erection.

9.17 RECTIFICATION OF DEFECTS IN WELDS

Limits of Acceptability of welding defects shall be as follows.

Visual inspection and Dye Penetration Test

The limits of acceptability of defects detected during visual inspection and Dye Penetration Test shall be in accordance with clauses 8.15.1 and clauses 9.25.3 of American National Standard ANSI / AWS D1.1-92 respectively, for statically and dynamically loaded structures.

Ultrasonic Testing

The limits of acceptability of defects detected during ultrasonic testing shall be in accordance with clause 8.15.4 and clause 9.25.3 of American National Standard ANSI / AWS D1-92 respectively, for statically and dynamically loaded structures.

Radiographic Testing:

The limits of acceptability of defects detected during Radiographic testing shall be in accordance with clause 8.15.3 and 9.25.2 of American National Standard ANSI / AWS D1.1-92 respectively for statically and dynamically loaded structures.

In case of detection of defects in welds, the rectification of the same shall be done as follows:

i) All craters in the weld and breaks in the weld run shall be thoroughly filled with weld.

ii) Undercuts, beyond acceptable limits, shall be repaired with dressing so as to provide smooth transition of weld to parent metal.

Welds with cracks and also welds with incomplete penetration, porosity, slag inclusion etc., exceeding permissible limits shall be rectified by removing the length of weld at the location of such defects plus 10 mm from both ends of defective weld and shall be re-welded. Defective weld shall be removed by chipping hammer gouging torch wheel. Care shall be taken not to damage the adjacent material.

9.18 ERECTION OF STRUCTURAL STEEL WORK

9.18.1 The works related to the erection of structural steelwork including receiving and taking delivery of fabricated structural steel materials arriving at site, installing the same in position, painting and grouting the stanchion bases all complete are detailed below:

a. Providing all construction & transport equipment, tools, tackles, consumables, materials, labour and supervision as required for the erection of the structural steelwork.

b. Receiving, unloading, checking and moving to storage yard at site including prompt attendance to all insurance matters as necessary.

c. Transportation of all fabricated structural steel materials from site storage yard, handling, rigging, assembling, bolting, welding and satisfactory installation in proper location as per approved erection drawings. If necessary suitable temporary approach roads should be built for transportation.

d. Checking centerlines, levels of all foundation blocks including checking line, level, position and plumb of all bolts and pockets. Any defect observed in the foundation shall be brought to the notice of the Engineer. The contractor shall fully satisfy himself regarding the correctness of the foundations before installing the fabricated steel structures on the foundation blocks.

e. Aligning, plumbing, leveling, bolting, welding and securely fixing the fabricated steel structures as per drawings.

f. Painting of the erected steel structures.

g. Minor modifications of the fabricated steel structures as directed by the Engineer including but not limited to the following:-

i) Removal of bends, kinks, twists etc. for parts damaged during transport and handling.

ii) Cutting, chipping, filling, grinding etc. if required for preparation and finishing of site connections.

iii) Reaming of holes for use of higher size bolt if required.

iv) Welding of connections in place of bolting for which holes are either not drilled at all or wrongly drilled during fabrication.

v) Refabrication of parts damaged beyond repair during transport and handling or refabrication of parts which are incorrectly fabricated.

vi) Fabrication of parts omitted during fabrication by error, or subsequently found necessary.

vii) Drilling of holes which are either not drilled at all or drilled in incorrect location during fabrication.

9.18.2 The work shall conform to the latest revisions of the following IS Codes:

IS-800	: Code of Practice for general construction in steel
IS-456	: Code of Practice for plain or reinforced concrete
IS-7205	: Safety Code for erection of Structural Steel work
IS-12840	: Tolerance for erection of Steel Structures

9.18.3 Conformity with designs:

The contractor should erect the fabricated steel structures, align all the members, complete all field connections as per approved drawings. All works shall conform to the provisions of the relevant IS. The testing and acceptance of the erected structures shall be in accordance with the provisions of this specification.

9.18.4 a. The contractor should take delivery of all the materials at site. He shall unload the materials and perform all formalities such as checking of materials and attend to insurance matters as specified above.

Contractor shall make good any such deficiency, if detected later, either by repair or with fresh material as may be directed by the Engineer at the contractor's own cost. All field connection materials such as bolts, nuts, washers and electrodes, other consumables such as oxygen and acetylene gas, paints, fuels, lubricants, oil, grease and any other material as required for the execution of the works shall be supplied by the contractor for erection work.

b. All materials shall be stored preventing deterioration and ensuring the preservation of their quality and fitness for use in the works. Any material which has been deteriorated or damaged beyond repairs and has become unfit for use shall be removed immediately from the site. The contractor should establish a suitable yard at site for storing the fabricated steel structures and other materials. The yard shall have

proper facilities such as drainage, lighting, suitable access for large cranes, trailers and other heavy equipment. The yard shall be fenced all around with security arrangement and shall be of sufficiently large area to permit systematic storage of the fabricated steel structures without overcrowding. All field connection materials, paints, cement etc. shall be stored on well designed racks and platforms off the ground in a properly covered store building.

c. The contractor shall establish and maintain quality control procedures for different items of work and materials; and shall submit the records of the same to the Engineer. The quality control operation shall include but not be limited to the following:

i) Erection : Lines, levels, grades, plumbs, joint characteristics including tightness of bolts.

ii) Painting : Preparation of surface for painting, quality of primers and paints, thinners, application and uniformity of coats.

9.19 WORKMANSHIP

a. The suitability and adequacy of all erection tools and plant and equipment proposed to be used shall be efficient, dependable, in good working condition. The method and sequence of erection shall have the prior approval of the Engineer. The Erection shall arrange in most economical method; and sequence available to him consistent with the drawings.

b. Unless adequate bracing is included as a part of the permanent framing, the erector during erection shall install, temporary guys and bracings where needed to secure the framing against loads such as wind or seismic forces comparable in intensity to that for which the structure has been designed, acting upon exposed framing as well as loads due to erection equipment and erection operations.

If additional temporary guys are required to resist wind or seismic forces acting upon components of the finished structure during the course of the erection of the steel framing, arrangement for installation by the erector shall be made.

The responsibility of the contractor in respect of temporary bracings and guys shall cease when the structural steel is once located, plumbed, leveled, aligned and grouted within the tolerances permitted under the specification and guyed and braced to the satisfaction of the Engineer. The temporary guys, braces, false work and cribbing shall be removed immediately upon completion of the erection

c. Positioning and leveling of all steelwork, plumbing of stanchions and placing of every part of the structure with accuracy shall be as per approved drawings. Anchor bolts and other anchor steel shall be embedded. The contractor shall check the positions and levels of the anchor bolts, etc. before concreting and get them properly secured against disturbance during pouring operations. He shall remain responsible for correct positioning. For heavy columns, the contractor shall set proper screed bars to maintain proper level. Each tier of column shall be plumbed and maintained in a true vertical position subject to the limits of tolerance allowable. No permanent field

connections by bolting or welding shall be carried out until proper alignment and plumbing has been attained.

d. All relevant portions in respect of bolted construction for fabrication of structural steelwork shall also be applicable for field bolting as below:

Bolts shall be inserted in such a way so that they may remain in position under gravity even before fixing the nut. Bolted parts shall fit solidly together when assembled; and shall not be separated by gaskets or any other interposed compressible materials. When assembled, all joint surfaces, including those adjacent to the washers shall be free of scales except light mill scales. They shall be free of dirt, loose scales, burns, and other defects that would prevent solid seating of the parts. Contact surfaces within friction-type joints shall be free of oil, paint, lacquer, or galvanizing. High tensile bolts shall be tightened to provide the required minimum bolt tension by any of the following methods:-

Turn-of-nut method: When the turn-of-nut method is used to provide the bolt tension, there shall first be enough bolts brought to a "Snug tight" condition to ensure that the parts of the joint are brought into good contact with each other. "Snug tight" is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation as below with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation, there shall be no rotation of the part not turned by the wrench.

Bolts shall be installed without hardened washers when tightening is done by the turn-of-nut method. However, normal washers shall be used.

Bolts tightened by the turn-of-nut method may have the outer face of the nut match-marked with the protruding bolt point before final tightening, thus affording the inspector visual means of noting the actual nut rotation. Such marks shall be made by the wrench operator by suitable means after the bolts have been brought up snug tight.

Torque Wrench tightening: When torque wrenches are used to provide the bolt tensions, the bolts shall be tightened to the torques as below. Nuts shall be in tightening motion when torque is measured. When using torque wrenches to install several bolts in a single joint, the wrench shall be returned to touch up bolts previously tightened, which may have been loosened by the tightening of subsequent bolts, until all are tightened to the required tension.

Nominal bolt diameter (mm)	Torque to be applied for bolt class 8.8 of IS:1367 (Kgm)
20	59.94
22	81.63
24	103.73

The above torque values are approximate for providing tensions of 14.7 MT for
20 mm dia; 18.2 MT for 22 mm dia; and 21.2 MT for 24 mm dia. bolts under moderately lubricated condition. The torque wrench shall be calibrated at least
once daily to find out the actual torque required to produce the above required
tension in the bolt by placing it in a tension indicating device. These torques shall be applied for tightening the bolts on that day with the particular torque
wrench.

In either of the above two methods, if required, for bolt entering and wrench operation clearances, tightening shall be done by turning the bolt while the nut is prevented from rotating.

Impact wrenches if used shall be of adequate capacity and sufficiently supplied with air to perform the required tightening of each bolt in approximately ten seconds.

Holes for turned bolts to be inserted in the field shall be reamed in the field. All drilling and reaming for turned bolts shall be done only after the parts to be connected are assembled. Tolerances applicable in the fit of the bolts shall be as per IS.

e. Field Welding: All field assembly and welding shall be carried out as specified for fabrication work, excepting such provisions therein which manifestly apply to shop conditions only. Where the fabricated structural steel members have been delivered painted, the paint shall be removed before field welding for a distance of at least 50 mm on either side of the joints.

f. Holes, cutting and fitting: No cutting of sections, flanges, webs, cleats, bolts, welds etc. shall be done. The erector shall not cut, drill or otherwise alter the work of other trades, or his own work to accommodate other trades, unless such work is clearly specified. Wherever such work is specified the contractor shall obtain complete information as to size, location and number of alterations prior to carrying out any work.

9.20 DRIFTING

Correction of minor misfits and reasonable amount of reaming and cutting of excess stock shall be considered as permissible. For this, light drifting shall be used to draw holes together; and drills shall be used to enlarge holes as necessary to make connections. Reaming, that weakens the member or makes it impossible to fill the holes properly or to adjust accurately after reaming shall not be allowed.

Any shop work error which prevents the proper assembling and fitting of parts by moderate use of drift pins and reamers shall immediately be called to the attention of the Engineer and approval of the method of correction obtained. The use of gas cutting torches at erection site is prohibited.

9.21 **LOAD TEST AND ACCEPTANCE CRITERIA**

a.) Loading tests shall be carried out on erected structures to check adequacy of fabrication and/or erection. Any structure or a part thereof found to be unsuitable for acceptance as a result of the test shall be dismantled and replaced with suitable member. On the basis of the tests, the Engineer will decide and his decision will be final. In course of dismantling, if any damage is done to any other parts of the structure or to any fixtures, the same shall be made good

The structure or structural member under consideration shall be loaded with its actual dead load for as long a time as possible before testing; and the tests shall be conducted as indicated below:-

i) Stiffness Test: In this test, the structure or member shall be subjected, in addition to its actual dead load, to a test load equal to 1.5 times the specified superimposed load, and this loading shall be maintained for 24 hours. The maximum deflection attained during the test shall be within the permissible limit. If, after removal of the test load, the member or structure does not show a recovery of at least 80 per cent of the maximum strain or deflection shown during 24 hours under load, the test shall be repeated. The structure or member shall be considered to have sufficient stiffness, provided that the recovery after this second test is not less than 90 per cent of the maximum increase in strain or deflection recorded during the second test.

ii) Strength Test: The structure or structural member under consideration shall be subjected, in addition to its actual dead load, to a test load equal to the sum of the dead load and twice the specified superimposed load, and this load shall be maintained for 24 hours.

In the case of wind load, a load corresponding to twice the specified wind load shall be applied and maintained for 24 hours, either with or without the vertical test load for more severe condition in the member under consideration or the structure as a whole. Complete tests under both conditions may be necessary to verify the strength of the structure. The structure shall be deemed to have adequate strength if, during the test, no part fails and if on removal of the test load, the structure shows a recovery of at least 20 per cent of the maximum deflection or strain recorded during the 24 hours under load.

b.) Structure of same design:

Where several identical same design structures exists as a prototype, one structure shall be fully tested, but in addition, during the first application of the test load, particular note shall be taken of the strain or deflection when the test load 1.5 times the specified superimposed load has been maintained for 24 hours.

When a structure of the same type is selected for a check test, it shall be subjected, in addition to its actual dead load, to a superimposed test load, equal to 1.5 time the specified live load, in a manner prescribed by the Engineer. This load shall be maintained for 24 hours, during which time, the maximum deflection shall be recorded. The check test shall be considered satisfactory, provided that the maximum strain or deflection recorded in the check test does not exceed by more than 20% of the

maximum strain or deflection recorded at similar load in the test on the prototype.

c.) Repair for subsequent test and use after strength tests: The structure passed the "Strength Test" as above and is subsequently to be erected for use, shall be considered satisfactory for use after it has been strengthened by replacing any distorted members and has subsequently satisfied the 'Stiffness Test' as specified in above.

9.22 TOLERANCES

Considering expected variation in the finished dimensions of structural steel frames, these shall be within the limits of good practice when they are not in excess of the cumulative effect of detailed erection clearances, fabrication tolerances for the finished parts; and the rolling tolerances for the profile dimensions permitted under the specification for fabrication of structural steelwork shall be as indicated below:

	Component	Description	Variation Allowed
a	For Buildings Containing Cranes		
	i) Main Colomn	a) Shifting of column axis at foundation level withrespect to building line	
		i) In longitudinal direction	(+/-) 3.0mm
		ii) In lateral direction	(+/-) 3.0mm
		b) Deviation of both major column axis from vertical between foundation and other member connection levels :	
		i) For a column upto including 10M	(+/-) 3.5 mm and from true height vertical
		ii) For a column greater than 10M but less than 40M height	(+/-) 3.5 mm from true vertical for length measured between conne-ction levels, but not more than (+/-) 7.0 mm per 30 m length
		c) For adjacent pairs of columns across the width of the building prior to placing of truss.	(+/-) 9 mm on true span.
		d) For any individual column deviation of any bearing or resting level from levels shown on drawings.	(+/-) 3 mm

	Component	Description	Variation Allowed
		e) For adjacent pairs of columns either across the width of building or longitudinally level difference allowed between bearing or seating level supposed to be at the same level.	3 mm
	ii) Trusses	a) Deviation at centre of span of upper chord member from vertical plane running through centre of bottom chord	1/1500 of the span or not greater than 10 mm which ever is the least
		b) Lateral displacement of top chord at centre of span from vertical plane running through centre of supports.	1/250 of depth of truss or 20 mm whichever is the least.
	iii) Cranes Girders & Tracks	a) Difference in levels of crane rail measured between adjacent columns.	2.0 mm
		b) Deviation to crane rail gauge	(+/-) 3 mm
		c) Relative shifting of ends of adjacent crane rail in plan and elevation after thermit welding.	1.0 mm
		d) Deviation of crane rail axis from centre line ofweb.	(+/-) 3.5 mm
	iv) Setting of expansion gaps	At the time of setting of the expansion gaps, due regard shall be taken of the ambient temperature above or below 30°C. The coefficient of expansion or contraction shall be taken as 0.000012 per Deg.C per unit length.	
b	For Buildings without Cranes		
	The maximum tolerances for line and level of the steel work shall be ±3mm on any part of the structure. The structure shall not be out of plumb more than 3.5 mm on each 10 m section of height and not more than 7 mm per 30 m section. These tolerances shall apply to all parts of the structure unless the drawings issued for erection purposes state otherwise.		

9.23 **QUALITY CONTROL PROCEDUREp**

The contractor shall establish & maintain quality control procedure for different items of works and material to ensure that all works are performed as per specification.

Contractor shall got approved field quality plan for all the works to be executed

Quality plan shall be prepared based on guide lines furnished in Volume-II of the specification.

CORPORATE QUALITY ASSURANCE

VENDOR'S PROPOSAL CUM EVALUATION REPORT

ANNEXURE- 3 ***(P4F1R0)***

****Supplier has to submit all the documents as per the annexures cited here and naming philosophy must be as prescribed in this document***

Ref No:		***Date:***	

i.	***Main Contractor***	Bharat Heavy Electricals Limited			
ii.	***Project***				
iii.	***Package Name***		***Package No***		
iv.	***Proposed Item/Scope of Sub-contracting***				
v.	***Item covered under***	***Schedule-1***	☐	***As per contract clause No-***	
		Schedule-2	☐		
vi.	***If item is Schedule-1 and proposed sub-vendor is indigenous, Main Contractor to explain how the contractual provisions will be fulfilled***				
vii.	***Name and Address of the proposed Sub-vendor's works: -***				
viii.	***PO placement date/ Start of manufacturing (if self-manufactured) as per L2 network***			***Under evaluation***	

ix.	***Item Description (Type/Size/Rating/Scope of Sub-Contracting)***	***Total quantity of proposed item envisaged in this package (Nos/ Running Meters/ Kgs/ Tons etc)***	***Quantity proposed to be procured from proposed sub-vendor (Nos/ Running Meters /Kgs /Tons etc)***	***Timeline for quantity requirements as per project schedule & whether the proposed Sub-vendor equipped with adequate capacity to supply proposed order quantity in time***

x. ***Supply experience of the proposed sub-vendor (including supplies to Main Contractor, if any) for similar item/scope of sub-contracting, for last 3 years (Note:- Only relevant experience details w.r.t. proposed item/scope of subcontracting to be brought out here)***

Project/Package	***Customer Name***	***Supplied Item (Type/Rating/Model /Capacity/Size etc)***	***PO ref no/date***	***Supplied Quantity***	***Date of Supply***

We confirm that as per our assessment, the proposed sub-vendor has requisite capabilities & supply experience and is suitable for supplying the proposed item/scope of sub-contracting.

Name :		***Desig:***		***Contact No:***		***Sign:***		***Date:***	

Company's Seal/Stamp:-

CORPORATE QUALITY ASSURANCE
VENDOR QUESTIONNAIRE

ANNEXURE- 4 ***(P4F2R0)***

****Supplier has to submit all the documents as per the annexures cited here and naming philosophy must be as prescribed in this document***

i.	***Item/Scope of Sub-contracting***			
ii.	***Address of the registered office***	***Details of Contact Person*** ***(Name, Designation, Mobile, Email)***		
iii.	***Name and Address of the proposed Sub-vendor's works where item is being manufactured***	***Details of Contact Person:*** ***(Name, Designation, Mobile, Email)***		
iv.	***Annual Production Capacity for proposed item/scope of sub-contracting***			
v.	***Annual production for last 3 years for proposed item/scope of sub-contracting***			
vi.	***Details of proposed works***			
1.	***Year of establishment of present works***			
2.	***Year of commencement of manufacturing at above works***			
3.	***Details of change in Works address in past (if any)***			
4.	***Total Area***			
	Covered Area			
5.	***Factory Registration Certificate***	***(Details to be attached as Annexure – F2.1)***		
6.	***Design/ Research & development set-up*** ***(No. of manpower, their qualification, machines & tools employed etc.)***	***Applicable / Not applicable if manufacturing is as per Main Contractor/purchaser design)*** ***(Details to be attached as Annexure – F2.2)*** ***(if applicable)***		
7.	***Overall organization Chart with Manpower Details (Design/Manufacturing/Quality etc.)***	***(Details to be attached as Annexure – F2.3)***		

CORPORATE QUALITY ASSURANCE
VENDOR QUESTIONNAIRE

8.	***After sales service set up in India, in case of foreign sub-vendor (Location, Contact Person, Contact details etc.)***	***Applicable / Not applicable (Details to be attached as Annexure – F2.4)***
9.	***Manufacturing process execution plan with flow chart indicating various stages of manufacturing from raw material to finished product including outsourced process, if any.***	***(Details to be attached as Annexure – F2.5)***
10.	***Sources of Raw Material/Major Bought Out Item***	***(Details to be attached as Annexure – F2.6)***
11.	***Quality Control exercised during receipt of raw material/BOI, in-process, Final Testing, packing***	***(Details to be attached as Annexure – F2.7)***
12.	***Manufacturing facilities (List of machines, special process facilities, material handling etc.)***	***(Details to be attached as Annexure – F2.8)***
13.	***Testing facilities (List of testing equipment)***	***(Details to be attached as Annexure – F2.9)***
14.	***If manufacturing process involves fabrication then-*** ***List of qualified Welders*** ***List of qualified NDT personnel with area of specialization***	***(Details to be attached as Annexure – F2.10) (if applicable)***
15.	***List of out-sourced manufacturing processes with Sub-Vendors' names & addresses***	***Applicable / Not applicable (Details to be attached as Annexure –F2.11) (if applicable)***
16.	***Supply reference list including recent supplies***	***Details to be attached as Annexure – F2.12 (as per format given below)***

Project/ package	*Customer Name*	*Supplied Item (Type/Rating/Model /Capacity/Size etc)*	*PO ref no/date*	*Supplied Quantity*	*Date of Supply*

17.	***Product satisfactory performance feedback letter/certificates/End User Feedback***	***(Details to be attached as Annexure - F2.13)***

	CORPORATE QUALITY ASSURANCE **VENDOR QUESTIONNAIRE**

18.	***Summary of Type Test Report (Type Test Details, Report No, Agency, Date of testing) for the proposed product (similar or higher rating)*** ***Note: - Reports need not to be submitted***	***Applicable / Not applicable*** ***(Details to be attached as Annexure – F2.14)*** ***(if applicable)***
19.	***Statutory / mandatory certification for the proposed product***	***Applicable / Not applicable*** ***(Details to be attached as Annexure – F2.15)*** ***(if applicable)***
20.	***Copy of ISO 9001 certificate (if available)***	***(Details to be attached as Annexure – F2.16)***
21.	***Product technical catalogues for proposed item (if available)***	***(Details to be attached as Annexure – F2.17)***

Name:		***Desig:***		***Sign:***		***Date:***	

Company's Seal/Stamp:-

	TITLE:	SPECIFICATION NO. PE-TS-999-600-C017
Maharatna Company	TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 1 OF 43

VOLUME: II B

SECTION - D
(PART I)

SUB-SECTION – D 17

FABRICATION OF STRUCTURAL STEEL WORK

Maharatna Company

Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301

C 0 N T E N T

SUB-SECTION – D XVII

FABRICATION OF STRUCTURAL STEEL WORK

1.00.00 SCOPE

This specification covers supply, fabrication, testing, painting and delivery to site of structural steelwork including supply of all consumable stores and rivets, bolts, nuts, washers, electrodes and other materials required for fabrication and field connections of all structural steelwork covered under the scope of the contract.

2.00.00 GENERAL

2.01.00 Work to be provided for by the Contractor

The work to be provided for by the Contractor, unless otherwise specified elsewhere in the contract, shall include, but not be limited to the following

a) Preparation of complete detailed fabrication drawings and erection marking drawings required for all the structures covered under the scope of the contract based on the approved design drawings. As decided by the Engineer, some or all of these detailed drawings will have to be submitted for approval.

b) To submit revised design with calculations and detailed fabrication drawings in case any substitution of the designed sections are to be made.

c) To submit design calculations for joints and. connections developed by the contractor along with detailed fabrication drawings.

d) Furnish all materials, labour, tools and plant and all consumables required for fabrication and supply, all necessary rivets, bolts, nuts, washers, tie rods and welding electrodes for field connections,

e) Furnish shop painting of all fabricated steelwork as per requirements of this Specification.

f) Suitably mark, bundle, and pack for transport all fabricated materials.

g) Prepare and furnish detailed Bill of Materials, Drawing Office Dispatch lists, Rivet and Bolt List and any other list of bought out items required in connection with the fabrication and erection of the structural steelwork.

h) Insure, load and transport all fabricated steelwork field connection materials to site.

i) Maintain a fully equipped workshop at site for fabrication, modification and repairs of steelwork at site as may be required to complete the works in accordance with the Contract.

2.02.00 Work by others

No work under this specification will be provided for by any agency other than the contractor, unless specifically mentioned otherwise elsewhere in the contract.

2.03.00 Codes and standards

All work under this specification shall, unless otherwise specified in the contract, conform to the requirements of the latest revision and/or replacements of the following or any other relevant Indian Standard specifications and codes of practice. In case any particular aspect of the work is not specifically covered by any Indian Standard specification, any other standard practice, as may be specified by the Engineer shall be followed:

IS : 226 - Structural steel (Standard Quality)

IS : 800 - Code of Practice for general construction in steel.

IS : 806 - Code of practice for use of steel tubes in general building construction.

IS : 808 - Rolled steel beams, channels, and angle sections

IS : 813 - Scheme of symbols for welding

IS : 814 - Covered electrodes for metal arc welding of structural steel

IS : 815 - Classification and coding of covered electrodes for metal arc welding of structural steels.

IS : 816 - Code of practice for use of metal arc welding for general construction in mild steel

IS : 817 - Code of practice for training and testing metal arc welders

IS : 818 - Code of practice for safety and health requirements in electric and gas welding and cutting operations

IS : 822 - Code of practice for inspection of welds

IS : 919 - Recommendations for limits and fits for Engineering

IS : 961 - Structural Steel (High Tensile)

IS : 1148 - Rivet bars for structural purposes

IS : 1149 - High tensile rivet bars for structural purposes

IS : 1161 - Steel Tubes for structural purposes

IS : 1200 - Method of measurement of steelwork and ironwork (Part 8)

IS : 1239 - Mild Steel Tubes

IS : 1363 - Black hexagon bolts, nuts and lock nuts (dia. 6 to 30 mm) and black hexagon screws (dia 6 to 24 mm)

IS : 1364 - Precision and semi-precision hexagon bolts, screws, nuts and l locknuts (dia, range 6 to 39 mm)

IS : 1367 - Technical supply conditions for threaded fasteners

IS : 1442 - Covered electrodes for the metal are welding of high tensile structural steel

IS : 1608 - Method for tensile testing of steel products other than sheet strip, wire and tube

IS : 1730 - Dimensions for steel plate, sheet, and strip for structural and general engineering purposes.

IS : 1731 - Dimensions for steel flats for structural and general engineering purposes

IS : 1852 - Rolling and cutting tolerances for hot-rolled steel products

IS : 1977 - Structural steel (ordinary quality) St-42-0

IS : 2062 - Steel for General Structural Purposes

IS : 2074 - Ready mixed paint, red oxide Zinc chromate priming

IS : 2595 - Code of Practice for Radiographic Testing

IS : 2629 - Recommended practice for Hot-Dip Galvanizing of Iron and Steel

IS : 2633 - Method for testing uniformity of coating on Zinc Coated Articles

IS : 3757 - High strength structural bolts

IS : 4759 - Specifications for Hot-Dip Zinc Coatings on Structural Steel and other allied products

IS : 7205 - Safety Code for Erection of Structural Steelwork

IS : 7215 - Tolerances for fabrication of steel structures

IS : 7280 - Bare wire electrodes for submerged arc welding of structural steels.

IS : 9595 - Recommendations for metal arc welding of carbon and carbon manganese steels.

2.04.00 Conformity with Designs

The contractor shall design all connections, supply and fabricate all steelwork and furnish all connection materials in accordance with the approved drawings and/or as instructed by the Engineer keeping in view the maximum Utilization of the available sizes and sections of steel materials. The methods of painting, marking, packing and delivery of all fabricated materials shall be in accordance with the provisions of the contract and/or as approved by the Engineer. Provision of all relevant Indian Standard Specifications and Codes of Practice shall be followed unless otherwise specified in the contract.

2.05.00 Materials to be used

2.05.01 General

All steel materials required for the work will be supplied by the contractor unless otherwise specified elsewhere in the contract. The materials shall be free from all imperfections, mill scales, slag intrusions, laminations, fittings, rusts etc. that may impair their strength, durability, and appearance. All materials shall be of tested quality only unless otherwise permitted by the Engineer and/or Consultant. If desired by the Engineer, Test Certificates in respect of each consignment shall be submitted in triplicate. Whenever the materials are required to be used from unidentified stocks, if permitted by the Engineer, a random sample shall be tested at an approved laboratory from each lot of 50 tones or less of any particular section.

The arc welding electrodes shall be of approved reputed manufacture and conforming to the relevant Indian Standard Codes of Practice and Specifications and shall be of heavily coated type and the thickness of the coating shall be uniform and concentric. With each container of electrodes,

the manufacturer shall furnish instructions giving recommended voltage and amperage (Polarity in case of D.C. supply) for which the electrodes are suitable.

2.05.02 Steel

All steel materials to be used in construction within the purview of this specification shall comply with any of the following Indian Standard Specifications as may be applicable:

a) IS : 2062 - Steel for general structural purposes

b) IS : 961 - Structural steel High Tensile

c) IS : 1977 - Structural steel (Ordinary quality) St-42-0

In case of imported steel materials being used, these shall conform to specifications equivalent to any of the above as may be applicable.

2.05.03 Rivet Steel

All rivet steel used in construction within the purview of this Specification shall comply with one of the following Indian Standard Specifications as may be applicable:

a) IS : 1148 - Rivet Bars for structural purpose

b) IS : 1149 - High tensile rivet bars for structural purposes. Where high tensile steel is specified for rivets, steps shall be taken to ensure that the rivets are so manufactured that they can be driven and heads formed satisfactorily without the physical properties of steel being impaired.

2.05.04 Electrodes

All electrodes to be used under the Contract shall be of approved reputed manufacture, low hydrogen electrode and shall comply with any of the following Indian Standard Specifications as may be applicable

a) IS : 814 - Covered electrodes for metal arc welding of structural steel

b) IS : 815 - Classification and coding of covered electrodes for metal arc welding of mild steel and low alloy high tensile steel

c) IS : 1442 - Covered electrodes for the metal arc welding of high tensile structural steel

d) IS : 7280 - Bare wire electrodes for submerged arc welding of structural steels

2.05.05 Bolts and Nuts

All bolts and nuts shall conform to the requirements of Indian Standard Specification IS: 1367 - Technical Supply Conditions for Threaded Fasteners.

Materials for Bolts and nuts under the purview of this contract shall comply with any of the following Indian Standard Specifications as may be applicable.

a) Mild Steel

All mild steel for bolts and nuts when tested in accordance with the following Indian Standard Specification shall have a tensile strength of not less than 44 Kg/mm² and a minimum elongation of 23 per cent on a gauge length of 5.6 _/A, where "A" is the cross sectional area of the test specimen

i) IS: 1367: Technical supply conditions for threaded fasteners

ii) IS: 1608: Method for tensile testing of steel products other than sheet, strip, wire and tube

b) High Tensile Steel

The material used for the manufacture of high tensile steel bolts and nuts shall have the mechanical properties appropriate to the particular class of steel as set out in IS: 1367 or as approved by the Engineer.

2.05.06 Washers

Washers shall be made of steel conforming to any of the following Indian Standard Specifications as may be applicable under the provisions of the Contract:

a) IS : 2062 - Steel for general structural purposes

b) IS : 961 - Structural Steel (High Tensile Quality)

c) IS : 1977 - Structural steel (Ordinary Quality) St-42-0

d) IS : 6649 - Hardened washers

2.05.07 Paints

Paints to be used for shop coat of fabricated steel under the purview of this contract shall conform to the Indian Standard Specification IS: 2074 - Ready mixed Paint, Red oxide Zinc Chromate Priming.

2.06.00 Coal Bin

2.06.01 Shape of bins shall be circular, polygonal, square, or rectangular in plan. Bottom hopper portion may have be conical-cum-hyperbolic or any other profile shape as shown in the drawing. Bin shall be termed as bunkers or silos according to their shape and plane of rupture of coal.

2.06.02 For general requirements, fabrication and construction details IS: 9178 (Pt.l & 11) shall be followed as general guidance. The bins shall be fabricated and erected in segments.

2.06.03 The Coal bins shall be made of mild steel plates joined together with full strength butt weld and provided with stiffeners at regular interval. Stiffeners shall be provided on the external face and it may be welded with external face.

2.06.04 Bending of plates and rolled sections to the required shape for fabrication shall be done by plate bending machine or cold bending process Without resorting to heating, hammering, angle smithy and black smithy process.

2.06.05 Poking hole (manual or pneumatic) and striking plate shall be provided to facilitate coal flow. Poking holes shall have circular MS pipe and cover cap as detailed in the drawing.

2.07.00 New Erection Marks

2.07.01 Additional structures involving new erection marks may be required to be added at any stage of work.

2.07.02 All such new erection marks shall be detailed and included in marking schemes and fabrication carded out thereafter.

2.07.03 All such new erection marks shall be considered under item of original fabrication work. As a result of additional structures becoming necessary if the work is delayed beyond the time schedule stipulated, the Engineer shall give suitable extension of time provided he is satisfied about the reasonableness of the delay involved. However, no claim for extra payments or revision of rates due to delay shall be entertained.

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2.08.00 ELECTRO FORGED STEEL GRATINGS

2.08.01 Factory made fabricated electro forged gratings unit with steel conforming to IS: 2062 shall be supplied, fabricated, transported, erected and aligned in floorings, platforms, drain and trench covers, walkways, passages, staircases with edge binding strips and anti skid nosing in treads etc.

2.08.02 All grating units shall be rectangular in pattern and electro forged. The size and the spacing of the bearing bars and cross bars shall be as detailed in fabrication drawings. The contractor shall submit the grating design for different spans and load intensities along with fabrication drawings. The depth of the grating unit shall be 40 mm, unless specified otherwise.

2.08.03 The gratings shall be made up in panel units designed to coincide with the span of the structural steel framing or openings as indicated in the design/ scope drawings. Maximum possible standardization of the grating panel sizes shall be tried and designed.

2.08.04 The grating unit shall be accurately fabricated and finished, free from wraps, twists, or any defects that would impair their strength, serviceability, and appearance.

2.08.05 Grating work shall include cut outs and clearance opening for all columns, pipes, ducts, conduits or any other installation penetrating through the grating work. Such cut outs and clearances shall be treated as specified in subsequent clauses.

2.08.06 The gratings shall be notched, trimmed and neatly finished around flanges and webs of the columns, moment connections, cap plates, and such other components of the steel structures encountered during the placement of the gratings. In all such cases, the trimming shall be done to follow the profile of the components encountered. After trimming, the binding strip shall be provided on the grating to suit the profile so obtained.

2.08.07 Opening in gratings for pipes or ducts that are 150mm in size or diameter or larger shall be provided with steel bar toe plates of not less than 5mm thickness and appropriate width, set flush with the bottom of the bearing bars.

2.08.08 Penetrations in gratings that are more than 50mm but less than 150mm in size or diameter shall be welded with plates of size shown in the detailed drawings set flush with the bottom of the grating panel.

2.08.09 Unless otherwise indicated on the drawings, grating units at all penetrations shall be made up in split section, accurately fitted and neatly finished to provide for proper assembly and erection at the job site.

2.08.10 Grating units shall be provided with all necessary clips, bolts, nuts and lock washers required for proper assembly and rigid installation and fastening to abutting units supporting structural steel framing members.

2.08.11 The gratings shall be of reputed make and manufacturer, as approved by Engineer. The unit rate quoted by him for this item shall be inclusive of transport of gratings to the project site, all taxes, duties etc. He shall also provide all facilities and access to the Engineer or his representative to carry out inspection during all stages of manufacturing of gratings.

2.08.12 Maximum deviation in linear dimension from the approved dimension shall not exceed 12mm.

2.08.13 All fabricated grating section and accessories shall be blast cleaned to near white metal surface (Sa 2½) followed by either of the following two:

(a) Two coats of red lead primer and two coats of black enamel finish paint.

(b) Hot dipped galvanization at 610 gm/sq.m.

in the shop prior to erection at site, as the approved drawing.

2.08.14 Prior to finishing all surfaces shall be cleaned, free from rust, mill scale, grease, oil, or any other foreign matter by blast cleaning. BS: 4232 shall be followed for blast cleaning.

2.08.15 Primer can be applied by spray guns or by brushes, however the finish paint shall necessarily be applied by means of spray guns. The applied coatings shall be uniform, free from voids and streaks; drilled or punched holes shall be touched up prior to erection or assembly.

2.09.00 GALVANIZATION OF GRATINGS

2.09.01 Purity of Zinc to be used-for galvanizing shall be 99.5% as per IS: 2 15

2.09.02 After the shop work is complete, the structural material shall be punched with erection mark and be hot double dip galvanized. Before galvanizing the steel section shall be thoroughly blast cleaned to near white metal surface (Sa 2½).

2.09.03 The weight of the zinc coating shall be at least 610 gm/m² - unless noted otherwise.

2.09.04 The galvanized surface shall consist of a continuous and uniformly thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be cleaned and smooth and shall be free from defects like discoloured

patches, bare spots, unevenness of coating, spelter that is loosely attached to the steel, blistered surface, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

2.09.05 There shall be no flaking or loosening when struck squarely with a chisel faced hammer. The galvanized steel member shall withstand minimum four one minute dips in copper sulphate solution as per IS: 2633.

2.09.06 When the steel section is removed from the galvanizing kettle, excess spelter shall be removed by 'bumping'. The processes known as 'wiping' or 'scrapping' shall not be used for this purpose.

2.09.07 Defects in certain members indicating presence of impurities in the galvanizing bath in quantities larger than that permitted by the specifications or lack of quality control in any manner in the galvanizing plant, shall render the entire, production in the relevant shift liable to rejection.

2.09.08 All structural steel shall be treated with sodium dichromate or an approved equivalent solution after galvanizing; so as to prevent white storage stains.

2.09.09 If the galvanizing of any member is damaged, the Engineer shall be shown of the extent of damage, if so directed the galvanizing may have to the redone in the similar manner as stated above at no extra cost to the Owner.

2.10.00 STAINLESS STEEL HOPPERS (As per BOQ item)

2.10.01 Material

In case SS Hopper is to be fabricated & erected as per BOQ item with SS415M, following specification shall be followed.
Stainless steel hopper of grade SS 415M as manufactured by SAIL or equivalent shall be provided in the lower portion of bunker hopper. SS 4 15M having the following chemical composition shall be used.

Material	**%**	**Remarks**
Carbon	10.03%	Max.
Silicon	1.60%	Max.
Manganese	0.80% to 1.50%	
Phosphorous	0.03%	Max.
Sulpher	0.03%	Max.

Chromium	10.80% to 12.50%	
Nickel	1.50%	Max.
Titanium	0.75%	Max.
Nitrogen	0.03%	Max.

The mechanical properties shall be as follows:

Description	**Value**	**Remarks**
Hardness Rock Well B Scale	90	Max.
Tensile Strength	450 MPa	Min.
Yield Strength	300 MPa	Min.
Elongation	25%	Min.

2.10.02 Fabrication

The fabrication, erection, alignment and welding shall be carried out as per the accepted practice and in accordance with relevant I.S. and international specification as well as stipulations contained herein. Fabrication drawings shall be prepared by the contractor on the basis of the design / scope drawings furnished by Engineer. The fabrication and erection works shall be done as per the approved fabrication drawings.

2.10.03 Fabrication Drawings

a) Fabrication drawing shall give the cutting plan for each hopper plate. Such, cutting plan shall be based on the size of the Stainless Steel plate available at store. In order to reduce the wastage and ensure the maximum utilization of stainless steel plate, the cutting plan shall take in the consideration of the reverse curvature and place the various elements of hopper plate in opposite fashion to reduce the end wastage. Similarly the hopper plate element having different radii shall be placed one inside the other, to optimize the stainless steel plate use. Such optimization may also required adjustment in the size of the each element of hopper plate and also additional weld joints.

b) The bill of material of hopper plate shall indicate the inner surface area of the hopper, weight of the hopper based on the inner surface area, weight of each of the cut plate of hopper fabrication, weight of cut and scrap pieces

generated. Contractor shall return to the Owner's store all unutilized (surplus) stainless steel plates and all waste and cut pieces generated. Non return of any part of the surplus/waste steel pieces to the Owner's store will call for the penal recovery at three (03) times the maximum procurement rate for the weight of stainless steel pieces not returned to the store.

c) In case the contractor does the cutting of the stainless steel without approved cutting plan then all the wastage (i.e. the difference between the weight of stainless steel plate cuts and the actual finished weight considered for the measurement for payment) shall be subjected to the penal recovery at the rate mentioned above.

2.10.04 Cuffing

Cutting may be affected by shearing, or by using plasma. The cut edges of all plates shall be perfectly straight and uniform through out. Cutting shall be done as per the cutting plan shown in the fabrication drawing. Should the Engineer find it necessary, the edges shall be ground smooth afterwards by contractor within the unit rates quoted by him. All the edge s shall be ground smooth before they are welded.

2.10.05 Jointing

Welding shall join stainless steel. All weld joints (along the inclined plane) shall be staggered. Any common welding process can weld stainless steel viz. MIG, metal arc or plasma using the covered compatible electrodes as per IS: 5206 or by inert gas arc welding as per IS: 2811. Shielding gas shall be Argon + Hydrogen mixture or Argon + Oxygen mixture. However, Argon + Oxygen mixture shall be preferred. Carbon-di-oxide mixture shall be avoided. 308L and 315L electrodes/fillers shall be used for the welding of Stainless Steel to Stainless Steel and Stainless Steel to Mild Steel respectively. However, the welding process and the type of the electrodes to be used for welding shall be as per welding procedure, as approved by the Engineer. On the basis of the welding procedure, the Contractor shall conduct qualification test.

2.10.06 Bending

The stainless steel plates shall be subjected to cold forming and bending in order to get the desired shape and profile.

2.10.07 Welding sequence

The type of electrodes, welding sequence, preheat and interpass temperature and post weld heat treatment shall be as approved by the Engineer.

2.10.08 Acceptance Criteria of Fabricated Structures

The acceptance of the fabricated structure work shall depend upon correct dimensions and alignment, absence of distortion in the structure, satisfactory results from the inspection and testing of the welded structure joints and the test specimens, general workmanship being good meeting the tolerance requirements given in IS: 7215.

2.11.00 BEARINGS

2.11.01 PTFE (Poly tetra fluorethylene) slide bearing

a) General

The bearings shall consist of upper and lower units. The upper unit shall include a sole plate with mirror finish stainless steel facing bonded to the bottom surface of the sole plate. The lower unit shall consist of a relevant laminated elastomers pad surfaced with PTFE. A rigid confining medium substructure bonds the PTFE to the pad. When the upper and lower units are mated the stainless steel slides on the PTFE surface with an extremely low coefficient of friction. These bearings shall be designed as per the performance requirements. The bearing shall be of reputed make and manufacturer as approved by Engineer, for required vertical loads, as per the construction drawings and for a maximum displacement of ± 50 mm.

b) Material

PTFE bearing shall be sliding against highly polished stainless steel and the coefficient of friction between them shall be less than 0.06 at 55 kg/cm². In order to prevent cold flow in the PTFE surface it shall be rigidly bonded by a special high temperature resistant adhesive to the stainless steel sub-strata. The stainless steel surface, which slides against the PTFE, is mirror polished. The stainless steel shall be bonded to the top plate by special high strength adhesive. The thickness of the stainless steel shall be between 1.0 to 1.5mm.

The resilient bearing pad shall consist of multiple layers of lightweight fabric impregnated with a high quality elastomer compound vulcanized into slabs of uniform standard thickness as per the requirement. This shall withstand vertical (compressive) load not less than 500 kg/cm² and shear loads upto 40 kg/cm².

c) Installation

The seating area for PTFE bearing shall be prepared accurately level and furnished with a thin layer of epoxy resin mortar. The bearing will be

placed on this layer while it is still workable and the bearing is levelled. The bearing should not be displaced as the beam is lowered into position. When the mortar and adhesive are fully set and the beam slightly above the top of the bearing. The upper surface of the bearing shall then be coated with sufficient thickness of epoxy resin mortar so that when the beam is lowered on to the temporary supports it comes into full contact with the mortar and some is squeezed out. The surplus shall be troweled off and after the mortar is fully set the temporary supports removed.

2.12.00 Storage of material

2.12.01 General

All materials shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged, shall be removed from the contractor's yard immediately, failing which, the Engineer shall be at liberty to get the material removed and the cost incurred thereof shall be realised from the Contractor. The Contractor shall maintain upto date accounts in respect of receipt, use, and balance of all sizes and sections of steel and other materials. In case the fabrication is carried out in contractor's fabrication shop outside the plant site where other fabrication works are also carried out, all materials meant for use in this contract shall be stacked separately with easily identifiable marks.

2.12.02 Steel

The steel to be used in fabrication and the resulting cut-pieces shall be stored in separate stacks off the ground section wise and lengthwise so that they can be easily inspected, measured, and accounted for at any time. If required by the Engineer, the materials may have to be stored under cover and suitably painted for protection against weather.

2.12.03 Electrodes

The electrodes for electric arc welding shall be stored in properly designed racks, separating different types of electrodes in distinctly marked compartments. The electrodes shall be kept in a dry and warm condition if necessary by resorting to heating.

2.12.04 Bolts, Nuts and Washers

Bolts, nuts and washers and other fastening materials shall be stored on racks off the ground with a coating of suitable protective oil. These shall be stored in separate gunny bags or compartments according to diameter, length, and quality.

2.12.05 Paints

Paints shall be stored under cover in air tight containers. Paints supplied in sealed containers shall be used up as soon as possible once the container is opened.

2.13.00 Quality Control

The Contractor shall establish and maintain quality control procedures for different items of work and materials to the extent he deems necessary to ensure that all work is performed in accordance with this specification. In addition to the Contractor's quality control procedures, materials and workmanship at all times shall be subjected to inspection by the Engineer or Engineer's representative. As far as possible, all inspection by the Engineer or Engineer's representative shall be made at the Contractor's fabrication shop whether located at Site or elsewhere. The Contractor shall co-operate with the Engineer or Engineer's representative in permitting access for inspection to all places where work is being done and in providing free of cost all necessary help in respect of tools and plants, instrument, labour and materials required to carry out the inspection. The inspection shall be so scheduled as to provide the minimum interruption to the work of the Contractor.

Materials or workmanship not in reasonable conformance with the provisions of this Specification may be rejected at any time during the progress of the work.

The quality control procedure shall cover but not be limited to the following items of work

a) Steel: Quality manufacturer's test certificates, test reports of representative samples of materials from unidentified stocks if permitted to be used.

b) Rivets, Bolts, Nuts & Washers : Manufacturer's certificate, dimension checks, material testing.

c) Electrodes : Manufacturer's certificate, thickness and quality of flux coating.

d) Welders : Qualifying Tests

e) Welding sets : Performance Tests

f) Welds : Inspection, X-ray, Ultrasonic tests

g) Paints : Manufacturer's certificate, physical inspection

reports

h) Galvanizing : Tests in accordance with IS 2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS : 4759 - Specification for Hot-Dip Zinc coatings on Structural Steel and other allied products.

2.14.00 Standard dimensions, forms and weights

The dimensions, forms, weights and tolerances of all rolled shapes rivets, bolts, nuts, studs, washers etc. and other members used in the fabrication of any structure shall, wherever applicable, conform to the requirements of the latest relevant Indian Standards, wherever they exist, or, in the absence of Indian Standards, to other equivalent standards.

2.15.00 Fabrication Drawings

The contractor shall within thirty (30) days after the award of the Contract submit to the Engineer the Schedule of Fabrication and erection of structural Steelworks, for approval. Within one week after receipt of approval on design of any steel structure (part or full) based on the approved design. As decided by the Engineer, six (6) copies each of some or all of the detailed fabrication drawings will have to be submitted for approval.

The sequence of preparation of fabrication drawings shall match with the approved fabrication and erection schedule. The above-mentioned approval for fabrication drawings will be accorded only towards the general conformity with the design requirements as well as specifications. The approval of drawing however shall not relieve the contractor of his sole responsibility in carrying out the work correctly and fulfilling the complete requirements of contract documents.

The fabrication drawings shall include but not limited to the following:

a) Assembly drawings giving exact sizes of the sections to be used and identification marks of the various sections.

b) Dimensional drawings of base plates, foundation bolts location etc.

c) Comparison sheets to show that the proposed alternative section, if any, is as strong as the original sections shown on the Design Drawings.

d) Complete Bill of Materials and detailed drawings of all sections as also their billing weights.

e) Any other drawings or calculations that may be required for the clarification of the works or substituted parts thereof.

These drawings shall give all the necessary information for the fabrication, erection, and painting of the steelwork in accordance with the provisions of this Specification. Fabrication drawings shall be made in accordance with the best modern practice and with due regard to sequence, speed and economy in fabrication and erection. Fabrication drawings shall give complete information necessary for fabrication of the various components of the steelwork, including the location, type, size, and extent of welds. These shall also clearly distinguish between shop and field rivets, bolts, and welds and specify the class of bolts and nuts. The drawings shall be drawn to a scale large enough to convey all the necessary information adequately. Notes on the fabrication drawings shall indicate those joints or groups of joints in which it is particularly important that the welding sequence and technique of welding shall be carefully controlled to minimize the locked up stresses and distortion. Welding symbols used shall be in accordance with the requirements of the Indian Standard Specification. IS: 813 - Scheme of symbols for Welding, and shall be consistent throughout. Weld lengths called for on the drawings shall mean the net effective length.

The Contractor shall be responsible for and shall carry out at his cost any alterations of the work due to any discrepancies, errors or omissions on the drawings or other particulars supplied by him, whether such drawings or other particulars have been duly approved or not in accordance with the Contract.

3.00.00 WORKMANSHIP

3.01.00 Fabrication

3.01.01 General

All workmanship shall be equal to the best practice in modern structural shops, and shall conform to the provisions of the Indian Standard IS: 800 - Code of Practice for general construction in steel and other relevant Indian Standards or equivalent.

3.01.02 Straightening Material

Rolled materials before being laid off or worked, must be clean, free from sharp kinks, bends or twists and straight within the tolerances allowed by the Indian Standard Specification on IS: 1552 - Specification for rolling and cutting tolerance for hot-rolled steel products. If straightening is necessary, it may be done by mechanical means or by the application of a limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 600°C.

3.01.03 Cutting

Shearing, cropping, or sawing shall affect cutting. Use of a mechanically controlled gas-cutting torch may be permitted for mild steel only. Gas cutting of high tensile steel may also be permitted provided special care is taken to leave sufficient metal to be removed by machining, so that all metal that has been hardened by flame is removed. Gas cutting without a mechanically controlled torch may be permitted if special care is taken and done under expert hand, subject to the approval of the Engineer.

To determine the effective size of members cut by gas, 3 mm shall be deducted from each cut edge. Gas cut edges, which will be subjected to substantial stress or which are to have weld metal deposited on them, shall be reasonably free from gouges, occasional notches or gouges not more than 4 mm deep will be permitted. Gouges greater than 4 mm that remain from cutting shall be removed by grinding. All re-entrant corners shall be shaped notch free to a radius of at least 12 mm. Shearing, cropping and gas cutting shall be clean, reasonably square and free from any distortion.

3.01.04 Planning of edges

Planning or finishing of sheared or cropped edges of plates or shapes or of edges gas-cut with a mechanically controlled torch shall not be required, unless specifically required by design and called for on the drawings, included in a stipulation for edge preparation for welding or as may be required after the inspection of the cut surface. Surface cut with hand-flame shall generally be ground, unless specifically instructed otherwise by the Engineer.

3.01.05 Clearances

The erection clearance for cleated ends of members connecting steel to steel shall preferably be not greater than 2 mm at each end. The erection clearance at ends of beams web shall be not more than 3 mm at each end, but where for practical reasons greater clearance is necessary, suitably designed cheatings shall be provided.

3.02.00 Riveted and bolted construction

3.02.01 Holes

Holes through more than one thickness of material for members, such as compound stanchions and girder flanges, shall be drilled after the members are assembled and tightly clamped or bolted together. Punching may be permitted before assembly, if the thickness of the material is not greater than the nominal diameter of rivet or bolt plus 3 mm subject to a maximum thickness of 16 mm

provided that the holes are punched 3 mm less in diameter than the required size and reamed after assembly to the full diameter.

Holes for rivets or black bolts shall be not more than 1.5 mm or 2.0 mm (depending on whether the diameter of the rivet or bolt is less or more than or equal to 25 mm) larger in diameter than the nominal diameter of the rivet or black bolt passing through them.

Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to a tolerance grade of BS as specified in IS: 919. Parts to be connected shall be firmly held together by tacking welds or clamps and the holes drilled through all the thicknesses in one operation and subsequently reamed to size. Holes not drilled through all thickness in one operation shall be drilled to a smaller size and reamed out after assembly.

Holes for rivets or bolts shall not be formed by gas cutting process.

3.02.02 Assembly

All parts of riveted members shall be well pinned or bolted and rigidly held together while riveting. Drifting to enlarge unmatching holes shall not generally be permitted. In case drifting is permitted to a slight extent during assembly, it shall not distort the metal or enlarge the holes. Holes that must be enlarged to admit the rivets or bolts shall be reamed. Poor matching of holes shall be cause for rejection .The component parts shall be so assembled that they are neither twisted not otherwise damaged, and shall be so prepared that the specified cambers, if any, are maintained.

Rivets shall ordinarily be hot driven, in which case their finished heads shall be approximately hemispherical in shape and shall be of uniform size throughout the work for rivets of the same size full, neatly finished and concentric with he holes. Rivets shall be heated uniformly to a temperature not exceeding 1 125°C they shall not be driven after their temperature has fallen below 540°C.

Rivets shall be driven by power riveters, of either compression or manually operated type, employing pneumatic, hydraulic or electric power. Hand driven rivets shall not be allowed unless in exceptional cases specifically approved by the Engineer. After driving, rivets shall be tight, shall completely fill the holes and their heads shall be in full contact with the surface. In case of countersunk rivets, the countersinking shall be fully filled by the rivet, any proudness of the countersunk head being dressed off flush, if required.

Riveted members shall have all parts firmly drawn and held together before and during riveting and special care shall be taken in this respect for all single

riveted connections. For multiple riveted connections, a service bolt shall be provided in every third or fourth hole.

All loose, burnt, or otherwise defective rivets shall be cut out and replaced and special care shall be taken to inspect all single riveted connections. Special care shall also be taken in heating and driving long rivets. The Contractor shall prove the quality of riveting by cutting some rivets chosen at random by the Engineer. No extra payment will be made to the Contractor for such cutting and replacing. Riveting work, for any particular section or group, will be considered satisfactory when at least 90% of the corresponding cut rivets is found to be sound. If the ratio is below 75%, all the rivets in the particular section or group shall be cut, removed and replaced and tested again at the Contractor's expense. For cases between 75% and 90% the engineer shall have the option to instruct cutting and replacing any number of further rivets at the Contractor's cost as he deems necessary.

Bolted construction shall be permitted only in case of field connections if called for on the Drawings and is subjected to the limitation of particular connections as may be specified. In special cases, however, shop bolt connections may be allowed if shown on drawing or directed by the Engineer.

Washers shall be tapered or otherwise suitably shaped, where necessary, to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project trough the nut at least one thread. In all cases the bolt shall be provided with a washer of sufficient thickness under the nut to avoid any threaded portion of the bolt being within the thickness of the parts bolted together. In addition to the normal washer one spring washer or lock nut shall be provided for each bolt for connections subjected to vibrating forces or otherwise as may be specified on the Drawings.

3.03.00 Welded Construction

3.03.01 General

Welding shall be in accordance with relevant Indian Standards and as supplemented in the Specification. Welding shall be done by experienced and good welders who have been qualified by tests in accordance with IS: 817.

3.03.02 Preparation of material

Surface to be welded shall be free from loose scale, slag, rust, grease, paint, and any other foreign material except that mill scale, which withstands vigorous wire brushing, may remain. Joint surfaces shall be free from fins and tears. Preparation of edges by gas cutting shall, wherever practicable, be done by a mechanically guided torch.

3.03.03 Assembling

Parts to be fillet welded shall be brought in, as close contact as practicable and in no event shall be separated by more than 4 mm. If the separation is 1.5 mm or greater, the size of the fillet welds shall be increased by the amount of the separation. The fit of joints at contact surfaces, which are not completely sealed by, welds, shall be close enough to exclude water after painting. Abutting parts to be butt-welded shall be carefully aligned. Misalignments greater than 3 mm shall be corrected and in making the correction the parts shall not be drawn into a sharper slope than two degrees (2°).

The work shall be positioned for flat welding whenever practicable.

3.03.04 Welding Sequence

In assembling and joining parts of a structure or of built-up members, the procedure and sequence of welding shall be such as will avoid needless distortion and minimize shrinkage stresses in the closing welds of a rigid assembly, such closing welds shall be made in compression elements.

In the fabrication of cover-plated beams and built-up members, all shop splices in each component part shall be made before such component part is welded to other parts of the member. Long girders or girder sections may be made by shod splicing not more than three sub-sections, each made in accordance with this paragraph.

When required by the Engineer, welded assemblies shall be stress relieved by heat-treating in accordance with the provisions of the relevant Indian Standard or any other Standard approved by the Engineer.

3.03.05 Welding technique

All complete penetration groove welds made by manual welding, except when produced with the aid of backing material not more than 8 m thick with root opening not less than one-half the thickness of the thinner part joined, shall have the root of the initial layer gouged out on the back side before welding is started from that side, and shall be so welded as to secure sound metal and complete fusion throughout the entire cross-section. Groove welds made with the use of the backing of the same material, as the base metal shall have the weld metal thoroughly fused with the backing material. Backing strips need not be removed. If required, they may be removed by gouging or gas cutting after welding is completed, provided no injury is done to the base metal and weld metal and the weld metal surface is left flush or slightly convex with full throat thickness.

Groove welds shall be terminated at the ends of a joint in a manner that will

ensure their soundness. Where possible, this should be done by use of extension bars or run-off plates. Extension bars or run-off plates need not be removed upon completion of the weld unless otherwise specified elsewhere in the contract.

To get the best and consistent quality of welding, automatic submerged arc process shall be preferred. The technique of welding employed, the appearance and quality of welds made, and the methods of correcting defective work shall all conform to the relevant Indian Standards.

3.03. 12 Temperature

No welding shall normally be done on parent material at a temperature below (-) 5°C. However, if welding is to undertaken at low temperature, adequate precautions as recommended in relevant Indian Standard shall be taken. When the parent material is less than 40 mm thick and the temperature is between (-) 5°C and 0°C, the surface around the joint to a distance of 100 mm or 4 times the thickness of the material, whichever is greater, shall be preheated till it is hand warm. When the parent material is more than 40 mm thick, the temperature of the area mentioned above shall be in no case be less than 20°C. All requirements regarding preheating of the parent material shall be in accordance with the relevant Indian Standard.

3.03. 13 Peening

Where required, intermediate layers of multiple-layer welds may be peened with light blows from a power hammer, using a round-nose tool, peening shall be done after the weld has cooled to a temperature warm to the hand. Care shall be exercised to prevent scaling or flaking of weld and base metal from over peening.

3.03. 14 Equipment

These shall be capable of producing proper current so that the operator may produce satisfactory welds. The welding machine shall be of a type and capacity as recommended by the manufacturers of electrodes or as may be approved by the engineer.

3.04.00 Finish

Column splices and butt joints of compression members depending on contact for stress transmission shall be accurately machined and close-butted over the whole section with a clearance not exceeding 0.1 mm locally at any place. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc; after welding/riveting together, should be accurately machined so that the parts connected butt over the entire surfaces of contact. Care should be taken that those connecting angles of channels are fixed with such accuracy that they are not reduced in thickness by machining by more

than 1.0 mm.

3.05.00 Slab bases and caps

Bases and caps fabricated out of steel slabs, except when cut material with true surface, shall be accurately machined over the bearing surface and shall be in effective contact with the end of the stanchion. A bearing face, which is to be grouted direct to a foundation, need not be machined if such face is true and parallel to the upper face.

To facilitate grouting, holes shall be provided, where necessary, in stanchion bases for the escape of air.

3. 12.00 Lacing bars

The ends of lacing bars shall be neat and free from burns.

3. 13.00 Separators

Rolled section or built-up steel separators or diaphragms shall be required for all double beams except where encased in concrete, in which case, pipe separators shall be used.

3.14.00 Bearing Plates

Provision shall be made for all necessary steel bearing plates to take up reaction of beams and columns and the required stiffeners and gussets whether or not specified in Drawings.

3.15.00 Floor Grating

All grating units shall be rectangular in pattern and of pressure locked assembly. The size and spacing of bearing bars and cross bars shall be as approved in detailed drawings. Alternatively diamond pattern grating if approved may be used.

The grating shall be made in panel units designed to span as indicated in structural steel framing drawing or as directed by the Engineer.

The grating units shall be finished free from warps, twists, or any other defects. Grating work shall include cutouts and clearance openings for all columns, pipes, ducts, conduits etc. The gratings shall be notched, trimmed, and neatly finished around components of the steel structures encountered.

Binding strip shall be provided on the grating to suit the profile. Openings in gratings shall be provided with steel bar toe plates of not less than 5 mm thickness and 100 mm width.

Unless otherwise indicated on drawings, all penetrations of grating units shall be made up in split section, accurately fitted, and neatly finished. Grating units shall be provided with all necessary clips, bolts, lock washers etc. for proper assembly and installation on supporting steel members. Maximum deviation in linear dimension shall not exceed 12 mm.

3.10.00 Chequered Plates

Minimum thickness of chequered plate floorings, covers etc. shall be 6 mm O/P. Chequered plate shall be accurately cut to the required sizes and shapes and the cut edges properly ground. Stiffeners shall be provided wherever required from design consideration.

3.11.00 Architectural Clearances

Bearing plates and stiffener connections shall not be permitted to encroach on the designed architectural clearances.

3.11.00 Shop connections

a) All shop connections shall be otherwise riveted or welded as specified on the Drawings.

b) Heads of rivets on surfaces carrying brick walls shall be flattened to 10 mm thick projection.

c) Certain connections, specified to be shop connections, may be changed to field connections if desired by the Engineer for convenience of erection and the contractor will have to make the desired changes at no extra cost to the exchequer.

3.13.00 Castings

Steel castings shall be annealed.

3.14.00 Shop erection

The steelwork shall be temporarily shop-erected complete or as directed by the Engineer so that accuracy of fit may be checked before dispatch. The parts shall be shop-erected with a sufficient number of parallel drifts to bring and keep the parts in place. In case of parts drilled or punched using steel jigs to make all similar parts interchangeable, the steelwork shall be shop erected in

such a way as will facilitate the check of interchange ability.

3.15.00 Shop painting

3.15.01 General

Unless otherwise specified, steelwork, which will be concealed by interior building finish, need not be painted; steelwork to be encased in concrete shall not be painted. Unless specifically exempted, all other steelwork shall be given one coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned, in accordance with the following paragraph, by brush, spray, roller coating, flow-coating or dipping as may be approved by the Engineer.

After inspection and approval and before leaving the shop, all steelwork specified to be painted shall be cleaned by hand-wire brushing or by other methods of loose mill scale, loose rust, weld slag or flux deposit, dirt and other foreign matter. Oil and grease deposits shall be removed by the solvent. Steelwork specified to have no shop paint shall, after fabrication, be cleaned of oil or grease by solvent cleaners and be cleaned of dirt and other foreign material by trough sweeping with a fibre brush.

3.15.02 Inaccessible parts

Surfaces not in contact, but inaccessible after assembly, shall receive two coats of shop paint, Positively of different colours to prove application of two coats before assembly. This does not apply to the interior of sealed hollow sections.

3.15.03 Contact surfaces

Contact surface shall be cleaned in accordance with sub-clause 3.13.1 before assembly.

3.15.04 Finished surfaces

Machine finished surfaces shall be protected against corrosion by a rust inhibiting coating that can be easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.

3.15.05 Surfaces adjacent to field welds

Unless otherwise provided for, surfaces within 50 of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

3.16.00 Galvanizing

3.16.01 General

Structural steelwork for switchyard or other structures as may be specified in the contract shall be hot dip galvanized in accordance with the American Society for Testing and Materials Specification ASTM-A 123 or IS: 2629 - Recommended practice for Hot-Dip Galvanizing of Iron and steel. Where the steel structures are required to be galvanized the field connection materials like bolts, nuts and washers shall also be galvanized.

3.16.02 Surface Preparation

All members to be galvanized shall be cleaned, by the process of pickling of rust, loose scale, oil, grease, slag and spatter of welded areas and other foreign substances prior to galvanizing. Pickling shall be carried out by immersing the steel in an acid bath containing either sulphuric or hydrochloric acid at a suitable concentration and temperature. The concentration of the acid and the temperature of the bath can be varied, provided that the pickling time is adjusted accordingly.

The pickling process shall be completed by thoroughly rinsing with water, which should preferably be warm, so as to remove the residual acid.

3.16.03 Procedure

Galvanizing shall be carried out by hot dip process in a proper and uniformly heated bath. It shall meet all the requirements when tested in accordance with IS: 2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS: 4759 - Specification for Hot-dip zinc coatings on Structural Steel & other allied products.

After finishing the threads of bolts, galvanizing shall be applied over the entire surface uniformly. The threads of bolts shall not be machined after galvanizing and shall not be clogged with zinc. The threads of nuts may be tapped after galvanizing but care shall be taken to use oil in the threads of nuts during erection.

The surface preparation for galvanizing and the process of galvanizing itself, shall not adversely affect the mechanical properties of the materials to be galvanized. Where members are of such lengths as to prevent complete dipping in one operation, great care shall be taken to prevent warping.

Materials on which galvanizing has been damaged shall be acid stripped and re-galvanized unless otherwise directed, but if any member becomes damaged after leaving been dipped twice, it shall be rejected. Special care shall be taken

not to injure the skin on galvanized surfaces during transport, handling, and erection. Damages, if occur, shall be made good in accordance or as directed by the Engineer.

4.00.00 INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY

4.01.00 Inspection

Unless specified otherwise, inspection to all, work shall be made by the or Engineer's representative at the place of manufacture prior to delivery. The Engineer or his representative shall have free access at all reasonable times to those parts of the manufacturer's works which are concerned with the fabrication of the steelwork under this Contract and he shall be afforded all reasonable facilities for satisfying himself that the fabrication is being done in accordance with the provisions of this Specification.

The Contractor shall provide free of charge, such labour, materials, electricity, fuel, water, stores, tools and plant, apparatus and instruments as may be required by the Engineer to carry out inspection and/or tests in accordance with the Contract. The Contractor shall guarantee compliance with the provisions of this Specification.

4.02.00 Testing and Acceptance Criteria

4.02.01 General

The Contractor shall carry out sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own Cost. The Contractor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the test results in triplicate within 3 (three) days after completion of the test.

4.02.02 Steel

All steel supplied by, the Contractor shall conform, to the relevant Indian Standards. Except otherwise mentioned in the contract, only tested quality steel having mill test reports shall be used. In case unidentified steel materials are permitted to be used by the Engineer, random samples of materials will be taken from each unidentified lot of 50 M.T or less of any particular section for tests to conform to relevant Indian Standards. Cost of all tests shall be born by the contractor.

All material shall be free from all imperfections, mill scales, slag intrusions, laminations, fittings, rusts etc. that may impair their strength, durability, and appearance.

4.02.02 Welding

a) The weld surface shall be cleaned with steel wire brush to remove spatter metal, slag etc. and 100% of welds shall be inspected visually for size, length of weldment and external defects. Weld gauges shall be used for checking weld sizes. The surface shall be clean with regular beads and free from slags, cracks, blow-holes etc.

b) Non-destructive examination shall be carried out to determine soundness of weldments as follows:

i) 10% at random on fillet-joints.

ii) 100% on all butt-joints.

c) Should the ND tests indicate defects like improper root penetration, extensive blowholes, slag intrusion etc., such welds shall be back gauged, joints prepared again and rewelded. All defects shall be rectified by the Contractor at no extra costs.

d) All electrodes shall be procured from approved reputed manufacturers with test certificates. The correct grade and size of electrode, which has not deteriorated in storage, shall be used. The inspection and testing of welding shall be performed in accordance with the provisions of the relevant Indian Standards or other equivalents. For every 50 tones of welded fabrication, the Engineer may ask for 1(one) test-destructive or non-destructive including X -ray, ultrasonic test or similar, the cost of which shall be borne by the Contractor.

4.02.04 Rivets, bolts, nuts and washers

All rivets, bolts, nuts, and washers shall be procured from M/s. Guest Keen William Ltd. or equivalent and shall confirm to the relevant Indian Standards. If desired by the Engineer, representative samples of these materials may have to be tested in an approved laboratory and in accordance with the procedures described in relevant Indian Standards. Cost of all such testing shall have to be borne by the Contractor. In addition to testing the rivets by hammer, 2% (two per cent) of the rivets done shall have to be cut off by chisels to ascertain the fit, quality of material and workmanship. The removal of the cut rivets and re-installing new rivets shall be done by the Contractor at his own cost.

4.02.05 Shop painting

All paints and primers shall be of standard quality and procured from approved

manufacturers and shall conform to the provisions of the relevant Indian Standards.

4.02. 12 Galvanizing

All galvanizing shall be uniform and of standard quality when tested in accordance with IS: 2633 - Method for testing uniformity of coating on Zinc Coated Articles and 15: 4759 - specification for Hot-Dip Zinc Coatings on Structural Steel & other allied products.

4.03.00 Tolerance

The tolerances on the dimensions of individual rolled steel components shall be as specified in IS: 1852 - specification for rolling and Cutting Tolerances for Hot-rolled Steel Products. The tolerances on straightness, length etc. of various fabricated components (such as beams and girders, columns, crane gantry girder etc.) of the steel structures shall be as specified in IS: 721 - Tolerances for Fabrication of Steel Structures.

4.04.00 Acceptance

Should any structure or part of a structure be found not to comply with any of the provisions of this specification, the same shall be liable to rejection. No Structure or part of the structure once rejected, shall be offered again for test, except in cases where the Engineer considers the defects rectifiable. The Engineer may, at his discretion, check some of the tests at an appropriate laboratory at the contractors cost.

When all tests to be performed in the Contractor's shop under the terms of this contract have been successfully carried out, the steelwork will be accepted forthwith and the Engineer will issue acceptance certificate, upon receipt of which, the items will be shop painted, packed and dispatched. No item to be delivered unless an acceptance certificate for the same has been issued. The satisfactory completion of these tests or the issue of the certificates shall not bind the Owner to accept the work, should it, on further tests before or after erection, be found not in compliance with the Contract.

4.05.00 Delivery of materials

4.05.01 General

The Contractor will deliver the fabricated structural steel materials to site with all necessary field connection materials in such sequence as will permit the most efficient and economical performance of the erection work. The Owner may prescribe or control the sequence of delivery of materials, at his own

discretion.

4.05.02 Marking

Each separate piece of fabricated steelwork shall be distinctly marked on all surfaces before delivery in accordance with the markings shown on approved erection drawings and shall bear such other marks as will further facilitate identification and erection.

4.05.03 Shipping

Shipping shall be strictly in accordance with the sequence stipulated in the agreed Programme. Contractor shall dispatch the materials to the e worksite securely protecting and packing the materials to avoid loss or damage during transport by rail, road or water. All parts shall be adequately braced to prevent damage in transit.

Each bundle, bale or package delivered under this contract shall be marked on as many sides as possible and such distinct marking (all previous irrelevant markings being carefully obliterated) shall show the following:

a) Name and address of the consignee

b) Name and address of the consignor

c) Gross weight of the package in tonnes and its dimensions

d) Identification marks and/or number of the package

e) Custom registration number, if required

All markings shall be carried out with such materials as would ensure quick drying and indelibility.

Each component or part or piece of material when shipped, shall be indelibly marked and/or tagged with reference to assembly drawings and corresponding piece numbers.

Each packing case shall contain in duplicate in English a packing list pasted on to the inside of the cover in a water-proof envelope, quoting especially -

a) Name of the Contractor

b) Number and date of the Contract

c) Name of the office placing the contract

d) Nomenclature of stores

e) A schedule of parts or pieces, giving the parts or piece number with reference to assembly drawings and the quantity of each.

The shipping dimensions of each packing shall not exceed the maximum dimensions permissible for transport over the Indian Railways/Roads.

After delivery of the materials at site, all packing materials shall automatically become the property of the Owner.

Notwithstanding anything stated hereinbefore, any loss or damage resulting from inadequate packing shall be made good by the Contractor at no additional cost to the Owner. When facilities exist, all shipments shall be covered by approved Insurance Policy for transit at the cost of the Contractor.

The contractor shall ship the complete materials or part on board a vessel belonging to an agency approved by the Owner or on rail and/or road transport as directed. The Contractor shall take all reasonable steps to ensure correct appraisal of freight rates, weights and volumes and in no case will the Owner be liable to pay any warehouse, wharfage, demurrage and other charges.

If, however, the Owner has to make payment of any of the above-mentioned charges, the amount paid will be deducted from the bills of the Contractor.

Necessary advise regarding the shipment with relevant details shall reach the Engineer at least a week in advance.

5.00.00 INFORMATION TO BE SUBMITTED

5.01.00 With Tender

The following information is required to be submitted with the Tender:

a) Progress Schedule

The Contractor shall quote in his Tender a detailed schedule of progress of work and total time of completion, itemizing the time required for each of the following aspects of work.

i) Preparation and approval of fabrication drawing

ii) Procurement of Materials

iii) Fabrication and shipping of all anchor bolts

iv) Fabrication and shipping of main steelwork.

v) Fabrication and shipping of steelwork for bunkers, tanks and/or silos as applicable.

vi) Fabrication and shipping of all other remaining steelwork including miscellaneous steelwork.

vii) Final date of completion of all shipments.

b) Shop

Location of the Tenderer's fabrication workshop giving details of equipment, manpower, the total capacity, and the capacity that will be available exclusively for this contract shall be submitted.

5.02.00 After Award

After award of the Contract the successful Tenderer is to submit the following:

a) Complete fabrication drawings, material lists, cutting lists, rive and bolt lists, field welding schedules based on the approved design drawings prepared by him in accordance with the approved schedule.

b) Monthly Progress Report with necessary photographs in six (6) copies to reach the Engineer on or before the 7th day o. each month, giving the up-to-date status of preparation of detailed shop drawings, bill of materials, procurement of materials, actual fabrication done, shipping and all other relevant information.

c) Detailed monthly material reconciliation statements relevant to the Work done and reported in the Progress Report, giving the stock at hand of raw steel, work in progress, finished materials.

d) Results of any test as and when conducted and as require by the engineer.

e) Manufacturer’s mill test report in respect of steel materials, rivets, bolts, nuts, and electrodes as may be applicable.

6.00.00 RATES AND MEASUREMENT

6.01.00 Rates

6.01.01 The items of work in the Schedule of items describe the work in brief. The various items of the Schedule of items shall be read in conjunction with these specifications including amendments and additions, general conditions of

contract, special conditions of contracts, and other tender documents, if any. For each item of Schedule of Items, the bidder's rates shall include the activities covered in the description of the item as well as all necessary operations described in the Specifications.

6.01.02 The bidder's rates shall include cost of all minor details which are obviously and fairly intended and which may not have been included in the description in these documents but are essential for the satisfactory completion of the work. Rates shall also include for taking all safety measures.

6.01.03 The bidder's -rates for all items of schedule of items shall include complete cost towards plant, equipment, erection and dismantling of scaffolding, men, materials and consumables, skilled and unskilled labour, levies, taxes, royalties, duties, transport, storage, repair/rectification/maintenance until handing over, contingencies, overhead and all incidental items not specifically mentioned but reasonably implied and necessary to complete the work.

6.01.04 No claims shall be entertained, if the details shown on the `Released for Construction' drawings differ from those shown on the bid/tender drawings.

6.01.05 Rates shall be inclusive of all leads and lifts/elevation.

6.01.06 The bidder's rates for Structural Steel shall include for fabrication and erection, transportation to site, preparation checking collecting and distributing of the fabrication drawings and design calculations, erection scheme, alignment, welding, including preheating and post heating, testing of welders, inspection of welds, visual inspection, non destructive and special testing, rectification and correction of defective welding works, production test plate, inspection and testing, erection scheme, protection against damage in transit, stability of structures, etc. The rates shall also be inclusive of providing and installing temporary structures, transport of Owner issue material from store, return of surplus/waste steel materials including cut pieces/waste steel, provision of additional butt/weld joint to reduce the wastage and all other general, special, such requirements as may be required, for the successful completion of the work.

The rates for fabrication are inclusive of all tests on welds and material and no extra shall be payable for quality tests specified for fabrication of structure in shop or at site.

Separate BOQ items for test on welds like radiography or Ultrasonic, DPT, magnetic particle tests are kept for tests on material/fabrication not covered under regular fabrication item of BOQ.

6.01.07 The bidder's rates for foundation bolts assembly shall include fabrication, threading, heat treatment, erection, installation, and alignment of complete bolt

assembly with nuts, locknuts, anchor plates, stiffener plates, protective tape, etc. This shall also include the cost of all materials not issued by the Owner. Material issued by Owner will be specified in GCC.

6.01.08 The bidders rates for application of inorganic primer shall include surface preparation to near white metal surface by blast cleaning, abrasives, touch up painting, suitable enclosure to avoid contamination and the necessary statutory approval from the factory inspector/pollution control board etc. regarding the method of blast cleaning and abrasives used, and getting approval of the specialized agency supplying the primer specified.

6.01.09 The bidder's rates for application of finish painting system shall include surface preparation, application of intermediate (under) coat, finish coat and final finish coat, and getting approval of the specialized agency supplying the finish paint.

6.01.10 The bidder's rates for electro-forged gratings (if specified) shall include supply, fabrication, transportation to the site, erection and alignment of factory made electro-forged gratings, all taxes, duties thereon etc. The rates shall also include preparation of grating design for different spans and load intensifies, preparation of design and fabrication drawings, edge preparation, blast cleaning followed by finish paint.

6.01.11 The bidder's rates for galvanization of factory made electro-forged gratings (if specified) shall include the application of hot dipped galvanization as finish over the fabricated gratings and the treatment to be given for prevention of white storage stains, as per the technical Aspiration.

6.01.12 The bidder’s rates for permanent mild steel bolts, nuts and washers shall include the supply and fixing of such bolts, nuts and washers in position, for various types of Structural Steel works, as per the technical specification.

6.01.13 The bidder’s rates for high strength structural bolts, nuts and washers shall include the supply and fixing of such bolts, nuts and washers in position, for various types, of Structural Steel works, as per the technical specification.

6.01.14 The bidder’s rates for dismantling, additions to, alterations in and/or modifications shall be inclusive of all operations such as lowering of material, carriage etc., as mentioned in the technical specification. Unutilised steel pieces cut/removed shall be returned to the project stores free of charge. Non-return of unublized steel pieces to the Owner's store would be considered as wastage and recovery would be affected as per the provision of contract for structural steel consumption. This shall not include the weight of temporarily dismantled/supported members, connected member.

The bidder should prepare an optimised cutting plan as per fabrication

drawing to utilise the steel material upto maximum extent and minimise the wastage/scrap. Quantity of wastage/scrap of material should be limited to the percentage mentioned elsewhere in the conditions of tender/ contract specifications.

6.01.15 The bidder's rates for re-erection of erection marks after additions to, alterations in and/or modifications shall be inclusive of all operations mentioned in technical specification for the calculated weight of the rectified/modified erection mark rejected at site. This shall not include the weight of temporarily dismantled/supported members, connected member. All the operations mentioned above for restoring such members shall be carried out at no extra cost. The work of erection of any erection mark which has not been dismantled but have been modified/rectified before erection shall not be paid under this item but shall be paid under relevant item of fabrication and erection of steel work of Schedule of items for the modified weight.

6.01.16 The bidder's rates for PTFE shall include design, supply, transportation of the complete assembly with guides and dust protection cover and installation of bearings in position drilling, bolting, erecting aligning etc. along with any taxes, duties thereon etc.

6.01.17 The bidder's rates for Stainless Steel hopper (if specified) shall include fabrication and erection, transportation to site, preparation checking collecting and distributing of the fabrication drawings and design calculations, all other operations mentioned in the technical specification. The rates shall also include for erection scheme, alignment, making cutting plan, cutting, jointing, bending, rolling, grinding, drilling, bolting, assembly, edge preparation, welding including pre-heating, post-heating, testing of welders, inspection of welds, inspection and testing, protection against damage in transit, stability of structures, installation of temporary structures etc. The rates shall also be inclusive of providing and installing temporary structures, transport of Owner issue material from store, return of surplus / waste steel materials including cut pieces/waste steel, provision of additional butt / weld joint to reduce the wastage and all other general, special, such requirements as may be required, for the successful completion of the work.

6.01.18 The bidders rates for preformed flexible open ended bellow strap of neoprene (if specified) shall include supply and transportation, installation in position, drilling, bolting, aligning etc. complete along with any taxes, duties thereon etc.

6.01.19 The bidder's rates for Stainless Steel Hand Rail (if specified) shall include complete Hand Rail including, materials, fabrication, grinding & finishing, stainless steel beading, stainless steel cleats, stainless steel fasteners, neoprene gaskets, preparation of shop drawing but excluding the cost of glazing. The Owner shall supply no material for this item of work.

6.02.00 MODE OF MEASUREMENT

6.02.01 The measurement for the item of foundation bolts assembly including that of nuts; locknuts shall be based on the calculated weight of steel installed in Metric Tonne, corrected to second place of decimal. The weight of the foundation bolt shall be calculated in the same way as that done for the item of fabrication, erection, alignment of structural steel. The weight of the nut / locknut shall be taken as per actual weight supplied by the contractor and accepted by the Engineer.

6.02.02 The measurement for the item of fabrication, erection, alignment, welding, etc. of structural steel work shall be based on the approved weight of steel nearest to a Kg, by applying the unit weight as adopted at the time of issue of structural steel on the measurements worked out as given below.

6.02.03 For ISMB, ISMC, ISA, flats, round bars, square bars and pipes, length shall be taken as per distance between planes normal to the axis of the member passing through the extreme points of the section.

6.02.04 Gussets plates in trusses, and bracings, brackets plates, stiffeners, and skew cuts if any in plates for butt welds, the area shall be assumed as the minimum circumscribed rectangle. However deduction for any notch/skew cut shall be made as mentioned in clause no-6.02.06.

6.02.05 For bunker wall plates, the minimum-circumscribing rectangle of the individual plate/pieces out of which these wall plates are assembled by butt-welding, shall be measured. Care shall be taken to ensure maximum utilization of cut-pieces generated by providing extra butt joints (for which no extra payment shall be made).

6.02.06 For all other plates, where the area of any notch/skew cut in the plate is less than 0.05 sq.m. the area of the plate shall be assumed as that of the minimum circumscribing rectangle for the purpose of measurement and calculation of area for the purpose of payment. However, if the area of any notch/skew cuts in a plate is more than 0.05 sq.m, the area of notch/skew cut shall be deducted from assumed minimum circumscribing rectangular area for the purpose of payment.

6.02.07 No deduction shall be made for the hole in the members, if the area of individual hole is less than 0.05 sq.m. The weight shall be calculated by deducting the area of holes, if area of individual hole is more than 0.05 sq.m.

6.02.08 All cut-pieces and scrap generated due to cutting of holes, skew-cuts of plates, gussets, brackets, stiffeners, etc. shall be stacked separately and handed over to the project stores without being considered for material accounting as the

circumscribing rectangle has been considered for payment.

6.02.09 The splice plate shown in the fabrication drawing or approved by the Engineer shall only be measured for payment.

6.02.10 The weight of permanent bolts, washers and nuts and welds shall not be included in the weights of the members. No extra payment shall be made for welding/bolting.

6.02.11 The bolts and nuts required for erection purpose shall not be paid for and may be taken away by the Contractor after final welding for members. Erection boltholes left after removal of erection bolts shall be suitably plugged with welds.

6.02.12 The measurement for the item of application of inorganic primer including blast cleaning of steel surfaces shall be based on the weight on which the zinc silicate primer is applied, after blast cleaning in Metric Tonne, corrected to third place of decimal. The weight shall be the weight as approved, for erection mark/element of the mark painted, for payment of the item of fabrication and erection of structural steel works.

6.02.13 The measurement for the item of application of finish primer system shall be based on the weight on which the epoxy based finish primer is applied in Metric Tonne, corrected to third place of decimal. The weight shall be the weight as approved, for erection mark/element of the mark painted, for payment of the item of fabrication and erection of structural steel works.

6.02.14 The measurement for the item of gratings shall be based on the actual weight in Kgs, corrected to second place of decimal, as supplied by the Contractor, and accepted by the Engineer. Nothing extra shall be payable for making cutouts, notches, openings of any profile, trimming profiles etc. in the grating units.

6.02.15 The measurement for the item of hot dipped galvanization of gratings shall be based on the actual weight in Kgs, corrected to second place of decimal of gratings galvanized by the Contractor and accepted by the Engineer.

6.02.16 The measurement for the item of permanent bolts with nuts and washers shall be based on the actual weight in Kgs, corrected to second place of decimal, as supplied by the Contractor and accepted by the Engineer, and as per the approved bolts and nuts schedules.

6.02.17 The measurement for the item of High Strength Structural bolts with nuts and washers shall be based on the actual weight in Kgs, corrected to second place of decimal, as supplied by the Contractor and accepted by the Engineer, and as per the approved bolts and nuts schedules.

6.02.18 The measurement for the item of the work of dismantling, additions, alterations, reerection etc. shall be as given below

6.02.19 For dismantling, the unmodified weight of the actually dismantled erection marks shall only be measured.

6.02.20 For the work of addition to, alteration in and / or modification of 'erection marks' either in erected position or in the fabrication yard, measurement of weight for payment purpose shall be calculated as the arithmetic sum of weight of steel cut and removed from the erection mark, weight of steel reutilised out of such cut and removed pieces and weight of additional new steel pieces added to the erection mark.

6.02.21 For re-erection the weight of the modified erection mark shall only be measured.

6.02.22 The weight shall be measured nearest to kg. and shall be arrived in a manner similar to the measurement for the item of fabrication, erection, alignment and welding of structural steel.

6.02.23 The measurement for the item of PTFE bearings shall be based on the load carrying capacity of PTFE in MT, corrected to third place of decimal, supplied by the contractor and as accepted by the Engineer and as per the approved bearing schedule, for the total vertical load carrying capacity, for all bearings.

6.02.24 The measurement for the item of stainless steel hopper shall be based on the actual finished weight of hopper weight in Kgs, corrected to second place of decimal. The hopper weight shall be arrived by multiplying of the inner surface area of the hopper with the unit weight of the hopper plate.

6.02.25 The measurement for the item of flexible open-ended bellows straps of neoprene shall be based in running meter, corrected to second place of decimal. Bellow Straps shall be supplied as per the requirement of the approved drawings. The measurement shall be done for the inner circumference of the bunker on which neoprene has been fixed and for the length supplied by the Contractor 'and as accepted by the Engineer.

6.02.26 The measurement for the item of Stainless Steel Hand Railing shall be based on finished weight of handrail in Kgs corrected to second place of decimal. The weight shall also include the weight of Stainless Steel fasteners, Stainless Steel beading, Stainless Steel cleats etc. The weight shall be the finished weight of Hand Rail, as accepted by the Engineer.

1x800 MW Exapansion Unit, DCRTPP Yamunanagar						
REPLY SHEET | TG EQUIPMENT PLAN AT GROUND FLOOR (EL 0.0 M) (Drg. No. PE-DG-510-100-M003 Rev. 2)						
S.No.	**Comments (Dtd 22.07.2024)**	**BHEL reply (Dtd 05.08.2024)**	**Comments (Dtd 16.09.2024)**	**BHEL reply (Dtd 14.10.2024)**	**MoM on 10.12.2024 & 11.12.2024**	**BHEL reply (Dtd 27.12.2024)**
1	Number of staircases on C Row column appears inadequate. Provide full access staircase from 0.00 M to TG Building Roof at intervals along C - Row. Full access staircase shall be provided along C Row. Ensure compliance to IS 1644 for fire safety of buildings - Exit requirements.	Two staircases have been provided at C-Row which are adequate. Same number of staircases are provided by BHEL in other projects as well.	Please confirm compliance to IS 1644 for fire safety of buildings - Exit requirements.	Fire Safety Requirements will be complied as per IS 1644.	BHEL confirmed that staircase between Grid 6-7 at C Row has been extended from 0.0 Mtr to deaerator floor (35.5 Mtr). BHEL further agreed that latest standard will be complied for fire safety of buildings. HPGCL/Desein/DCPL Noted.	Staircase updated in the attached drawing.
2	Space allocation for following shall be provided in the Control Building : i. Maintenance Engineer's Room/computer's room (air-conditioned) ii. Unit In-charge (Shift Supervisor) room (air-conditioned) iii. Station In-charge room (air-conditioned) iv. FSSS/BMS room (air-conditioned) v. Conference rooms (air-conditioned) vi. Documentation room (air-conditioned) vii. C&I staff room (air-conditioned) viii. EDMS room (air-conditioned) ix. OPC Servers, MIS Servers/Station-LAN room (air-conditioned) x. PADO room (air-conditioned) xi. Pantry air-conditioned room (air-conditioned) xii. Toilets/refreshing rooms separate for Ladies & Gents (air-conditioned) xiii. Visitor gallery/area (air-conditioned) xiv. Main Central Control Room (air-conditioned) xv.Electronic Cubicle Room (air-conditioned) xvi.UPS & 24V DC Charger Rooms (air-conditioned) xvii.Separate Battery Rooms each for UPS & 24VDC Charger xviii.Cable vaults shall be indicated for the following rooms as minimum: • Main Central Control Room • Electronic Cubicle Room • UPS & 24V DC charger Rooms xix. Centralized SWAS room (air-conditioned)	(i-x, xiii, xiv, xv) : Space Allocation shall be as per CCR/EER/COMPUTER ROOM layout (Doc No: PE-DG-510-145-H401). (xvi, xvii) : Refer UPS ROOM LAYOUT (Doc No: PE-DG-510-145-H405) (xviii) : Noted. Drawing no. PE-DG-510-100-E010 to be referred for the same. (xix) : SWAS Room details shall be as per SWAS ROOM LAYOUT (Doc No: PE-DG-510-145-H403).	Please submit the referred drawings for review. Kindly ensure that space allocation for commented facilities is available in the referred layouts.	Space allocation of commented facilities will be ensured in the respective drawings. Referred drawings will be submitted progressively after detailed engineering of respective facilities.	BHEL informed that this drawing has been prepared in consultation with respective engineering teams. BHEL further confirmed that the required space has been allocated for facilities in line with tender reequirement. BHEL further intimated that detailed drawings of respective facilities will be submitted progressively and this drawing will be updated accordingly. HPGCL/Desin/DCPL Noted.	-
3	xx. C&I Lab (air-conditioned) Please ensure that the space allocated in building shall be enough and sufficient for the above areas. Size/area of the rooms should be adequate to accommodate the necessary equipment along with all miscellaneous items, furniture etc. in line with the contractual requirement.	(xix) : Currently available space of C&I lab is 10.27M x 9.72M) which is sufficient. It has been ensured that the space allocated in building is enough and sufficient for the above areas. It is adequate to accommodate the necessary equipment along with all miscellaneous items, furniture etc. in line with the contractual requirement.	Please submit the layout to verify the same.	Referred drawings will be submitted progressively after detailed engineering of respective facilities.	BHEL informed that this drawing has been prepared in consultation with respective engineering teams. BHEL further confirmed that the required space has been allocated for facilities in line with tender reequirement. BHEL further intimated that detailed drawings of respective facilities will be submitted progressively and this drawing will be updated accordingly. HPGCL/Desin/DCPL Noted.	-
4	Uninterrupted Power Supply panels with AC distribution boards shall be located in UPS room and 24 V DC charger panels with DC distribution boards shall be located in 24 V DC charger room. Separate rooms shall also be provided for Battery banks of UPS & Battery banks of Charger. UPS & Charger systems to be denominated as Parallel redundant UPS system & Parallel redundant 24VDC charger system.	UPS Scheme (Doc No: PE-DG-510-145-H004) and UPS ROOM LAYOUT (Doc No: PE-DG-510-145-H405) to be referred for details.	Please submit the layout to verify the same.	Referred drawings will be submitted progressively after detailed engineering of respective facilities.	BHEL informed that this drawing has been prepared in consultation with respective engineering teams. BHEL further confirmed that the required space has been allocated for facilities in line with tender reequirement. BHEL further intimated that detailed drawings of respective facilities will be submitted progressively and this drawing will be updated accordingly. HPGCL/Desin/DCPL Noted.	-
5	Please allocate sufficient space for the following as per specification: i. On-line battery health monitoring system separate for each type of battery bank. ii. Cell boost charger for each battery bank. iii. Discharge resistor for each battery bank.	Sufficient space is available for the battery banks. Respective Electrical drawing may klindly be referred for detailed layout.	Please submit the layout to verify the same.	Referred drawing will be submitted progressively after detailed engineering of respective facilities.	BHEL informed that this drawing has been prepared in consultation with respective engineering teams. BHEL further confirmed that the required space has been allocated for facilities in line with tender reequirement. BHEL further intimated that detailed drawings of respective facilities will be submitted progressively and this drawing will be updated accordingly. HPGCL/Desin/DCPL Noted.	-
6	OPC servers, MIS servers & station LAN Network panels shall be located in separate Air-conditioned room	All the systems/rooms shall be applicable as per CCR/EER/COMPUTER ROOM layout (Doc No: PE-DG-510-145-H401).	Please submit the referred layout to verify the same.	Referred drawing will be submitted progressively after detailed engineering of respective facilities.	BHEL informed that this drawing has been prepared in consultation with respective engineering teams. BHEL further confirmed that the required space has been allocated for facilities in line with tender reequirement. BHEL further intimated that detailed drawings of respective facilities will be submitted progressively and this drawing will be updated accordingly. HPGCL/Desin/DCPL Noted.	-

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7	Unit Control Desk (UCD), Printers, Electrical Control Panels (ECP), LVS, Fire Alarm Panels, Plant CCTV monitoring System etc. shall be located in the main central control room. Each LVS with dedicated work station to be included.	All the systems/rooms shall be applicable as per CCR/EER/COMPUTER ROOM layout (Doc No: PE-DG-510-145-H401).	Please submit the referred layout to verify the same.	Referred drawing will be submitted progressively after detailed engineering of respective facilities.	BHEL informed that this drawing has been prepared in consultation with respective engineering teams. BHEL further confirmed that the required space has been allocated for facilities in line with tender reequirement. BHEL further intimated that detailed drawings of respective facilities will be submitted progressively and this drawing will be updated accordingly. HPGCL/Desin/DCPL Noted.	-
8	System cabinets, marshalling cabinets, relay cabinets, electrical auxiliary cabinets, TSI & VMS panels, Electrical panels, DAVR panels, GCP, GRP, Synchronizing panel, DDCMIS/DCS Network panels, other aux. system cabinets etc. shall be located in the electronic cubicle room.	All the systems/rooms shall be applicable as per CCR/EER/COMPUTER ROOM layout (Doc No: PE-DG-510-145-H401).	Please submit the referred layout to verify the same.	Referred drawing will be submitted progressively after detailed engineering of respective facilities.	BHEL informed that this drawing has been prepared in consultation with respective engineering teams. BHEL further confirmed that the required space has been allocated for facilities in line with tender reequirement. BHEL further intimated that detailed drawings of respective facilities will be submitted progressively and this drawing will be updated accordingly. HPGCL/Desin/DCPL Noted.	-
9	Each type of Cable tray .i.e. Ladder, perforated etc. to be indicated for all elevations and the legends for all types of electrical, instrumentation, networking trays etc. also to be included.	Same will be part of separate Electrical drawings	Noted	-	BHEL informed that this drawing has been prepared in consultation with respective engineering teams. BHEL further confirmed that the required space has been allocated for facilities in line with tender reequirement. BHEL further intimated that detailed drawings of respective facilities will be submitted progressively and this drawing will be updated accordingly. HPGCL/Desin/DCPL Noted.	-
10	Two full capacity lube oil coolers shall be provided for each TDBFP unit.	Number of coolers will be given as per design and requirement.	Noted	-	BHEL agreed that number of coolers will be given as per tender specifications. HPGCL/Desin/DCPL Noted.	It is being further informed that this drawing will be updated based on final approved GA drawing of coolers.
11	Indicated capacities for all cranes/monorails shall be substantiated with calculations.	Separate document will be submitted for this.	Noted	-	BHEL informed that design memorandum shall be submitted separately for Cranes and Hoists. HPGCL/Desin/DCPL Noted.	Cranes will be provided as per approved Design Memorandum of EOT (Doc. No. PE-DC-510-501-A001).
12	Please provide oil tank and pump handling arrangement	No separate arrangement is required for Oil Tank & Pump Handling	Please explain how it will be handled?	Placement of Oil tanks is one time activity, which is done through portable crane from C-Row side. Oil Pumps are small pumps which, as per standard practice, are handled through chain pulley block, if required.	HPGCL/Desein/DCPL noted BHEL's reply reagrding Dirty Oil Tank (DOT) and Clean Oil Tank (COT) handling. Further BHEL informed that capacity for DOT and COT will be indicated in the next revision. HPGCL/Desein/DCPL Noted.	Capacity of COT & DOT has been mentioned.
13	Please identify the items (between Grid 1-2)	These are foundations of HP Stand Plate and HP Assemble Fixture as mentioned. For details, civil drawing of 0.0M to be referred (currently under development).	Noted	-	BHEL intimated that respective GA drawings will be submitted progressively and reference drawing number will be updated in this drawing. HPGCL/Desein/DCPL Noted.	Drawing number of respective drawing has been mentioned in the reference drawing list.
14	01. No Air-washer Unit shown near A-row side.	Air Washer on A-Row side is not required. Area will be catered through ducting from Air Washers located elsewhere.	Air Washer Unit at 'A' Row side is required for proper distribution of air from both sides. Please therefore consider the Air Washer Unit at 'A' Row side also and show the tentative locations of the units.	Louvers will be given on A-Row side for proper distribution of Air. Respective drawing will be submitted progressively after detailed engineering of respective facilities.	BHEL intimated that detailed drawings of recpective facilities will be submitted and this drawing will be updated accordingly. HPGCL/Desein/DCPL Noted.	-
	02. Floor openings required for AC & Vent ducts are to be shown and marked.	Floor Openings given at A, B and C rows will be used for duct routing. Any additional opening, if required, will be indicated progressively during detailed engineering of AC and ventilation system.	All the Floor openings intended to be used for HVAC purpose need to be properly marked	Floor openings intended to be used for HVAC purpose will be marked during further detailed engineering.	BHEL informed that that reference drawing of Floor Opening Drawing will be mentioned in this drawing. HPGCL/Desein/DCPL Noted.	Drawing no. of EPs and Floor Openings in TG Building has been mentioned in the reference drawings list.
15	Please check the requirement and location of LAVT cubicle.	LAVt Cubical is not applicable.	Please furnish Key SLD.	SLD will be submitted progressively after detailed engineering of related facilities.	BHEL clarified that IPBD related accessories are located at 8.5 Mtr. HPGCL/Desein/DCPL Noted.	-
16	Please confirm that all the equipment are shown here. Also please mention the foot print dimension of all equipment.	This is being confirmed that all Equipment have been shown. Footprint dimensions have been provided in the drawing wherever available. For other equipment, same will be indicated upon finalisation of respective GAs.	Kindly confirm that the actual equipment dimension shall not be more than foot print dimension of equipment as shown in this layout.	Foot print dimensions indicated are more or less firm dimensions based on data bank. However, if there is any change (less likely), same would be accommodated.	HPGCL/Desein/DCPL Noted.	-

Closed Points:

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1	TO be cheked WHETHER VERTICAL BRACING IS REQUIRED AT THIS PANEL (TYP.)	Vertical bracing is required.	Noted	-	-	-
2	SHOW BOTH THE PLANT NORTH AND THE GEOGRAPHICAL NORTH AND THE ANGLE OF INCLINATION BETWEEN THEM	Indicated	Noted	-	-	-
3	Provide Dimension	Dimension has been provided.	Noted	-	-	-
4	Provide DIM.	Dimension has been provided.	Noted	-	-	-

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5	SHOW PROPER LEVELS AND DIMENSIONS FOR THE STAIRCASE W.R.T PLANT GRID	Proper levels of the staircase will be indicated upon finalisation of civil drawing.	Noted	-	-	-
6	THE LANDING / MIDLANDING LVLS. AND FLIGHT ORIENTATION IS NOT CLEAR. PLS. DEPICT CLEARLY.	Proper levels of the staircase will be indicated upon finalisation of civil drawing.	Noted	-	-	-
7	SHOW THIS SHADING IN THE LEGEND CLEARLY	Brick Wall in the legend has been indicated.	Noted	-	-	-
8	Please shift SWAS room towards power house	Water sample in the SWAS room to come from Boiler, Deaerator and AC plant. Hence the current location shownis in order.	Noted	-	-	-
9	FOR FINALIZATION OF LOCATION , SEPARATE DRG. TO BE REFERRED TO	Reference Drawing nos have been mentioned.	Noted	-	-	-
10	CEP VFD room shal preferably be close to CEP.	Layout has been updated.	Noted	-	-	-
11	GIVE DIM.	Dimension has been provided.	Noted	-	-	-
12	Rolling shutter shall be free from obstruction. Please shift the toilet to any other area.	There is currently no obstruction from the toilet as toilet is indicated between 1 & 2 while rolling shutter is between 2 & 3.	Noted	-	-	-
13	LOCATING DIMS. OF THE WALLS TO BE FURNISHED (TYP.)	For these details, respective Architectural drawing to be referred. (under development)	Noted	-	-	-
14	LINE TO BE COMPLETED	Line has been completed	Noted	-	-	-
15	Please provide rolling shutter and indicate its dimension.	Rolling Shutter has been indicated	Noted	-	-	-
16	FURNISH DIMENSIONS	Dimension has been provided.	Noted	-	-	-
17	Please mention the elevation level of the staircase.	Landing level has been indicated. For intermediate levels of the staircase, respective staircase drawing to be referred. (under development)	Noted	-	-	-
18	CHK. FOR OVERLAP OF TEXT	Overlaping Cleared.	Noted	-	-	-
19	Cooler tube removal space is coming outward the area.	It may be noted that the tube withdrawal space is not interferring with any equipment/facility. Hence, same is in order.	Noted	-	-	-
20	ALL CONSOLE SPACES TO BE CLEARLY DIMENSIONED (TYP. AT ALL LOCATIONS)	Indicated.	Noted	-	-	-
21	WHY REVISION 1 ?	Revision mark was placed inadvertantly. Same has been removed.	Noted	-	-	-
22	DIM. TO BE ADDED	Dimension has been provided.	Noted	-	-	-
23	PLAN LOCATION ?	Locations of all equipment (in lube oil area) have been marked.	Noted	-	-	-
24	REMOVE HATCH	Removed.	Noted	-	-	-
25	COMPLETE HATCHING	Hatching has been completed	Noted	-	-	-
26	DIM	Dimension has been provided.	Noted	-	-	-
27	provide locating dimension	Locating dimensions have been provided	Noted	-	-	-
28	Show lub oil filter properly	Lub oil filters are correctly indicated.	Noted	-	-	-
29	LEGEND NOT CLEAR	Kindly refer "Note for Civil" given above title block.	Noted	-	-	-
30	DIM	Dimension has been provided.	Noted	-	-	-
31	C/L TO BE LOCATED	CL of Lube Oil Console has been indicated	Noted	-	-	-
32	EXTENT OF MONORAILTO BE SHOWN	Extent indicated	Noted	-	-	-
33	Please mention the dimension of Air receiver	Dimension has been marked.	Noted	-	-	-
34	Where is the space for Hydrazine dosing.	Hydrazine dosing has been indicated near Grid 12 between Ad & B Rows.	Noted	-	-	-
35	DIM. NOT CLEAR	Corrected.	Noted	-	-	-
36	MENTION THE CRANE CAPACITY	Indicated.	Noted	-	-	-
37	Please provide the dimension of the staircase and the lift.	Dimensions have been marked.	Noted	-	-	-
38	Please provide rolling shutter and indicate its dimension.	Rolling Shutter Already given between Grid 2-3. Rolling Shutter between Grid 1-2 is not required.	Noted	-	-	-
39	Please locate Hot wel makeup station.	Same will be indicated in Composite Piping Drawing at 0.0M.	Noted	-	-	-
40	CHK. REV. MARK	Revision mark was placed inadvertantly. Same has been removed.	Noted	-	-	-
41	Please mention the elevation of the staircase.	Elevation indicated	Noted	-	-	-
42	Please show entry trench for ACW/DMCW pipes & cable along with it's invert level.	No trench is required for ACW/DMCW pipes as they will be routed above ground (below 8.5M floor).	Noted	-	-	-
43	Please show the local control panel of Self cleaning Strainer along with its dimension.	Same is already indicated at Grid-14 between rows A & Aa	Noted	-	-	-
44	Please Include in the Note	It is confirmed that these guidelines have been taken care and will also be taken care during development of Piping layouts. Since guidelines are not made part of the notes, hence, these are not included in the notes of the drawing.	Noted	-	-	-
	Suitable fencing shall be provided to enclose all openings or doorways used for the hoisting and lowering of machinery etc.		Noted	-	-	-
	The minimum width of clear access corridors around equipment shall be 1.2 meters.		Noted	-	-	-
	A clear head room of 2.2 meters shall be maintained between the floor and any overhead piping/cables or other obstruction.		Noted	-	-	-
	All valves, gates, dampers and other devices shall be located and oriented in such a way that they are accessible from operating floor levels. Where this cannot be adhered to, platforms and walkways with access ladders shall be provided to facilitate operation and maintenance.		Noted	-	-	-
	Basic amenities like toilet, Tiffin rooms, wash basins, rest rooms etc. shall be provided near the Control Room.		Noted	-	-	-
	All Power house Staircases for approaching different floors should have door openings leading to a passage at the respective floors and not to any equipment room.		Noted	-	-	-
45	Generator Stator Handling provision using Strand Jack is to be indicated.	Indicated.	Noted	-	-	-
46	TO ADD THE LIST OF ABBREVIATIONS USED IN THE DRG. WITH THEIR FULL FORM	Abbrevation list has been added.	Noted	-	-	-
47	FOR EXACT LOCATION AND DETAILS OF DOORS , WINDOWS , ROLLING SHUTTERS ETC. RELEVANT APPROVED ARCHITECTURAL DRGS. TO BE REFERRED TO	Same has been mentioned in the Notes.	Noted	-	-	-

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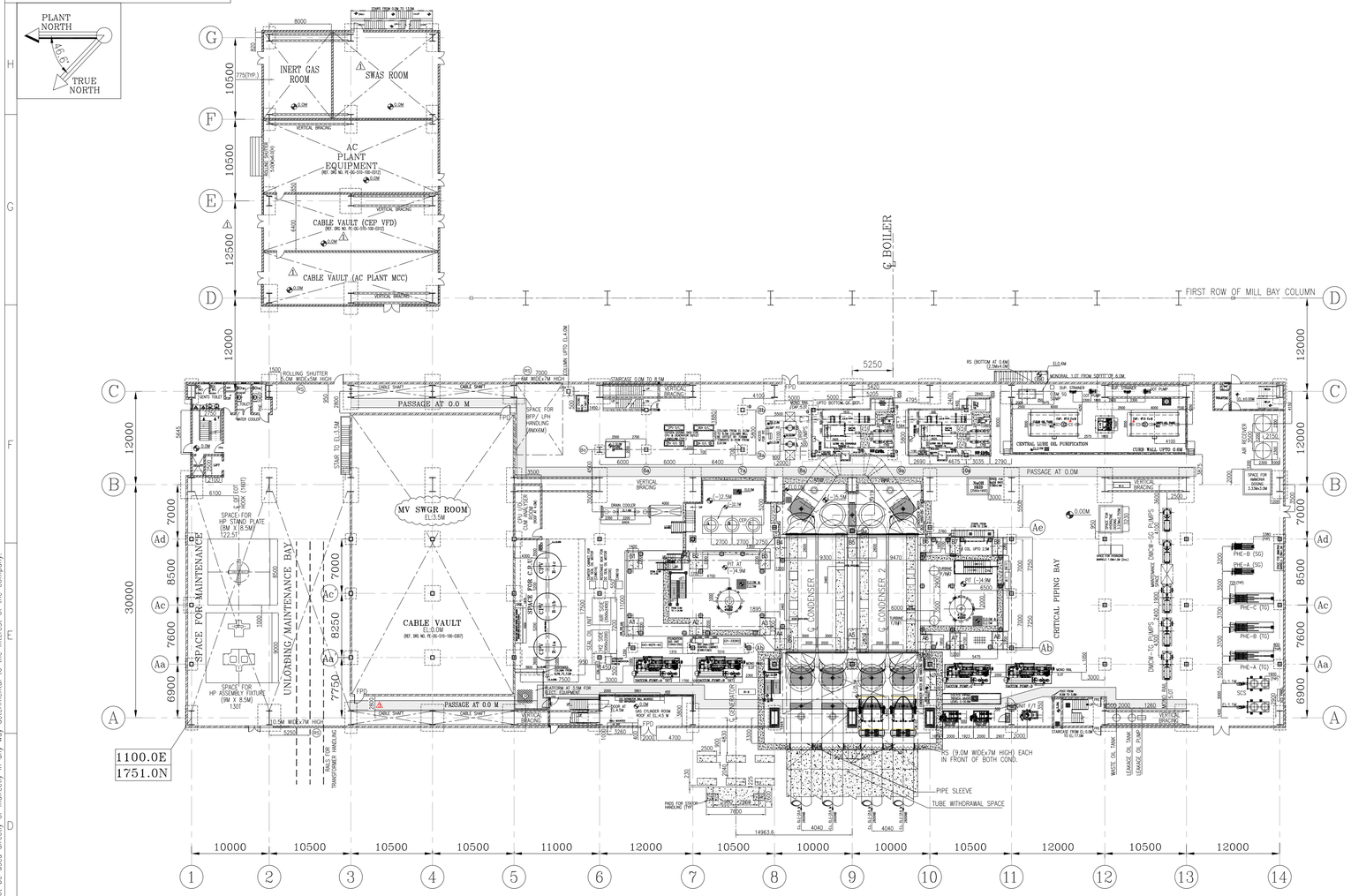
48	FOR DETAILED ARRGT. OF STAIRCASES , SEPARATE DETAILED DRG. TO BE REFERRED TO	Same has been mentioned in the Notes. Drawing nos. will be added in the drawing once these drawings are finalised.	Noted	-	-	-
49	FINAL REQUIREMENTS AS PER APPD. ARCH. DRGS. (Rolling shutter)	Noted.	Noted	-	-	-
50	PROVIDE DISTANCE (TYP.)	Dimension has been provided.	Noted	-	-	-
51	CHECK FOR 0.00 M IN PLAN AT 3.5 / 4.0 M	In the Plan View at 3.5M/4.0M, where there is no Floor/Framing at 3.5M or 4.0M, El. 0.0M has been marked.	Noted	-	-	-
52	EXTENT OF FLOOR TO BE SHOWN CLEARLY FROM THE NEAREST GRID	Same has been marked.	Noted	-	-	-
53	EXTENT OF COLS. TO BE SPECIFIED (TYP.)	Level of Floor between Grids 3-5 is 3.5M while between Grids 5-8 is 4.0M (in BC Bay and Some portion of Ab Bay) as clearly marked.	Noted	-	-	-
54	SHADING FOR PASSAGE TO BE SHOWN CLEARLY	Since Passage is part of Grated floor only, no separate shading is required.	Noted	-	-	-
55	SUPPORTING EXTENT OF THE COL. TO BE STATED	Same has been mentioned.	Noted	-	-	-
56	FURNISH DIMENSION	Dimension has been provided.	Noted	-	-	-
57	DEMARCATION OF EXTENT AT 3.5 / 4.0 M IS NOT CLEAR. PLEASE SHOW CLEARLY	Level of Floor between Grids	Noted	-	-	-
58	CHK. THIS DIM.TO BE FINALIZED BASED ON DETAILED ENGINEERING	Noted.	Noted	-	-	-
59	CHK. FOR ACTUAL EXTENT	Plan at 0.0M to be referred for extent of the Wall.	Noted	-	-	-
60	Please write rolling shutter dimension	Rolling Shutter dimension has been mentioned.	Noted	-	-	-
61	Please mark tube withdrawal space dimension	Same has been marked.	Noted	-	-	-
62	Please itemise this equipment.	It is encased A-Row column.	Noted	-	-	-
63	Space adequacy to be checked by BHEL for all HVAC Equipment .	Space for HVAC equipment checked and found in order.	Noted	-	-	-
64	Please furnish All GAD nos	Drawing nos. will be updated after finalisation of respective drawings.	Noted	-	-	-

FIRST ANGLE PROJECTION

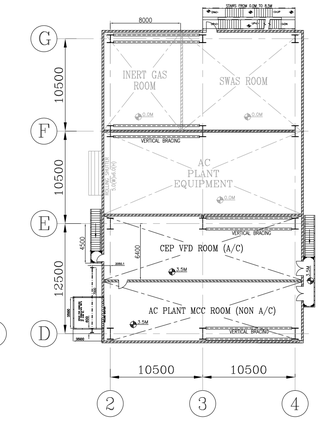
ALL DIMENSIONS ARE IN MM

DRAWING NO. PE-DG-510-100-M003

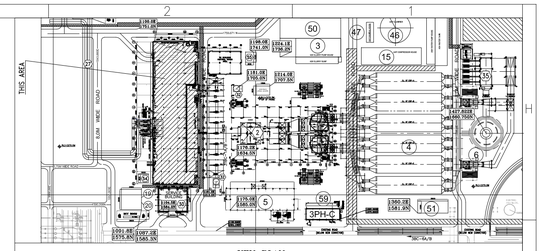
PLANT NORTH 46.5° TRUE NORTH



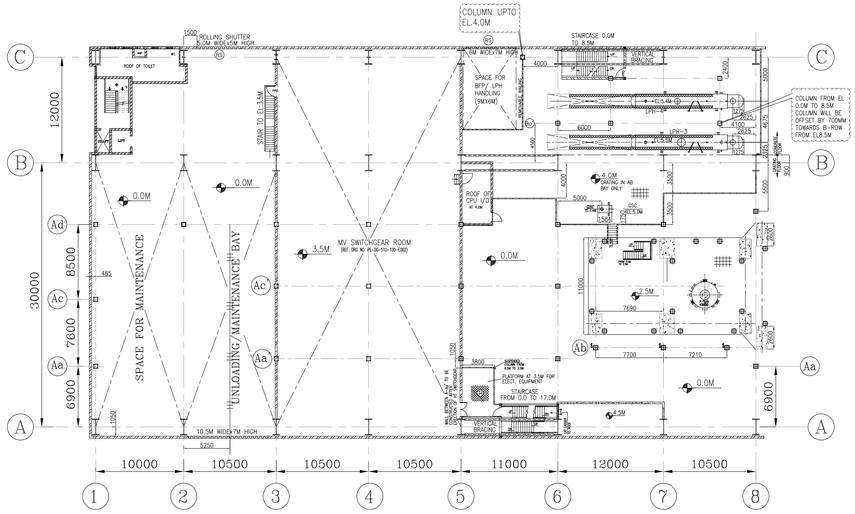
TG HALL EQUIPMENT LAYOUT PLAN AT EL: 0.0M



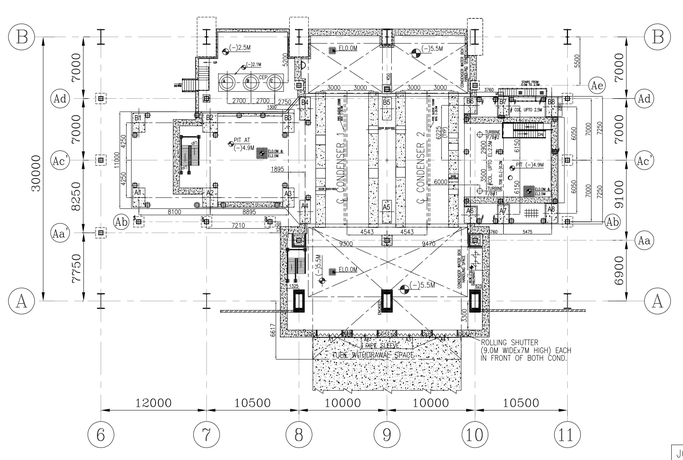
⚠ PLAN AT EL. 3.5M (CONTROL TOWER AREA)



KEY PLAN



PLAN AT EL. 3.5/4.0M (AB & BAC BAY)



PLATFORM AT 0.0M

⚠ ABBREVIATION LIST

SL. NO.	ABBREVIATION	FULL FORM	SL. NO.	ABBREVIATION	FULL FORM
1	EOT	ELECTRONIC OVERHEAD TRAVEL	21	LV SWGR	LOW VOLTAGE SWITCHGEAR
2	MS	MAIN STEAM	22	PW	POTABLE WATER
3	CRH	COLD REHEAT	23	CEP	CONDENSATE EXTRACTION PUMP
4	HRH	HOT REHEAT	24	CPU	CONDENSATE POLISHING UNIT
5	LPBP	LOW PRESSURE BYPASS	25	VFD	VARIABLE FREQUENCY DRIVE
6	HPBP	HIGH PRESSURE BYPASS	26	HPSU	HIGH PRESSURE OIL SUPPLY UNIT
7	CW	COOLING WATER	27	ESV	EMERGENCY STOP VALVE
8	HVAC	HEATING & VENTILATION AIR CONDITIONING	28	IV	INTERCEPTOR VALVE
9	MCC	MOTOR CONTROL	29	OLV	OVER LOAD VALVE
10	AHU	AIR HANDLING UNIT	30	F/T	FLASH TANK
11	FPD	FIRE PROOF DOOR	31	GSC	GLAND STEAM CONDENSOR
12	CR	CABLE RISER	32	SWAS	STEAM AND WATER ANALYSIS ROOM
13	PRDS	PRESSURE REDUCING DE-SUPER HEATING STATION	33	DOT	DIRTY OIL TANK
14	RS	ROLLING SHUTTER	34	COT	CLEAN OIL TANK
15	BP	BOOSTER PUMP	35	EOP	EMERGENCY OIL PUMP
16	BFP	BOILER FEED PUMP	36	JOP	JACKING OIL PUMP
17	D/A	DEAERATOR	37	TOG	TOP OF GRATING
18	LPH	LOW PRESSURE HEATER	38	PHE	PLATE HEAT EXCHANGER
19	HPH	HIGH PRESSURE HEATER	39	SCS	SELF CLEAN STRAINER
20	VD	VENTILATION DUCT	40	DMCW	DE-MINERALISED COOLING WATER

LEGENDS

	PIPE HATCH
	VERTICAL BRACING
FPD	FIRE PROOF DOOR
	GRATING
	CHEQUERED PLATE
(R)	REMOVABLE
	HAND RAILING
	CABLE TRAY
	FIRE BARRIER WALL
	PIPE/CABLE TRESTLE
(RS)	ROLLING SHUTTER
	RAIL TRACK
	CABLE TRENCH
	PASSAGEWAY
	BRICK WALL

REFERENCE DRGS:

SL.No.	TITLE	NUMBER	UNIT
1	MAIN PLANT EQUIPMENT LAYOUT PLAN	PE-DG-510-100-M002	PEM
2	TG EQUIPMENT PLAN AT EL8.5 M	PE-DG-510-100-M004	PEM
3	TG EQUIPMENT PLAN AT EL17.0 M	PE-DG-510-100-M005	PEM
4	TG EQUIPMENT PLAN AT MISCELLANEOUS FLOORS IN BC BAY	PE-DG-510-100-M006	PEM
5	T.G. HALL CROSS SECTION	PE-DG-510-100-M007	PEM
6	CONDENSER ASSEMBLY (GENERAL ARRANGEMENT)	01601070071C241	HWR
7	GENERAL ARRANGEMENT OF DRAIN COOLER	--	HYD
8	GENERAL ARRANGEMENT OF GLAND STEAM CONDENSER	--	HWR
9	GENERAL ARRANGEMENT OF LPH # 3	--	HYD
10	GENERAL ARRANGEMENT OF LPH # 4	--	HYD
11	GENERAL ARRANGEMENT F / T-A	--	BPL
12	GENERAL ARRANGEMENT F / T-B	--	BPL
13	GENERAL ARRANGEMENT CEP	--	HYD
14	GENERAL ARRANGEMENT OF VACCUM PUMPS CONDENSER # 1	--	HWR
15	GENERAL ARRANGEMENT OF VACCUM PUMPS CONDENSER # 2	--	HWR
16	EQUIPMENT LAYOUT FOR TDBFP	--	HYD
17	GA & FOUNDATION DETAILS DRIP PUMPS	--	HYD
18	GA WASTE OIL TANK	--	HWR
19	GA OF PHE	--	PEM
20	GA DMCW PUMP	--	PEM
21	GA LEAKAGE/DIRTY TANK AND PUMP	--	HWR
22	AIR RECEIVER	--	BPL
23	GA OF CPU (EQUIPMENT LAYOUT FOR SERVICE VESSEL AREA)	--	PEM
24	GA AMMONIA SKID	--	PEM
25	GA HYDRAZINE SKID	--	PEM
26	GA OF OXYGEN DOSING	--	PEM
27	GA NACH TANK / SKID	--	PEM
28	LIST OF JUNCTION BOX	--	HWR
29	GA OF COLTCS	--	PEM
⚠ 30	EPs AND FLOOR OPENINGS IN TG BUILDING	PE-DG-510-100-M019	PEM
31	DIMENSIONAL SKETCH FOR MOUNTING FRAMS & HP PLATE	DSPPG-0049828	HWR
32	GA OF MV SWITCHGEAR ROOM	PE-DG-510-100-E002	PEM
33	CABLE TRAY LAYOUT BELOW MV SWITCHGEAR ROOM	PE-DG-510-100-E007	PEM

CIVIL TO NOTE:

$ COLUMN FROM 0.0 TO ~13.5(BOTTOM OF OIL CANAL)

COLUMN UPTO EL:2.5M

@ COLUMN UPTO BOTTOM OF BFP DECK

MAX BEAM DEPTH FOR PLATFORM BELOW TG DECK AT EL:2.5M TO BE RESTRICTED TO 400MM.

NOTES:-

1. ALL DIMENSION ARE IN MM AND LEVELS ARE IN METRES.
2. ALL ELEVATION MARKED ARE W.R.T. TG HALL FINISHED FLOOR ELEVATION OF EL 0.00M WHICH CORRESPONDS TO RL(+)270.5M.
3. CABLE DUCT/TRENCH/SLIT LAYOUT IS SHOWN FOR REPRESENTATION PURPOSE ONLY. FOR DETAILS REFER ELECTRICAL DRAWING.
4. ELEVATIONS OF EQUIPMENT/PIPES INDICATED ARE CENTER LINE ELEVATIONS UNLESS OTHERWISE SPECIFIED.
5. FOR EXACT LOCATION AND DETAILS OF DOORS, WINDOWS, ROLLING SHUTTERS ETC., RELEVANT APPROVED ARCHITECTURAL DRGS. TO BE REFERRED.
6. FOR DETAILED ARRANGEMENT OF STAIRCASES, RESPECTIVE DETAILED DRAWINGS TO BE REFERRED.

REV.	DATE	ALTD	CHD	APPD
3	27.12.2024	VKS Sd/-	RC Sd/-	PM Sd/-
1	DRAWING REVISED AS PER MoM HELD DURING THE MEETING DTD. 10.12.2021 AND 11.12.2024. REVISION MARKED AS ⚠			
2	14.10.2024	VKS Sd/-	RC Sd/-	PM Sd/-
1	DRAWING BEING RESUBMITTED.			
1	05.08.2024	VKS Sd/-	RC Sd/-	PM Sd/-
1	DRAWING REVISED AS PER HPGCL COMMENTS ON REV-0 DTD. 2.07.2024. REVISION MARKED AS ⚠			

JOB NO. 510

STATUS CONTRACT

DISTRIBUTION

PROJECT: 1X800 MW ULTRA SUPER CRITICAL EXPANSION UNIT, DEEN BANDHU CHHOTU RAM THERMAL POWER PLANT, YAMUNA NAGAR

OWNER: HARYANA POWER GENERATION CORPORATION LTD.

OWNER'S CONSULTANT: DESEIN PRIVATE LIMITED, CONSULTING ENGINEERS, NEW DELHI

OWNER'S REVIEW CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD., CONSULTING ENGINEERS, KOLKATA

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD, NEW DELHI

BHEL UNIT: BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR PROJECT ENGINEERING MANAGEMENT,NOIDA

DEPT CODE		NAME	SIGN	DATE
MPL	DRN	VKS		20.06.2024
	DESN	RC		20.06.2024
	CHD	RC		20.06.2024
	APPD	BKA		20.06.2024

TITLE:-

TG EQUIPMENT PLAN AT GROUND FLOOR (AT EL 0.0M)

DEPT. | SCALE 1:225 | SIGN

DRAWING NO. PE-DG-510-100-M003

SHEET 1 OF 1 | REV. 3

SIZE-A0

COMPUTER FILE NAME: 510-100-M003

1x800 MW Exapansion Unit, DCRTPP Yamunanagar

REPLY SHEET | TG EQUIPMENT PLAN AT EL MEZZANINE FLOOR (8.5 M)
(Drg. No. PE-DG-510-100-M004 Rev. 2)

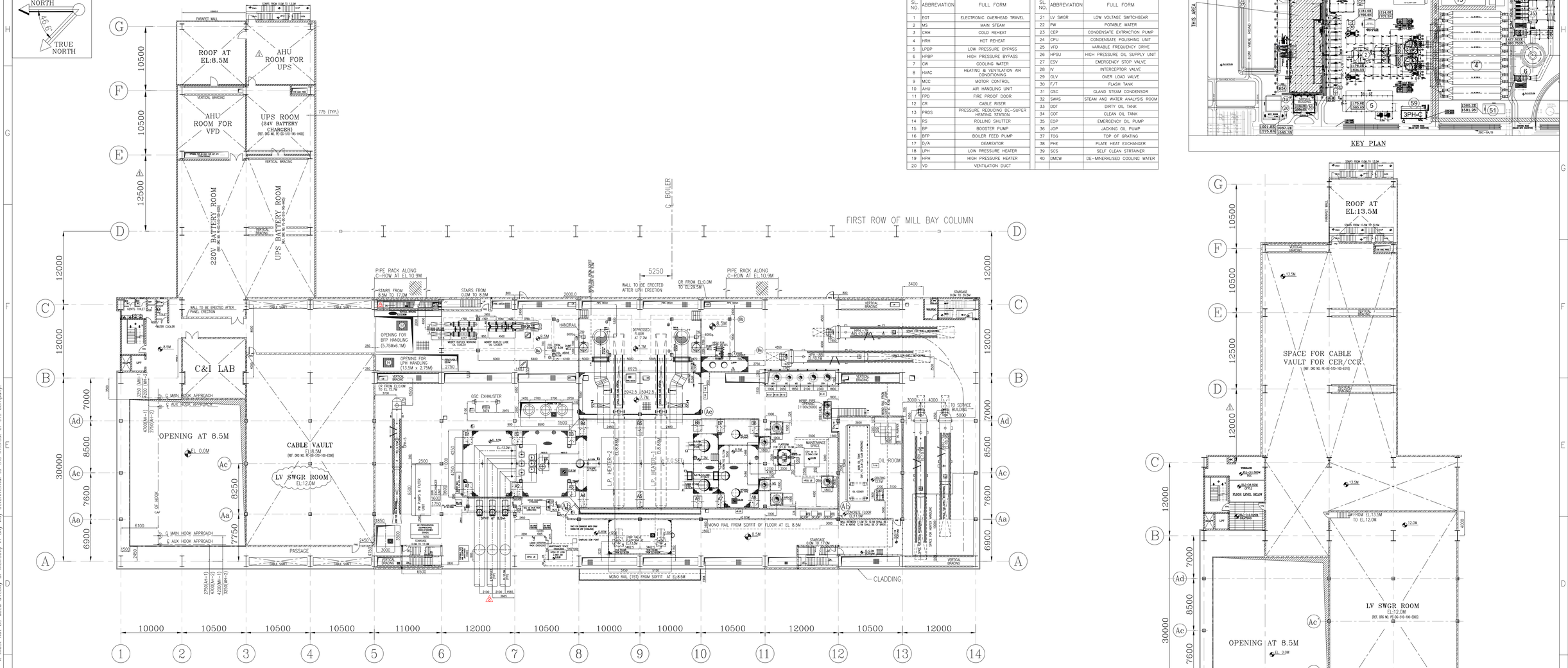
S.No.	Comments (Dtd 22.07.2024)	BHEL reply (Dtd 05.08.2024)	Comments (Dtd 16.09.2024)	BHEL reply (Dtd 14.10.2024)	MoM on 10.12.2024 & 11.12.2024	BHEL reply (Dtd 27.12.2024)
1	Show two (2) nos. AC main oil pumps, one no. DC motor driven emergency oil pump.	Same will be part of Oil Room, which is under development.	Noted	-	BHEL stated that these pumps are tank mounted pumps and cannot be indicated in this drawing however reference drawing number of the respective drawing will be mentioned. BHEL confirmed that number of pumps will be given in the respective GA drawings as per tender specifications. HPGCL/Desein/DCPL Noted.	Drawing number of Oil Room Arrangement, which houses the Main Oil Tank (MOT) etc. has been mentioned in the reference drawing list. It may kindly be noted that pumps etc. are BHEL-HWR's vendor items.
2	Indicate capacity of main oil tank.	Capacity will be indicated upon finalisation of GA.	Noted	-	BHEL informed that capacity for Main Oil Tank (MOT) will be indicated in the next revision. HPGCL/Desein/DCPL Noted.	MOT capacity has been indicated.
3	Identify location for main turbine Control Fluid unit.	Same will indicated after finalisation of Oil Room Layout, which is under development.	Please update progressively	Same will be on the top of Main Oil Tank (placed in Oil Room b/w grids 12-13, in AB Bay)	BHEL stated that Control Fluid Unit will be mounted on the MOT and cannot be indicated in this drawing however reference drawing number of the respective drawing will be mentioned. HPGCL/Desein/DCPL Noted.	Drawing number of Oil Room Arrangement, which houses the Main Oil Tank (MOT) etc. has been mentioned in the reference drawing list. It may kindly be noted that control fluid unit is BHEL-HWR's vendor item.
4	Furnish a separate plan for the switchgear room at El 12.0M as a common layout for El 8.5M & EL 12.0M is creating confusion. At grid A4 a single leaf door is shown. Please clarify how transformer/panels shall be taken inside the room from the equipment handling area.	Separate Plan at 12.0 & 13.5 M is already given in the drawing. Respective electrical drawings will be submitted separately.	Noted	-	BHEL intimated that respective drawings will be submitted progressively and reference drawing number will be updated in this drawing. HPGCL/Desein/DCPL Noted.	Reference drawing numbers of Electrical's LV switchgear room at 12.0M & cable tray layout at 8.5M have been mentioned in the reference drawing list.
5	In absence of the electrical layout drawings, BHEL to ensure that the space considered by them is adequate. In case there is any additional space requirement the room/building shall be modified to accommodate the equipment/panels suitably.	Noted. Same will be ensured.	Please submit the layouts for review	Space adequacy will be ensured in the respective drawings. Referred drawings will be submitted progressively after detailed engineering of respective facilities.	BHEL informed that this drawing has been prepared in consulation with respective engineering teams. BHEL further confirmed that the required space has been allocated for the facilities in line with tender requirement. BHEL further intimated that detailed drawings of respective facilities will be submitted progressively and this drawing will be updated accordingly. HPGCL/Desein/DCPL Noted.	-
6	Please ensure adequacy of the space provided for 220 V battery room, ups battery room and ups room (24v battery charger) at el 8.5m based on the type of battery/charger as per the tender specification.	Noted.	Please submit the layouts for review	Space adequacy will be ensured in the respective drawings. Referred drawings will be submitted progressively after detailed engineering of respective facilities.	BHEL informed that this drawing has been prepared in consulation with respective engineering teams. BHEL further confirmed that the required space has been allocated for the facilities in line with tender requirement. BHEL further intimated that detailed drawings of respective facilities will be submitted progressively and this drawing will be updated accordingly. HPGCL/Desein/DCPL Noted.	-
7	Final location (both position and elevation) of ng cubicle and SPVT shall be as per IPBD (OEM) layout.	Tentative Location has been indicated. Same will be updated oncearrangement is finalised.	Please submit the layouts for review	Referred drawings will be submitted progressively after detailed engineering of respective facilities.	BHEL intimated that detailed drawings of recpective facilities will be submitted and this drawing will be updated accordingly. HPGCL/Desein/DCPL Noted.	-
8	Area of C&I lab seems to be on lower side	Area shown has been reviewed and seems to be adequate.	Please check and review the same in consultation with C&I.	Same has been reviewed by C&I. Respective detailed drawings will be submitted progressively after detailed engineering of these facilities.	BHEL confirmed that the area required for C&I lab has been allocated to fulfill all the lab equipments in line with tender requirement. BHEL further intimated that detailed drawings of respective facilities will be submitted progressively and this drawing will be updated accordingly. DCPL will check & revert back.	-
9	Above this floor, there is control room. Please show it properly.	Control Room has been shown in the Equipment Layout at Operating Floor.	Please check and review the same in consultation with C&I.	Same has been checked with C&I and found in order.		-
10	Please mention the bend radius	Heater removal path is provided as guidance for the site. Bend radius will vary as per site suitability.	Please indicate the same in this drawing as civil drawing will be prepared from this drawing.	Since the turning radius of heater removal path will vary, it cannot be predicted & indicated in the drawing. Further, it is not requirted by civil as this area of the floor is designed by Civil on the basis of Uniform Distributed Load.	BHEL clarified that insert plates have been already indicated for Heater Shell withdraw. However no insert plates are required for heater withdrawl path. Heater withdrawl will be done by site as per site suitability hence bend radius not required. HPGCL/Desein/DCPL Noted.	-

S.No.	Comments (Dtd 22.07.2024)	BHEL reply (Dtd 05.08.2024)	Comments (Dtd 16.09.2024)	BHEL reply (Dtd 14.10.2024)	MoM on 10.12.2024 & 11.12.2024	BHEL reply (Dtd 27.12.2024)

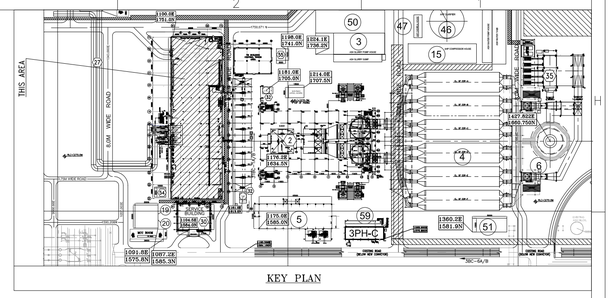
Closed Points:

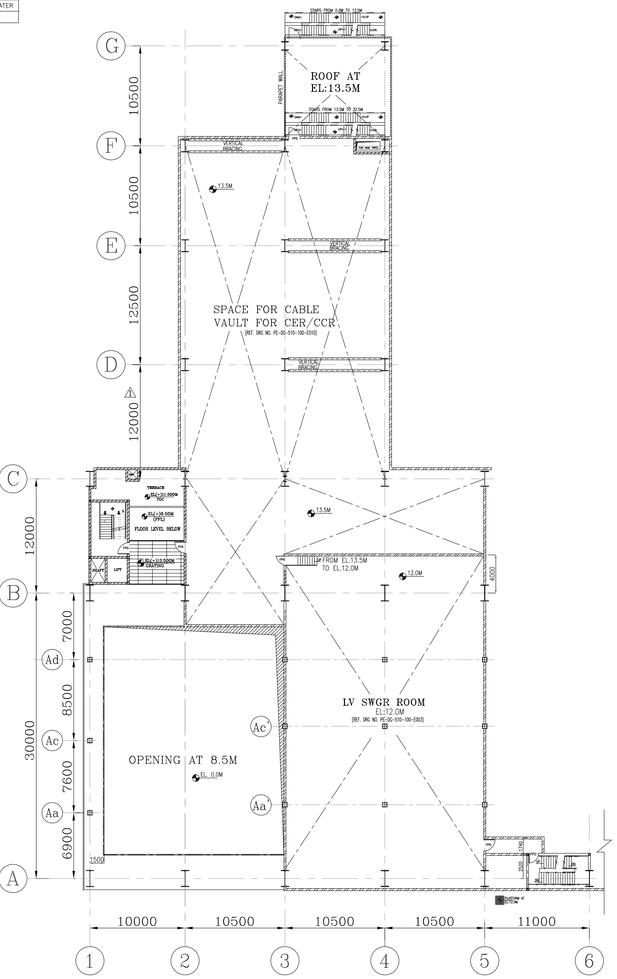
S.No.	Comments (Dtd 22.07.2024)	BHEL reply (Dtd 05.08.2024)	Comments (Dtd 16.09.2024)	BHEL reply (Dtd 14.10.2024)	MoM on 10.12.2024 & 11.12.2024	BHEL reply (Dtd 27.12.2024)
1	Indicate key plan.	Key Plan has been indicated	Noted	-	-	-
2	Please clarify the whether the elevations indicated for Turbine vents going to condense are centerline or BOP and indicate the same on the drawing.	All elevations are Center Line elevations unless mentioned. Note has been added for this.	Noted	-	-	-
3	Plan at EL 7.70M - Indicate hand railing all around.	Already Indicated.	Noted	-	-	-
4	Please clarify whether the elevations indicated for all heaters are centerline or bottom and indicate the same on the drawing.	Elevations indicated are center line elevations. Same is mentioned under notes.	Noted	-	-	-
5	Indicate One (1) no. ACJOP & one (1) no. DCJOP as per specification.	Indicated.	Noted	-	-	-
6	Indicate 2x100% lube oil coolers and also space for tube removal.	Lube Oil Coolers already indicated between Grids 6-7, BC bay.	Noted	-	-	-
7	Confirm whether it is oil pit shown to the right of oil cooler. If so, oil pit clearing arrangement to be indicated.	It is floor opening.	Noted	-	-	-
8	"Space for shell withdrawal" has been indicated beside the heaters LPH-5, (HPH-8A/8B, 7A/7B). Space for handling of the heaters to be indicated along with the handling arrangement required for the desired movement to the handling place. Also indicate arrangement proposed for heater replacement.	Heaters will be dragged on the wheels along the path indicated. Incase of replacement, heaters can be withdrawn with the help of EOT through the openings for Heaters handling in the above floor(s).	Noted	-	-	-
9	Indicate location for oil system with 100% redundant pumps, motors, accumulators for HPBP.	Indicated between Aa-Ad, Grid 12-13.	Noted	-	-	-
10	Mention the purpose of the 3m x 3.5m opening provided near grid a/col. 5 between col 5 &6 at el 8.5m.	Same has been given for handling of MV Switchgears at El. 3.5M platform below.	Noted	-	-	-
11	All doors provided in cable vault for CER/CCR at el 13.5m shall be fireproof door as per cl no. 1.44.01 (xiii) of volume iv of tender specification.	Noted and Updated.	Noted	-	-	-
12	Tentative location of pressurization unit for IPBD shall be shown.	Already Indicated.	Noted	-	-	-
13	SHOW BOTH THE PLANT NORTH AND THE GEOGRAPHICAL NORTH AND THE ANGLE OF INCLINATION BETWEEN THEM	Indicated	Noted	-	-	-
14	STAIRCASE ARRGT. IS NOT CLEAR	Staircase shown is indicative and will be updated as per civil drawing (under development)	Noted	-	-	-
15	PROVIDE DIMENSION (TYP.)	Dimension has been provided.	Noted	-	-	-
16	Please provide Handrail for all opening. (Typ.)	All openings have been provided with handrails or with removable grating.	Noted	-	-	-
17	ACTUAL EXTENT OF FLOOR TO BE SHOWN CLEARLY	Updated	Noted	-	-	-
18	THIS LEVEL IS NOT UNDERSTOOD FOR PLAN VIEW AT 12.0 / 13.5 M	El. 8.5 M has been indicated in this zone to reflect that there is no framing/floor in this zone at 12.0M/13.5M.	Noted	-	-	-
19	CHECK FOR THE ARRANGEMENT OF COLS. FROM 8.5 M TO 13.5 M	Noted. Same will be detailed in the civil drawing.	Noted	-	-	-
20	TO MENTION THE CAPACITY OF THE MONORAIL	Capacity (15T) has been indicated.	Noted	-	-	-
21	EXTENT OF CLADDING IS NOT CLEAR	Architectural drawings (currently under development) to be referred for cladding details.	Noted	-	-	-
22	INDICATE DIMENSION	Dimension has been indicated.	Noted	-	-	-
23	FOR EXACT LOCATION AND DETAILS OF DOORS , WINDOWS , ROLLING SHUTTERS ETC. RELEVANT APPROVED ARCHITECTURAL DRGS. TO BE REFERRED TO	Same has been mentioned in the Notes.	Noted	-	-	-
24	UTILITY OUTSIDE THE FLOOR PLAN	Drawing has been updated.	Noted	-	-	-
25	ADD THE LIST OF ABBREVIATIONS USED WITH THEIR FULL FORMS	Abbrevation list has been added.	Noted	-	-	-
26	Please provide all drawing nos	Drawing nos. will be updated after finalisation of respective drawings.	Noted	-	-	-

PLANT NORTH 46°6' TRUE NORTH



PLAN AT EL:7.7/8.5M





PLAN AT EL:12.0M/13.5M

⚠ ABBREVIATION LIST

SL. NO.	ABBREVIATION	FULL FORM	SL. NO.	ABBREVIATION	FULL FORM
1	EOT	ELECTRONIC OVERHEAD TRAVEL	21	LV SWGR	LOW VOLTAGE SWITCHGEAR
2	MS	MAIN STEAM	22	PW	POTABLE WATER
3	CRH	COLD REHEAT	23	CEP	CONDENSATE EXTRACTION PUMP
4	HRH	HOT REHEAT	24	CPU	CONDENSATE POLISHING UNIT
5	LPBP	LOW PRESSURE BYPASS	25	VFD	VARIABLE FREQUENCY DRIVE
6	HPBP	HIGH PRESSURE BYPASS	26	HPSU	HIGH PRESSURE OIL SUPPLY UNIT
7	CW	COOLING WATER	27	ESV	EMERGENCY STOP VALVE
8	HVAC	HEATING & VENTILATION AIR CONDITIONING	28	IV	INTERCEPTOR VALVE
9	MCC	MOTOR CONTROL	29	OLV	OVER LOAD VALVE
10	AHU	AIR HANDLING UNIT	30	F/T	FLASH TANK
11	FPD	FIRE PROOF DOOR	31	GSC	GLAND STEAM CONDENSOR
12	CR	CABLE RISER	32	SWAS	STEAM AND WATER ANALYSIS ROOM
13	PRDS	PRESSURE REDUCING DE-SUPER HEATING STATION	33	DOT	DIRTY OIL TANK
14	RS	ROLLING SHUTTER	34	COT	CLEAN OIL TANK
15	BP	BOOSTER PUMP	35	EOP	EMERGENCY OIL PUMP
16	BFP	BOILER FEED PUMP	36	JOP	JACKING OIL PUMP
17	D/A	DEAREATOR	37	TOG	TOP OF GRATING
18	LPH	LOW PRESSURE HEATER	38	PHE	PLATE HEAT EXCHANGER
19	HPH	HIGH PRESSURE HEATER	39	SCS	SELF CLEAN STRTAINER
20	VD	VENTILATION DUCT	40	DMCW	DE-MINERALISED COOLING WATER

REFERENCE DRGS:

SL NO	TITLE	NUMBER	UNIT
1	TG EQUIPMENT PLAN AT EL 0.0 M	PE-DG-510-100-M003	PEM
2	TG EQUIPMENT PLAN AT EL17.0 M	PE-DG-510-100-M005	PEM
3	TG EQUIPMENT PLAN AT MISCELLANEOUS FLOORS IN BC BAY	PE-DG-510-100-M006	PEM
4	T.G. HALL CROSS SECTION	PE-DG-510-100-M007	PEM
5	OIL ROOM ARRANGEMENT	--	HWR
6	LP BYPASS VALVE ARRANGEMENT	--	HWR
7	OIL CANAL DETAILS	--	HWR
8	GA OF LP HEATER 1	--	HWR
9	GA OF LP HEATER 2	--	HWR
10	GA OF LP HEATER 5	--	HYD
11	GA HP HEATER 7A	--	HYD
12	GA HP HEATER 7B	--	HYD
13	GA HP HEATER 8A	--	HYD
14	GA HP HEATER 8B	--	HYD
15	HPSU FOR ESV, IV & OVER LOAD VALVE	--	HWR
16	HPSU FOR LP BYPASS VALVE	--	HWR
17	GA OF MDBFP HC COOLERS	--	HYD
18	GA OF OLV	--	HWR/SAG
19	GA OF HP BP VALVE	--	TRY
20	TURBINE JB LIST & LAYOUT	--	HWR
21	ASSEMBLY PLATFORM FOR OVERLOAD VALVE	--	HWR
22	TDBFP LUBE OIL EQUIPMENT LAYOUT	--	HYD
23	SWAS ROOM LAYOUT	--	PEM
24	TURBINE & GEN JUNCTION BOXES LISTS & LAYOUT	--	HWR
25	LAYOUT OF DC EQUIPMENT ROOM	--	PEM
26	GA OF LV SWITCHGEAR ROOM	PE-DG-510-100-E003	PEM
27	CABLE TRAY LAYOUT BELOW LV SWITCHGEAR ROOM	PE-DG-510-100-E008	PEM
28	UPS BATTERY ROOM	PE-DG-510-145-H405	PEM
29	OIL ROOM ARRANGEMENT DRAWING	0-13100-J5010	HWR
30	GA OF OIL MODULE	--	HWR

LEGENDS

	PIPE HATCH
	VERTICAL BRACING
FPD	FIRE PROOF DOOR
	GRATING
	CHEQUERED PLATE
(R)	REMOVABLE
	HAND RAILING
	CABLE TRAY
	FIRE BARRIER WALL
	PIPES/CABLE TRESTLE.
(RS)	ROLLING SHUTTER
	RAIL TRACK
	PIPE TRENCH WITH PCC COVERED SAND FILLED
	BRICK WALL
	BUS DUCT
	WALK WAY
	CONCRETE

NOTES:-

1. ALL DIMENSION ARE IN MM AND LEVELS ARE IN METRES.
2. ALL ELEVATION MARKED ARE W.R.T. TG HALL FINISHED FLOOR ELEVATION OF EL 0.00M WHICH CORRESPONDS TO RL(+)270.5M.
3. CABLE DUCT/TRENCH/SLIT LAYOUT IS SHOWN FOR REPRESENTATION PURPOSE ONLY. FOR DETAILS REFER ELECTRICAL DRAWING.
4. ELEVATIONS OF EQUIPMENT/PIPES INDICATED ARE CENTER LINE ELEVATIONS UNLESS OTHERWISE SPECIFIED.
5. FOR EXACT LOCATION AND DETAILS OF DOORS, WINDOWS, ROLLING SHUTTERS ETC., RELEVANT APPROVED ARCHITECTURAL DRGS. TO BE REFERRED.

CIVIL TO NOTE:

$ COLUMN FROM 0.0 TO ~13.5(BOTTOM OF OIL CANAL)
@ COLUMN UPTO BOTTOM OF BFP DECK
SC* COLUMN FROM 8.5M TO 17.0M

REV.	DATE	ALTD	CHD	APPD
3	27.12.2024	VKS Sd/-	RC Sd/-	PM Sd/-
1	DRAWING REVISED AS PER MoM HELD DURING THE MEETING DTD. 10.12.2021 AND 11.12.2024. REVISION MARKED AS ⚠			
2	14.10.2024	VKS Sd/-	RC Sd/-	PM Sd/-
1	BUS DUCT ARRANGEMENT REVISED. REVISION MARKED AS ⚠			
1	05.08.2024	VKS Sd/-	RC Sd/-	PM Sd/-
1	DRAWING REVISED AS PER HPGCL COMMENTS ON REV-0 DTD. 2.07.2024. REVISION MARKED AS ⚠			

JOB NO. 510
STATUS CONTRACT
DISTRIBUTION

PROJECT: 1X800 MW ULTRA SUPER CRITICAL EXPANSION UNIT, DEEN BANDHU CHHOTU RAM THERMAL POWER PLANT, YAMUNA NAGAR

OWNER: HARYANA POWER GENERATION CORPORATION LTD.

OWNER'S CONSULTANT: DESEIN PRIVATE LIMITED, CONSULTING ENGINEERS, NEW DELHI

OWNER'S REVIEW CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD., CONSULTING ENGINEERS, KOLKATA

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD, NEW DELHI

BHEL UNIT: BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR, PROJECT ENGINEERING MANAGEMENT,NOIDA

DEPT CODE		NAME	SIGN	DATE
MPL	DRN	VKS		20.06.2024
	DESN	RC		20.06.2024
	CHD	RC		20.06.2024
	APPD	BKA		20.06.2024

TITLE:-
TG EQUIPMENT PLAN AT MEZZANINE FLOOR (AT EL 8.5M)

DEPT. | SCALE 1:225 | DRAWING NO. PE-DG-510-100-M004
SIGN | SHEET 1 OF 1 | REV. 3

SIZE-A0

COMPUTER FILE NAME: 510-100-M004

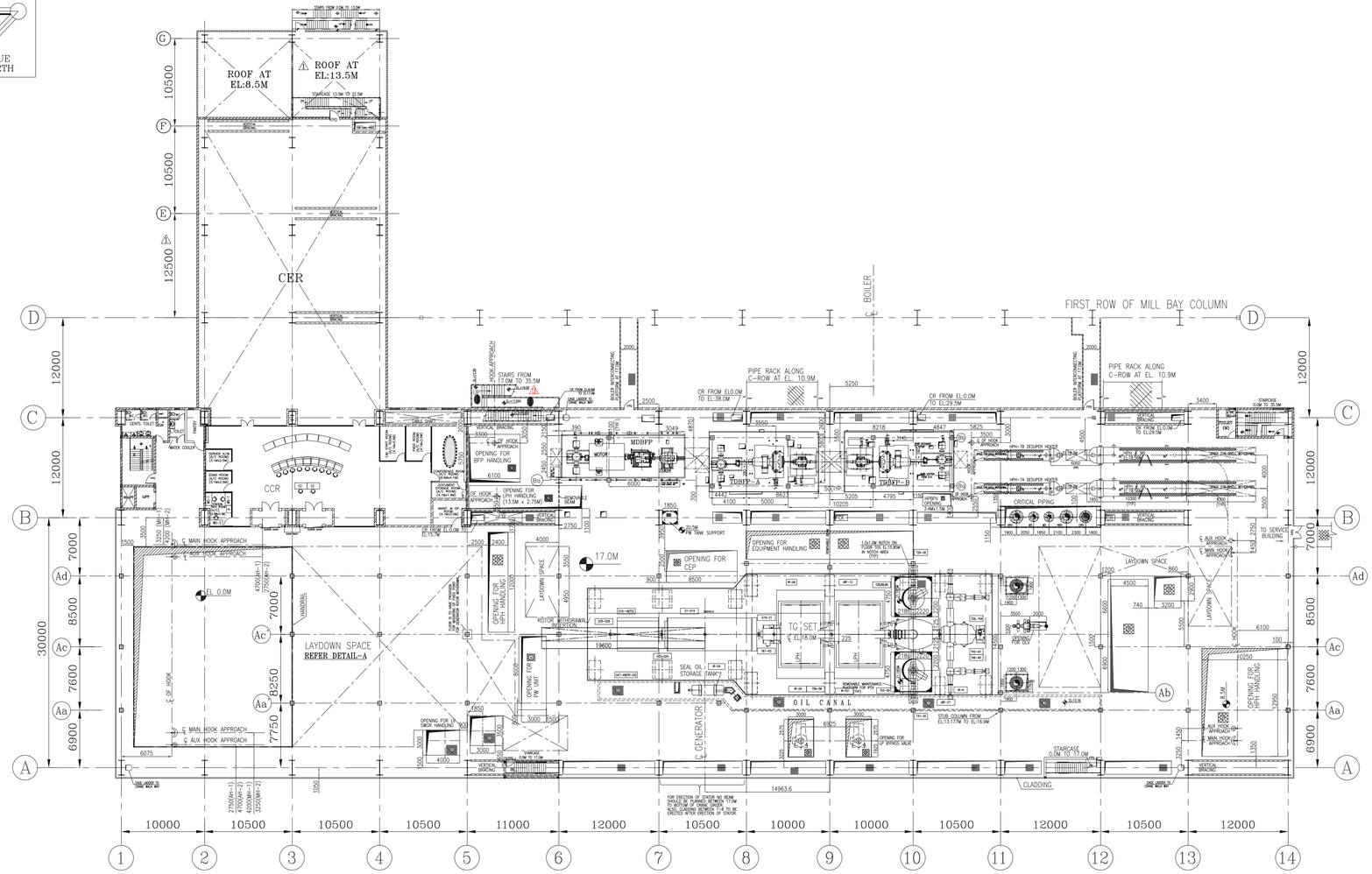
1x800 MW Exapansion Unit, DCRTPP Yamunanagar						
REPLY SHEET | TG EQUIPMENT PLAN AT OPERATING FLOOR (EL 17.0 M) (Drg. No. PE-DG-510-100-M005 Rev. 2)						
S.No.	**Comments (Dtd 22.07.2024)**	**BHEL reply (Dtd 05.08.2024)**	**Comments (Dtd 16.09.2024)**	**BHEL reply (Dtd 14.10.2024)**	**MoM on 10.12.2024 & 11.12.2024**	**BHEL reply (Dtd 27.12.2024)**
1	Sliding doors have been indicated at entry to CCR, which is not in line with specification. The main entrance to Control room shall be provided with air locked lobby with automatic sliding glass doors. Air Curtains at each entrance to Main Control room shall also be provided in line with specification.	Noted. CCR layout is under development. Same will be updated progressively.	Please submit the same for review	Referred drawings will be submitted progressively after detailed engineering of respective facilities.	BHEL intimated that detailed drawings of recpective facilities will be submitted and this drawing will be updated accordingly. HPGCL/Desein/DCPL Noted.	-
2	Indicate separate room for panels (UPS, ACDB and 24 VDC charger) and batteries indicating AC and Non AC area.	Noted. Same will be taken care while developing CCR Layout.	Please submit the same for review	Referred drawings will be submitted progressively after detailed engineering of respective facilities.	BHEL intimated that detailed drawings of recpective facilities will be submitted and this drawing will be updated accordingly. HPGCL/Desein/DCPL Noted.	-
3	As per cl 1.44.01 (xxiii) no roof opening leading to electrical /C&I panels shall be allowed. Hence, roof opening for HVAC pipes is not allowed in CER at el 17.0m.	Roof openings for HVAC pipes for all floors shall be covered by brick work as per standard practice.	Please avoid pipe openings in CCR at EL 17 m to the extent possible.	Noted. Same will be explored during detailed engineering.	BHEL intimated that for HVAC pipes enclosed openings have been provided.	-
4	identify this space (in CCR)	Facilities indicated in CCR are indicative. Same will be updated as per respective detailed CCr Layout drawing (PE-DG-510-145-H401) which is presently under development.	Some of Identified name should be given to the rectangular boxes for understanding.	Boxes have been Identified.	HPGCL/Desein/DCPL Noted.	-

Closed Points:

S.No.	**Comments (Dtd 22.07.2024)**	**BHEL reply (Dtd 05.08.2024)**	**Comments (Dtd 16.09.2024)**	**BHEL reply (Dtd 14.10.2024)**	**MoM on 10.12.2024 & 11.12.2024**	**BHEL reply (Dtd 27.12.2024)**
1	Indicate key plan.	Key Plan has been indicated	Noted	-	-	-
2	Please clarify whether the elevations indicated for all heaters are centerline or bottom and indicate the same on the drawing.	Elevations indicated are center line elevations. Same is mentioned under notes.	Noted	-	-	-
3	The OWS have been located very near to the "C" row column. Please ensure minimum movement space between OWS console and Column.	Noted. Sufficient space is available.	Noted	-	-	-
4	Mention the purpose of the 3m x 3.5m opening provided near grid a/col. 5 between col 5 &6 at el 17.0m.	Opening has been given to handle MV switch gears at 3.5M platform.	Noted	-	-	-
5	SHOW BOTH THE PLANT NORTH AND THE GEOGRAPHICAL NORTH AND THE ANGLE OF INCLINATION BETWEEN THEM	Indicated	Noted	-	-	-
6	CRANE CAPACITY TO BE MENTIONED ALONG WITH CROSS SECTION FOR FURTHER CLAROTY	Crane capacity already mentioned in Cross Section Drawing (PE-DG-510-100-M007).	Noted	-	-	-
7	CHECK FOR PLAN AT 0.0M IN PLAN AT 17.0 M	Since there is an opening (refer opening symbol) in AB Bay between grids 1-3 at operating floor as well as at 8.5M floor, El. 0.0M indicated in this zone is correct. Handrail at operating floor for this opening is also indicated.	Noted	-	-	-
8	write dim of all rooms (in CCR)	Sizes have been indicated.	Noted	-	-	-
9	ALL OPENING FRAMES SHALL BE SUPPORTED ADEQUATELY. PORTION COMING WITHIN THE MAIN FRAMING FROM COLUMN TO COLUMN TO BE TAKEN CARE OF ACCORDINGLY (TYP.). MAY FOUL WITH THE MAIN FRAMING BEAMS AT THIS LOCATION (TYP. AT ALL LOCATIONS)	Noted. Same will be taken care in the civil drawing.	Noted	-	-	-
10	provide dimension	Dimension Indicated.	Noted	-	-	-
11	WITHDRAWAL	Corrected	Noted	-	-	-
12	GIVE DIMENSION (Door to Service Building)	Dimension Indicated	Noted	-	-	-
13	DISCONTINUATION OF LOUVER LINE	Corrected	Noted	-	-	-
14	FOR EXACT LOCATION AND DETAILS OF DOORS , WINDOWS , ROLLING SHUTTERS ETC. RELEVANT APPROVED ARCHITECTURAL DRGS. TO BE REFERRED TO	Same has been mentioned in the Notes.	Noted	-	-	-
15	THIS IS THE LEGEND FOR BRICK WALL AND NOT FOR THE PIPE / CABLE TRESTLE	Description of Legend corrected	Noted	-	-	-
16	Please provide drawing nos.	Drawing nos. will be updated after finalisation of respective drawings.	Noted	-	-	-
17	CHECK FOR DISCONTINUATION OF THIS LINE	Corrected	Noted	-	-	-
18	PROVIDE DIMENSION (TYP.)	Indicated	Noted	-	-	-
19	ROUND OFF THIS DIMENSION	This dimension indicates the exact dimension of Generator from Grid-9.	Noted	-	-	-
20	ADD THE LIST OF ABBREVIATIONS USED WITH THEIR FULL FORMS	Abbrevation list has been added.	Noted	-	-	-
21	C. LINE TO BE MARKED ALONG WITH DIMENSIONS (TYP.)	Same has been marked.	Noted	-	-	-

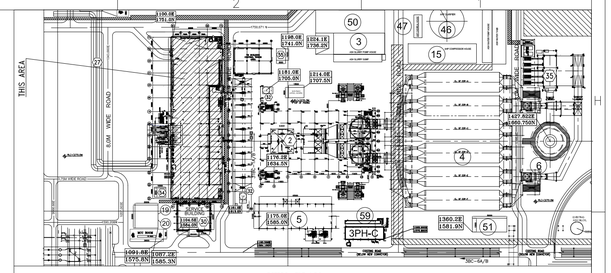
DRAWING NO. PE-DG-510-100-M005

PLANT NORTH 45.5° TRUE NORTH



PLAN AT 17.0M

KEY PLAN



⚠ ABBREVIATION LIST

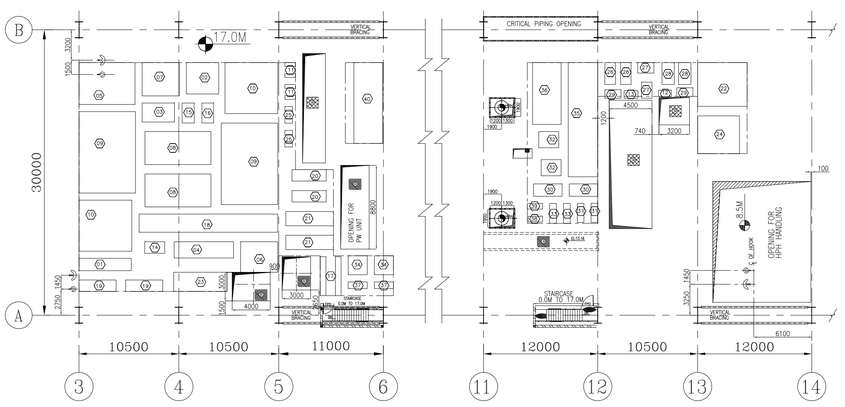
SL. NO.	ABBREVIATION	FULL FORM	SL. NO.	ABBREVIATION	FULL FORM
1	EOT	ELECTRONIC OVERHEAD TRAVEL	21	LV SWGR	LOW VOLTAGE SWITCHGEAR
2	MS	MAIN STEAM	22	PW	POTABLE WATER
3	CRH	COLD REHEAT	23	CEP	CONDENSATE EXTRACTION PUMP
4	HRH	HOT REHEAT	24	CPU	CONDENSATE POLISHING UNIT
5	LPBP	LOW PRESSURE BYPASS	25	VFD	VARIABLE FREQUENCY DRIVE
6	HPBP	HIGH PRESSURE BYPASS	26	HPSU	HIGH PRESSURE OIL SUPPLY UNIT
7	CW	COOLING WATER	27	ESV	EMERGENCY STOP VALVE
8	HVAC	HEATING & VENTILATION AIR CONDITIONING	28	IV	INTERCEPTOR VALVE
9	MCC	MOTOR CONTROL	29	OLV	OVER LOAD VALVE
10	AHU	AIR HANDLING UNIT	30	F/T	FLASH TANK
11	FPD	FIRE PROOF DOOR	31	GSC	GLAND STEAM CONDENSOR
12	CR	CABLE RISER	32	SWAS	STEAM AND WATER ANALYSIS ROOM
13	PRDS	PRESSURE REDUCING DE-SUPER HEATING STATION	33	DOT	DIRTY OIL TANK
14	RS	ROLLING SHUTTER	34	COT	CLEAN OIL TANK
15	BP	BOOSTER PUMP	35	EOP	EMERGENCY OIL PUMP
16	BFP	BOILER FEED PUMP	36	JOP	JACKING OIL PUMP
17	D/A	DEAREATOR	37	TOG	TOP OF GRATING
18	LPH	LOW PRESSURE HEATER	38	PHE	PLATE HEAT EXCHANGER
19	HPH	HIGH PRESSURE HEATER	39	SCS	SELF CLEAN STRTAINER
20	VD	VENTILATION DUCT	40	DMCW	DE-MINERALISED COOLING WATER

LEGENDS

	PIPE HATCH
	VERTICAL BRACING
FPD	FIRE PROOF DOOR
	GRATING
	CHEQUERED PLATE
(R)	REMOVABLE
	HAND RAILING
	CABLE TRAY
	FIRE BARRIER WALL
	PIPES/CABLE TRESTLE.
(RS)	ROLLING SHUTTER
	RAIL TRACK
	PIPE TRENCH WITH PCC COVERED SAND FILLED
	BRICK WALL
	BUS DUCT
	WALK WAY
	CONCRETE

REFERENCE DRGS:

SL.NO.	TITLE	NUMBER	UNIT
1	TG EQUIPMENT PLAN AT EL 0.0 M	PE-DG-510-100-M003	PEM
2	TG EQUIPMENT PLAN AT EL 8.5 M	PE-DG-510-100-M004	PEM
3	TG EQUIPMENT PLAN AT MISCELLANEOUS FLOORS IN BC BAY	PE-DG-510-100-M006	PEM
4	T.G. CROSS SECTION	PE-DG-510-100-M007	PEM
5	GA OF MDBFP	--	HYD
6	GA OF TDBFP	--	HYD
7	GA OF HP HEATER 9A	--	HYD
8	GA OF HP HEATER 9B	--	HYD
9	GA OF DESUPERHEATER-7A	--	HYD
10	GA OF DESUPERHEATER-7B	--	HYD
11	FOUNDATION ARRANGEMENT FOR BFP AND DRIVE TURBINE	--	HYD
12	FOUNDATION ARRANGEMENT OF MDBFP	--	HYD
13	TG DECK FOUNDATION PLAN	--	HWR
14	OIL CANAL DETAILS	--	HWR
15	LAYDOWN SPACE FOR GENERATOR COMPONENTS	--	HWR
16	LAYDOWN SPACE FOR STEAM TURBINE COMPONENTS	--	HWR
17	REMOVABLE MAINTENANCE PLATFORM FOR IPSV	--	HWR



DETAIL-A

EQUIPMENT LAYDOWN ARRANGEMENT FOR TG & GENERATOR COMPONENTS AT 17.0M

DETAIL OF LAY-DOWN SPACE FOR TG COMPONENTS

S.No	DESCRIPTION	WT.IN T	AREA M x M
(01)	HP SHAFT	20.0	5.5 X 1.3
(02)	EXHAUST CASING	25.0	3.4 X 3.3
(03)	INNER CASING UPPER PART	17.0	3.4 X2.0
(04)	IP SHAFT	40.0	6.232 X 1.7
(05)	IP TURBINE OUTER CASING UPPER PART	41.0	5.89 X 4.4
(06)	IP TURBINE INNER CASING UPPER PART	32.0	3.9 X 3.2
(07)	IP TURBINE INNER CASING LOWER PART	37.0	3.9 X 3.5
(08)	LP1 & LP2 SHAFT	76.0	6.932 X 3.46
(09)	LP1 & LP2 OUTER CASING UPPER PART	28.0	8.56 X 5.935
(10)	LP1 & LP2-INNER CASING UPPER HALF	26.0	5.55 X 5.36
(11)	LP SHAFT SEAL CAS -TE & GE (4 Nos.)	0.5	0.405 X 1.12
(12)	HP FRONT BEARING UPPER PART PEDESTAL COVER	0.6	0.65 X 1.35
(13)	HP REAR BEARING UPPER PART PEDESTAL COVER	0.9	0.8 X 1.45
(14)	IP REAR BEARING UPPER PART PEDESTAL COVER	2.3	1.215 X 2.1
(15)	LP REAR BEARING UPPER PART PEDESTAL COVER	2.3	1.275 X 2.1
(16)	LP REAR-2 BEARING UPPER PART PEDESTAL COVER	2.3	1.235 X 2.1
(17)	GUIDE BLADE CARRIER ASSEMBLY 2 NOS	3.55	4.1 X 0.6
(18)	GENERATOR – ROTOR	93.0	14.57 X 1.91
(19)	END SHIELD UPPER & LOWER HALF (ES) 2 NOS	9.0	1.2 X 3.9
(20)	END SHIELD UPPER & LOWER HALF (TS) 2 NOS	8.0	1.2 X 3.6

S.No	DESCRIPTION	WT.IN T	AREA M x M
(21)	HYDROGEN COOLERS (2 NOs TWIN TYPE)	4.5	5.0 X 1.5
(22)	HYDROGEN COOLERS HOUSING	26.0	4.6 X 5.2
(23)	EXCITER	30.0	5.6 X 2.01
(24)	EXCITER HOUSING	3.5	4.4 X 3.97
(25)	BEARING SHELLS –TS & ES 4NOS	0.5	0.5 X 0.8
(26)	HP CONTROL VALVE 2 Nos.	3.0	2.3 X 1.1
(27)	HP CONTROL VALVE ACTUATOR 2 Nos.	2.0	1.7 X 1.1
(28)	HP STOP VALVE 2 Nos.	4.5	2.5 X 1.3
(29)	HP STOP VALVE ACTUATOR 2 Nos.	1.5	1.7 X 0.9
(30)	IP CONTROL VALVE 2 Nos.	6.5	3.0 X 1.3
(31)	IP CONTROL VALVE ACTUATOR 2 Nos.	1.6	2.0 X 0.7
(32)	IP STOP VALVE 2 Nos.	7.0	2.1 X 1.7
(33)	IP STOP VALVE ACTUATOR 2 Nos.	1.4	2.1 X 0.7
(34)	LP BYPASS CONTROL VALVE 2 NOS	2.2	2.0 X 2.0
(35)	CROSS OVER PIPE – PART1	30	12 X 3.1
(36)	CROSS OVER PIPE – PART2	22	6.5 X 3
(37)	LP BYPASS CONTROL VALVE ACTUATOR 2 NOS	0.5	2 X 0.7
(38)	OVERLOAD CONTROL VALVE	0.8	1.5 X 0.6
(39)	OVERLOAD CONTROL VALVE ACTUATOR	1.0	1.6 X 0.6
(40)	LIFTING BEAM	8.0	8.5 X 3.0

NOTES:–

1. ALL DIMENSION ARE IN MM AND LEVELS ARE IN METRES.
2. ALL ELEVATION MARKED ARE W.R.T. TG HALL FINISHED FLOOR ELEVATION OF EL 0.00M WHICH CORRESPONDS TO RL(+)270.5M.
3. CABLE DUCT/TRENCH/SLIT LAYOUT IS SHOWN FOR REPRESENTATION PURPOSE ONLY. FOR DETAILS REFER ELECTRICAL DRAWING.
4. ELEVATIONS OF EQUIPMENT/PIPES INDICATED ARE CENTER LINE ELEVATIONS UNLESS OTHERWISE SPECIFIED.
5. FOR EXACT LOCATION AND DETAILS OF DOORS, WINDOWS, ROLLING SHUTTERS ETC., RELEVANT APPROVED ARCHITECTURAL DRGS. TO BE REFERRED.

REV.	DATE	ALTD	CHD	APPD
3	27.12.2024	VKS Sd/–	RC Sd/–	PM Sd/–
1	DRAWING REVISED AS PER MoM HELD DURING THE MEETING DTD. 10.12.2021 AND 11.12.2024. REVISION MARKED AS ⚠			
2	14.10.2024	VKS Sd/–	RC Sd/–	PM Sd/–
1	DRAWING BEING RESUBMITTED.			
1	05.08.2024	VKS Sd/–	RC Sd/–	PM Sd/–
1	DRAWING REVISED AS PER HPGCL COMMENTS ON REV–0 DTD. 2.07.2024. REVISION MARKED AS ⚠			

JOB NO. 510

STATUS CONTRACT

DISTRIBUTION

PROJECT: 1X800 MW ULTRA SUPER CRITICAL EXPANSION UNIT, DEEN BANDHU CHHOTU RAM THERMAL POWER PLANT, YAMUNA NAGAR

OWNER: HARYANA POWER GENERATION CORPORATION LTD.

OWNER'S CONSULTANT: DESEIN PRIVATE LIMITED CONSULTING ENGINEERS, NEW DELHI

OWNER'S REVIEW CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS, KOLKATA

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD, NEW DELHI

BHEL UNIT: BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR PROJECT ENGINEERING MANAGEMENT,NOIDA

DEPT CODE		NAME	SIGN	DATE
MPL	DRN	VKS		20.06.2024
	DESN	RC		20.06.2024
	CHD	RC		20.06.2024
	APPD	BKA		20.06.2024

TITLE:–

TG EQUIPMENT PLAN AT OPERATING FLOOR (AT EL 17.0M)

DEPT. | SCALE 1:225 | SIGN

DRAWING NO. PE-DG-510-100-M005

SHEET 1 OF 1 | REV. 3

SIZE–A0

COMPUTER FILE NAME: 510-100-M005

1x800 MW Exapansion Unit, DCRTPP Yamunanagar						
REPLY SHEET | TG EQUIPMENT PLAN AT MISCELLANEOUS FLOORS ABOVE OP. FLOOR IN BC BAY (Drg. No. PE-DG-510-100-M006 Rev. 2)						
S.No.	**Comments (Dtd 22.07.2024)**	**BHEL reply (Dtd 05.08.2024)**	**Comments (Dtd 16.09.2024)**	**BHEL reply (Dtd 14.10.2024)**	**MoM on 10.12.2024 & 11.12.2024**	**BHEL reply (Dtd 27.12.2024)**
1	Furnish a separate plan for the switchgear room at El 27.0M. At grid D2 a single leaf door is shown.	Same will be covered in separate drawing (PE-DG-510-100-E009)	Noted	-	BHEL intimated that detailed drawings of recpective facilities will be submitted and this drawing will be updated accordingly. HPGCL/Desein/DCPL Noted.	-
2	Please clarify how the monorail provided at el 27.5m for handling of panel/transformers is supported	It will be provided by giving Auxiliary structure above. Details will be covered in respective civil drawing.	Noted	-	BHEL intimated that detailed drawings of recpective facilities will be submitted and this drawing will be updated accordingly. HPGCL/Desein/DCPL Noted.	-
3	As per cl 1.44.01 (xxiii) no roof opening leading to electrical /C&I panels shall be allowed. Hence, roof opening for HVAC pipes is not allowed in boiler switchgear room at el 27.5m.	Roof openings for HVAC pipes for all floors shall be covered by brick work as per standard practice.	Please avoid pipe openings in CCR at EL 17 m to the extent possible.	Noted. Same will be explored during detailed engineering.	BHEL intimated that reference drawing for Floor opening (for Duct, piping and cable) will be submitted and this drawing will be updated accordingly. HPGCL/Desein/DCPL Noted.	-
4	FOR EXACT LOCATION AND DETAILS OF DOORS , WINDOWS , ROLLING SHUTTERS ETC. RELEVANT APPROVED ARCHITECTURAL DRGS. TO BE REFERRED TO	Same has been mentioned in the Notes.	Noted	-	BHEL agreed to correct numbering of NOTES mentioned in the drawing. HPGCL/Desein/DCPL Noted.	Numbering has been corrected.
5	Please mark piping corridor	For piping related information, separate piping drawings of respective floor to be referred. Same are under development.	Please show piping corridor in this drawing also.	Kinldy note that this layout depicts location of Equipment only. Piping Layout will be prepared by ensuring adequate walk way. For Piping Layout/corridor separate drawing will be submitted.	BHEL intimated that detailed drawings of piping layout will be submitted progressively and this drawing will be updated accordingly. HPGCL/Desein/DCPL Noted.	-

Closed Points:

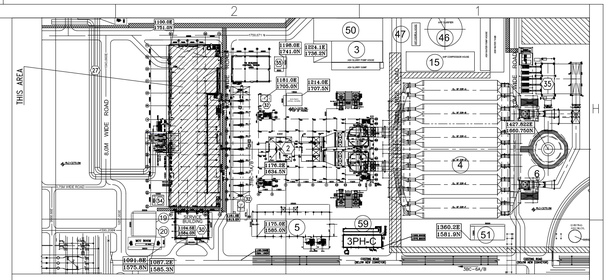
S.No.	**Comments (Dtd 22.07.2024)**	**BHEL reply (Dtd 05.08.2024)**	**Comments (Dtd 16.09.2024)**	**BHEL reply (Dtd 14.10.2024)**	**MoM on 10.12.2024 & 11.12.2024**	**BHEL reply (Dtd 27.12.2024)**
1	Indicate key plan.	Key Plan has been indicated	Noted	-	-	-
2	In absence of the electrical layout drawings, BHEL to ensure that the space considered by them is adequate. In case there is any additional space requirement the room/building shall be modified to accommodate the equipment/panels suitably.	Noted.	Noted	-	-	-
3	Please clarify how panels shall be taken inside the room from the equipment handling area.	panels will be taken inside through trolley.	Noted	-	-	-
4	Bracing provided between col 3 & 4 /grid d & e at el 24.0m should be designed such that there is no obstruction in routing the cable trays.	Noted.	Noted	-	-	-
5	Double door provided near col 2 for cable vault at el 24.0m shall be fireproof door as per cl no. 1.44.01 (xiii) of volume iv of tender specification.	Noted.	Noted	-	-	-
6	SHOW BOTH THE PLANT NORTH AND THE GEOGRAPHICAL NORTH AND THE ANGLE OF INCLINATION BETWEEN THEM	Indicated	Noted	-	-	-
7	CHECK FOR FRAMING ARRANGEMENT WITHIN THE OPENING PORTION	Framing Arrangement will be part of civil drawing.	Noted	-	-	-
8	PROVIDE DIMENSION (TYP.)	Indicated	Noted	-	-	-
9	GRIDS B AND C TO BE SHOWN PROPERLY	Grids are already properly shown.	Noted	-	-	-
10	SHOULD BE 12000 (BC Bay Width in Plan View at 47.5M)	Corrected.	Noted	-	-	-
11	provide drawing nos (in the table)	Drawing nos. will be updated after finalisation of respective drawings.	Noted	-	-	-
12	CHK. DIMENSION (in 27.5M Plan)	Corrected.	Noted	-	-	-
13	CHECK FOR THE CANTILEVER PORTION -SEEMS TO BE QUITE LONG	Reviewed and found in order. May be noted that Monorail beam shall be supported between main columns.	Noted	-	-	-
14	DESCRIBE ARROWHEAD	Arrowhead was placed inadvertantly. Same has been removed.	Noted	-	-	-
15	SHIFT (VERTICAL BRACING) TO THE EDGE OF THE FLANGE OF THE COL.	Vertical Bracing indicated is correct as column width is lower at this level. May review w.r.t. Cross Section Drawing (PE-DG-510-100-M007)	Noted	-	-	-
16	ADD THE LIST OF ABBREVIATIONS USED WITH THEIR FULL FORMS	Abbrevation list has been added.	Noted	-	-	-
17	FURNISH DIMENSION	Indicated	Noted	-	-	-
18	CHECK OUT FOR THE REVISION MARK	Revision mark was placed inadvertantly. Same has been removed.	Noted	-	-	-
19	PROVIDE DIM. FOR THE LOCATION OF THE TANK	Indicated	Noted	-	-	-

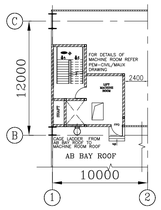
DRAWING NO. PE-DG-510-100-M006

PLANT NORTH 46.6° TRUE NORTH

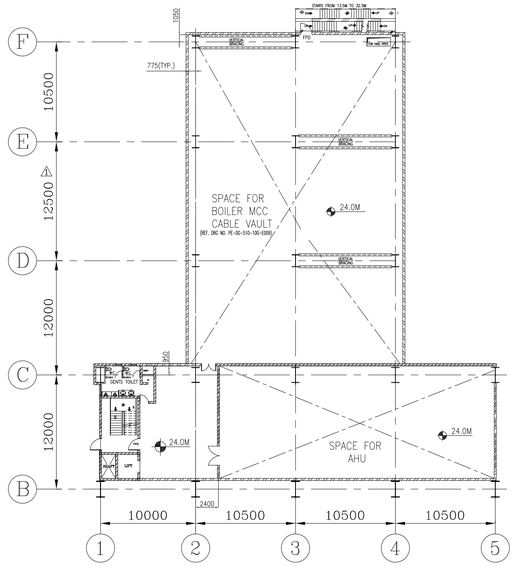
REFERENCE DRAWINGS:

SL No		DRG. NUMBER	UNIT
1	TG EQUIPMENT PLAN AT EL 0.0 M	PE-DG-510-100-M003	PEM
2	TG EQUIPMENT PLAN AT EL 8.5 M	PE-DG-510-100-M004	PEM
3	TG EQUIPMENT PLAN AT 17.0 M	PE-DG-510-100-M005	PEM
4	T.G. HALL CROSS SECTION	PE-DG-510-100-M007	PEM
5	GA OF SPRAY CUM TRAY DEAERATOR	--	HYD
6	GA D/A PLATFORM	--	HYD
7	GA OF DMCW TANK	--	BPL
8	GA OF POTABLE WATER TANK	--	BPL
9	GA AIR WASHER LAYOUT	--	PEM
10	GA OF SERVICE WATER TANK	--	BPL

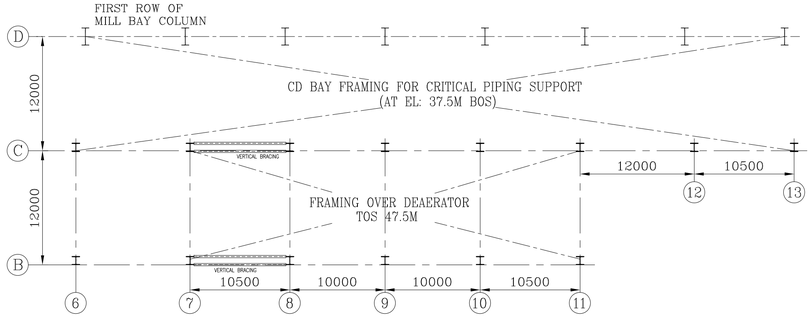




MACHINE ROOM PLAN AT EL(+)41.0M

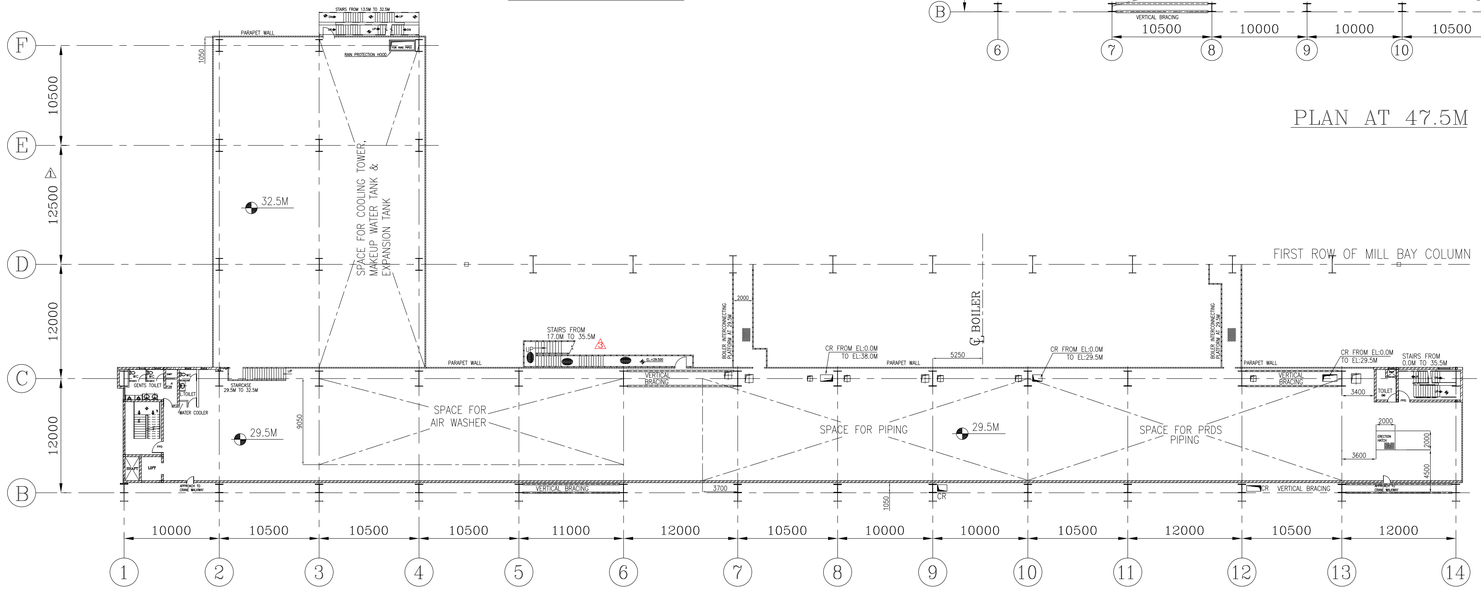


PLAN AT 24.0M

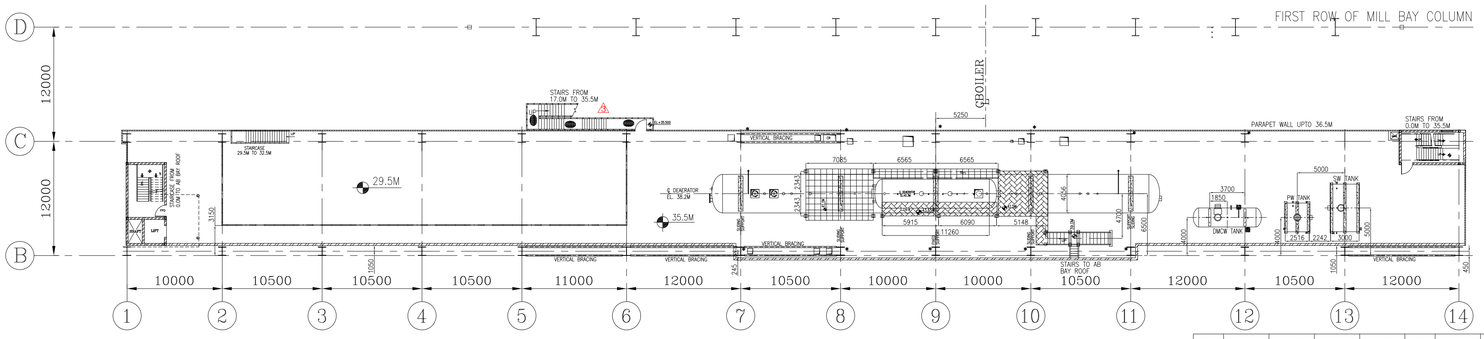


PLAN AT 47.5M

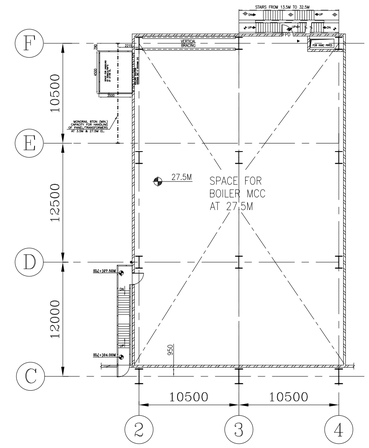
ABBREVIATION LIST					
SL. NO.	ABBREVIATION	FULL FORM	SL. NO.	ABBREVIATION	FULL FORM
1	EOT	ELECTRONIC OVERHEAD TRAVEL	21	LV SWGR	LOW VOLTAGE SWITCHGEAR
2	MS	MAIN STEAM	22	PW	POTABLE WATER
3	CRH	COLD REHEAT	23	CEP	CONDENSATE EXTRACTION PUMP
4	HRH	HOT REHEAT	24	CPU	CONDENSATE POLISHING UNIT
5	LPBP	LOW PRESSURE BYPASS	25	VFD	VARIABLE FREQUENCY DRIVE
6	HPBP	HIGH PRESSURE BYPASS	26	HPSU	HIGH PRESSURE OIL SUPPLY UNIT
7	CW	COOLING WATER	27	ESV	EMERGENCY STOP VALVE
8	HVAC	HEATING & VENTILATION AIR CONDITIONING	28	IV	INTERCEPTOR VALVE
9	MCC	MOTOR CONTROL	29	OLV	OVER LOAD VALVE
10	AHU	AIR HANDLING UNIT	30	F/T	FLASH TANK
11	FPD	FIRE PROOF DOOR	31	GSC	GLAND STEAM CONDENSOR
12	CR	CABLE RISER	32	SWAS	STEAM AND WATER ANALYSIS ROOM
13	PRDS	PRESSURE REDUCING DE-SUPER HEATING STATION	33	DOT	DIRTY OIL TANK
14	RS	ROLLING SHUTTER	34	COT	CLEAN OIL TANK
15	BP	BOOSTER PUMP	35	EOP	EMERGENCY OIL PUMP
16	BFP	BOILER FEED PUMP	36	JOP	JACKING OIL PUMP
17	D/A	DEAERATOR	37	TOG	TOP OF GRATING
18	LPH	LOW PRESSURE HEATER	38	PHE	PLATE HEAT EXCHANGER
19	HPH	HIGH PRESSURE HEATER	39	SCS	SELF CLEAN STRTAINER
20	VD	VENTILATION DUCT	40	DMCW	DE-MINERALISED COOLING WATER



PLAN AT 29.5M



PLAN AT 35.5M



PLAN AT 27.5M

NOTES:-

1. ALL DIMENSION ARE IN MM AND LEVELS ARE IN METRES.
2. ALL ELEVATION MARKED ARE W.R.T. TG HALL FINISHED FLOOR ELEVATION OF EL 0.00M WHICH CORRESPONDS TO RL(+)270.5M.
3. CABLE DUCT/TRENCH/SLIT LAYOUT IS SHOWN FOR REPRESENTATION PURPOSE ONLY. FOR DETAILS REFER ELECTRICAL DRAWING.
4. DETAILS FOR AIR WASHER ARE INDICATIVE.
5. ⚠ FOR EXACT LOCATION AND DETAILS OF DOORS, WINDOWS, ROLLING SHUTTERS ETC., RELEVANT APPROVED ARCHITECTURAL DRGS. TO BE REFERRED.

LEGENDS	
	PIPE HATCH
	VERTICAL BRACING
FPD	FIRE PROOF DOOR
	GRATING
	CHEQUERED PLATE
Ⓡ	REMOVABLE
	HAND RAILING
	BRICK WALL
	CONCRETE
	PARAPET WALL

COMPUTER FILE NAME: 510-100-M006

REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD	REV.	DATE	ALTD	CHD	APPD
3	27.12.2024	VKS Sd/-	RC Sd/-	PM Sd/-	2	14.10.2024	VKS Sd/-	RC Sd/-	PM Sd/-	1	05.08.2024	VKS Sd/-	RC Sd/-	PM Sd/-
1	DRAWING REVISED AS PER MoM HELD DURING THE MEETING DTD. 10.12.2021 AND 11.12.2024. REVISION MARKED AS ⚠				1	DRAWING BEING RESUBMITTED.				1	DRAWING REVISED AS PER HPGCL COMMENTS ON REV-0 DTD. 2.07.2024. REVISION MARKED AS ⚠			

JOB NO. 510
STATUS CONTRACT
DISTRIBUTION

PROJECT: 1X800 MW ULTRA SUPER CRITICAL EXPANSION UNIT, DEEN BANDHU CHHOTU RAM THERMAL POWER PLANT, YAMUNA NAGAR

OWNER: HARYANA POWER GENERATION CORPORATION LTD.

OWNER'S CONSULTANT: DESEIN PRIVATE LIMITED, CONSULTING ENGINEERS, NEW DELHI

OWNER'S REVIEW CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD., CONSULTING ENGINEERS, KOLKATA

EPC CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD, NEW DELHI

BHEL UNIT: BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR PROJECT ENGINEERING MANAGEMENT,NOIDA

DEPT CODE		NAME	SIGN	DATE
MPL	DRN	VKS		20.06.2024
	DESN	RC		20.06.2024
	CHD	RC		20.06.2024
	APPD	BKA		20.06.2024

TITLE:- TG EQUIPMENT PLAN AT MISCELLANEOUS FLOORS ABOVE OPERATING FLOOR IN BC BAY

DEPT. SIGN | SCALE 1:225 | DRAWING NO. PE-DG-510-100-M006

SHEET 1 OF 1 | REV. 3 | SIZE-A0