Sr. No	PMS Nos.	Description
		System
5	700 MWe /71710/1/PMS	Piping Material Specification for Non-Active Drainage System
6	700 MWe /71850/1/PMS	Piping Material Specification for Auxiliary Service Water System
7	700 MWe /71900/1/PMS	Piping Material Specification for Chilled Water System

Valve Specification Sheets

Sr. No.	VSS Nos.	Description
1	700 MWe/71003/2201/VSS	Typical Valve Specification Sheet for valve size 15 - 50 DN Forged Carbon Steel Manually operated Gate Valve with SW ends
2	700 MWe/71003/2202/VSS	Typical Valve Specification Sheet for valve size 80 - 250 DN Cast Carbon Steel Manually operated Gate Valve with Flanged ends
3	700 MWe/71003/2203/VSS	Typical Valve Specification Sheet for valve size 15 - 50 DN Forged Carbon Steel Manually operated Globe Valve with SW ends
4	700 MWe/71003/2204/VSS	Typical Valve Specification Sheet for valve size 80 - 250 DN Cast Carbon Steel Manually operated Globe Valve with Flanged ends
5	700 MWe/71003/2205/VSS	Typical Valve Specification Sheet for 15 - 50 DN Cast Carbon Steel Manually operated Ball type Lift Check valve
6	700 MWe/71003/2206/VSS	Typical Valve Specification Sheet for 80 - 450 DN Cast Carbon Steel Manually operated Single Plate Wafer type Check valve
7	700 MWe/71003/2208/VSS	Typical Valve Specification Sheet for Automatic Air Release cum vacuum brake valve.
8	700 MWe/71003/2213/VSS	Typical Valve Specification Sheet for 80 – 150 DN, Cast Carbon Steel Manually operated Balancing Valve with Flanged ends for Chilled Water System.
9	700 MWe/71003/2214/VSS	Typical Valve Specification Sheet for 15 – 50 DN Pilot operated, Cast Carbon Steel Pressure Reducing Valve with Flanged ends.
10	700 MWe/71003/2215/VSS	Typical Valve Specification Sheet for 15 – 50 DN Direct Acting, Bronze Pressure Reducing Valve with Threaded ends for Domestic Water System.
11	700 MWe/71003/2221/VSS	Typical Valve Specification Sheet for valve size 15 - 50 DN Forged Stainless Steel

Sr. No.	VSS Nos.	Description
		Manually operated Gate Valve with SW ends.
12	700 MWe/71003/2222/VSS	Valve Specification Sheet for valve size 80 - 250 DN Cast Stainless Steel Manually operated Gate Valve with Flanged ends.
13	700 MWe/71003/2223/VSS	Valve Specification Sheet for valve size 15 - 50 DN Forged Stainless Steel Manually operated Globe Valve with SW ends.
14	700 MWe/71003/2224/VSS	Valve Specification Sheet for valve size 80 - 250 DN Cast Stainless Steel Manually operated Globe Valve with Flanged ends.
15	700 MWe/71003/2225/VSS	Valve Specification Sheet for 15 - 50 NB Stainless steel Manually operated Float Valve with Threaded ends.
16	700 MWe/71003/2226/VSS	Valve Specification Sheet for valve size 15 - 50 DN Forged Stainless Steel Electrically operated Gate Valve with SW ends.
17	700 MWe/71003/2228/VSS	Valve Specification Sheet for valve size 15 - 50 DN Cast Stainless Steel, Pilot operated, Pressure Reducing Valve with Flanged ends for DM water system.
18	700 MWe/71203/2201/VSS	Valve Specification Sheet of Electrically operated Butterfly valves with flanged ends for Condenser Cooling Water system.
19	700 MWe/71353/2201/VSS	Valve Specification Sheet for Manually operated Butterfly valves with flanged ends in Auxiliary Cooling Water system.
20	700 MWe/71353/2202/VSS	Valve Specification Sheet of Electrically operated Butterfly valves with flanged ends for Auxiliary Cooling Water system.
21	700 MWe/71353/2203/VSS	Valve Specification Sheet for 500 NB Dual Plate Check valve with flanged ends in Auxiliary Cooling Water system.
22	700 MWe/71403/2201/VSS	Valve Specification Sheet for Fire Landing Angle valve (Hydrant Valve) with single outlet
23	700 MWe/71403/2202/VSS	Valve Specification Sheet for Cast Carbon steel Deluge Valve (80 – 150 DN) with flanged end (Electric trim)
24	700 MWe/71403/2203/VSS	Valve Specification Sheet for Cast Carbon steel Flanged end Manual Gate Valve (100 – 250 DN) with Extended stem & Floor stand
25	700 MWe/71403/2204/VSS	Valve Specification Sheet for Chain operated Cast Carbon steel Gate Valve (100 – 250 DN) with flanged end.

Sr. No.	VSS Nos.	Description
26	700 MWe/71403/2205/VSS	Valve Specification Sheet for Electrically Operated Cast Carbon Steel Gate Valve (80 – 250 DN) with flanged ends
27	700 MWe/71603/2227/VSS	Valve Specification Sheet for 100 NB Electrically Operated Forged Stainless Steel Globe Control Valve With Flanged Ends
28	700 MWe/71853/2201/VSS	Typical Valve Specification Sheet for Manually operated Butterfly valves with flanged ends in Auxiliary Service Water system.

C-2.5.10 SPECIFIC MECHANICAL REQUIREMENTS

1. Availability Requirements

1.1 Plant and Equipment included in this Contract shall be designed for maximum reliability and availability. The design life of all Plant & Equipment and their components supplied under this Contract except for renewable parts such as bearings, seals, liners, etc. which have a limited life and which are covered under spares, shall not be less than 40 years.

1.2 All standby equipment/auxiliaries shall be designed for automatic startup on failure of running auxiliaries unless otherwise specified.

1.3 All equipment and systems shall be of proven design, using materials with established physical and chemical properties adequately demonstrated in operation and as appropriate to the services intended.

1.4 Instrumentation and control systems shall be designed for maximum reliability and availability considering the environmental conditions.

2 Layout Requirements

2.1 The ACW pumps and associated accessories shall be installed inside TB. The general arrangement of the pumps should be similar in both Units. The layout shall facilitate easy handling, erection, operation and maintenance.

2.2 Plate type heat exchangers shall be located considering material handling, operation and maintenance requirements and minimum clear space of 1 m around PHE shall be provided other than plate laydown area. Plate laydown area shall be as per PHE supplier’s guidelines.

2.3 The pumps, motors and associated equipment shall be provided with suitable Crane / arrangement for handling. CONTRACTOR shall confirm the adequacy of the crane capacity and select the minimum capacity (with adequate margin) based on the weight of heaviest component to be handled during erection/maintenance. Minimum clear space of 1 m around pump shall be provided for inspection.

2.4 All pipe sizes selected shall be as per PMS only. The pipelines and the valves shall be laid out in such a way that they are easily accessible for maintenance and repair and shall not come in the way of free movement around the pumps and also shall not come in the way of taking the motor and other components to the maintenance area.

2.5 It is the CONTRACTOR'S responsibility to plan and finalize layout of all piping in his scope in accordance with the final general arrangement (GA) drawings. Any layout if shown in PURCHASER's drawings is for CONTRACTOR's guidance only. Layout drawings shall indicate valve orientation and mounting of all specialities.

2.6 The layout of valves, equipment, instruments and root valves shall be such that these are fully accessible, leaving adequate headroom clearance for movement of plant personnel.

3 Performance Requirements

3.1 As the 700 MWe units are designed as base load units, it is essential that all the pumps in this Contract and their accessories be designed to operate continuously at the specified conditions.

3.2 The total design head at duty point and power consumption shall be the basis for performance evaluation with tolerances specified in the relevant specification.

4 Maintenance Requirements

4.1 All equipment and valves larger than 250 NB size as well as those which are not easily approachable shall have adequate material handling arrangement like monorail with hoist, maintenance platforms, chain pulley block etc. Lifting lugs or eye bolts shall be provided for ease of installation or maintenance.

4.2 The CONTRACTOR shall supply all the maintenance tools required for attending to different equipment offered by him. In general these shall include, but not be limited to, the following:

Pipe wrenches, screw spanners and box spanners of various sizes and types; wire brushes and scrapers; eye bolts of various sizes; wire ropes; screw drivers of different sizes; hammers and crow bars; column clamps.

4.3 In addition to the above, the CONTRACTOR shall also supply special maintenance tools for equipment under his scope. These shall include tools required for removal of pump impeller, couplings and PHE plates; precision tools for alignment and jacking operations, maintenance jigs, etc.

4.4 All precision measuring instruments such as special gauges, leveling instruments required for maintenance shall be supplied.

4.5 Any of the above items which are found necessary during erection but not specifically brought out in the schedule of maintenance tools are deemed to have been included in the CONTRACTOR'S scope.

5 **Specific Requirements for Pumps**

5.1 The design of the pumps and their associated accessories shall be as per enclosed specifications. All pumps shall be supplied with Mechanical Seals.

5.2 Selection of Motors

The motor rating shall be selected as per relevant pump specifications.

The supplier shall submit the HQ curves superimposed on the system resistance curves. The pump supplier shall also submit the motor selection criteria in the tabular form indicating power requirement under above operating conditions and at 48.5 Hz, 50 Hz and 51.5 Hz power supply frequency.

5.3 Speed-torque curves for the pumps including different cases like one pump, two pumps and three pumps operation shall be submitted by Contractor over full range of operation.

C-2.5.11 SPECIFIC INSTRUMENTATION & CONTROLS REQUIREMENTS

Refer Instrumentation & Controls Requirements C-2.4

C-2.5.12 WELDING, RADIOGRAPHY AND OTHER NDE

All above requirements and acceptance norms are as per design codes and standards. for further details refer Section C-1 except CMLC piping.

C-2.5.13 INSPECTION, TESTING AND TYPICAL QUALITY ASSURANCE PLAN

For general clauses on Inspection and Testing, refer section C-1.

1.0 **Scope and Purpose**

The purpose of enclosed Sample Quality Assurance Plans (QAPs) as listed below is to describe stage-wise inspection requirements and purchaser's hold points to be followed during the manufacture of various types of equipment/components used in Nuclear Power Plants. Wherever specific QAP is not given for a particular type of item, the QAP closely applicable to that type of items should be taken as reference QAP. Also wherever specific QAP is not given for a particular type of item, the inspection and testing requirements as specified in respective specification and data sheets shall be considered while preparing QAP for that item. The QAP given for each product is only indicative. Inspection / examination requirements of equipment / components widely vary depending upon its design and fabrication code. Hence, the actual QAP for each product shall be prepared by the contractor after incorporating suitable additions, deletions or modifications as per the specification requirements of that equipment / components.

Sr. No	Description
1	Quality Assurance Plan for Centrifugal Pumps
2	Quality Assurance Plan for Plate Heat Exchangers
3	Quality Assurance Plan for SGBD Vapour Absorption Chiller
4	Quality Assurance Plan for Butterfly Valves
5	Quality Assurance Plan for Dual Plate Check Valves
6	Quality Assurance Plan for Gate Valves
7	Quality Assurance Plan for Balancing Valves
8	Quality Assurance Plan for Pressure Reducing Valves
9	Quality Assurance Plan for Rubber Expansion Joints
10	Quality Assurance Plan for Submersible pumps

2.0 Abbreviations and Definitions

H – Hold Point W – Witness Point R – Review / Verification
P - Performing Agency

1 - NPCIL QS or his authorized representative (Purchaser)
2 - Contractor (Prime Supplier)
3 - Sub-Vendor

3.0 General

(i) All test reports, test certificates and inspection reports shall be reviewed by Manufacturer before submitting the same for verification by Purchaser.

(ii) Chemical and mechanical tests on the material shall be performed in Laboratories approved by NPCIL.

(iii) Castings shall be taken from foundries approved by NPCIL.

(iv) Heat treatment shall be carried out in furnaces approved by NPCIL.

(v) Calibrated instruments shall be used during inspection, examination and testing.

(vi) NPCIL approved chemicals for liquid penetrant examination shall be used.

(vii) Non-destructive examinations shall be carried out by personnel qualified to Level – II of ISNT or ASNT.

(viii) Electrodes / filler wire shall be of brand approved by NPCIL. Batch testing of electrodes is required, if specified in the applicable specification.

(ix) Sampling Plan

Wherever quantum of check is indicated as sampling, it should be done generally in accordance with Double Sampling Plan of IS : 2500, Part-I, AQL:

1% Normal Level – II of Inspection. If 100% witness of test is carried out by 'Prime Supplier', Purchaser may witness on sample basis. Any deviation to this has to be specifically mentioned in the remarks column of QAP.

(x) QA Requirements

Quality Assurance requirements shall be as per the guidelines given in Section – C-1.

4.0 **Notes**

a. Co-related original material test certificate is acceptable. In absence of co-related original material test certificates, sample per lot (lot means, all material having same heat mark / material specification requirements) for chemical and physical test shall be drawn and witnessed by PC Contractor Q.S. Chemical and Physical Test shall be carried out in NPCIL approved labs only and PC Contractor QS shall witness physical tests. PC Contractor Q.S. shall submit all material verification reports and test reports as per material specification to NPCIL, QS for checking / verification and clearance. Customer Hold Point is only review and clearance. Stamping of raw material and stamp transfer shall be done by PC Contractor QS. NPCIL, QS, however reserves the right to physically verify such activities by surprise visits and by retesting the material at NPCIL's cost. In case the test results are not in line with TC submitted / material specification the cost will have to be borne by the PC Contractor.

b. Welding procedure and welder performance qualification shall be witnessed by PC Contractor QS and report along with test results shall be submitted to NPCIL, QS for review, NPCIL, QS shall witness welder procedure cum performance qualification on atleast one welder of each PC Contractor / Sub-Vendor based on each approved welding procedure specification. If the sample of procedure cum performance qualification witnessed by NPCIL, QS fails to meet the requirements specified for procedure and welder qualification, then re-qualification of all welders in the PC Contractor / Sub-Vendor will be carried out in presence of NPCIL, QS.

c. Random check of LPE on final pass of weld joints by NPCIL, QS – This is "Witness Point". LPE other than welds, NPCIL, QS will witness on 100% basis if no sample size is mentioned in the QAP.

C-2.5.14 ESSENTIAL SPARES

Horizontal Pump

Following Essential Spare parts shall be furnished by the supplier for each type of pumps and drives. The supplier may also recommend spare parts, other than listed below, if necessary. Supplier shall furnish and separately quote with item wise unit rates for the following spare parts separately.

For each type of Horizontal Pump of each water system

- Impeller (1No)
- Shaft sleeves (2 Sets)
- Shaft with keys and circlips (1 No.)
- Coupling (1 Set)
- Casing wearing rings (2 Sets)
- Mechanical Seal (as applicable) - 2 sets of full assemblies.
- Stuffing box packing (as applicable) (2 Sets)
- Gaskets (12 Nos.)
- Bearings (2 Sets each type)
- Impeller wear ring (as applicable) – 2 Sets
- RTD / Temperature Gauge (2 Nos.)
- Impeller Nut (1 No.)
- 1 spare motor for ACW pump

For each type of Pump Motor of each water system

Motor spares as per PC-E-501, PC-E-502 and PC-E-503 as applicable

Plate Heat Exchangers

a) 5% of the total no. of heat transfer plates supplied in all heat exchangers of one unit. These shall include four sets of end plates and sealing plates.
b) One set of additional gaskets as spares for all plates joint of one heat exchanger.
c) 25% of total number of port rings.

Hot water (SGBD) driven VAM Chiller

a)	Temperature Sensor (insertion type)	nos.	2
b)	Pressure Transmitter	nos.	2
c)	Differential Pressure Switch	nos.	2
d)	Pressure Switch	nos.	1
e)	Hot water Control valve	nos.	2
f)	Cooling water control valve	nos.	1
g)	Valves (Angle/Diaphragm/Ball/ Needle/Non return etc) used in internal piping of machine	nos.	2 nos. of each type and each size
h)	Refrigerant and Solution Circulation Pump	nos.	1 no. each type
i)	Absorber Liquid level sensors	nos.	3
j)	Sight Glass	nos.	1 nos of each size
k)	Microprocessor Card Digital/Analog Input /output cards	nos.	2 nos. of each type
l)	Power Supply	nos.	1
m)	CPU	nos.	1
n)	RTD card	nos.	2
o)	Temperature Sensor (pad type)	nos.	2
p)	Solenoid valve	nos.	1 of each type
q)	Service valve (internal threaded)	nos.	4
r)	Service valve (external threaded)	nos.	2

s)	Damper valve	nos.	2
t)	Special tools and tackles kit (consisting of sampling cylinder, hydrometer, thermometer, spanner etc	nos.	1
u)	Vacuum pump oil (10 liters)	nos.	1
v)	Any other specific spare in manufacturers judgment necessary for smooth functioning of the chiller		Provide list & include in the mandatory requirement.

Valves

(i) ***Butterfly Valves :***

a) Disc seal	:	1 set for each valve.
b) Flange gasket	:	1 set for each valve
c) Seat/seal clamping bots	:	10% of total number required
d) "O" rings seals /or packing	:	1 set for each valve
e) Shear pins	:	1 set for each valve

*** "Set" refers to the total number of the "O" rings/ packing for each valve (e.g. if one valve has four "O" ring seals, one set refers to four "O" ring seals).*

(ii) Other Valves

10% of quantity, (but not less than one) in the scope for each type, size & material

Expansion Joints

Following essential spares shall be supplied along with the main equipment.

Control unit: One (1) set, consisting of stretcher bolt, nuts, steel washer for each expansion joint.

Instruments : 10% (but not less than one) in the scope for each type, size & material

Fasteners : 10% of quantity in the scope for each type, size & material (Fasteners shall include lock washers and lock nuts.)

For all other general technical requirements, refer Section - C1 of this specification.

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SPECIFICATION NO. : PC-E-549

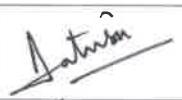
TECHNICAL SPECIFICATION

FOR

CEMENT MORTAR LINED & COATED LARGE DIAMETER CARBON STEEL PIPING DESIGN, FABRICATION, ERECTION AND TESTING

REF USI: 71200

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1.0 SCOPE

This specification covers the technical requirements for materials, design, fabrication, inspection & testing, painting, cement mortar lining and coating, excavation & back filling, handling and erection at site and final hydro testing over to Purchaser for large diameter cement mortar lined & coated piping of Atomic Power Project.

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3.0 APPLICABLE CODES AND SPECIFICATIONS

For Applicable Specifications, Codes and Standards – Refer following Applicable Specification Sheets / Drawings:

Piping Material Specification (PMS) and this will be enclosed with Tender.

Unless otherwise specified herein, the design, materials and workmanship shall conform to the latest edition as on bid due date of the following standards and codes or other approved equivalents as applicable.

3.1 Materials Specifications

Mechanical :-

IS : 2002 Gr.2 - Steel Plates for Pressure Vessels for Intermediate & High Temperature Service Including Boilers.

IS : 2062 - Structural steel (Fusion welding quality- To be used for Support structure only)

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

IS : 814 - Specification for covered electrodes.

IS : 1363 &1364 - Black hexagonal bolts, nuts & lock nuts and black hexagonal screws (Size Range M5 to M64)

IS : 3589 - Steel pipes for water and sewage.

IS : 1352 - Specification for rolling & cutting tolerance for hot rolled steel products.

Civil :-

IS : 432 - Steel wire for concrete reinforcement.

IS : 383 - Specification for coarse and fine aggregates from natural sources for concrete.

IS : 12330 - Sulphate resisting Portland cement.

IS : 8041 - Specification for Rapid hardening Portland cement.

IS : 1786 - High strength deformed steel bars and wires for concrete reinforcement

3.2 Specification for Codes of Practice

Civil :-

IS : 456 - Code of practice for plain & reinforced concrete.

IS : 3764 - Safety code for excavation work.

IS : 2720 - Methods of test for soils.

IS : 516 - Method of test for strength of concrete.

IS : 4082 - Recommendations on stacking and storage of construction materials and components at site.

AWWA Standard C – 205 - Cement mortar lining & coating system.

AWWA Standard C – 602 - Cement mortar lining of water pipelines in place.

Mechanical :-

IS : 1916 - Steel cylinder pipes with concrete lining & coating.

IS : 1730 - Steel plates, sheets, strips and flats for structural and general engineering purposes – dimensions.

IS : 5822 - Code of practice for laying of electrically welded steel pipes for water supply.

IS : 800 - Code of practice for use of structural steel in general building construction.

IS : 919 - Recommendations for limits and fits for engineering.

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

IS : 4353 - Submerged Arc Welding of Mild Steel and Low Alloy Steels-Recommendations.

IS : 7322 - The permissible tolerances for specials for diameter, arm length and angular deviation.

IS : 1566 - Recommendations Specification for Hard-drawn Steel Wire Fabric for Concrete Reinforcement.

AWWA Standard C – 200 - Steel water pipe.

AWWA Standard C - 206 - Field welding of steel water pipe.

AWWA Standard C – 207 - Steel pipe flanges.

AWWA Standard C – 208 - Dimensions for steel pipe fittings.

AWWA Manual M 11 - Steel pipe - Guide for design and installation.

ASME Sections - V, VIII DIV-I and IX - Boiler and Pressure Vessel Code.

3.3 Applicable NPCIL Specifications:

PC-P-285 - Technical specification for field welding of piping for nuclear power plants.

PC-P-344 - Technical specification for fabrication & erection of piping for nuclear power plants.

PC-P-345 - Technical specification for cleaning methods of piping in nuclear power plants.

In the event of conflicting requirements, between specifications or the drawings, the governing requirements shall be at the discretion of the Purchaser.

4.0 MATERIALS & WORKMANSHIP

All material required for fabrication of pipes & specials and fittings shall be as per PMS or as specified in data sheet (Annexure –A of this specification).

All steel used for pipe & specials shall be as per IS: 2002 Gr.2 and have a 255 MPa minimum yield strength unless otherwise directed by purchaser.

All material i.e. consumable and non consumable material required for fabrication, handling, excavation, erection, testing and inspection etc. shall be arranged by the Contractor.

Raw Material Inspection & Testing

1. Chemical test Certificate for steel plate material.

2. All steel used in fabricating pipe which exceeds 1/2-inch in thickness shall be tested for notch toughness using the Charpy V-Notch test.

3. Tensile tests as per IS: 1608.

5.0 DESIGN OF PIPES & SPECIALS

All information about design pressure, temperature & different type of loads to be considered for the design of piping shall be as per PMS or as specified in data sheet (Annexure –A of this specification).

The pipe shall be designed & manufactured according to applicable requirements of AWWA C200 and AWWA M11 except as hereinafter modified.

Specials shall be designed per AWWA M11 and as a minimum shall conform to the pressure rating, grade of steel and cylinder thickness of the adjoining standard pipe sections. Fitting dimensions shall conform to AWWA C208 and PMS. Reinforcing collars, wrappers, crotch plates, and anchor rings shall be designed and fabricated per AWWA M11.

Pipe installed on saddle supports shall be designed to limit the longitudinal bending stress to a maximum of 17,000 psi. Design shall be in accordance with the provisions of Chapter 7 of AWWA M-11.

Reinforcement for wyes, tees, outlets, and nozzles shall be designed in accordance with AWWA Manual M-11.

6.0 FABRICATION REQUIREMENT

6.1 A pipe special is any piece of pipe other than a normal length of straight pipe. This includes, but is not limited to, elbows, miters, short pieces; reducers, tees,

crosses, tangential Nozzles, Wyes ,spools, sections with outlets, beveled sections and manholes.

6.2 The term 'diameter of pipe' as used in this specification means the net inside diameter of mortar lining.

6.3 The steel pipes shall be formed by shaping and welding together steel plates of specified thickness. Plate size should be selected in such way that minimum welds are required to fabricate the required pipe spool, special or fittings. All pipes, specials & fittings shall be fabricated as per PMS or approved drawings.

6.4 Minimum thickness for pipe & specials shall be as per PMS or tender specifications. Fitting dimensions shall conform to AWWA C208.

6.5 The piping shall be of welded construction. All welds shall be continuous single V with backup strip / double V butt full penetration type. For welding joints preferably submerged metal arc welding (SMAW) process shall be used.WPS of the welding procedure used shall be submitted to Purchaser for approval.

6.6 The pipe spool length for erection shall be selected depending on the handling facility available at site.

6.7 Pipes and fittings shall be furnished with bevel ends to enable butt welding at site.

6.8 Pipe specials, fittings shall be as per PMS. For greater than 3000 mm NB specials and fitting design calculation as per ASME Section VIII Div-I and detail fabrication drawing along with QAP shall be furnished for Purchasers approval.

6.9 Flanges greater than 1200 mm NB can be made from single plate or cast as indicated in PMS.

6.10 Temporary internal bracing shall be installed in all the pipes prior to shipment to job site and field to control the deformation within permissible limits.

6.11 Edge Protection on all pipes & specials shall be provided and maintain it until the pipe is ready to be installed in the trench.

6.12 For hydro testing of ≥3000 mm line to reduce the blind flange loads special arrangement like special attachment having reducer with terminal end diameter of 1000 mm with blind flange or end cap or any other method selected by Contractor subject to Purchaser approval.

7.0 WELDING

7.1 The welding procedure and Welder's qualification shall be as per PC-P-285 and ASME Section -IX. The procedure of welding and electrodes to be used shall be approved by the Purchaser before commencing qualification/fabrication.

7.2 All electrodes shall be selected to match the mechanical and chemical properties of the parent material. The welding rods shall be as per PC-P-285 or AWS-E-7018 and shall be subjected to Purchaser's approval.

7.3 The edge preparation and fit-up of weld joints shall be as indicated in the approved drawing. However, in case of conflicting requirement between the specification and the drawings the governing requirements shall be at the discretion of the Purchaser.

7.4 The pipe circumferential welds shall be done in such a way that the longitudinal welds are staggered in any two consecutive sections.

8.0 INSPECTION AND TESTING OF STEEL PIPES

All the work and fabrication being carried out shall be subjected to inspection and testing as per approved QAP generally in line with the following;

8.1 Fit-Up Checking

Inspection of the fit-up for both longitudinal and circumferential welding shall be carried out before the welding in order to ensure its proper alignment. Tack welds shall be used to hold the edges in position during the fit-up operation.

8.2 Check of Diameter

Once the fit up check is over and found satisfactory, the diameter of the pipe shall be measured and checked with the requirement.

8.3 Check on Weld Joints

Pipe spool pieces (straight) , specials which are being subjected to hydro test prior to cement mortar lining and coating weld joint inspection shall be as indicated in table-1 .

Table-1

Type Of Welds							
Butt Welds		Nozzle Welds		Seal Welds		Socket Weld/ Slip on Flanges Joints	
Root Pass	Completed Weld	Root Pass	Completed Weld	First Pass	Final Pass	First Pass	Final Pass
V+ S1	V+ S2	V+ S1	V+ S2	V	V	V	V+ S1

V = 100% Visual Examination.

S1 = 10% Supplementary Examination it may be Liquid Penetration or Magnetic Particle.

S2 = 10% Supplementary Examination it may be Ultrasonic or Radiographic.

Pipe spool pieces (straight) , specials ,butt weld , nozzle weld joints and terminal point tie-up joints which are not subjected to hydro test prior to cement mortar lining and coating, on these joints 100 % radiography inspection at completed weld joint shall be carry out apart from visual inspection.

8.4 Visual Examination

Visual Examination method shall extend to cover atleast the following steps

(a) Base metal identification, punching details.

(b) Base metal defects, if any such as surface irregularities, cracks or lamination or surface corrosion.

(c) Edge preparation.

(d) fit-up, Joints

(e) Tacking

(f) Root pass & subsequent pass appearances

(g) Cleaning between passes

(h) Appearance of completed welds, their conforming to drawings and method of examination.

(i) Condition of base metal in the area adjoining the weldments.

(j) Excessive or unexpected distortion due to welding.

(k) Cleanliness of pipes, cement mortar lining & coating surface finish.

8.5 Procedure and Acceptance Standards for Non Destructive Tests (NDT)

All the NDTs shall be carried out as per ASME Boiler and pressure vessel code Section V and VIII division I.

Acceptance standard shall be as per ASME Section VIII division I mandatory Appendix as given below.

a. Radiography Test - Appendix- 4

b. Magnetic particle test - Appendix- 6

c. Liquid Penetrant Test - Appendix- 8

d. Ultrasonic test - Appendix- 12

8.6 Dimensional Checks

On the completion of welding, the pipe shall be checked for diameter, length, wall thickness, straightness and out of roundness and the same shall be within acceptable limits. Tolerances for fabrication of pipes and fittings are as follows.

a. The tolerances on the outside diameter of the pipe shall be within ± 2.5 mm from nominal dimension (as calculated by measurement of the outside circumference).

b. Finished pipe sections shall be truly straight with wall parallel to the axis of the pipe and not to be out of alignment by more than 5mm for every 3m of length.

c. Out of roundness: The difference between maximum and minimum diameter shall not exceed 5 mm.

d. All angular dimensions of bends shall be maintained within ± 1/16 degree.

e. Reinforcement pads for structural attachment shall be accurately shaped so that no gap greater than 1.5 mm measured before welding shall exist between periphery of pad and pipe to which it fits.

f. The tolerance for edge preparation and fit-up of weld joints shall be as per Clause 7.3.

8.7 Hydro testing

Hydro test can be done by two ways as per Contractor's convenient depending upon feasibility.

1. Fabricate all pipe spools, specials & fittings without lining and coating, erect all piping and then do final field hydro test. After this hydro test total lining and coating of piping shall be done. Hydro test pressure shall be as per PMS. Field hydro test shall be done as follow.

   a. Before hydro testing the pipe lines shall be cleaned to make it free from dirt, loose scale, debris or other loose foreign material.

   b. Notwithstanding the satisfactory completion of the hydraulic test, if there is any discernible leakage of water from any pipe or joint, replace the pipe, repair the pipe or re-make the joint and repeat the hydraulic test.

   c. After hydro testing dewatering and drying of complete is carried out.

2. If above said hydro test is not possible then each pipe spool, specials and fittings shall be hydro tested in the shop before the lining and coating. After the erection of lined and coated pipe spools and specials in the field to check field weld joint final hydro test shall be carried out terminal point to terminal point following the procedure indicated in above paragraph. Please note that hydro test shall be carried out before field joint lining and coating.

   Shop hydro test shall be done as follow.

   a. Each pipe spool and specials shall be subjected to hydrotest before cement mortar lining and coating of pipe. Hydrotest pressure shall be AS per PMS.

   b. Length of the pipe spool / specials to be tested shall be capped or blanked off at each end and securely strutted or restrained to withstand the forces which will be exerted when the test pressure is applied. Accepted spools will be stamped and released for further processing.

3. Performance of hydrostatic testing is included in Contractor's scope of work. The supply lines for water filling and the pressuring water pump shall be arranged by the contractor. The contractor shall provide fit up and temporary closures used for hydro testing as per approved procedures.

4. Steel pipe shall be kept under pressure by pumping water for a period not less than 10 minutes and while under pressure; pipe shall be moderately hammered with a 1 kg hammer throughout its length. The steel pipe shall withstand the test pressure without showing leakage. Pipes which show leakage may be rewelded at the point of leakage and subjected to a repeat hydro test and may be accepted if it does not show any leakage. After hydro test, water from pipe will be drained and pipe shall be dried by suitable means.

9.0 CLEANING AND PAINTING

9.1 Cleaning

The surfaces (both inside and outside) of pipe shall be thoroughly cleaned i.e. loose rust, loose mill scale, dirt, debris, oil grease and other deleterious material shall be removed by manual, mechanical or chemical means. If chemicals deleterious to steel or cement are used to clean the steel surface, such chemicals shall be removed at the completion of cleaning process.

9.2 Painting

After the shop lining & coating is over, unlined & uncoated portion (250 mm on each side of pipe or specials) shall be painted with pillable paint which shall be removed prior to field wielding. If there is gap of long duration between field lining & coating and time of field welding, then suitable arrangement should be made so that pipe ends will not get corroded.

10.0 CEMENT MORTAR LINING & COATING

Work of cement mortar linings and coatings can be done at shop on pipe spools pieces and specials as per AWWA C205 and lining and coating of field joints to be carry out as per AWWA C 602 (manual) after hydro test of total system pipe line

Work of cement mortar linings and coatings can be done on total system pipe line at field as per AWWA C 602 (mechanized method) after hydro test of total system pipe line

10.1 Materials required for cement mortar linings and coatings

1. Reinforcement - All reinforcement material used in the pipe shall conform to 1S: 432 (Part 1 - 1982) or IS: 432 (Part 2 -1982).

2. Cement - Cement used in mortar lining and coating shall be sulphate resistant portland cement conforming to IS: 12330 or ordinary portland cement- 33 grade conforming to IS: 269 as per Purchaser requirement. Cement shall be free of lumps.

3. Aggregates - The aggregates used shall conform to IS 383 : 1970 grading zone III. Sand shall consist of inert granular material and the grain shall be strong, durable and uncoated. Sand shall be clean and free from injurious amount of dust, clay, flaky particles, oil, alkali, mica and other deleterious substances. The maximum size of aggregate shall be one-third the thickness of concrete covering the steel cylinder either outside or inside.

4. Water -Water used for cement mortar mixing and curing shall be clean and free from injurious ingredients or organic matter, alkali, oil, acid, salt, sugar or other impurities and shall confirm to IS: 456. Salt water shall not be used for mixing under any circumstances.

10.2 Thickness & Cover

The minimum thickness of lining and coating shall be as per PMS ensuring the sufficient cover over the reinforcement.

10.3 Application of Reinforcement

1. The reinforcement shall be wire fabric and applied to the interior pipes, specials & fittings before lining and exterior at the time of coating.

2. Reinforcement for lining 2.5 mm dia. wire @ 25 c/c and for coating 5 mm dia. wire @ 50 c/c. Reinforcement wire mesh size shall be conforming to IS: 1566 and wire to IS: 432. The mesh sheets shall overlap each other by a minimum of 100 mm and be tied with mild steel wire at 200 mm intervals. The

reinforcement shall be held off the pipe wall by a series of equally spaced (500 mm c/c distance) 6 mm dia. reinforcement bars (which shall run the full length of the lining and coating.

3. Reinforcement shall be placed in pipe in such a way as to cover the whole pipe length or section to be lined. The reinforcement shall terminate at a distance of approx. 100 mm from the ends. The reinforcement then shall be suitably tack welded.

4. For field cement mortar lining & coating of erected piping, reinforcement in the form of strip approx. 400 mm wide shall be placed and tack welded. There shall be an overlap of minimum 50 mm between two reinforcement sections.

5. The wire reinforcement may be given a tension of 50 to 75 Mpa while wrapping on the pipe before the coating is applied.

10.4 Mixing of Concrete or Mortar

1. The concrete or mortar for lining and coating shall be mixed in mechanical mixers. Mixing shall be continued until there is a uniform distribution of the materials and the mass is uniform in color and consistency to obtain a dense, homologous lining and coating that shall adhere firmly to the pipe surface. Water and cement ratio by mass shall not exceed 0.3:1.

2. The lining shall be applied in one course for the pipe section. So it is expected that batching plants shall produce minimum capacity of mortar required for complete lining of a maximum size pipe spool or specials.

3. Prior to the application of the cement lining the manufacturer shall perform procedure tests and qualify a working procedure to demonstrate that he is able to produce a lining system in accordance with design requirements. The constituents, mortar & finished pipe shall be tested. To establish the correct combination of cement, sand & water, minimum of five samples shall be prepared. For each mix following shall be accurately checked and recorded:

   For individual constituents
   - Cement / admixture ,
   - Sand
   - Water
   - Proportions & weight of respective materials.

   For cement mortar test specimen
   - Density
   - Compressive Strength
   - Water absorption

4. Test blocks of this material when subjected to testing as per IS 6441/IS 4031 shall exhibit compressive strength of not less than 300 kg/sq. cm. after 28 days

of curing or 170 Kg/cm^2 of 7 days of curing and the density of cured lining shall be less than 2150 kg/cu.m . Water absorption shall not exceed 10 % for the test specimen. Based on the test results a procedure shall be standardized for mixing of the materials. Inspection personnel shall witness the mixing of materials and sample preparations for procedure qualification. Test result shall be correlated with sample number and a standard procedure shall be evolved.

5. Final designed proportions shall be maintained during subsequent concrete batching by means of weigh batchers capable of controlling the weights within one percent of the desired value.

10.5 Shop Cement mortar lining and coating

10.5.1 Shop Cement mortar lining and curing

1. At the time of application of the concrete or mortar, the pipe surface shall be thoroughly cleaned.

2. The lining shall be applied in one course for the pipe section. No unfinished surface shall remain exposed for more than 20 minutes.

3. Mortar shall be handled so as to avoid any kind of segregation and excessive moisture loss. Prior to mortar filling cement slurry may be applied on the surface.

4. During mortar application pipes should be at ambient temperature. If pipe is hot due to such reasons as lying in the hot sun, then the pipe must be cooled with the help of wet gunny bags prior to application of mortar.

5. Approx. 250 mm length on either side of the spools shall be left unlined for field welds and shall be lined after field welds are completed and hydro tested.

6. The lining thickness shall be 25 mm with a negative tolerance of 1 mm and with a positive tolerance of 3 mm.

7. Thickness of lining shall be ascertained frequently during placing of mortar and trowelling using an approved non-destructive method.

8. Straight section of pipe shall be lined by using spinning method or centrifugal lining or a method known to provide equivalent results such as by a machine travelling through the pipe and distributing the freshly mixed mortar at high velocity and uniformly along the full section and long radius bends of the pipe. The mortar must be densely packed shall adhere to the pipe wherever applied.

9. The trowel attachment, the rate of travel of machine and the rate of discharge of mortar shall be such that the pressure applied to the lining will

be uniform and produce a lining of uniform thickness with a smooth and even finished surface throughout.

10. The lining machine shall be provided with attachment for mechanically trowelling the mortar. Both the application and trowelling of the mortar shall take place at the rear of the machine so that the freshly placed and trowelled mortar will not be damaged.

11. Cement mortar lining of bends, specials, areas closely adjacent to valves and other such places where machine placing may not be practical shall be performed by hand with same standard as straight pipe.

12. The seal coat as pore sealer shall be applied to the surface of lining with the prior approval of engineer-in-charge. The seal coat shall be continuous and shall adhere to the mortar lining at all points. The seal coat after drying for at least 48 hours shall have no harmful effect to the quality of the water or on the lining.

13. Lining shall be free of any sharp corners and edges and must be suitably contoured / rounded prior to curing.

14. For the lining at the joints of two pipes at field, reinforcement shall be applied as per 10.3.1 above. Old lining shall be suitably hacked to make it rough before filling mortar.

15. Cement mortar lining curing

    After lining, the pipe shall be marked with the date of lining and shall be cured either by misting curing as per AWWA C-205.Moist curing shall starts after 24 hours of completion of cement lining and shall be done by continuous wetting or pounding. Under no circumstances the lining shall be allowed to dry during curing period. Open ends of pipes shall be suitably closed so as to maintain a moist atmosphere and prevent draught Curing shall be carried out for minimum period of 14 days.

10.5.2 Cement Coating and curing

1. Coating shall not commence before the expiry of three days after the completion of the lining unless otherwise it is established that the lining has attained a works cube strength of not less than 10 MPa earlier than this period. During this entire period the lining shall be under curing. The coating shall be applied under pressure by rotary brushes or guniting.

2. Approx 250 mm length on either side of the spools shall be left uncoated for field welds and shall be coated after field welds are completed and hydro tested.

3. All deposits of loose sand shall be removed prior to placing any layer of gunite. Gunite shall be shot in one coat to the specified thickness.

4. Every precaution shall be taken to prevent the formation of sand pockets and if any develop, they shall be cut out and replaced with satisfactory machine placed material. No hand patching will be allowed. The Contractor shall apply the coating in such a manner that no sloughing shall occur at any time during or following its application.

5. Gunite shall be placed in the top and sides of the pipe, then screeded to a uniform thickness and the ground lines or blocks removed.

6. All rebound and waste materials shall then be removed by air blowing and gunite placed in the bottom of the fittings and screeded. When completed, the coating shall be concentric with the barrel of an even thickness. The entire surface shall then receive a final flash coat of gunite and shall be steel towelled to a true surface equal in smoothness to the spun lining in such a manner not to impair the bond between mortar and steel plate. The guniting and surface finishing shall complete in set and shall be applied continuously without the use of construction joints. In case, for any reason whatsoever, the cement does not adhere to the walls of pipes and sloughs off, swabbing the pipe with cement slurry shall not be permitted.

7. If for any reason it is necessary to interrupt the placing of the gunite for a length of time that will result in the material taking a permanent set, a square shoulder shall be formed at the ends of the sections and/or elsewhere by shooting against a back or by working with a trowel or other suitable tools the irregular edges of the material last placed to a clean unbroken surface face perpendicular to the pipe that will provide a suitable connection or construction joint between such material and the material to be placed subsequently. When performing this work, care shall be taken not to shatter or disturb the material remaining in place or disturb the embedded wire mesh. Before placing fresh material against the surface of such joints, they shall be carefully cleaned and wetted to ensure a good bond between the fresh material and that previously applied.

8. <u>Coating curing</u>

   After the mortar has set, but not later than twelve (12) hours after application of the coating, curing shall be commenced. Coating shall be kept continuously moist by any suitable means such as immersion in water, covering by wet gunny bags or by mechanical sprinklers for a period of not less than 14 days.

10.6 Field Cement Mortar Lining & Coating on field joint of lined and coated pipe spools and specials

1. Field cement lining and coating shall be done as per AWWA C-602 (manual method) standard at field welded area (area which is not lined and coated at shop) after the inspection and testing and also hydro test.
2. Reinforcement shall be applied as per clause no.10.3.4 of this specification.
3. Complete the interior mortar joints by the trowel method. Finish the surface with a steel trowel to a smooth finish and equal thickness to match the adjoining pipe mortar.
4. The coating with reinforcement shall be applied at the joints under pressure by rotary brushes or guniting.
5. After completion of lining and coating all piping shall be cleaned i.e. cement, aggregates will be removed by chipping.

10.7 Field Cement Mortar Lining & Coating on total piping after erection and hydro test

Work of cement mortar linings and coatings can be done on total system pipe line at field as per AWWA C 602 (mechanized method) after completion of hydro test of total system pipe line with in terminal points.

Material, thickness & cover .reinforcement, mixing of concrete or mortar shall be as indicated in clause no 10.1 to 10.4 respectively.

Lining and coating and its curing shall be followed similar to shop method and also AWWA C 602 Mechanized method.

10.8 Inspection & Testing of Lining & Coating

1. The entire procedure of applying cement-mortar lining and coating shall be subjected to continuous manual visual inspection by purchaser or their authorized representative. However, such inspection shall not relieve the contractor of the responsibility of meeting the specifications. The job shall be subjected to inspection at the following stages:
   - After surface preparation and prior to application of lining.
   - After the application of reinforcement and lining.
   - After application coating.
   - After curing.
2. Any lining not applied in accordance with this standard or as per required thickness shall be subjected to rejection and replaced / repaired at the expense of the contractor.

3. Defects in lining and coating including but not restricted to sand pockets, voids, over sanded areas, blisters, cracked and dummy areas, and thin spots shall be removed, and the area shall be repaired to the full required thickness of the mortar lining by pneumatic placement or hand application as approved by the Engineer.

4. In the stretch of pipe that has been lined and trowelled in each day's run, ten places shall be selected in straight sections of the pipe by Purchaser. In each of the ten places the thickness of the lining shall be re measured by non-destructive means such as ultrasonic thickness gauge.

5. Defective areas encompassing the full diameter of the pipe shall be replaced by machine. Defective lining rejected at the time of lining shall be removed before initial set of the mortar. Defective lining rejected after initial set shall be replaced or repaired by the most efficient practical method.

6. Hair cracks up to 0.25 mm width and not over 300 mm in length in finished linings may be considered acceptable at the discretion of the Purchaser but larger cracks shall be repaired or removed and redone all as directed by Purchaser. Trough to crest height shall not exceed 1.0 mm.

7. Test blocks for each day have 3 no. of samples and each sample shall have 3 no. of specimens as used for the lining and coating. Each shall be made in 100 mm cube moulds and subjected to cube crushing tests. Each block shall be removed from its mould as soon as practicable and cured under the conditions of temperature and humidity identical with those in which the lining of the pipe is cured. This test cube shall have properties as specified in clause 10.3.2 of this specification.

11.0 EXCAVATION, PIPING ERECTION AND BACKFILLING

All the excavation work required for laying of buried piping and backfilling for the same after laying the piping may or may not be included in the scope of the Contractor. If excavation work is not in the scope of Contractor, he may give the approximate dimensions to excavate the trenches to the Purchaser. If excavation work is in the scope of Contractor, excavation work shall be done as follow.

11.1 Excavation

11.1.1 General Requirements

1. General arrangement drawings for piping shall be studied in details.
2. Carryout the required soil investigation of excavation area as per IS: 2720 , wherever required.

3. Make detailed procedure and work plan with detailing scheme indicating sequence of operations, limits of excavation and the capacity and other details of the equipment and accessories he intends to use for excavation and dewatering for excavation of trenches.

4. All the areas upon which the construction is to be carried out and areas which are required for construction facilities are to be cleared of all rubbish and other objectionable matter. Trees, if any shall be uprooted or cut with the prior approval of the Engineer. All spoils and unserviceable materials and rubbish shall be burnt or removed from the site, useful materials, saleable timber, fire-wood etc, shall be stacked properly at the work site.

5. Boulders, stones and other materials usable in construction shall be neatly stacked as directed by the Engineer. Stacking stumps, boulders, stones etc., shall be done at specified spots with all lifts and lead so that it does not endanger the work and avoids obstructing footpaths and roads.

6. The areas to be excavated shall be clearly demarcated in the field. Excavation shall be done to lines and levels defined on drawings, and specifications. The earthwork shall include, where required, temporary sheet piling or sheeting, bracing and shoring to maintain excavations, maintenance without interruptions to service of all cables duct, banks, pipe lines etc, encountered within the area of excavation and also furnishing, erecting and maintaining of substantial barricades around excavated areas with `RED' lamps in the night for ensuring safety.

7. During construction of the works statutory Sign Boards and Warning Signs shall be provided in Local and English languages. These safety signs shall cover mandatory, prohibition, warning, emergency, fire-fighting and general notices.

8. Provide and maintain lights, guards, fencing for the safety and conveniences of those employed on the works or the public. All fencing shall be at least 1 m tall, rigid in nature and strong enough to prevent people falling into the trench.

9. The trench shall be shored, wherever necessary, and kept dry so that the workman may work therein safely, and efficiently Timber shoring shall be `Close' type. Timber shoring shall be as specified in IS 3764 – safety code for excavation work.

10. The methods of excavation shall be as per standard practices with consideration of stability and safety of the excavation, adjacent structure services and other works.
11. Trees, shrubs, any other plants, pole lines, fences, signs, monuments, buildings, pipelines, sewers and all facilities within or adjacent to the site which are not to be disturbed shall be protected from injury or damage.

12. During clearing and grubbing adequate precautions against soil erosion, water pollution shall be taken.

13. The withdrawal of the timber shall be done very carefully to prevent the collapse of the pit or trench. It shall be started at one end and preceded systematically to the other end. No part of the work should be damaged during the removal of the timber.

14. Suitable berms shall be left at the appropriate places with necessary approach ramps for installation of dewatering pumps or other purposes These shall be excavated later.

15. The excavation and the pipes are free from water at all stages of construction and shall take all necessary precautions and measures to exclude ground water and water from other sources such as underground streams, aquiforms, springs, artesians, precipitatic or infiltrations from the surface flows water drained during laying of pipes and after hydrotest so as to enable the work to proceed unhindered and be carried out in reasonably dry condition in accordance with the specifications and the construction schedule.

11.1.2 Excavation and Bed preparation process

1. Trenching work shall be carried out as per IS: 5822 for different types of soil, such as trench in earth or murum, trench in hard rock with cement concrete bedding.

2. Excavation in soil shall include in sand, clay, all solids and such other materials which can be excavated with spades without resorting to barring, wedging and/or blasting with approval of Engineer.

3. Excavation shall be carried out to such widths, lengths, depths and profiles so that pipes & fittings may be laid to the required alignment and at required depth etc, as may be specified by the Engineer.

4. Rough excavation shall be carried out to depth 250 mm, above the final level. The balance shall be excavated with special care, soft pockets shall be removed even below the final level and extra excavation filled up as directed by the Engineer.

5. The width of the trench shall be kept to a minimum consistent with the working space required. At the bottom between the faces, it shall be such as to provide not less than 200 mm clearance on either side of the pipe.

6. When welding is to be carried out with the pipe in the trench, additional excavation of not more than 1000 mm in depth and 1500 mm in length should be provided all round the pipe at the position of the joints for facilities of welding.

7. The trenches will be excavated up to a depth of 250 mm below the bottom the pipeline. Provide a layer of "well densified fine material free of stones and rubbles "up to a depth of 150 mm from bottom of the trench. Over this will be a 100 mm thick layer of cement concrete bedding on which the pipeline will rest. The specification of the "well densified material" shall be as per 12.2 of AWWA Manual M 11 (latest edition).

8. In case of poor soil conditions, separate foundations, pedestals or bedding might be required to support the buried piping and shall be provided.

11.2 Piping Erection

11.2.1 General requirements

1. Make the procedures & work plan for laying of pipes, specials & fittings, field welding, inspection, testing, painting, lining and coating for approval.

2. Erection shall be done in proper sequence and in an organized manner. Work shall not interfere or cause damage to work done by himself or others.

11.2.2 Laying of Pipes, specials & fittings

1. Pipes shall be laid as per IS: 5822 and civil specification.

2. Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the work.

3. Install all pipe, specials, fittings, closure pieces, valves, supports, bolts, nuts, gaskets, jointing materials, and all other appurtenances as shown in the approved drawing and as required to provide a complete and workable installation.

4. Pipes and specials shall only be handled with appropriate spreader bar and wide nylon slings. Chains and wire rope slings shall not be used to avoid damage to cemented lined and coated pipes and specials.

5. Pipe should be lowered into the trench with tackle suitable for weight of pipes, such as well designed slings with chain blocks or mobile crane. The factory applied pipe coatings and linings should not be damaged. The pipes shall be visually inspected to check the damage to coatings and linings.
6. No pipe shall be installed where the linings or coatings show cracks that may be harmful as determined by the Purchaser. Such damaged linings and coatings shall be repaired or new undamaged pipe shall be provided.

7. Where pipes are to be laid to curves, the deflection at each joint shall not exceed one degree. For sharper curves specifically made bends shall be provided.

8. The pipe shall be lowered into the trenches such that no part of any shoring is disturbed or damaged and, if necessary, additional temporary struts may be fixed during the lowering operations. Care shall be taken to ensure that the longitudinal joints of two consecutive pipes at each circumferential joint are staggered by 90^{o}.

9. While assembling the pipes, the ends shall have to be brought close enough to leave a uniform gap minimum 1.5 mm and not exceeding 4 mm. There shall be no lateral displacement between the pipe faces to be joined.

10. If necessary, spiders from inside and tightening rings from outside or other suitable equipment shall be used to bring the two ends in perfect contact and alignment. In no case shall hammering or longitudinal slitting be permitted. Jacking may be permitted for this purpose in particular circumstances.

11. When the pipe is properly assembled firmly supported on wooden beams and wedges or by other approved means it shall be checked for correct line and level and tack welded. The tack welded circumferential joints shall then be welded fully.

12. Pipes and fittings shall be aligned and fit-up shall be done in such way that welding can be done properly. Tack welding joint may be permitted to hold the pipe in place. If the joint is to be circumferentially welded, sufficient time shall elapse to allow for an initial set of interior joint lining prior to proceeding with joint welding. Rapid-setting mortar may be used in accordance with this Section.

13. When laying is not in progress, the open end of the pipe line should be covered with temporary end closures.

14. Thrust blocks shall be provided at appropriate locations.

15. Nuts shall be tightened in an alternating "star" pattern to the manufacturer's recommended torque with a torque wrench.

16. Carry out the cleaning, disinfecting and dewatering work as a part of laying the pipes.

11.3 Backfilling

1. After laying and testing of the pipelines backfilling shall be done with fine materials, selected from the excavated material. The stipulations of AWWA manual M11 shall be generally followed.

2. Care shall be taken during backfilling, not to injure or disturb the pipes, joints or coating.
3. The filling shall be done in layers not exceeding 300mm, watered, rammed and consolidated at each stage so that 95% of the maximum dry density is achieved as per Part 7 of IS: 2720.
4. Filling to a level of 300 mm above the crown of the pipe shall be done in accordance with the requirements of the clause on bedding.
5. Filling shall be carried out simultaneously on both sides of the pipes so that unequal pressure does not occur on piping and piping will not get shifted.
6. The water contents of the soil shall be kept as near the optimum moisture content as possible. The trench shall be refilled so as to build up to the original ground level, keeping due allowance for subsequent settlement likely to take place. The surface of the refilled excavations shall be left slightly higher than the adjacent ground and maintained to a smooth even slope.
7. Smooth wheeled, vibratory, and pneumatic tyred, sheep foot or pad foot rollers, etc., of suitable size and capacity shall be used for the different types and grades of materials required to be compacted either individually or in suitable combinations.
8. If suitable material for backfilling shall be taken from already excavated material or shall be imported from the other area.
9. All surplus materials shall be carried away from the site and dumped at dumping sites in regular heaps, bunds, blankets & level so as to provide natural drainage

12.0 SHIPMENT

The supplier shall be responsible for ensuring that all edges of piping are carefully boxed and/or protected for shipment so that they will arrive at Site in a satisfactory condition. Each pipe shall be identified by a from the purchaser. No shipment shall be made unless clear instructions with shipping release are obtained from the Purchaser.

Openings of all instruments shall be plugged with suitable plastic caps to prevent the ingress of dust and moisture.

No pipes shall be dispatched unless the shipping release is issued by the Purchaser.

13. SUBMISSION OF DOCUMENTS / DRAWINGS

i. During Bidding Stage

a. Type of piping considered
b. Fabrication methodology
c. Shop testing
d. Inspection methodology
e. Lining and coating methodology
f. Proposed Welding technology
g. Site erection and in-situ inspection methodology
h. Hydrotesting methodology
i. Infrastructure and machinery required for execution
j. Fabrication area required, excavation
k. Backfilling methodology
l. QAP
m. Conceptual write-up
n. Any deviations from the specifications
o. Main package contractor to indicate whether piping job will be executed by himself or subcontractor and related experience on this.

ii. After Placement of Order and Before Execution

The Contractor shall be required to submit five sets hard copies and 2 sets of soft copies each comprising Design calculations, other documents and drawings for purchaser's approval as follows.

a. P.O. and Sub-Order copies
b. Design calculations for CMLC pipelines
c. Layout drawings
d. Detailed fabrication drawings for special pieces like mitres, tees etc
e. Fabrication methodology
f. Shop testing
g. Inspection methodology
h. Lining and coating methodology
i. Welding technology
j. Welding Procedures
k. Site erection and in-situ inspection methodology
l. Hydrotesting methods in shop or insitu
m. Infrastructure and machinery required for execution
n. Fabrication area required, excavation
o. Backfilling methodology
p. QAP

q. Detailed work schedule to meet project milestones

iii. <u>After completion of work</u>

a. Bound History dockets five sets hard copies and 2 sets of soft copies each comprising the following documents.

1. NDT Reports.
2. Stress relief Time-Temperature charts.
3. Hydrostatic Test Certificates.
4. Dimensional Reports.
5. Radiography films if any.
6. Shipping release copies.
7. All Design Concession reports if any.
8. Guarantee and Compliance Certificate.
9. As built drawings.

b. Reproducibles for each of the drawings, and drawings on magnetic media preferably on CD (5 hard and soft copies).

ANNEXURE-A

For detail of Cement Mortar Lined & Coated Large Diameter Carbon Steel Piping Data Sheet refer the PMS no. KAPP-3&4 / 71200/1/PMS

न्यूक्लियर पावर कार्पोरेशन ऑफ इंडिया लिमिटेड
(भारत सरकार का उद्यम)

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



PIPING MATERIAL SPECIFICATION (PMS) FOR DOMESTIC WATER SYSTEM FOR 700 MWe PHWR

DOCUMENT NO. : 700 MWe/71500/1/PMS

NO. OF PAGES : 5
(Including cover page)

0	1	FIELD CONSTRUCTION	A. Sinha 13/6/17			14/6	
REV	**ISSUE**	**DESCRIPTION**	**PREPARED BY**	**CHECKED BY**	**REVIEWED BY**	**APPROVED BY**	**TESS Change Order**

PREPARED BY	:	ARUNAVA SINHA	A. Sinha	13.06.17
CHECKED BY	:	C.R. KAKADE		13.06.2017
REVIEWED BY	:	H.W. PANDEY		13.06.2017
APPROVED BY	:	S.K. DATIR		14/6/2017
		NAME	SIGNATURE	DATE

File Name : 700 MWe-71500-1-PMS-R0.docx

USI	71500		
SYSTEM	DOMESTIC WATER SYSTEM		
DESIGN CODE	ANSI B 31.1	**SAFETY CLASS** (As per AERB SG-D1)	NINS
DESIGN CODE *(for modeling)*	ASME SECTION III NC	**SEISMIC CATEGORY** (As per AERB SG-D1)	CATEGORY-3 (CODAL)
SERVICE FLUID:	FILTERED WATER		

DESIGN PARAMETERS		**TEST PRESSURE (kg/cm^2 (g))**		**SPECIFICATIONS**	
DESIGN TEMPERATURE (^0C)	50	**AIR HOLD**	NA	**FABRICATION, ERECTION, CLEANING & TESTING REQUIREMENTS**	PC-P-344, PC-P-345, PC-P-285
		HYDROSTATIC	15 *(Pumped Lines)* 10 *(Gravity Lines from Overhead Tank to distribution points)*		
DESIGN PRESSURE (kg/cm^2 (g))	10 *(Pumped Lines)* 5 *(Gravity Lines from Overhead tank to distribution points)*	**PNEUMATIC**	NA	**PIPES & PIPE FITTINGS**	PC-M-599
		HELIUM LEAK	NA	**INSULATION**	Not Applicable

NOM. PIPE SIZE (DN)	15	25	50	80	100	150	200	250
SCHEDULE	40	40	40	40	40	40	40	40

PIPE TO PIPE JOINT TYPE		
LINE JOINT	≤ 50 DN	SOCKET WELDED TO ANSI B 16.11 (SEE NOTE- 1)
	≥ 80 DN	BUTT WELD AS PER ANSI B16.25

PIPE & PIPE FITTINGS – MATERIAL & DIMENSION DETAILS

ITEM		**SIZE (DN)**	**MATERIAL**		**DIMENSION STANDARD**	**REMARKS**
PIPES		≤ 50	CS	SA 53 Gr. B	ANSI B 36.10	SMLS, PLAIN ENDS
		80 - 250	CS	SA 53 Gr. B		SMLS, BW ENDS
ELBOWS		≤ 50	CS	SA 105	ANSI B 16.11, 3000#	SW END, LR/SR, SEE NOTE-8
		80 - 250	CS	SA 234 Gr. WPB	ANSI B 16.9, SCH 40	SMLS, BW ENDS, LR/SR, SEE NOTE-8
PIPE BENDS		≤ 50	CS	SAME AS PARENT PIPE	BEND RADIUS = 5D	TO BE BENT AS PER NPCIL SPECS No. PC-P-344. SEE NOTE - 2
BRANCH CONNECTION SEE TABLE-1, Page 4	**TEES**	≤ 50	CS	SA 105	ANSI B 16.11 3000#	SW ENDS
		80-250	CS	SA 234 Gr WPB	ANSI B 16.9, SCH 40	SMLS, BW ENDS
	SOCKOLET	≤ 50	CS	SA 105	MSS-SP-97, 3000#	SW ENDS
	ELBOLET LATROLET THREDOLET	≤ 50	CS	SA 105	MSS-SP-97, 3000#	NPT THREADS
	STUB-IN NOZZLES	≥ 80	CS	SAME AS PARENT PIPE	STUB-IN WITHOUT REINFORCEMENT	BW ENDS

ITEM		SIZE (DN)	MATERIAL		DIMENSION STANDARD	REMARKS
REDUCERS		80-250	CS	SA 234 Gr WPB	ANSI B 16.9, SCH 40	SMLS, BW ENDS
FLANGES		≤ 50	CS	SA 105	ANSI B 16.5, 150#	SW, RF, CONCENTRIC TYPE SERRATED FINISH
		80-250	CS	SA 105	ANSI B 16.5, 150#	SO, RF, CONCENTRIC TYPE SERRATED FINISH
WELD-NECK FLANGES		UPTO 250	CS	SA 105	ANSI B 16.36, 300#	WN, RF, CONCENTRIC TYPE SERRATED FINISH, FOR FLOW ELEMENT, SEE NOTE –10
BLIND FLANGES		≤ 250	CS	SA 105	ANSI B 16.5, 150#	RF, CONCENTRIC TYPE SERRATED FINISH
GASKETS		ALL SIZES		EPDM – DURAMETER HARDNESS SHORE – A 60± 5	ANSI B 16.21	1.6 mm THK, SEE NOTE – 11
CAPS	**SCREWED**	≤ 50	CS	SA 105	ANSI B 16.11, 3000#	NPT THREADS
	SW END	≤ 50	CS	SA 105	ANSI B 16.11, 3000#	
	BW ENDS	80-250	CS	SA 234 Gr. WPB	ANSI B 16.9	BW ENDS, THK - TO MATCH PIPE SCH
PLUGS		≤ 50	CS	SA 105	ANSI B 16.11, 3000#	SQUARE HEAD NPT THREADS
COUPLINGS	**FULL SCREWED**	≤ 50	CS	SA 105	ANSI B 16.11, 3000#	NPT THREADS, FOR INSTRUMENT CONNECTIONS
	FULL, SW ENDS	≤ 50	CS	SA 105	ANSI B 16.11, 3000#	SW ENDS, SEE NOTE – 1
	REDUCING SW ENDS	≤ 50	CS	SA 105	ANSI B 16.11, 3000#	SW ENDS
NIPPLES		≤ 50	CS	SAME AS PIPE	SAME AS PIPE, 150 mm LONG	TOE OR BOTH ENDS PLAIN, SEE NOTE – 4
BOLTS		ALL SIZES	CS	SA 193 Gr. B 7 PHOSPHATED	ANSI B 18.2.1	HEX. HEAD, SEE NOTE – 5
NUTS		ALL SIZES	CS	SA 194 Gr. 2H PHOSPHATED	ANSI B 18.2.2	HEAVY HEX. HEAD, SEE NOTE – 5
WASHER		ALL SIZES	CS	SA 515 Gr. 60 PHOSPHATED	ANSI B 18.22M	REGULAR SIZE

NOTES

1. For straight pipe joints of 50 DN and smaller bore piping, socket weld full couplings shall be used for every 6 m, if continuous length in the 3D model is more than 6 m and based on piping routing.
2. For pipe size 50 DN and below, 5D bends shall be used instead of elbows. However, in case of layout constraints, short/long radius elbow(s) can be used.
3. Reducers shall be manufactured using plate of thickness equivalent to pipe thickness by rolling. Reducers shall be manufactured using single longitudinal seam weld.
4. Pipe nipples to be made at site from pipe with plain ends, Threaded One End (TOE) or Threaded Both Ends (TBE) as per the threading detail given in ANSI B 16.31.
5. Impact test shall be required as per SEC-III ND for bolts, nuts of nominal size greater than 25 mm diameter. Phosphated bolts and nuts shall be provided.
6. Turns less than 30°, may be made through a suitable cut and single weld on piping. For turns greater than 30°, std. elbows of 45° and 90° only should be used.

7. Concentric reducers shall be used as a general practice. Eccentric reducers, wherever required, shall be provided in horizontal lines with flat face at the bottom. However, flat face shall be at the top in case of eccentric reducers provided in horizontal pump suction lines.
8. Generally LR elbow should be used to reduce the pressure drop. However, in case of layout constraints, short radius elbow(s) can be used.
9. In lieu of SA 53 Gr. B pipe material, SA 106 Gr. B pipe material is also acceptable.
10. Flow measuring orifice is to be procured as a complete assembly having weld-able flanges, gasket, nut & bolts etc.
11. For gasket, dimensional standard of flange and rating should be reflected in Bill of quantities (BOQ).
12. Material classification for 3D modeling: Use 31.1/ ND/ NC for all seamless pipes and fittings.
13. For vent connections, 15 DN pipe size shall be provided unless mentioned otherwise. Isolation valve with screwed cap to be provided.
14. Generally the drain shall be provide based on process line size as follows:

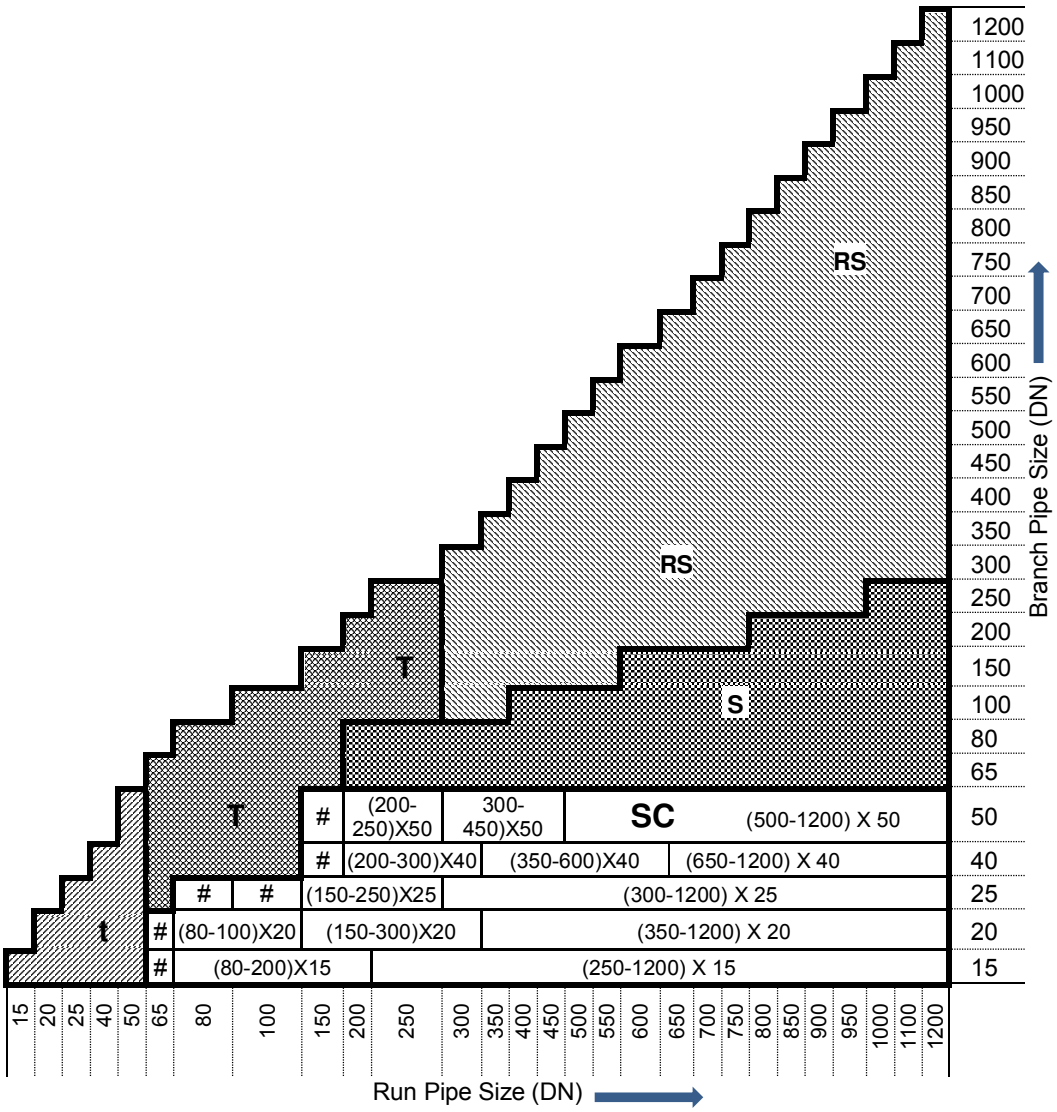
Sr.No	Main process line size, DN	Drain Line size, DN	Remarks
1	15 to 50	15	Isolation valve with Screwed cap to be provided.
2	80 to 250	25	-do-

15. Process and Instrumentation Connections

Sr.No	Instrumentation Connections	Main process line size, DN	Line size, DN	Remarks
1	Pressure gauge (PG) / Point (PP)	All sizes	15	Isolation valve with Screwed full coupling (NPT) & plug to be provided.
2	Temperature element	≤ 50	25	Line size to change to 80 DN with expander & reducer, Laterolet / Elbolet, NPT (F) to be provided opposite to flow direction.
		80 to 100		Laterolet / Elbolet, NPT (F) to be provided opposite to flow direction.
		150 to 250		Threadolet NPT (F) to be provided.
3	Flow element	All sizes	Orifice # / Venturi / Ultrasonic	Refer guideline & ISS (# - This should include mating flange, bolts, nuts, gasket, washer, Flange Material, rating, type of flange)
4	pH & Conductivity (KE) element	≥ 50	32	Threadolet NPT (F) to be provided.
5	Restriction Orifice Flange	All sizes		Refer respective data sheet

TABLE-1

BRANCH CONNECTION MATRIX



BRANCH CONNECTIONS		
t	TEE (SOCKET WELDED)	
T	TEE (BUTT WELDED)	THK TO MATCH WITH PIPE THK OR HIGHER THK
SC	SOCKOLET	UNHATCHED AREA IN THE ABOVE MATRIX
RS	STUB IN WITH REINFORCEMENT (RF) PAD	RF PAD THK SHALL HAVE SAME THK AS THAT OF THE RUN AND WIDTH EQUAL TO OUTER RADIUS OF BRANCH
S	STUB-IN WITHOUT RF PAD	

 # – Specific size is available.

न्यूक्लियर पावर कार्पोरेशन ऑफ इंडिया लिमिटेड
(भारत सरकार का उद्यम)

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

एनपीसीआईएल
NPCIL

PIPING MATERIAL SPECIFICATION (PMS) FOR NON ACTIVE DRAINAGE SYSTEM FOR 700 MWe PHWR

DOCUMENT NO. : 700 MWe/71710/1/PMS

NO. OF PAGES : 5
(Including cover page)

REV	ISSUE	DESCRIPTION	PREPARED BY	CHECKED BY	REVIEWED BY	APPROVED BY	TESS Change Order
0	1	FIELD CONSTRUCTION	A. Sinha 13/06/17			14/6	

PREPARED BY	:	ARUNAVA SINHA	A. Sinha.	13.06.17
CHECKED BY	:	C.R. KAKADE		13.06.2017
REVIEWED BY	:	H.W. PANDEY		13.6.2017
APPROVED BY	:	S.K. DATIR		14/6/2017
		NAME	SIGNATURE	DATE

File Name : 700 MWe-71710-1-PMS-R0.docx

USI	71710		
SYSTEM	NON ACTIVE DRAINAGE SYSTEM		
DESIGN CODE	ANSI B 31.1	**SAFETY CLASS** (As per AERB SG-D1)	NINS
DESIGN CODE *(for modeling)*	ASME SECTION III NC	**SEISMIC CATEGORY** (As per AERB SG-D1)	CATEGORY-3 (CODAL)
SERVICE FLUID:	NON ACTIVE DRAINAGE WATER		

DESIGN PARAMETERS		**TEST PRESSURE (kg/cm^2 (g))**		**SPECIFICATIONS**	
DESIGN TEMPERATURE (^0C)	50	**AIR HOLD**	NA	**FABRICATION, ERECTION, CLEANING & TESTING REQUIREMENTS**	PC-P-344, PC-P-345, PC-P-285
		HYDROSTATIC	7.5 *(Pumped Lines)* Fill Test *(Gravity Lines)*		
DESIGN PRESSURE (kg/cm^2 (g))	5 *(Pumped Lines)* Atmospheric *(Gravity Lines)*	**PNEUMATIC**	NA	**PIPES & PIPE FITTINGS**	PC-M-599
		HELIUM LEAK	NA	**INSULATION**	Not Applicable

NOM. PIPE SIZE (DN)	15	25	50	80	100	150	200	250
SCHEDULE	40	40	40	40	40	40	40	40

PIPE TO PIPE JOINT TYPE		
LINE JOINT	≤ 50 DN	SOCKET WELDED TO ANSI B 16.11 (SEE NOTE- 1)
	≥ 80 DN	BUTT WELD AS PER ANSI B16.25

PIPE & PIPE FITTINGS – MATERIAL & DIMENSION DETAILS

ITEM		**SIZE (DN)**	**MATERIAL**		**DIMENSION STANDARD**	**REMARKS**
PIPES		≤ 50	CS	SA 53 Gr. B	ANSI B 36.10	SMLS, PLAIN ENDS
		80 - 250	CS	SA 53 Gr. B		SMLS, BW ENDS
ELBOWS		≤ 50	CS	SA 105	ANSI B 16.11, 3000#	SW END, LR/SR SEE NOTE-8
		80 - 250	CS	SA 234 Gr. WPB	ANSI B 16.9, SCH 40	SMLS, BW ENDS, LR/SR SEE NOTE-8
PIPE BENDS		≤ 50	CS	SAME AS PARENT PIPE	BEND RADIUS = 5D	TO BE BENT AS PER NPCIL SPECS No. PC-P-344. SEE NOTE - 2
BRANCH CONNECTIONS SEE TABLE-1, Page 4	**TEES**	≤ 50	CS	SA 105	ANSI B 16.11 3000#	SW ENDS
		80 - 250	CS	SA 234 Gr WPB	ANSI B 16.9, SCH 40	SMLS, BW ENDS
	SOCKOLET	≤ 50	CS	SA 105	MSS-SP-97, 3000#	SW ENDS
	ELBOLET LATROLET THREDOLET	≤ 50	CS	SA 105	MSS-SP-97, 3000#	NPT THREADS
	STUB-IN NOZZLES	≥ 80	CS	SAME AS PARENT PIPE	STUB-IN WITHOUT REINFORCEMENT	BW ENDS
	LATERAL	≤ 50	CS	SA 105	ANSI B 16.11 3000#	SW ENDS
		80-250	CS	SA 234 Gr WPB	ANSI B 16.9, SCH 40	SMLS, BW ENDS

ITEM		SIZE (DN)	MATERIAL		DIMENSION STANDARD	REMARKS
REDUCERS		80-250	CS	SA 234 Gr WPB	ANSI B 16.9, SCH 40	SMLS, BW ENDS
FLANGES		≤ 50	CS	SA 105	ANSI B 16.5, 150#	SW, RF, CONCENTRIC TYPE SERRATED FINISH
		80-250	CS	SA 105	ANSI B 16.5, 150#	SO, RF, CONCENTRIC TYPE SERRATED FINISH
WELD-NECK FLANGES		UPTO 250	CS	SA 105	ANSI B 16.36, 300#	WN, RF, CONCENTRIC TYPE SERRATED FINISH, FOR FLOW ELEMENT, SEE NOTE – 10
BLIND FLANGES		≤ 250	CS	SA 105	ANSI B 16.5, 150#	RF, CONCENTRIC TYPE SERRATED FINISH
GASKETS		ALL SIZES	CS	EPDM – DURAMETER HARDNESS SHORE – A 60± 5	ANSI B 16.21	1.6 mm THK, SEE NOTE – 11
CAPS	**SCREWED**	≤ 50	CS	SA 105	ANSI B 16.11, 3000#	NPT THREADS
	SW END	≤ 50	CS	SA 105	ANSI B 16.11, 3000#	
	BW ENDS	80-250	CS	SA 234 Gr. WPB	ANSI B 16.9	BW Ends, THK - TO MATCH PIPE SCH
PLUGS		≤ 50	CS	SA 105	ANSI B 16.11, 3000#	SQUARE HEAD NPT THREADS
COUPLINGS	**FULL SCREWED**	≤ 50	CS	SA 105	ANSI B 16.11, 3000#	NPT THREADS, FOR INSTRUMENT CONNECTIONS
	FULL, SW ENDS	≤ 50	CS	SA 105	ANSI B 16.11, 3000#	SW ENDS, SEE NOTE-1
	REDUCING SW ENDS	≤ 50	CS	SA 105	ANSI B 16.11, 3000#	SW ENDS
NIPPLES		≤ 50	CS	SAME AS PIPE	SAME AS PIPE, 150 mm LONG	TOE OR BOTH ENDS PLANE, SEE NOTE-4
BOLTS		ALL SIZES	CS	SA 193 Gr. B 7 PHOSPHATED	ANSI B 18.2.1	HEX. HEAD, SEE NOTE – 5
NUTS		ALL SIZES	CS	SA 194 Gr. 2H PHOSPHATED	ANSI B 18.2.2	HEAVY HEX. HEAD, SEE NOTE – 5
WASHER		ALL SIZES	CS	SA 515 Gr. 60 PHOSPHATED	ANSI B 18.22M	REGULAR SIZE

NOTES

1. For straight pipe joints of 50 DN and smaller bore piping, socket weld full couplings shall be used for every 6 m, if continuous length in the 3D model is more than 6 m and based on piping routing.
2. For pipe size 50 DN and below, 5D bends shall be used instead of elbows. However, in case of layout constraints, short/long radius elbow(s) can be used.
3. Reducers shall be manufactured using plate of thickness equivalent to pipe thickness by rolling. Reducers shall be manufactured using single longitudinal seam weld.
4. Pipe nipples to be made at site from pipe with plain ends, Threaded One End (TOE) or Threaded Both Ends (TBE) as per the threading detail given in ANSI B 16.31.
5. Impact test shall be required as per SEC-III ND for bolts, nuts of nominal size greater than 25 mm diameter. Phosphated bolts and nuts shall be provided.
6. Turns less than 30°, may be made through a suitable cut and single weld on piping. For turns greater than 30°, std. elbows of 45° and 90° only should be used.

7. Concentric reducers shall be used as a general practice. Eccentric reducers, wherever required, shall be provided in horizontal lines with flat face at the bottom. However, flat face shall be at the top in case of eccentric reducers provided in horizontal pump suction lines.
8. Generally LR elbow should be used to reduce the pressure drop. However, in case of layout constraints, short radius elbow(s) can be used.
9. In lieu of SA 53 Gr. B pipe material, SA 106 Gr. B pipe material is also acceptable.
10. Flow measuring orifice is to be procured as a complete assembly having weld-able flanges, gasket, nut & bolts etc.
11. For gasket, dimensional standard of flange and rating should be reflected in Bill of quantities (BOQ).
12. Material classification for 3D modeling: Use 31.1/ ND/ NC for all seamless pipes and fittings.
13. For vent connections, 15 DN pipe size shall be provided unless mentioned otherwise. Isolation valve with screwed cap to be provided.

14. Generally the drain shall be provide based on process line size as follows:

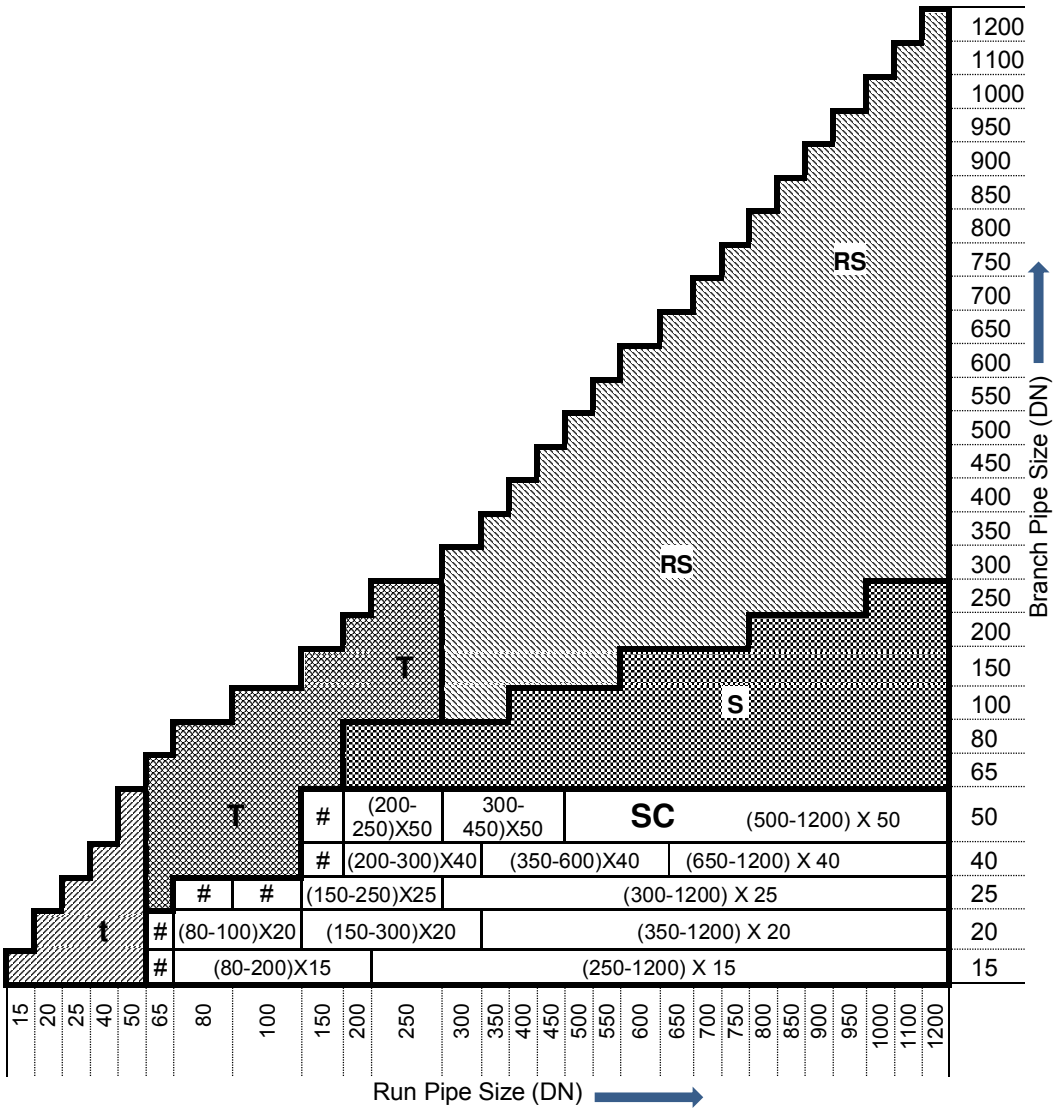
Sr.No	Main process line size, DN	Drain Line size, DN	Remarks
1	15 to 50	15	Isolation valve with Screwed cap to be provided.
2	80 to 250	25	-do-

15. Process and Instrumentation Connections

Sr.No	Instrumentation Connections	Main process line size, DN	Line size, DN	Remarks
1	Pressure gauge (PG) / Point (PP)	All sizes	15	Isolation valve with Screwed full coupling (NPT) & plug to be provided.
2	Temperature element	≤ 50	25	Line size to change to 80 DN with expander & reducer, Laterolet / Elbolet, NPT (F) to be provided opposite to flow direction.
		80 to 100		Laterolet / Elbolet, NPT (F) to be provided opposite to flow direction.
		150 to 250		Threadolet NPT (F) to be provided.
3	Flow element	All sizes	Orifice # / Venturi / Ultrasonic	Refer guideline & ISS (# - This should include mating flange, bolts, nuts, gasket, washer, Flange Material, rating, type of flange)

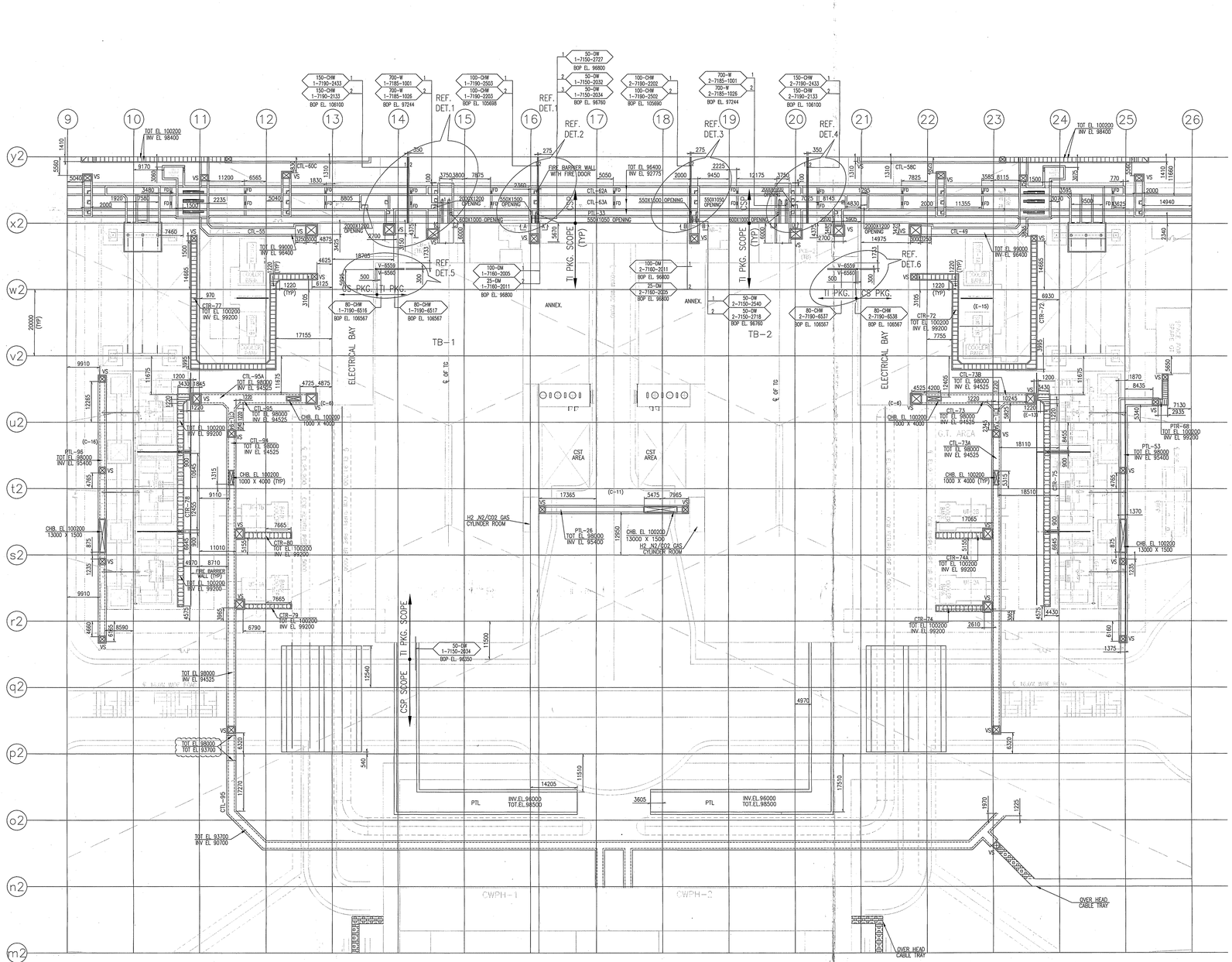
TABLE-1

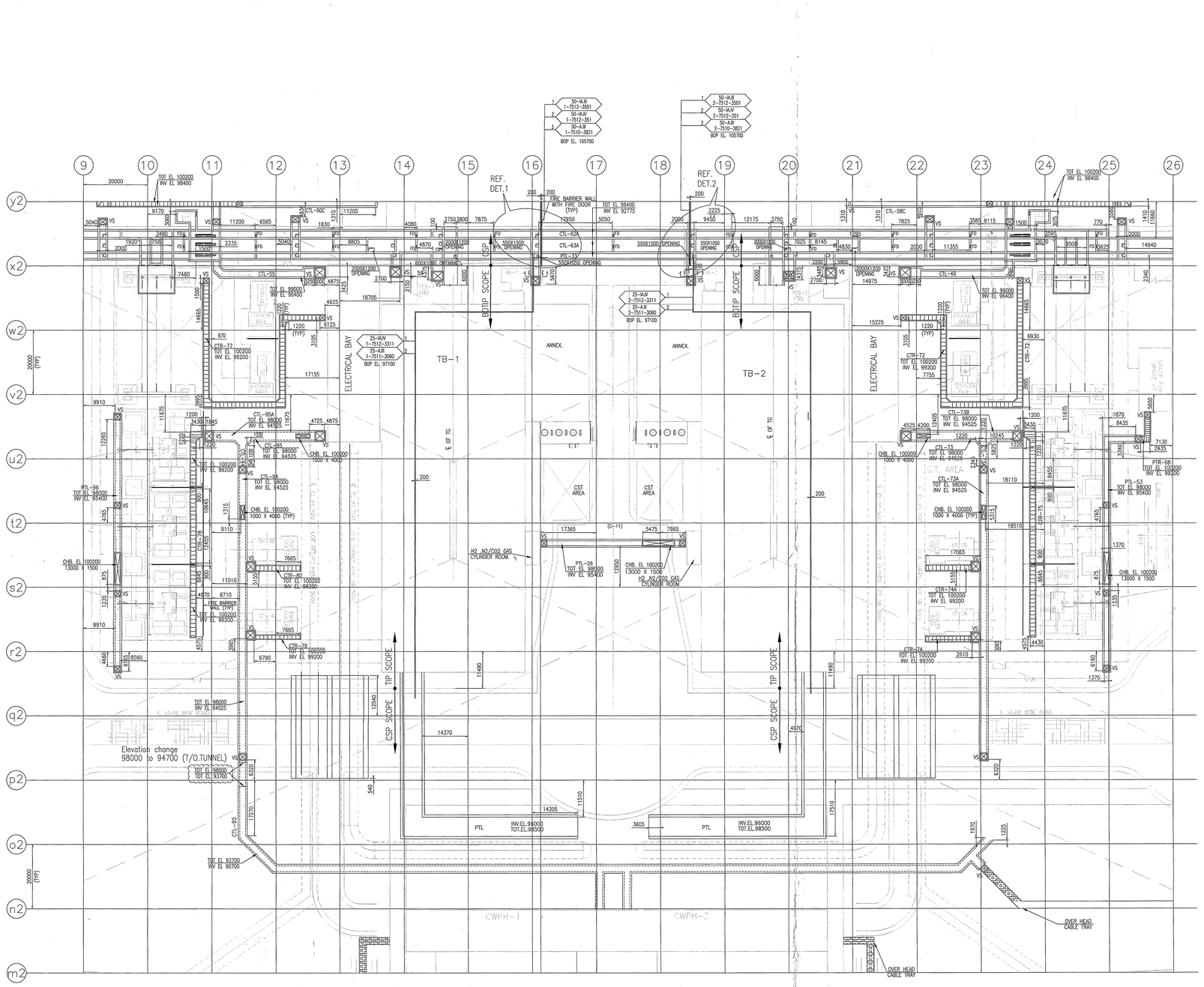
BRANCH CONNECTION MATRIX

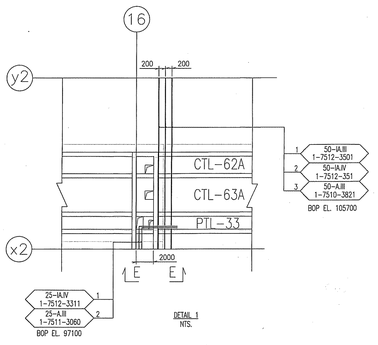


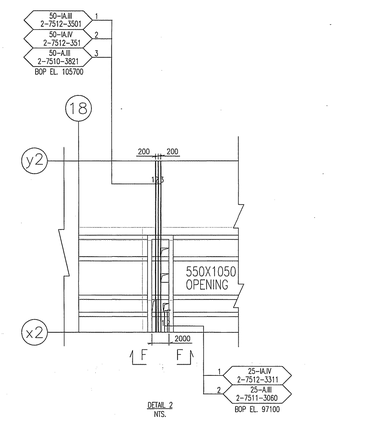
BRANCH CONNECTIONS		
t	TEE (SOCKET WELDED)	
T	TEE (BUTT WELDED)	THK TO MATCH WITH PIPE THK OR HIGHER THK
SC	SOCKOLET	UNHATCHED AREA IN THE ABOVE MATRIX
RS	STUB IN WITH REINFORCEMENT (RF) PAD	RF PAD THK SHALL HAVE SAME THK AS THAT OF THE RUN AND WIDTH EQUAL TO OUTER RADIUS OF BRANCH
S	STUB-IN WITHOUT RF PAD	

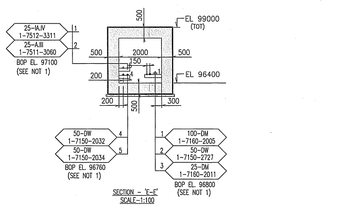
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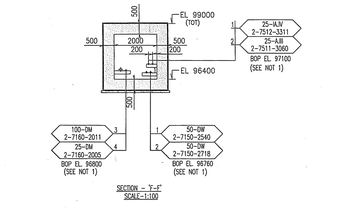

NORTH
TOT EL 100200 INV EL 98400
TOT EL 96400 INV EL 92775
TOT EL 99000 INV EL 96400
TOT EL 98000 INV EL 94525
TOT EL 98000 INV EL 94525
TOT EL 98000 INV EL 94525











NOTE:-

1) THIS LAYOUT IS INDICATIVE CHANGES TO THE EXTRACT OF 100MM MAY BE EXPECTED. FINAL LAYOUT BE PROVIDED TO SUCCESSFUL BIDDER.
2) THIS SHEET IS FOR AIR SYSTEM.

REV. No.	DESCRIPTION	DATE	APP'D.
0	FOR TENDERING	6/05/2018	

DRAWING ISSUED FOR

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

TITLE :- GORAKHPUR HARYANA ANU VIDHUT PARYOJNA

CSP/ TI PACKAGE CONTRACT TERMINAL POINT DETAIL FOR LWS & AESF

DRN	DRG.CHK'D	DES'D	DES.CHK'D	REV'D	APP'D
		Sandeep Yadav	Sajan Gupta	M.K.SINGH	S.K.DATTA
		4/05/18	4/05/18	4/05/18	

PROJECT GHAVP-1&2 — SCALE - 1:500 — PROJECTION

DRG. No. GHAVP12-/70000/2201/GA (SHT. 2 OF 5) — REV. No. 0

FILE NAME: GHAVP12_70000_2201_GA_R0_2

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

DO NOT SCALE THE DRAWING.

UNLESS OTHERWISE STATED :-
ALL DIMENSIONS ARE IN mm.
MACHINE ALL OVER.
SURFACE FINISH TO BE 3.2/ OR BETTER. *
REMOVE ALL BURRS.
REMOVE ALL EXTERNAL SHARP CORNERS AND EDGES BY CHAMFERING TO 0.15 / 0.40 X 45°.
ROUND ALL INTERNAL CORNERS AND EDGES TO R 0.15 / 0.40.
TOLERANCES ON RADII AND CHAMFERS (IS : 2102)

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

TOLERANCES ON LINEAR DIMENSIONS (IS:2102) * *

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

TOLERANCES ON LINEAR DIMENSIONS *

SPECIFIED DIMENSIONS	TOLERANCE
XX	± 0 . 40
XX.X	± 0 . 40
XX.XX	± 0 . 25

TOLERANCES ON ANGULAR DIMENSIONS : 0°– 30'

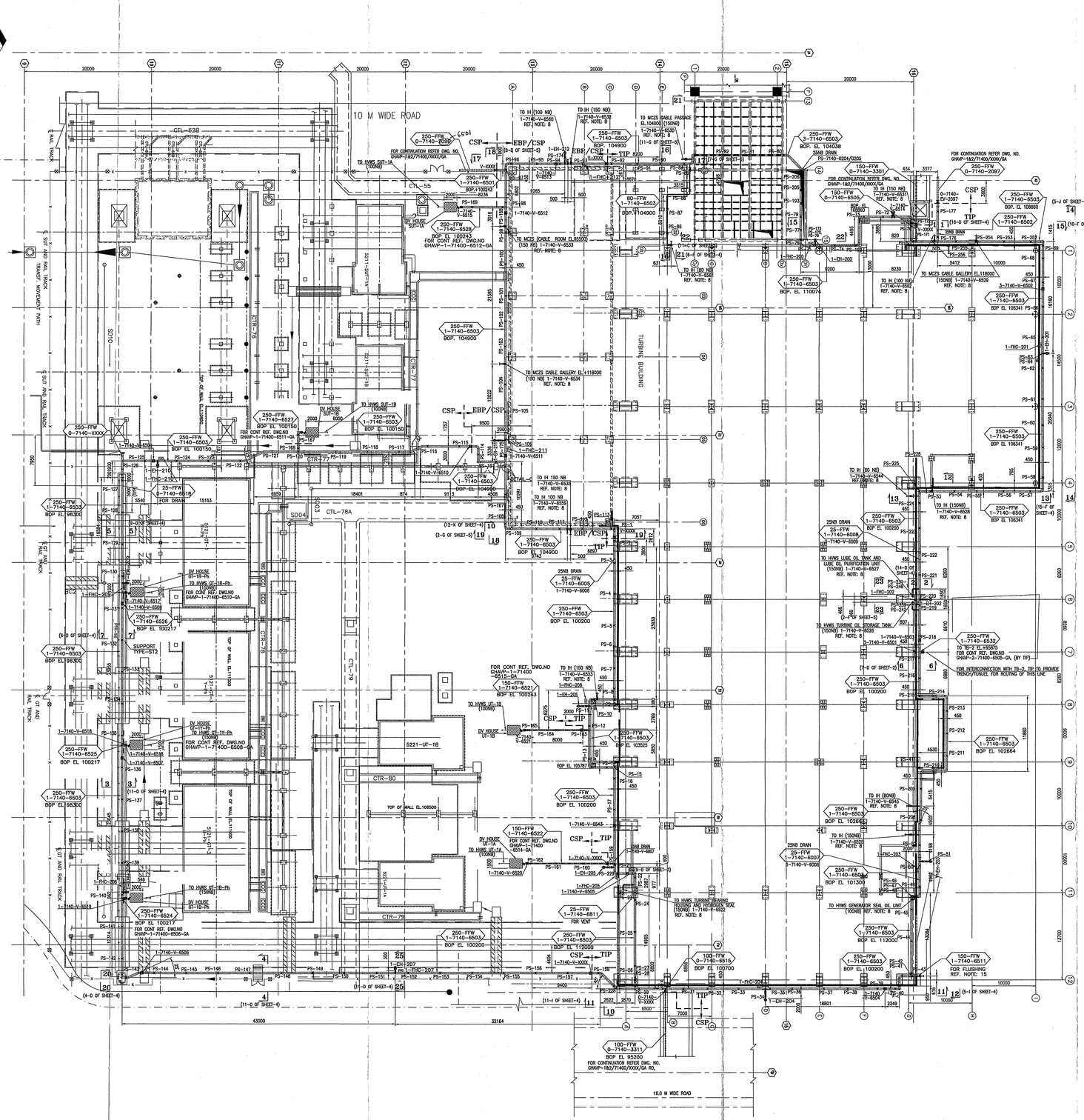
* FOR MACHINED COMPONENTS/SURFACES
* * FOR UNMACHINED COMPONENTS

REFERENCE DRAWINGS	DRAWING No.

REV. NO.	LOCATION	DESCRIPTION	DRN.	DES'D.	DES.CHK'D.	REV'D.	APP'D.

REVISIONS — SIGNATURE (NPCIL)

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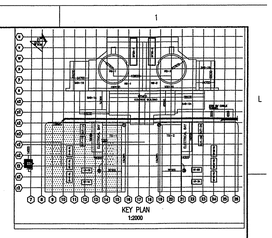


TABLE NO. 1

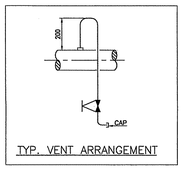
SR. NO.	EH NO.	VALVE NO.	FHC NO.	ORIFICE NO.	LINE NO.
1	1-EH-200	1-7140-V-6546	1-FHC-200	1-7140-RO-6501	80-FFW-1-7140-6537
2	1-EH-201	1-7140-V-6547	1-FHC-201	1-7140-RO-6502	80-FFW-1-7140-6538
3	1-EH-202	1-7140-V-6548	1-FHC-202	1-7140-RO-6503	80-FFW-1-7140-6539
4	1-EH-203	1-7140-V-6549	1-FHC-203	1-7140-RO-6504	80-FFW-1-7140-6540
5	1-EH-204	1-7140-V-6550	1-FHC-204	1-7140-RO-6505	80-FFW-1-7140-6541
6	1-EH-205	1-7140-V-6551	1-FHC-205	1-7140-RO-6506	80-FFW-1-7140-6542
7	1-EH-206	1-7140-V-6552	1-FHC-206	1-7140-RO-6507	80-FFW-1-7140-6543
8	1-EH-207	1-7140-V-6553	1-FHC-207	1-7140-RO-6508	80-FFW-1-7140-6544
9	1-EH-208	1-7140-V-6554	1-FHC-208	1-7140-RO-6509	80-FFW-1-7140-6545
10	1-EH-209	1-7140-V-6555	1-FHC-209	1-7140-RO-6510	80-FFW-1-7140-6546
11	1-EH-210	1-7140-V-6556	1-FHC-210	1-7140-RO-6511	80-FFW-1-7140-6547
12	1-EH-211	1-7140-V-6557	1-FHC-211	1-7140-RO-6512	80-FFW-1-7140-6548
13	1-EH-212	1-7140-V-6558	1-FHC-212	1-7140-RO-6513	80-FFW-1-7140-6549

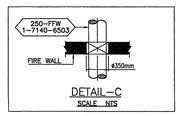
TABLE NO. 2

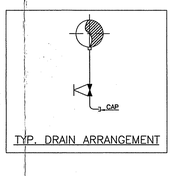
SR. NO.	LINE NO.	VALVE NO.	TAPOFF DESCRIPTION
1	150-FFW-1-7140-6533	1-7140-V-6562	TO IH
2	150-FFW-1-7140-6506	1-7140-V-6528	TO IH
3	80-FFW-1-7140-6535	1-7140-V-6544	TO IH
4	80-FFW-1-7140-6536	1-7140-V-6545	TO IH
5	150-FFW-1-7140-6513	1-7140-V-6525	TO IH
6	150-FFW-1-7140-6517	1-7140-V-6523	TO IH
7	150-FFW-1-7140-6520	1-7140-V-6535	TO IH
8	150-FFW-1-7140-6550	1-7140-V-6559	TO IH
9	150-FFW-1-7140-6551	1-7140-V-6560	TO IH
10	150-FFW-1-7140-6531	1-7140-V-6532	TO IH
11	80-FFW-1-7140-6552	1-7140-V-6561	TO IH
12	150-FFW-1-7140-6534	1-7140-V-6531	TO IH
13	150-FFW-1-7140-6513	1-7140-V-6524	TO HWS
14	150-FFW-1-7140-6510	1-7140-V-6526	TO HWS
15	150-FFW-1-7140-6509	1-7140-V-6527	TO HWS
16	150-FFW-1-7140-6507	1-7140-V-6529	TO MCZS
17	150-FFW-1-7140-6508	1-7140-V-6530	TO MCZS
18	150-FFW-1-7140-6516	1-7140-V-6522	TO HWS
19	150-FFW-1-7140-6530	1-7140-V-6533	TO MCZS
20	150-FFW-1-7140-6529	1-7140-V-6534	TO MCZS
21	250-FFW-1-7140-6528	1-7140-V-6515	TO HWS
22	250-FFW-1-7140-6527	1-7140-V-6516	TO HWS
23	250-FFW-1-7140-6522	1-7140-V-6520	TO HWS
24	250-FFW-1-7140-6521	1-7140-V-6521	TO HWS
25	250-FFW-1-7140-6526	1-7140-V-6517	TO HWS
26	250-FFW-1-7140-6525	1-7140-V-6518	TO HWS
27	250-FFW-1-7140-6524	1-7140-V-6519	TO HWS
28	150-FFW-1-7140-6511	1-7140-V-6536	TO FLUSH

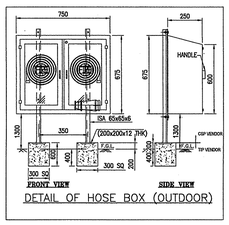
LEGEND

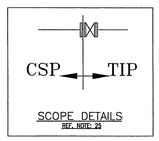
SL. NO.	SYMBOL	TAG	DESCRIPTION
1		NB	FIRE WATER HEADER
2		GV	GATE VALVE
3		Y-STR	Y-STRAINER
4		EH	HYDRANT VALVE
5	X	PS	SUPPORT
6	FHC	FHC	FIRE HOSE CABINET
6	RO	RO	RESTRICTED ORIFICE
7	PG	PG	PRESSURE GAUGE
8	PS	PS	PRESSURE SWITCH
9		GV	EXTENDED STEM GATE VALVE
10			SCOPE DEMARCATION

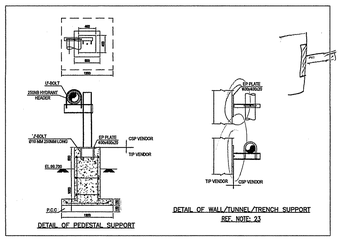


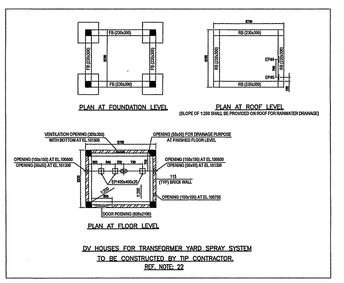












NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
2. ALL PIPE SIZES INDICATED ARE DIAMETER NOMINAL (DN) IN MILLIMETRES.
3. THIS GA IS FOR INDICATIVE PURPOSE ONLY VENDOR HAS TO FINALISED LAYOUT BASED ON FINAL LAYOUT OF AREA.
4. REFER LATEST CONCRETE FORMING DRAWING (CFD) & CIVIL GAs DURING PIPING LAYOUT.
5. FINAL OUTDOOR PIPING LAYOUT (PIPING NOT IN SCOPE OF TIP) WILL BE GIVEN TO SUCCESSFUL BIDDER. FOR SUPPORT EP & PEDESTAL REQUIREMENT.
6. FIRE WATER PIPING SHALL BE AS PER LATEST REVISION OF PMS.NO. GHAVP-1&2/71400/1/PMS.
7. TERMINAL POINTS SHOWN IN THIS DRAWING IS INDICATIVE & WILL BE FINALIZED DURING DETAIL ENGINEERING AND GIVEN TO PACKAGE CONTRACTOR.
8. TB INTERNAL HYDRANT & SPRAY SYSTEM IS IN SCOPE OF TIP.
9. FOR PIPE SUPPORT & SCHEDULE DETAIL SHALL BE PREPARED BY VENDER OF TI PACKAGE.
10. FOR LINE NO. & VALVE NO. OF EH(EXTERNAL HYDRANTS) REF. TABLE NO 1.
11. FHC FOR EH LOCATED NEAR TB/EB PREFERABLY TO BE ERECTED TO THE NEAREST TB/EB COLUMNS.
12. HOSE CABINET SHALL BE INSTALLED NEAR EACH EXTERNAL HYDRANT. EACH HOSE CABINET SHALL CONSIST OF TWO NOS. 15M LONG HOSES WITH COUPLINGS, ONE NO. BRANCH PIPE AND NOZZLE.
13. ORIFICE PLATE SHALL BE USED AT THE INLET OF EXTERNAL HYDRANT VALVE WHERE THE RESIDUAL PRESSURE EXCEEDS 4.5Kg/cm^2.
14. ALL THE EXTERNAL & INTERNAL HYDRANT VALVE SHALL BE 1m TO 1.2m ABOVE FROM THE FINISH FLOOR LEVEL.
15. DISTRIBUTION OF FIRE WATER SUPPLY SHOULD BE THROUGH MAIN LOOP SUCH THAT WATER CAN REACH EACH CONNECTION FROM TWO DIFFERENT DIRECTION.
16. TAPPING PROVIDED FOR OPEN LOOP FLUSHING OF FIRE WATER HEADER. ALL FLUSHING POINTS SHOULD BE DIRECTED SAFELY TO NEAREST PLANT DRAIN.
17. ALL VENT AND DRAIN VALVE SHALL BE 25NB UNLESS OTHERWISE NOTED. VENT & DRAIN SHALL BE PROVIDED WITH TOE NIPPLE & THREADED CAP AND ROUTED TO NEAR FLOOR DRAIN.
18. ALL SUPPORT TAG NO. FOR UNIT-1 SHALL BE PREFIX WITH "1-7140".
19. TAG NOS FOR LINE, VALVE & OTHER FITTINGS SHALL BE PROVIDED AREA WISE (PROVIDED BLOCK OF TAG NOS FOR EACH AREA)
20. VALVE WHICH ARE NOT APPROACHABLE FROM RESPECTIVE FLOOR/ PLATFORM SHALL BE OF CHAIN OPERATED GATE VALVES AND VALVE PRESENT IN TRENCH SHALL BE OF EXTENDED STEM GATE VALVES.
21. ALL TAG NOS, SHOWN IN THIS GAs. ARE ONLY INDICATIVE. FINAL TAG NO. BLOCKS WILL BE PROVIDED TO EACH PACKAGE CONTRACTOR.
22. DV HOUSES TO BE CONSTRUCTED BY TIP CONTRACTOR. FINAL LAYOUT/ REQUIREMENT WILL BE PROVIDED TO SUCCESFUL VENDOR.
23. SUPPORT EPs ALONG WITH PEDESTALS FOR PIPING SHOWN IN THE CSP AND EPB SCOPE ARE IN SCOPE OF TIP.
24. EPs IN TRENCH/TUNNEL TO BE PROVIDED BY TIP CONTRACTOR FOR FIRE WATER SYSTEM PIPING SUPPORTS.
25. WHEREVER SCOPE CHANGES , IF GATE VALVE IS UNDER ONE VENDOR SCOPE, GATE VALVE MATING FLANGE, BOLTS NUTS & GASKET IS UNDER SCOPE OF OTHER VENDOR.

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REV. No.	DESCRIPTION	DATE	APP'D.
0	FOR TENDERING.		

DRAWING ISSUED FOR

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

THIS GA IS PREPARED BASED ON GA NO. KAPP-3/71400/6505/GA

DO NOT SCALE THE DRAWING.

UNLESS OTHERWISE STATED :-
ALL DIMENSIONS ARE IN mm.
MACHINE ALL OVER.
SURFACE FINISH TO BE 3.2 OR BETTER.
REMOVE ALL BURRS.
REMOVE ALL EXTERNAL SHARP CORNERS
AND EDGES BY CHAMFERING TO 0.15 X 45°, 0.40 X 45°.
ROUND ALL INTERNAL CORNERS AND EDGES TO R 0.15, 0.40.

TOLERANCES ON RADII AND CHAMFERS (IS : 2102)

RADII AND CHAMFERS	0.5-3	1-6	6-30
TOLERANCES	± 0.2	± 0.5	± 1.0

TOLERANCES ON LINEAR DIMENSIONS (IS:2102)

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

TOLERANCES ON LINEAR DIMENSIONS

SPECIFIED DIMENSIONS	TOLERANCE
XX	± 0.4
XX.X	± 0.25
XX.XX	

TOLERANCES ON ANGULAR DIMENSIONS : ± 0° - 30'

REV. No.	REV. LOCATION	DESCRIPTION	DR'N.	DES'D.	DES.CHK'D.	REV'D.	APP'D.
		REVISIONS		SIGNATURE (NPCIL)			

REFERENCE DRAWINGS	DRAWING No.	REFERENCE DRAWINGS	DRAWING No.	REFERENCE DRAWINGS	DRAWING No.
AROUND TURBINE BUILDING 1, ELECTRICAL BAY-1 & TRANSFORMER YARD PIPING LAYOUT OF FIRE HYDRANT & WATER SPRAY SYSTEM	GHAVP-1&2/70000/2201/GA SHEET 5 OF 5				
AROUND TURBINE BUILDING 1, ELECTRICAL BAY-1 & TRANSFORMER YARD PIPING LAYOUT OF FIRE HYDRANT & WATER SPRAY SYSTEM	GHAVP-1&2/70000/2201/GA SHEET 4 OF 5				
BALANCE OF TURBINE ISLAND PACKAGE FOR GHAVP 1&2 (BOTIP)	GHAVP-1/71400/6501/PID				

TITLE :-
GORAKHPUR HARYANA ANU VIDYUT PARIYOJNA
CSP/TI PACKAGE CONTRACT TERMINAL POINT DETAIL FOR LWS & AESF

DES'D.	DR'N. (KAPL)	REV'D.
DES. CHK'D.	DRG. CHK'D.	APP'D.

PROJECT GHAVP-1&2

SCALE -

PROJECTION

DRG. No. GHAVP-1&2/70000/2201/GA

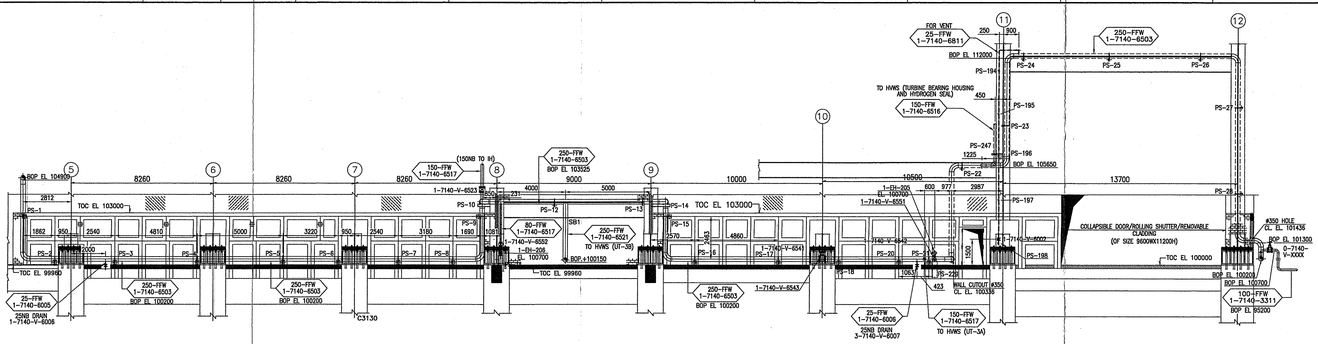
REV. No. R0

FILE NAME: GHAVP12_70000_2201_GA SHEET 3 OF 5

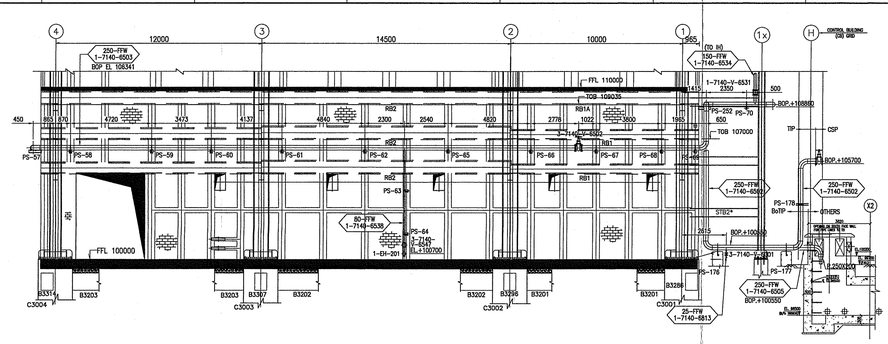
DRG. TO BE READ IN CONJUNCTION WITH DCN/FCN/ECN, IF ANY.

DRG. No. GHAVP-1&2/70000/2201/GA SHEET 3 OF 5

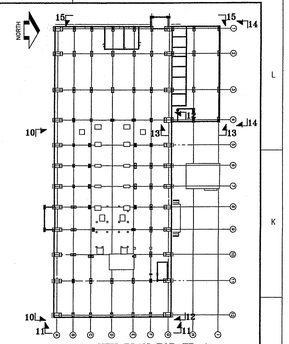
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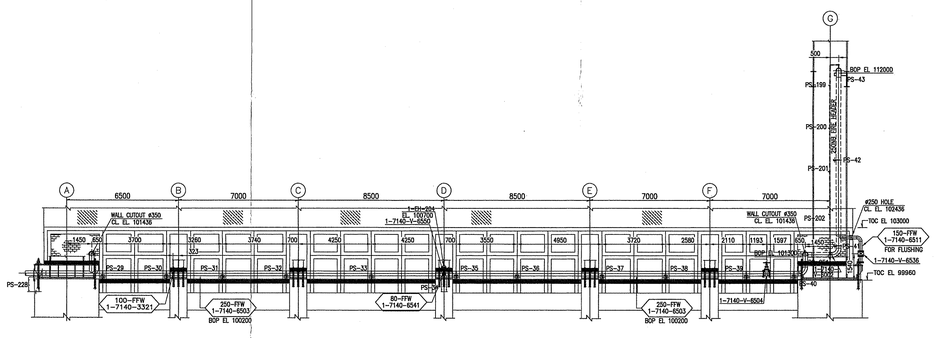


SECTION 10–10 (11–H OF SHEET–3)
SCALE – 1:125

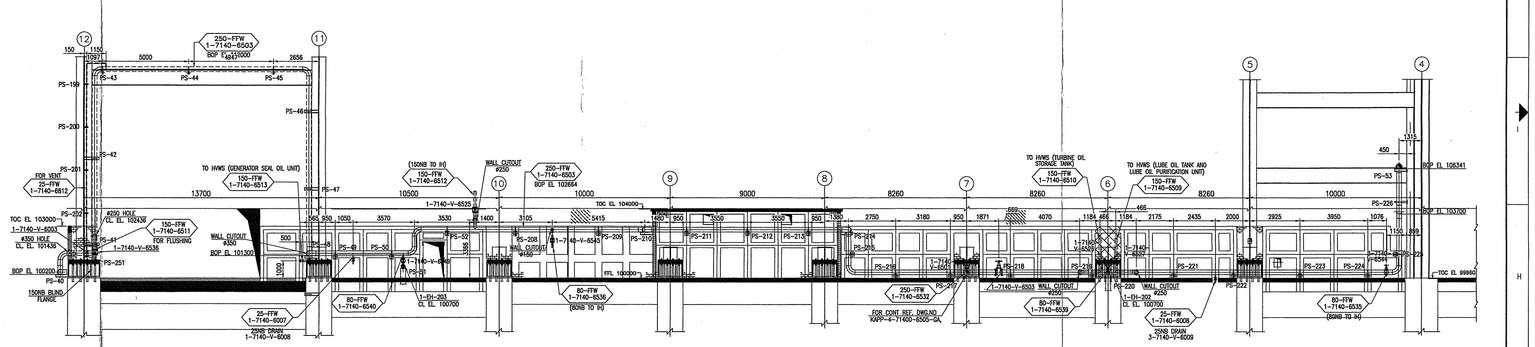


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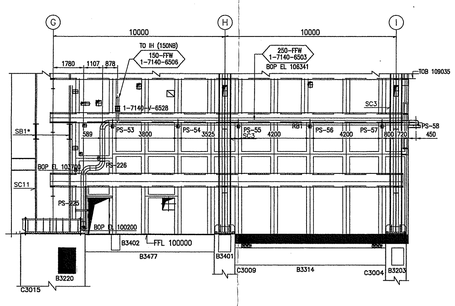




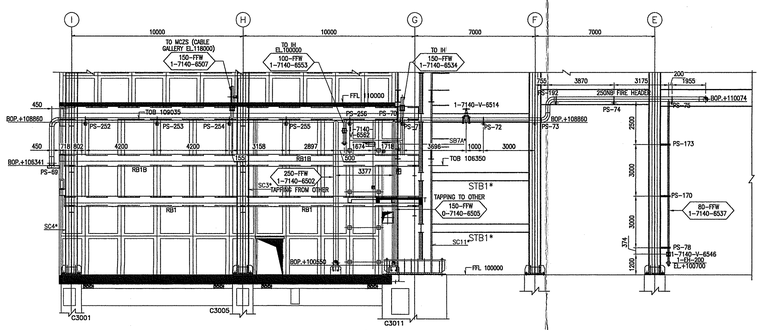
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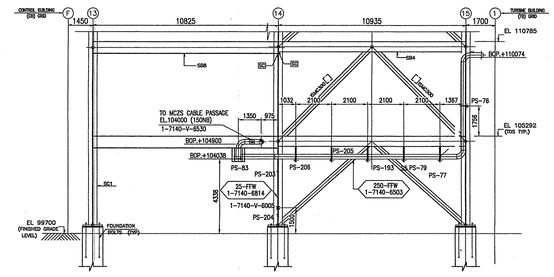
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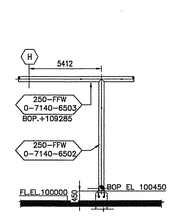
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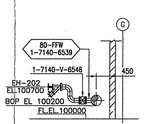
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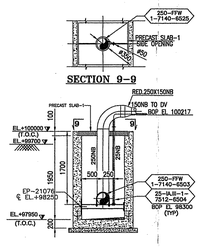
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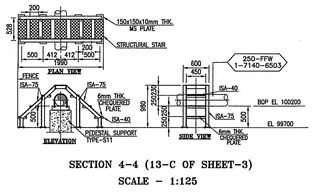
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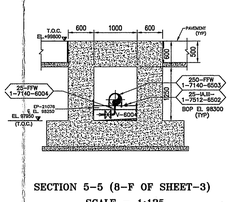
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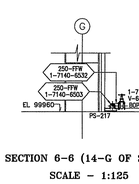
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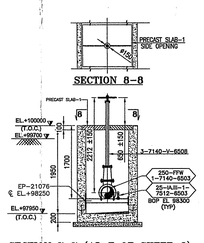
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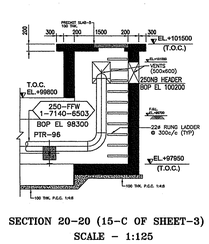
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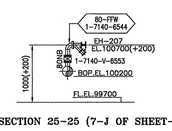
SECTION 6–6 (14–G OF SHEET–3)
SCALE – 1:125



SECTION 7–7 (15–F OF SHEET–3)
SCALE – 1:125



SECTION 20–20 (15–C OF SHEET–3)
SCALE – 1:125



SECTION 25–25 (7–J OF SHEET–3)
SCALE – 1:125

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REV. No.	DESCRIPTION	DATE	APP'D.
0	FOR TENDERING	04/07/2018	

DRAWING ISSUED FOR

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

TITLE :– GORAKHPUR HARYANA ANU VIDYUT PARIYOJNA
CSP/TI PACKAGE CONTRACT TERMINAL POINT DETAIL FOR LWS & AESF

DES'D.	DR'N. (KAPL)	REV'D.	
DES. CHK'D.	DRG. CHK'D.	APP'D.	04/07/2018
PROJECT: GHAVP–1&2		SCALE –	1:1
		PROJECTION	
DRG. No. GHAVP–1&2/70000/2201/GA		REV. No.	R0

FILE NAME: GHAP1&2_70000_2201_GA SHEET 4 OF 5

DO NOT SCALE THE DRAWING.

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

RADII AND CHAMFERS	0.5–3	1–6	6–30
TOLERANCES	± 0.2	± 0.5	± 1.0

TOLERANCES ON LINEAR DIMENSIONS (IS:2102)

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

TOLERANCES ON LINEAR DIMENSIONS

SPECIFIED DIMENSIONS	TOLERANCE
XX	± 0.4
XX.X	± 0.4
XX.XX	± 0.25

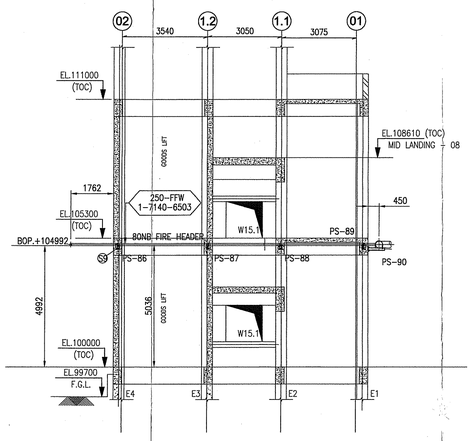
TOLERANCES ON ANGULAR DIMENSIONS : ± 0° – 30'

REFERENCE DRAWINGS	DRAWING No.	REFERENCE DRAWINGS	DRAWING No.	REFERENCE DRAWINGS	DRAWING No.
TI PACKAGE CONTRACT TERMINAL POINT DETAIL FOR LWS & AESF	GHAVP–1&2/70000/2201/GA				

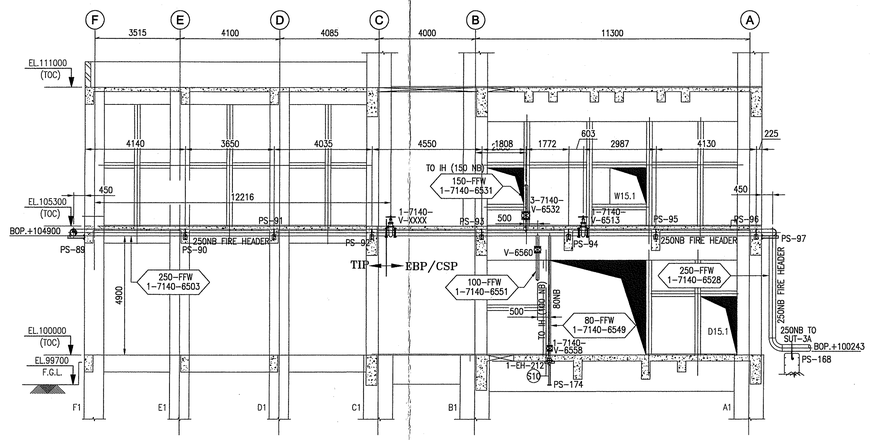
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REVISIONS			SIGNATURE (NPCIL)				

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

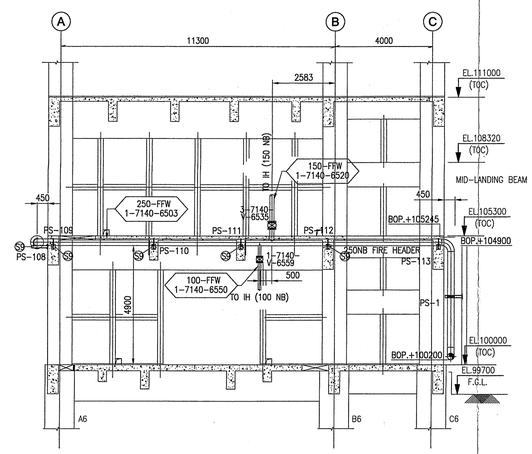
A0 DRG. No. GHAVP–1&2/70000/2201/GA SHEET 4 OF 5



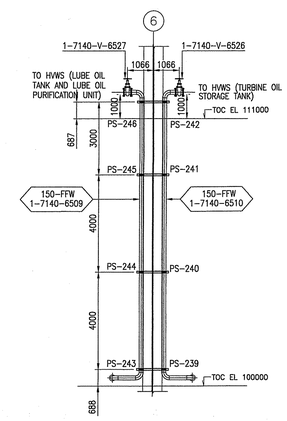
SECTION 16-16 (10-K OF SHEET-3)
SCALE - 1:125



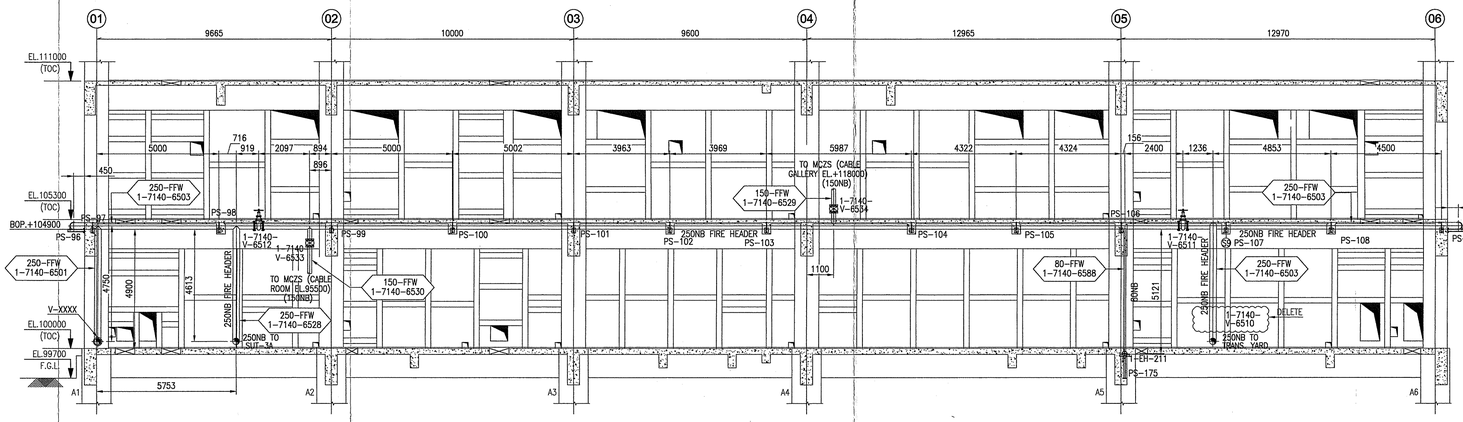
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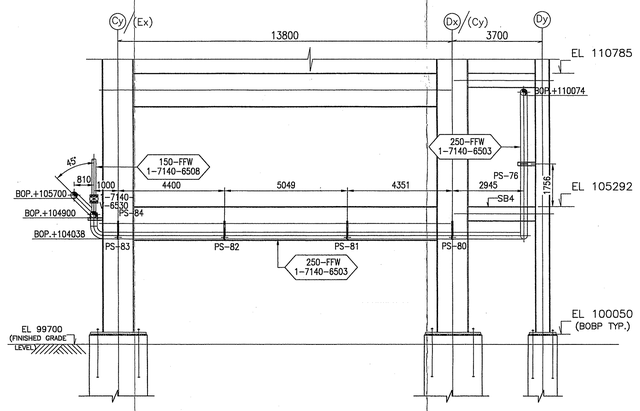
SECTION 19-19 (12-G OF SHEET-3)
SCALE - 1:125



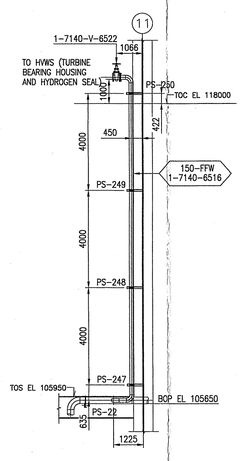
SECTION 23-23 (8-G OF SHEET-3)
SCALE - 1:125



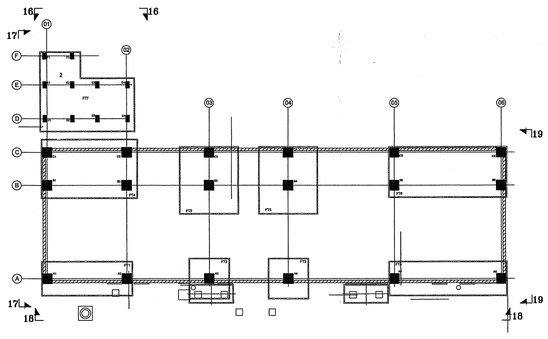
SECTION 18-18 (11-K OF SHEET-3)
SCALE - 1:125



SECTION 22-22 (10-J OF SHEET-3)
SCALE - 1:125



SECTION 24-24 (10-D OF SHEET-3)
SCALE - 1:125



KEY PLAN FOR EB-1
SCALE : N.T.S.

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REV. No.	DESCRIPTION	DATE	APP'D.
0	FOR TENDERING	6/8/18	

DRAWING ISSUED FOR

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

TITLE :- GORAKHPUR HARYANA ANU VIDYUT PARIYOJNA
CSP/TI PACKAGE CONTRACT TERMINAL POINT DETAIL FOR LWS & AESF

DES'D.	DR'N. (KAPL)	REV'D.	
DES. CHK'D. 06.06.2018	DRG. CHK'D.	APP'D. 6/8/18	
PROJECT GHAVP-1&2		SCALE - 1:1	
		PROJECTION	
DRG. No. GHAVP-1&2/70000/2201/GA		REV. No. R0	

FILE NAME: GHAVP1&2_70000_2201_GA SHEET 5 OF 5

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

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XX.XX	± 0.25

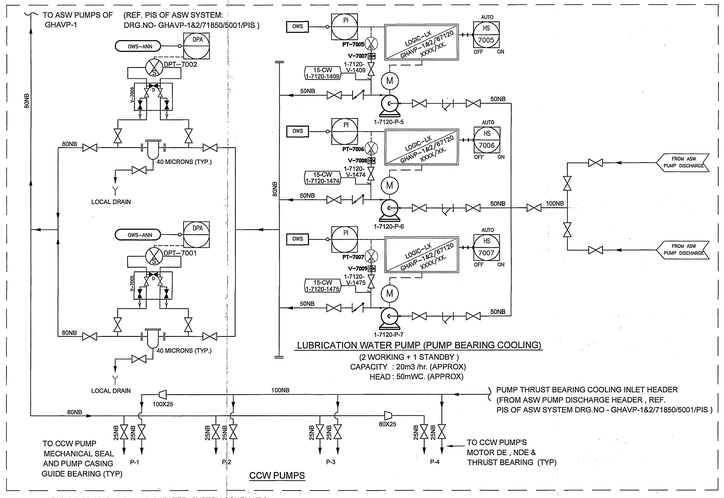
TOLERANCES ON ANGULAR DIMENSIONS : ± 0°-30'

REFERENCE DRAWINGS	DRAWING No.	REFERENCE DRAWINGS	DRAWING No.
TI PACKAGE CONTRACT TERMINAL POINT DETAIL FOR LWS & AESF	GHAVP-1&2/70000/2201/GA		

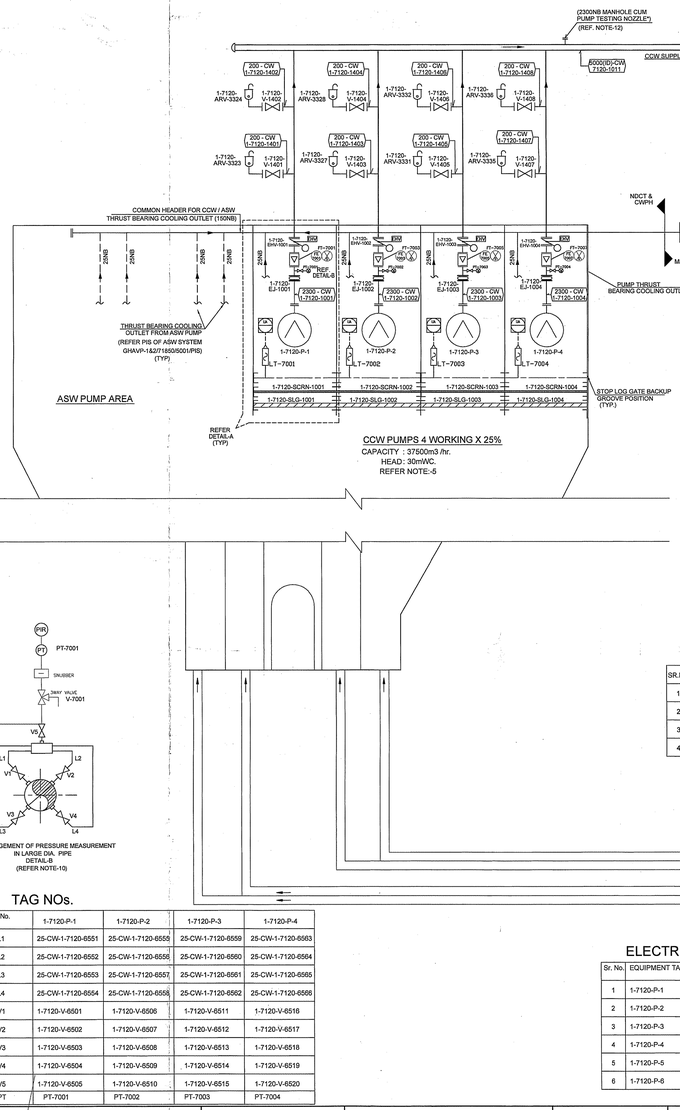
REVISIONS: REV. No. | REV. LOCATION | DESCRIPTION
SIGNATURE (NPCIL): DR'N. | DES'D. | DES.CHK'D. | REV'D. | APP'D.

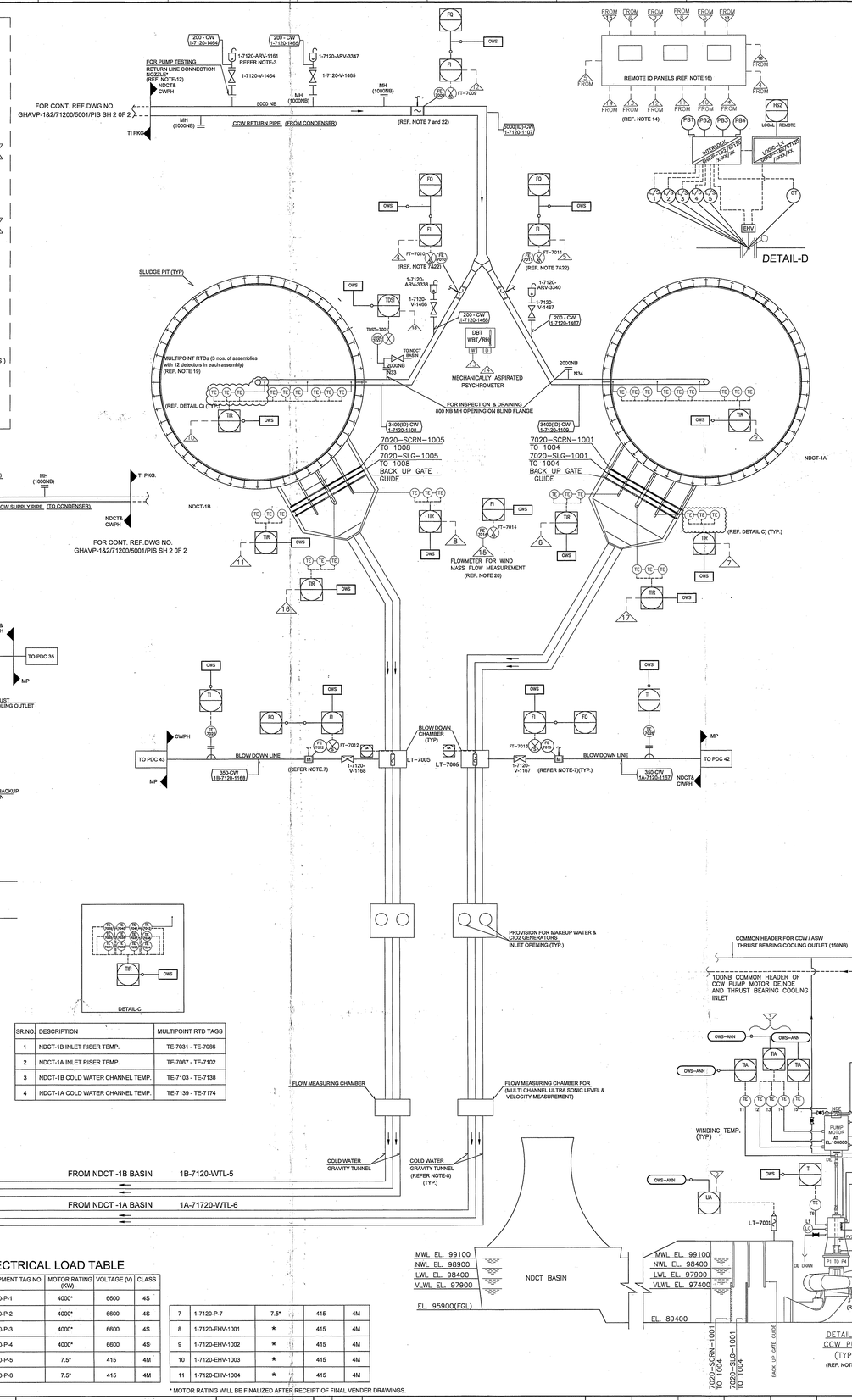
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A1

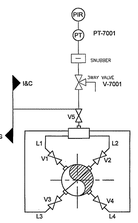


PUMP'S LUBRICATION / SEAL WATER SYSTEM SCHEMATIC
(REF. NOTE-11)





SR.NO.	DESCRIPTION	MULTIPOINT RTD TAGS
1	NDCT-1B INLET RISER TEMP.	TE-7031 - TE-7066
2	NDCT-1A INLET RISER TEMP.	TE-7067 - TE-7102
3	NDCT-1B COLD WATER CHANNEL TEMP.	TE-7103 - TE-7138
4	NDCT-1A COLD WATER CHANNEL TEMP.	TE-7139 - TE-7174



ARRANGEMENT OF PRESSURE MEASUREMENT IN LARGE DIA. PIPE
DETAIL-B
(REFER NOTE-10)

TAG NOs.

Sr. No.	1-7120-P-1	1-7120-P-2	1-7120-P-3	1-7120-P-4
L1	25-CW-1-7120-6551	25-CW-1-7120-6555	25-CW-1-7120-6559	25-CW-1-7120-6563
L2	25-CW-1-7120-6552	25-CW-1-7120-6556	25-CW-1-7120-6560	25-CW-1-7120-6564
L3	25-CW-1-7120-6553	25-CW-1-7120-6557	25-CW-1-7120-6561	25-CW-1-7120-6565
L4	25-CW-1-7120-6554	25-CW-1-7120-6558	25-CW-1-7120-6562	25-CW-1-7120-6566
V1	1-7120-V-6501	1-7120-V-6506	1-7120-V-6511	1-7120-V-6516
V2	1-7120-V-6502	1-7120-V-6507	1-7120-V-6512	1-7120-V-6517
V3	1-7120-V-6503	1-7120-V-6508	1-7120-V-6513	1-7120-V-6518
V4	1-7120-V-6504	1-7120-V-6509	1-7120-V-6514	1-7120-V-6519
V5	1-7120-V-6505	1-7120-V-6510	1-7120-V-6515	1-7120-V-6520
PT	PT-7001	PT-7002	PT-7003	PT-7004

ELECTRICAL LOAD TABLE

Sr. No.	EQUIPMENT TAG NO.	MOTOR RATING (KW)	VOLTAGE (V)	CLASS
1	1-7120-P-1	4000*	6600	4S
2	1-7120-P-2	4000*	6600	4S
3	1-7120-P-3	4000*	6600	4S
4	1-7120-P-4	4000*	6600	4S
5	1-7120-P-5	7.5*	415	4M
6	1-7120-P-6	7.5*	415	4M
7	1-7120-P-7	7.5*	415	4M
8	1-7120-EHV-1001	*	415	4M
9	1-7120-EHV-1002	*	415	4M
10	1-7120-EHV-1003	*	415	4M
11	1-7120-EHV-1004	*	415	4M

* MOTOR RATING WILL BE FINALIZED AFTER RECEIPT OF FINAL VENDER DRAWINGS.

EHV TAG TABLE:

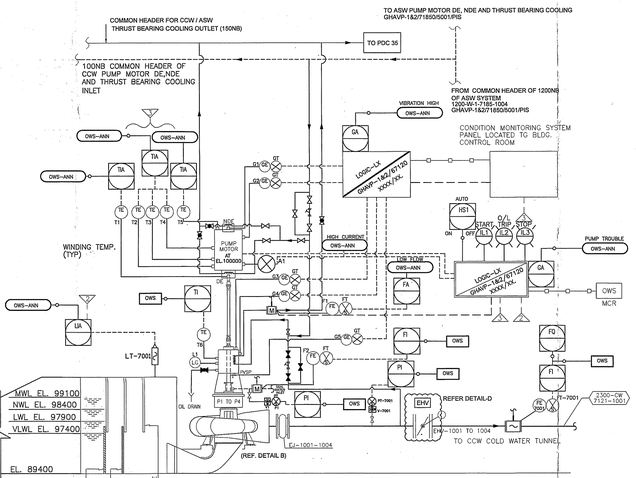
Sr. No.	1-7120-EHV-1001	1-7120-EHV-1002	1-7120-EHV-1003	1-7120-EHV-1004
L/S-1	L/S-7001	L/S-7006	L/S-7011	L/S-7016
L/S-2	L/S-7002	L/S-7007	L/S-7012	L/S-7017
L/S-3	L/S-7003	L/S-7008	L/S-7013	L/S-7018
L/S-4	L/S-7004	L/S-7009	L/S-7014	L/S-7019
L/S-5	L/S-7005	L/S-7010	L/S-7015	L/S-7020
GT	GT-7001	GT-7002	GT-7003	GT-7004
PB1	PB-7001	PB-7005	PB-7009	PB-7013
PB2	PB-7002	PB-7006	PB-7010	PB-7014
PB3	PB-7002	PB-7007	PB-7011	PB-7015
PB4	PB-7004	PB-7008	PB-7012	PB-7016
HS2	HS-7008	HS-7009	HS-7010	HS-7011

TAG NOS. TABLE

	ITEM	ALLOTTED	USED
LINE NOS.	MAIN PROCESS INLET LINE	1001-1099	1001-1011
	MAIN PROCESS OUTLET LINE	1101-1199	1101-1109
	DRAIN & VENT LINES	1201-1299	1201-1212
	INSTRUMENT LINE	1401-1599	1401-1475
VALVES	VALVE MAIN PROCESS SUPPLY	1001-1099	1001-1010
	VALVE MAIN PROCESS RETURN	1101-1199	1101-1107
	DRAIN & VENT VALVES	1201-1299	1201-1220
	ROOT VALVES	1401-1599	1401-1475
TI AREA	INSTRUMENT TAG NOS.	6501-6999	CONTRACTOR TO FINALISE
INSTRUMENTS (CWPH PACKAGE)	TEMPERATURE ELEMENT	7001-7030	7001-7026
	FE & FT	7001-7018	7001-7016
	LEVEL TRANSMITTER	7001-7006	7001-7006
	PRESSURE TRANSMITTER	7001-7011	7001-7011
	GE & GT	7001-7199	7001-7020
	LEVEL GAUGE	7001-7199	7001-7004
	MOTOR CURRENT (AT)	7001-7199	7001-7004
	INDICATING LAMPS	7001-7199	7001-7012
	HAND SWITCHES	7001-7199	7001-7011
	INST. ISOLATION VALVE	7001-7199	7001-7013
	LIMIT SWITCHES	7001-7199	7001-7020
	PUSH BUTTONS	7001-7199	7001-7016
	POSITION TRANSMITTER(GT)	7001-7199	7001-7004
	DIFF. PRESSURE TRANSMITTER(DPT)	7001-7199	7001-7002
NDCT AREA	MULTIPOINT RTD (TE)	7031-7200	7031-7174

PUMP TAG TABLE:

Sr. No.	1-7120-P-1	1-7120-P-2	1-7120-P-3	1-7120-P-4
T1	TE-7001	TE-7007	TE-7013	TE-7019
T2	TE-7002	TE-7008	TE-7014	TE-7020
T3	TE-7003	TE-7009	TE-7015	TE-7021
T4	TE-7004	TE-7010	TE-7016	TE-7022
T5	TE-7005	TE-7011	TE-7017	TE-7023
T6	TE-7006	TE-7012	TE-7018	TE-7024
G1	GE-7001 & GT-7001	GE-7006 & GT-7006	GE-7011 & GT-7011	GE-7015 & GT-7016
G2	GE-7002 & GT-7002	GE-7007 & GT-7007	GE-7012 & GT-7012	GE-7017 & GT-7017
G3	GE-7003 & GT-7003	GE-7008 & GT-7008	GE-7013 & GT-7013	GE-7018 & GT-7018
G4	GE-7004 & GT-7004	GE-7009 & GT-7009	GE-7014 & GT-7014	GE-7019 & GT-7019
G5	GE-7005 & GT-7005	GE-7010 & GT-7010	GE-7015 & GT-7015	GE-7020 & GT-7020
F1	FE-7002 & FT-7002	FE-7004 & FT-7004	FE-7006 & FT-7006	FE-7008 & FT-7008
F2	FE-7015 & FT-7015	FE-7016 & FT-7016	FE-7017 & FT-7017	FE-7013 & FT-7018
L1	LG-7001	LG-7002	LG-7003	LG-7004
A1	AT-7001	AT-7002	AT-7003	AT-7004
HS1	HS-7001	HS-7002	HS-7003	HS-7004
IL1	IL-7001	IL-7004	IL-7007	IL-7010
IL2	IL-7002	IL-7005	IL-7008	IL-7011
IL3	IL-7003	IL-7006	IL-7009	IL-7012
V1	V-7010	V-7011	V-7012	V-7013
P1	PT-7008	PT-7009	PT-7010	PT-7011



LEGEND :-

TIP - TURBINE ISLAND PACKAGE
TGB - TURBINE GENERATOR BUILDING
NDCT & CWPH - NATURAL DRAFT COOLING TOWER & COOLING WATER PUMP HOUSE
PWPH - PLANT WATER PUMP HOUSE
EHV - ELECTRO HYDRAULIC VALVE .
ARV - AIR RELEASE VALVE
PDC - PLANT DRAIN CHAMBER
SLG - STOP LOG GATE
SCG - SLUICE GATE
SCRN - SCREEN
EJ - EXPANSION JOINT
GE - VIBRATION SENSOR
TE - TEMPERATURE ELEMENT
TIG - TEMPERATURE GAUGE WITH SWITCH CONTACTS
FS - FLOW SWITCH
FT - FLOW TRANSMITTER
FI - FLOW INDICATOR
FQ - FLOW TOTALIZER
LT - LEVEL TRANSMITTER
PG - PRESSURE GAUGE
PT - PRESSURE TRANSMITTER
MJB - MARSHALLING JUNCTION BOX
VMS - VIBRATION MONITORING SYSTEM
AT - MOTOR CURRENT
WTL - WATER TUNNEL
MP - MISC. PACKAGE
- PROCESS LINE
- INSTRUMENT ELECTRICAL LINES
- SOFT COMMUNICATION
- DISTRIBUTED CONTROL SYSTEM - DCS LOCATED IN TG BUILDING CONTROL ROOM.
- GUIDED WAVE RADAR LEVEL TRANSMITTER
- ELECTRO MAGNETIC FLOW METER WITH FLOW TOTALISER/INTEGRATOR
- BUTTERFLY VALVE - (MANUALLY OPERATED)
- DIAPHRAGM VALVE
- GATE VALVE (NORMALLY OPEN)
- GATE VALVE (NORMALLY CLOSED)
- GLOBE VALVE (NORMALLY OPEN)
- CHANGE IN SCOPE
- EXPANSION JOINT
- ULTRASONIC TYPE FLOW ELEMENT ALONG WITH TRANSMITTER.
- ELECTRO HYDRAULICALLY OPERATED BUTTERFLY VALVE.
- CONE TYPE FLOW ELEMENT ALONG WITH TRANSMITTER.

GENERAL NOTES:-

1. THIS DRAWING IS APPLICABLE FOR BOTH UNIT #1 AND UNIT #2. ALL THE LINE NOS. VALVE NOS. EQUIPMENT TAG NOS. OF UNIT 1 ARE IDENTICAL FOR UNIT EXCEPT FOR THE UNIT NO. WICH SHALL BE SUITABLY REPLACED IN THE FORMATS OF LINE, EQUIPMENT TAG NOS. FOR UNIT 2.
2. FOR ANY NEW PROCESS LINES, VENT AND DRAIN LINES ALONG WITH VALVE OTHER THAN AS SHOWN IN THIS DRAWING RESPECTIVE CONTRACTOR SHOULD ALLOCATE TAG NOS. FROM THE BLOCK INDICATED IN TAG NO . TABLE .
3. ADEQUATE NO. OF 200 NB ARV SHALL BE PROVIDED ON CCW PUMP DISCHARGE LINE, CCW SUPPLY & RETURN PIPE BASED ON TRANSIENT ANALYSIS. DRAIN OF THESE ARV SHALL BE LED TO THE NEAREST PDC.
4. INSPECTION MANHOLE OPENING SIZE IS MINIMUM 600NB ON THE PIPE (UNLESS NOTED). LINING MANHOLE OF 1000 NB ON EVERY 50 M SPAN OF 5 M ID PIPE (CCW SUPPLY AND RETURN HEADER) SHALL BE PROVIDED.
5. CCW PUMP CAPACITY AND HEAD INDICATED HERE ARE TENTATIVE - SAME SHALL BE FINALIZED AFTER GETTING PRESSURE DROP IN CONDENSER, NDCT ETC.FROM VENDOR.
6. CCW SUPPLY HEADER FROM CWPH TO OUTSIDE TB WALL AND CCW RETURN HEADER FROM OUTSIDE TB WALL TO NDCT INLET ARE MADE OF CEMENT MORTAR LINED AND COATED PIPES HAVING FOLLOWING DIMENSIONS:
a) CEMENT MORTAR LINED PIPES (INNER DIA.-8000mm, OUTER DIA.-8200mm (CWPH TO OUTSIDE TB WALL)
INNER DIA.-3400mm, OUTER DIA.-3200mm (AT NDCT INLET)
b) CEMENT MORTAR PIPE LINING THICKNESS-INNER 25mm(MIN.) OUTER 50mm(MIN.)
c) BURIED PORTION OF 1.8 M DIA. NEAR TURBINE BUILDING SHALL BE HAVING 25mm LINING & 50 mm QUINTING.
7. MINIMUM STRAIGHT LENGTH OF 10 PIPE DIA UP STREAM AND 5 PIPE DIA DOWN STREAM IS RECOMMENDED TO BE MAINTAINED DURING INSTALLATION OF FLOW METER.
8. SIZING OF COLD WATER TUNNEL & FOREBAY SHALL BE DONE DURING HYDRAULIC STUDY
9. DETAIL OF CONDENSER NOT SHOWN IN THIS PIS, SAME SHALL BE AVAILABLE IN RESPECTIVE PACKAGE VENDOR DWG/DOCUMENT. PRESSURE AND TEMPERATURE DIFFERENCE ACCROSS THE CONDENSER GIVEN BASED ON NPCIL'S REFERANCE PROJECT OF SIMILAR TYPE.
10. DETAIL 'B' PROVIDED, SHOWS THE ARRANGEMENT OF PRESSURE AT PUMP DISCHARGE.
11. LUBRICATION SYSTEM SCHEME SHOWN HERE IS INDICATIVE ONLY. COMPLETE SYSTEM ALONG WITH PUMPS, PIPING, FILTER, STRAINER, INSTRUMENTATION IS IN THE SCOPE OF CCW / ASW PUMP VENDOR. LUBRICATING PUMP'S HEAD AND CAPACITY, LINE SIZE GIVEN HERE ARE TENTATIVE, SAME SHALL BE FINALIZED BY PUMP VENDOR.
12. A PROVISION HAS BEEN KEPT FOR A TEMPORARY CONNECTION REQUIRED TO BE MADE BETWEEN TWO NOZZLES (MARKED BY *) DURING TESTING OF CCW PUMP BY PASSING THE FLOW TO THE CONDENSER.
13. INSTRUMENT REQUIRMENT FOR PUMP AND AUXILIARIES SHOWN HERE IS INDICATIVE ONLY- SAME SHALL BE FINALIZED DURING DETAIL ENGINEERING BY PUMP VENDOR.
14. INSTRUMENT REQUIRED FOR NDCT PERFORMANCE MONITORING SHOWN HERE IS INDICATIVE ONLY- SAME SHALL BE FINALIZED DURING DETAIL ENGINEERING. INSTRUMENT'S TYPE, NO OF MEASUREMENT STATION AND THEIR LOCATION, ETC SHOULD MEET THE REQUIREMENT AS SPECIFIED IN ATC-105 AND ASME PTC-23 OR EQUIVALENT STANDARD.
15. MAGNETIC FLOW METER SHALL BE PROVIDED ON BOTH THRUST BEARING AND SEAL WATER LINE GOING TO INDIVIDUAL PUMP.
16. CCW PUMPS WILL BE CONTROLLED FROM DCS LOCATED IN TB THROUGH REMOTE I/O PANEL LOCATED IN CWPH. ALL I/Os FROM CWPH TO BE WIRED TO RIO PANELS INCLUDING BLOW DOWN FLOW TRANSMITTER.
17. DETAIL VIEW OF TEMPERATURE MEASUREMENT IN NDCT (WHEREVER MULTIPLE TE IS INVOLVED) SHALL BE SHOWN DURING DETAIL ENGINEERING.
18. AS PER PTC-23 ADEQUATE NOS. OF WET BULB TEMPERATURE MEASUREMENT STATIONS TO BE PROVIDED BY THE CONTRACTOR. CONTINUOUS WATER FLOW ARRANGEMENT FOR MAINTAINING THE WETNESS OF THE BULB SHALL ALSO BE ENGINEERED, SUPPLIED AND ERECTED BY THE CONTRACTOR. ALTERNATIVELY, INFERENCE TYPE MEASUREMENT CAN BE USED BY DOING RH MEASUREMENT.
19. DRY BULB AND WET BULB TEMPERATURERH SHALL BE MEASURED FOR CONTINUOUS REMOTE MEASUREMENT AT THE INLET AIR PATH OF EACH NDCT. THE NUMBER OF MEASUREMENTS AND THE LOCATION SHALL BE IN COMPLIANCE TO ASME PTC 23.
20. FLOW ELEMENT IS THERMAL MASS FLOWMETER TYPE.
21. MANHOLES SHALL BE PROVIDED IN FLOW CHAMBER WITH RUNG LADDER.
22. 8000mm X 8000mm CLEAR DIMENSION REQUIRED IN FLOW CHAMBER FOR INSTRUMENTATION AND CABLING.

FOR LOGIC NOTES REFER SHEET 2 OF 2 OF GHAVP-1&2/71200/5001/PIS

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REFERENCE DRAWINGS	DRAWING No.	REFERENCE DRAWINGS	DRAWING No.	REFERENCE DRAWINGS	DRAWING No.
PIS FOR PLANT WATER SYSTEM	GHAVP-1&2/71120/5001/PIS SH 1 OF 2				
PIS FOR AUXILIARY SERVICE WATER SYSTEM	GHAVP-1&2/71850/5001/PIS				
PIS FOR CONDENSER COOLING WATER SYSTEM	GHAVP-1&2/71200/5001/PIS-SH 2 OF 2				

REV. No.	REV. LOCATION	DESCRIPTION	DR'N.	DES'D	DES.CHK'D	REV'D	APP'D
		REVISIONS	SIGNATURE WITH DATE (CONSULTANT)				
R0C		REVISED AS PER NPCIL'S COMMENT'S					
R0B		REVISED AS PER NPCIL'S COMMENT'S					

DES'D	CHK'D	REVIEWED	APPROVED
SIGNATURE (NPCIL)			

REV. No.	DESCRIPTION	CONSULTANT / NPCIL SIGNATURE WITH DATE
R0	FOR TENDERING	

DRAWING ISSUED FOR

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

DES'D. | CHK'D. 06.08.2018 | REV'D. | APP'D.

TATA CONSULTING ENGINEERS LIMITED,MUMBAI
JOB REF. No.10590A

TITLE :- GHAVP POWER PROJECT-1&2
PIS FOR CONDENSER COOLING WATER SYSTEM

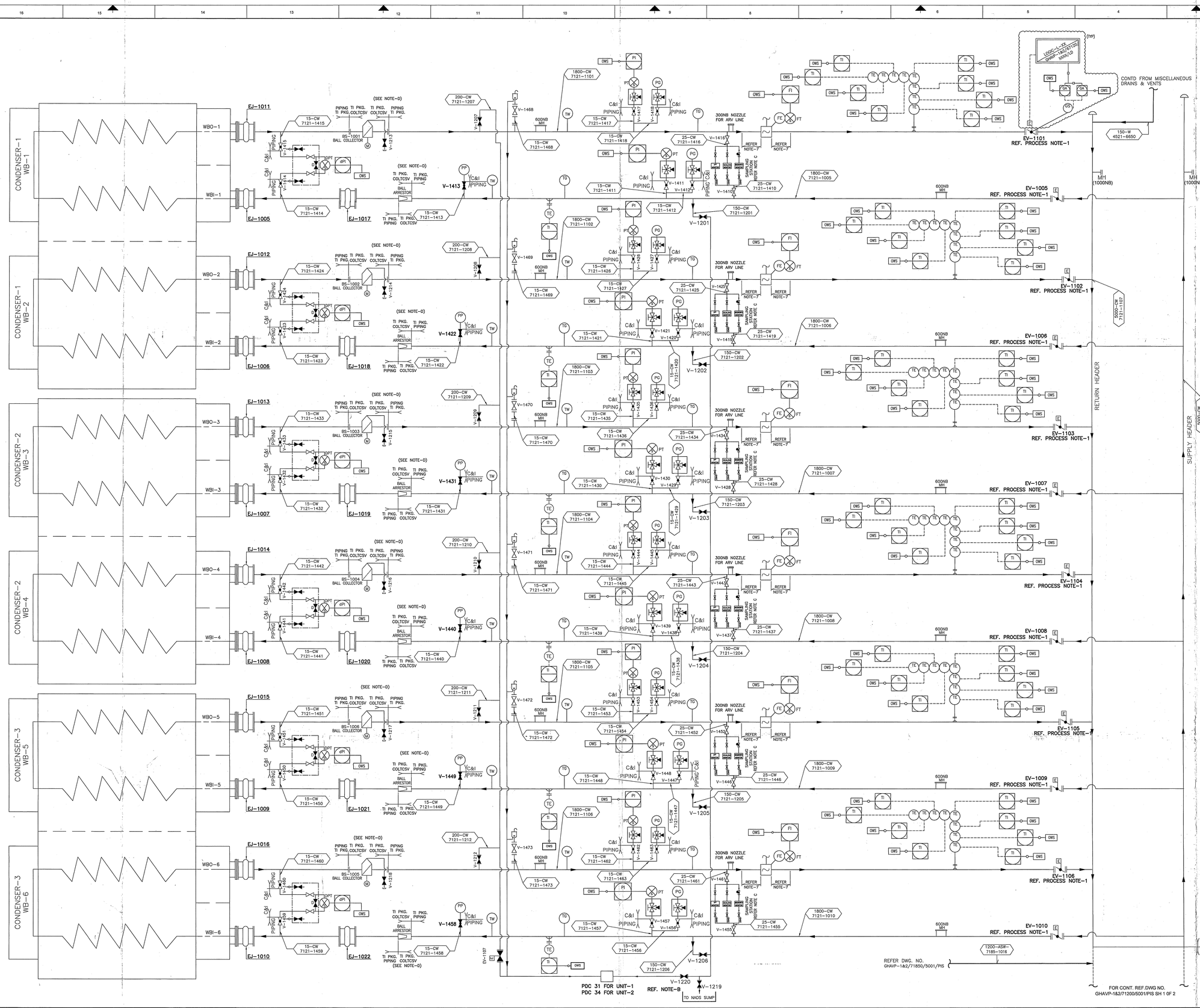
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PROJECT GHAVP-1&2		SCALE - NTS	
		PROJECTION	
DRG. No. GHAVP-1&2/71200/5001/PIS SH 1 OF 2			REV. No. R0

FILE NAME: GHAVP12_71200_5001_PIS_SH_1 OF 2

DRG. No GHAVP-1&2/71200/5001/PIS SH 1 OF 2

A0

DRG. TO BE READ IN CONJUNCTION WITH DCNFCN#CN, IF ANY.



PROCESS NOTES:

1. IN NORMAL OPERATION MOTORIZED BUTTERFLY VALVE WILL BE IN OPEN CONDITION. MOTORIZED BUTTERFLY VALVE WILL BE IN CLOSED CONDITION TO ISOLATE CONDENSER WATERBOX INCASE OF MAINTENANCE.

NOTES:

A. FOR ALL GENERAL NOTES REFER SHEET NO. GHAVP-12/71200/5001/PIS SH 1 OF 2.

B. DRAINING OF WATER BOX UPTO ELEVATION EL. 100.0M SHALL BE DONE THROUGH V-1220. DRAINING OF WATER BOX BELOW EL. 100.0M SHALL BE CARRIED OUT MODERATELY WITH ADMINISTRATIVE CONTROL THROUGH V-1219, SO THAT FLOODING OF THE NADS SUMP IS AVOIDED.

C. SAMPLING IS IN THE SCOPE OF NPCIL O&M. TI CONTRACTOR TO GIVE TAPPING WITH GATE VALVE AT THE INLET AND OUTLET OF THE SAMPLING STATION.

D. CONDENSER ONLINE TUBE CLEANING SYSTEM (OLCTCS) IS PRESENTLY NOT ENVISAGED FOR THIS PROJECT. HOWEVER CONCERENED CONTRACTOR SHALL KEEP ADEQUATE PROVISIONS FOR SPACE IF OLCTCS IS PROVIDED AT LATER DATE. PLEASE REFER TENDER SPECIFICATIONS IN THE TENDER DOCUMENT FOR FURTHER DETAILS.

LOGIC NOTES:

1. CCW PUMP

(SUGGESTIVE ONLY. SAME SHALL BE FINALISED DURING DETAIL ENGINEERING.)

i. PUMP SHALL START WHEN :

a) WATER LEVEL IN SUMP IS NORMAL AND
b) BUTTERFLY VALVE IN DISCHARGE LINE IS CLOSED AND
c) MOTOR WINDING AND BEARING TEMPERATURE IS NOT HIGH AND
d) MOTOR PROTECTION IS NOT ACTIVATED AND
e) SEAL WATER FLOW NOT LOW OR SEAL WATER PRESSURE NOT LOW WITH 30 SECONDS DELAY AND
f) COOLING WATER FLOW TO THRUST BEARING NOT LOW WITH 30 SECONDS DELAY.
g) EMERGENCY PUSH BUTTON NOT OPERATED.

ii. PUMP SHALL TRIP WHEN :

a) MOTOR PROTECTION IS ACTIVATED.

2. LOGIC FOR LUBRICATION WATER PUMP

i. PUMP SHALL START WHEN :

a) WHEN 'HS' IS SELECTED IN 'ON' POSITION
b) WHEN 'HS' IS SELECTED IN 'AUTO' POSITION AND RUNNING PUMP TRIP AND NO ELECTRICAL FAULT EXISTS.

ii. PUMP STOPS WHEN 'HS' IS SELECTED IN 'OFF' POSITION.

iii. PUMP TRIPS WHEN ELECTRICAL FAULT OCCURS OR DISCHARGE PRESSURE LOW. TRIP CONDITION IS LATCHED UNTIL IT IS RESET THROUGH CONTROL SWITCH 'OFF/RESET'

3. ELECTROHYDRAULIC VALVE

i. EHV OPEN:

(A) WHEN PUMP PERMISSIVES SATISFIED & PUMP HS SELECTED IN "ON" EHV STARTS TO OPEN AND ONCE VALVE 5%OPEN LIMIT SWITCH ACTUATED ITS FEEDBACK GOES TO PUMP & PUMP STARTS.
(B) AFTER SENSING PUMP STARTING EHV WILL FURTHER OPEN TO 100%.

ii EHV CLOSING:

(A) NORMAL MODE: WHEN PUMP HS IS OFF/RESET, SIGNAL IS GIVEN FOR VALVE CLOSURE FROM 100% OPEN TO FULL CLOSE. AT 10% VALVE OPEN, LIMIT SWITCH FEEDBACK/COMMAND WILL TRIP THE PUMP. AFTER SENSING CCW PUMP TRIP CONDITION, EHV WILL FURTHER CLOSE TO 100%.

(B) EMERGENCY MODE: SIGNAL IS GIVEN TO VALVE CLOSE FROM 100% OPEN TO 10% OPEN TO ENSURE CLOSURE IN 30 SECS & REMAINING WILL CLOSE IN NEXT 30 SECS.

4. CONDENSER WATER BOX ISOLATION EVs

1. THE VALVE IS PROVIDED WITH THREE POSITION (OPEN-CLOSE-STOP/RESET) SOFT HANDSWITCH IN DCS

2. LOGIC IN DCS
A) VALVE OPENS DURING FOLLOWING CONDITIONS – PROVIDED THERE IS NO MOTOR PROTECTION OR HIGH WINDING TEMPERATURE

I) WHEN HS IS IN OPEN POSITION

B) VALVE CLOSES DURING FOLLOWING CONDITIONS – PROVIDED THERE IS NO MOTOR PROTECTION OR HIGH WINDING TEMPERATURE

I) WHEN HS IS IN CLOSE POSITION

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REV. No.	DESCRIPTION	CONSULTANT SIGNATURE WITH DATE
R0	FOR TENDERING	05.01.17

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DES'D. | CHK'D. 04.01.2018 | REV'D. 05.01.2018 | APP'D. 05.01.17

TATA CONSULTING ENGINEERS LIMITED,MUMBAI
JOB REF. No.10990A

TITLE :- GHAVP POWER PROJECT-1&2
PIS FOR CONDENSER COOLING WATER SYSTEM

DES'D. DATE 01-02-18	DRN. DATE 01-02-18	REV'D. DATE 01-02-18	PW
DES. CHK'D. DATE 01-02-18	DRG. CHK'D. 01-02-18	APP'D. DATE 01-02-18	SSS

PROJECT GHAVP-1&2 | SCALE - NTS | PROJECTION

DRG. No. GHAVP-1&2/71200/5001/PIS SH 2 0F 2 | REV. No. R0

FILE NAME: GHAVP12_71200_5001_PIS_SH_2 0F 2

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

REFERENCE DRAWINGS	DRAWING No.	REFERENCE DRAWINGS	DRAWING No.	REFERENCE DRAWINGS	DRAWING No.
PIS FOR AUXILIARY SERVICE WATER SYSTEM	GHAVP-1&2/71850/5001/PIS				
PIS FOR CONDENSER COOLING WATER SYSTEM	GHAVP-1&2/71200/5001/PIS-SH 2 OF 2				

REV. NO.	REV. LOCATION	DESCRIPTION	DRN.	DES'D	DES.CHK'D	REV'D	APP'D
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R0B		REVISED AS PER NPCIL'S COMMENT'S					

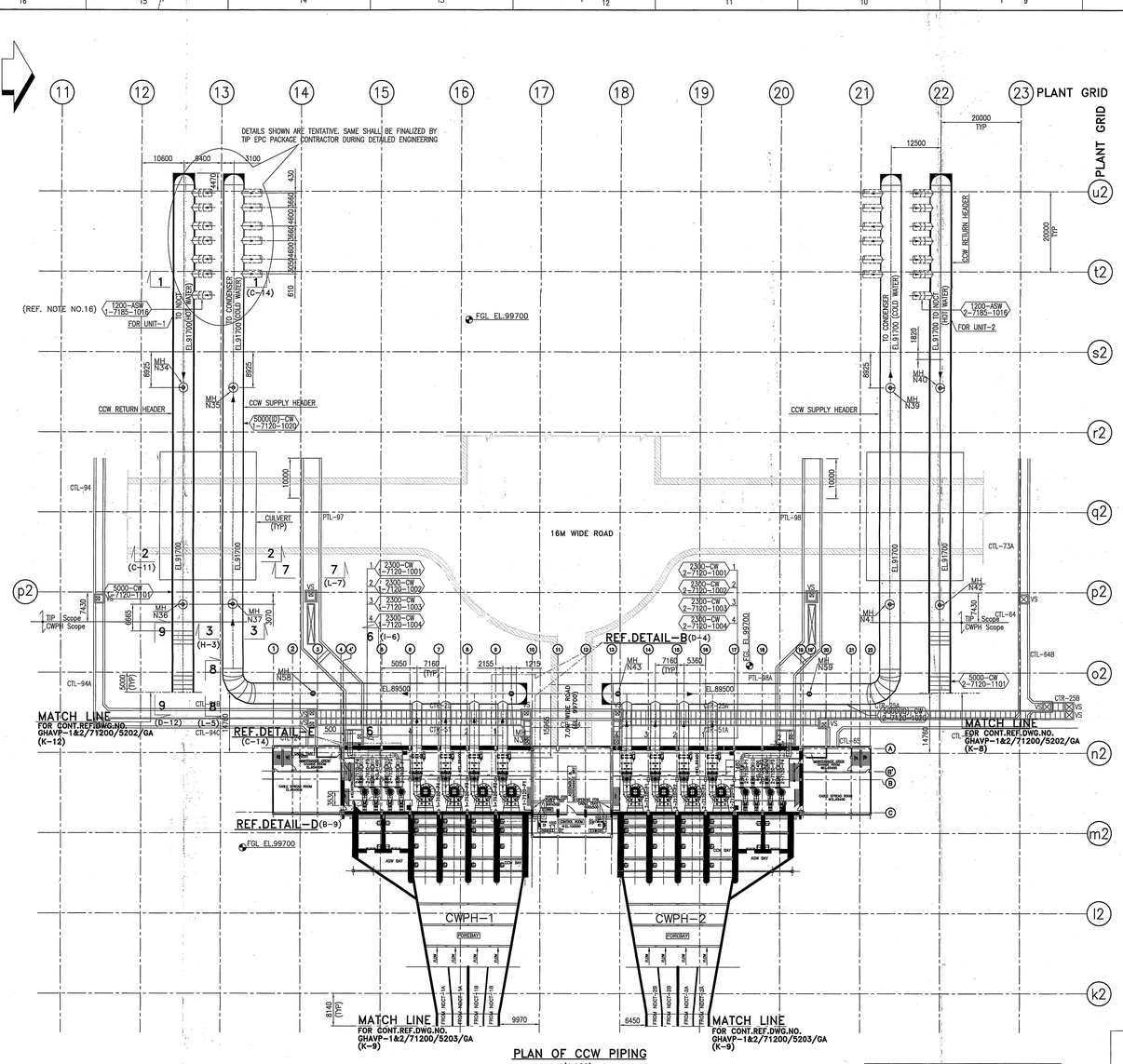
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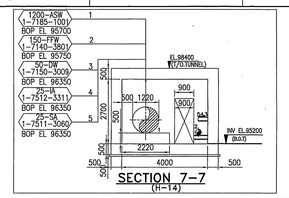
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DRG. No. GHAVP-1&2/71200/5001/PIS SH 2 OF 2

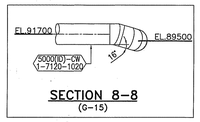
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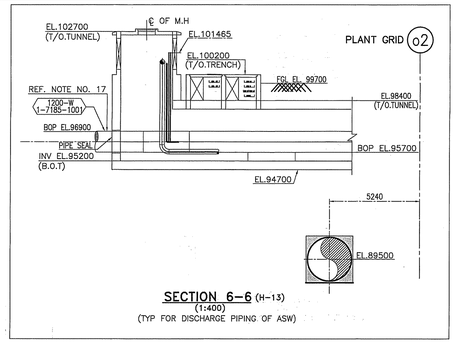
PLAN OF CCW PIPING
(1:100)



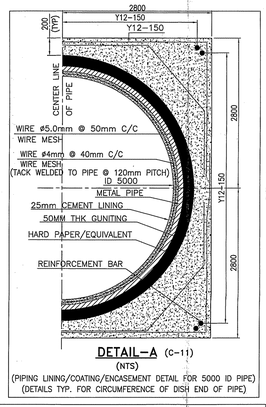
SECTION 7-7
(H-14)



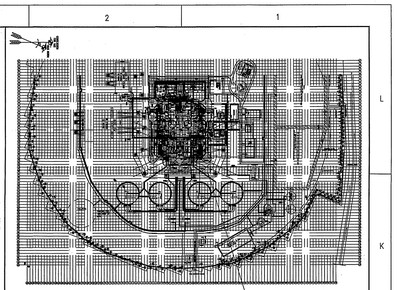
SECTION 8-8
(G-15)



SECTION 6-6 (H-13)
(1:400)
(TYP FOR DISCHARGE PIPING OF ASW)



DETAIL-A (C-11)
(NTS)
(PIPING LINING/COATING/ENCASEMENT DETAIL FOR 5000 ID PIPE)
(DETAILS TYP. FOR CIRCUMFERENCE OF DISH END OF PIPE)

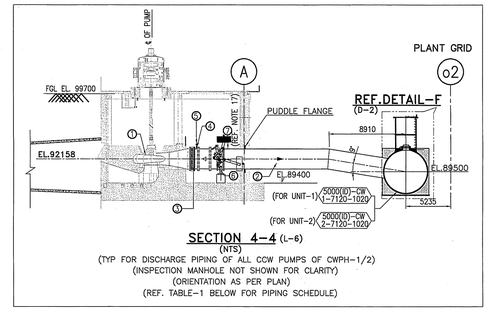


LEGEND:-

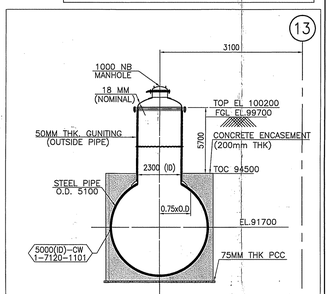
BOP	–	BOTTOM OF PIPE
EL	–	ELEVATION
CWPH	–	COOLING WATER PUMP HOUSE
FGL	–	FINISH GRADE LEVEL
RL	–	REDUCED LEVEL
PT	–	PRESSURE TRANSMITTER
PI	–	PRESSURE INDICATOR
MH	–	MANHOLE
TYP	–	TYPICAL
EJ	–	EXPANSION JOINT
EHV	–	ELECTRO HYDRAULIC VALVE
TIP	–	BALANCE OF TURBINE ISLAND PACKAGE
PBE	–	PLAIN BOTH END
POE	–	PLAIN ONE END
TOE	–	THREADED ONE END
FOF	–	FACE OF FLANGE
CMLC	–	CEMENT MORTAR LINED & COATED
FE	–	FLOW ELEMENT (CONE TYPE)
NRV	–	NON RETURN VALVE (DOUBLE DISC SWING CHECK)
	–	CONE TYPE FLOW METER
	–	ELECTROHYDRAULICALLY OPERATED BUTTERFLY VALVE
	–	RUBBER EXPANSION JOINT

NOTES:

1. ALL DIMENSIONS AND ELEVATIONS ARE IN MILLIMETER.
2. FINISHED GRADE LEVEL FOR THE MAIN PLANT IS RL. 219.300m ABOVE MSL WHICH CORRESPONDS TO EL. (+)99.700m.
3. ARV LOCATION AND QUANTITY TO BE SHOWN AFTER CCW SYSTEM TRANSIENT ANALYSIS.
4. ROUTING AND LOCATION OF 1800NB CCW INLET & OUTLET PIPE CONNECTION IS IN TIP SCOPE.
5. FOR ROAD LAYOUT REF. GHAVP-1&2/15600/5001/GA.
6. CCW SUPPLY AND RETURN HEADER PIPING LAYOUT OF UNIT-1 IS TYP AND MIRROR IMAGE OF THAT FOR UNIT-2.
7. PIPING ELEVATION INDICATED ARE TO BE CONSIDERED AT ITS CENTER LINE ELEVATIONS UNLESS OTHERWISE NOTED.
8. ALL PIPING INDICATED (EXCEPT FOR THE 2300 NB PUMP DISCHARGE AND 1800 NB CONDENSER INLET AND OUTLET PIPING) IN THIS DWG. IS OF CMLC PIPE.
9. CULVERT WALL THICKNESS AND ITS LOCATIONS INDICATED ARE TENTATIVE & TO BE FINALIZED LATER.
10. UTILITY PIPING FROM MATCH LINE ONWARDS AND INSIDE THE CWPH TO BE DONE BY PACKAGE CONTRACTOR.
11. THE TAG NO. FOR UTILITY PIPING FOR CWPH-2 ARE IDENTICAL TO THAT OF CWPH-1 AND AS INDICATED IN THE DETAIL, EXCEPT FOR THE UNIT NO. WHICH SHALL BE READ AS '2' IN PLACE OF '1'.
12. CONCRETE ENCASEMENT IS APPLICABLE FOR BOTH 3400 AND 5000ID CCW PIPES
13. FOR SITE GRADING LAYOUT REFER GHAVP-1&2/15100/5001/GA
14. SIZING OF CONE TYPE FLOW METER SHOWN IN 2300 NB PUMP DISCHARGE LINE IS INDICATIVE ONLY AND TO BE FINALIZED BY PACKAGE CONTRACTOR.
15. STIFFENER RING, REINFORCEMENT PAD DETAIL IS IN PACKAGE CONTRACTORS SCOPE.
16. ASW 1200NB RETURN HEADER LOCATION SHOWN IS INDICATIVE ONLY SAME TO BE FINILIZED BY TIP PACKAGE CONTRACTOR.
17. 50mm EXTERNAL CEMENT COATING SHALL BE DONE FOR ALL BURIED PORTION OF PIPING OTHER THAN CCW PIPING. FOR CCW PIPING RESPECTIVE TENDER SPECIFICATIONS SHALL BE USED.
18. LOCATION OF THRUST BLOCK FOR CCW PIPE SUPPLY AND RETURN HEADER WILL BE FINALIZED DURING DETAIL ENGINEERING.



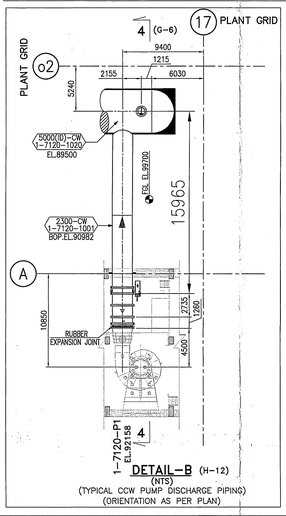
SECTION 4-4 (L-6)
(NTS)
(TYP FOR DISCHARGE PIPING OF ALL CCW PUMPS OF CWPH-1/2)
(INSPECTION MANHOLE NOT SHOWN FOR CLARITY)
(ORIENTATION AS PER PLAN)
(REF. TABLE-1 BELOW FOR PIPING SCHEDULE)



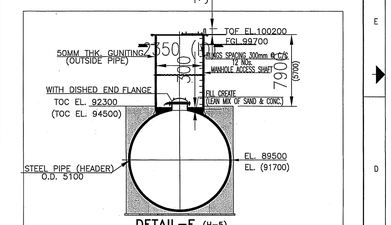
SECTION 3-3 (H-15)
(NTS)
(SECTIONAL VIEW OF MH FOR TESTING CCW PUMP (2300NB)
(TYP. FOR MH-N36,37,41,42,)

TABLE-1 : CCW PUMP DISCHARGE PIPING SCHEDULE

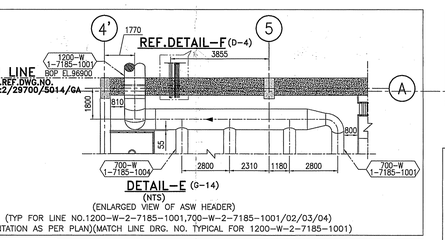
PUMP NO. ①	LINE NO. ②	EJ NO. ③	VALVE NO. ④	PT NO. ⑤	MV NO. ⑥	FE NO. ⑦
1-7120-P1	2300-CW-1-7120-1001	1-7120-EJ-1001	1-7120-V-6505	1-7120-PT-7001	1-7120-MV-1001	FE-001
1-7120-P2	2300-CW-1-7120-1002	1-7120-EJ-1002	1-7120-V-6510	1-7120-PT-7002	1-7120-MV-1002	FE-003
1-7120-P3	2300-CW-1-7120-1003	1-7120-EJ-1003	1-7120-V-6515	1-7120-PT-7003	1-7120-MV-1003	FE-005
1-7120-P4	2300-CW-1-7120-1004	1-7120-EJ-1004	1-7120-V-6520	1-7120-PT-7004	1-7120-MV-1004	FE-007
2-7120-P1	2300-CW-2-7120-1001	2-7120-EJ-1001	2-7120-V-6505	2-7120-PT-7001	2-7120-MV-1001	FE-001
2-7120-P2	2300-CW-2-7120-1002	2-7120-EJ-1002	2-7120-V-6510	2-7120-PT-7002	2-7120-MV-1002	FE-003
2-7120-P3	2300-CW-2-7120-1003	2-7120-EJ-1003	2-7120-V-6515	2-7120-PT-7003	2-7120-MV-1003	FE-005
2-7120-P4	2300-CW-2-7120-1004	2-7120-EJ-1004	2-7120-V-6520	2-7120-PT-7004	2-7120-MV-1004	FE-007



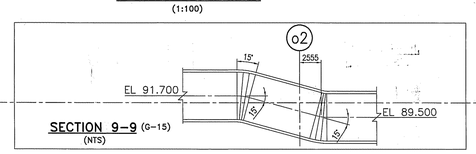
DETAIL-B (H-12)
(NTS)
(TYPICAL CCW PUMP DISCHARGE PIPING)
(ORIENTATION AS PER PLAN)



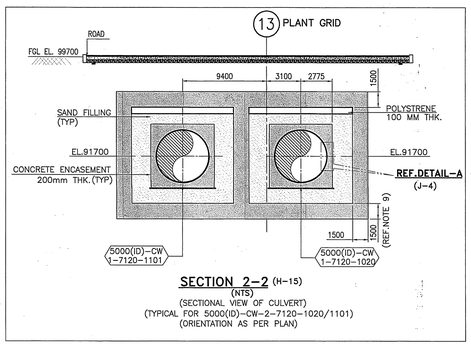
DETAIL-F (H-5)
(NTS)
(DIMENSION INSIDE BRACKET ARE APPLICABLE FOR MANHOLE 34,35,39,40)



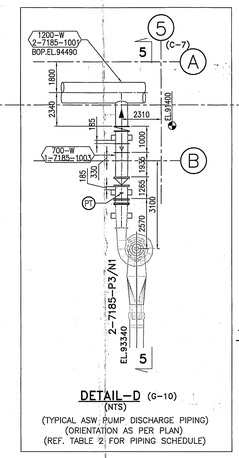
DETAIL-E (G-14)
(NTS)
(ENLARGED VIEW OF ASW HEADER)
(TYP FOR LINE NO.1200-W-2-7185-1001,700-W-2-7185-1001/02/03/04)
(ORIENTATION AS PER PLAN)(MATCH LINE DRG. NO. TYPICAL FOR 1200-W-2-7185-1001)



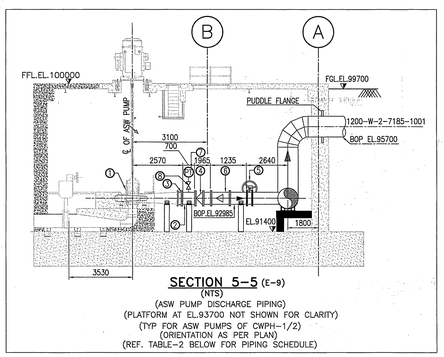
SECTION 9-9 (G-15)
(NTS)



SECTION 2-2 (H-15)
(NTS)
(SECTIONAL VIEW OF CULVERT)
(TYPICAL FOR 5000(ID)-CW-2-7120-1020/1101)
(ORIENTATION AS PER PLAN)



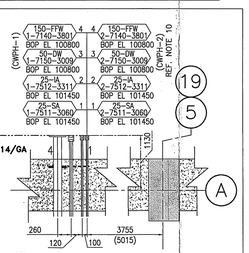
DETAIL-D (G-10)
(NTS)
(TYPICAL ASW PUMP DISCHARGE PIPING)
(ORIENTATION AS PER PLAN)
(REF. TABLE 2 FOR PIPING SCHEDULE)



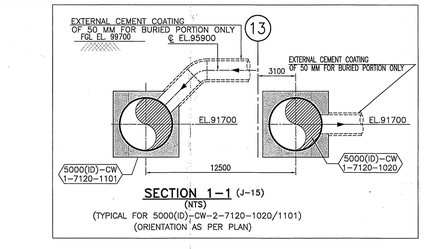
SECTION 5-5 (E-9)
(NTS)
(ASW PUMP DISCHARGE PIPING)
(PLATFORM AT EL.93700 NOT SHOWN FOR CLARITY)
(TYP FOR ASW PUMPS OF CWPH-1/2)
(ORIENTATION AS PER PLAN)
(REF. TABLE-2 BELOW FOR PIPING SCHEDULE)

TABLE-2 : ASW PUMP DISCHARGE PIPING SCHEDULE

PUMP NO. ①	LINE NO. ②	EJ NO. ③	VALVE NO. (NRV) ④	VALVE NO. (BUTTERFLY) ⑤	CONE METER ⑥	PRESSURE TRANSMITTER ⑦	VALVE NO. ⑧
1-7185-P1	700-W-1-7185-1001	1-7185-EJ-1001	1-7185-V-1030	1-7185-V-1001	1-7185-FE-7001	1-7185-PT-7001	1-7185-V-7025
1-7185-P2	700-W-1-7185-1002	1-7185-EJ-1002	1-7185-V-1031	1-7185-V-1002	1-7185-FE-7003	1-7185-PT-7002	1-7185-V-7026
1-7185-P3	700-W-1-7185-1003	1-7185-EJ-1003	1-7185-V-1032	1-7185-V-1003	1-7185-FE-7005	1-7185-PT-7003	1-7185-V-7027
1-7185-P4	700-W-1-7185-1004	1-7185-EJ-1004	1-7185-V-1033	1-7185-V-1004	1-7185-FE-7007	1-7185-PT-7004	1-7185-V-7028
2-7185-P1	700-W-2-7185-1001	2-7185-EJ-1001	2-7185-V-1030	2-7185-V-1001	2-7185-FE-7001	2-7185-PT-7001	2-7185-V-7025
2-7185-P2	700-W-2-7185-1002	2-7185-EJ-1002	2-7185-V-1031	2-7185-V-1002	2-7185-FE-7003	2-7185-PT-7002	2-7185-V-7026
2-7185-P3	700-W-2-7185-1003	2-7185-EJ-1003	2-7185-V-1032	2-7185-V-1003	2-7185-FE-7005	2-7185-PT-7003	2-7185-V-7027
2-7185-P4	700-W-2-7185-1004	2-7185-EJ-1004	2-7185-V-1033	2-7185-V-1004	2-7185-FE-7007	2-7185-PT-7004	2-7185-V-7028



DETAIL-F (D-14)
(NTS)
(ENLARGED VIEW OF UTILITY PIPING AT ENTRANCE TO ASW PUMP AREA)
(TYP FOR CWPH-2)
(DIMENSION INSIDE BRACKET ARE FOR CWPH-2)
(ALL OTHER DIMENSION REMAIN SAME FOR CWPH-2)
(ORIENTATION AS PER PLAN)



SECTION 1-1 (J-15)
(NTS)
(TYPICAL FOR 5000(ID)-CW-2-7120-1020/1101)
(ORIENTATION AS PER PLAN)

DO NOT SCALE THE DRAWING.

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

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

TOLERANCES ON LINEAR DIMENSIONS (IS:2102)

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

TOLERANCES ON LINEAR DIMENSIONS

SPECIFIED DIMENSIONS	TOLERANCE
XX	±
XX.X	±
XX.XX	±

TOLERANCES ON ANGULAR DIMENSIONS : ± 0° – 30'

REV. No.	DESCRIPTION	CHK'D.	APP'D.
0	TENDERING		

DRAWING ISSUED FOR

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

DES'D. | CHK'D. 05.08.2018 | REV'D. 05.08.2018 | APP'D. 06/08/2018

CONSULTING ENGINEERS LIMITED
MUMBAI

TITLE :- CCW SYSTEM
PIPING LAYOUT PLAN AND SECTION

DES'D. BLY DATE 22-01-18	DR'N. MFK DATE 22-01-18	REV'D. PBW DATE 22-01-18	
DES. CHK'D. HWJ DATE 22-01-18	DRG. CHK'D. VRR DATE 22-01-18	APP'D. SSS DATE 22-01-18	

PROJECT: GORAKHPUR HARYANA ANU VIDYUT PARIYOJANA-1&2
SCALE – 1:500
PROJECTION

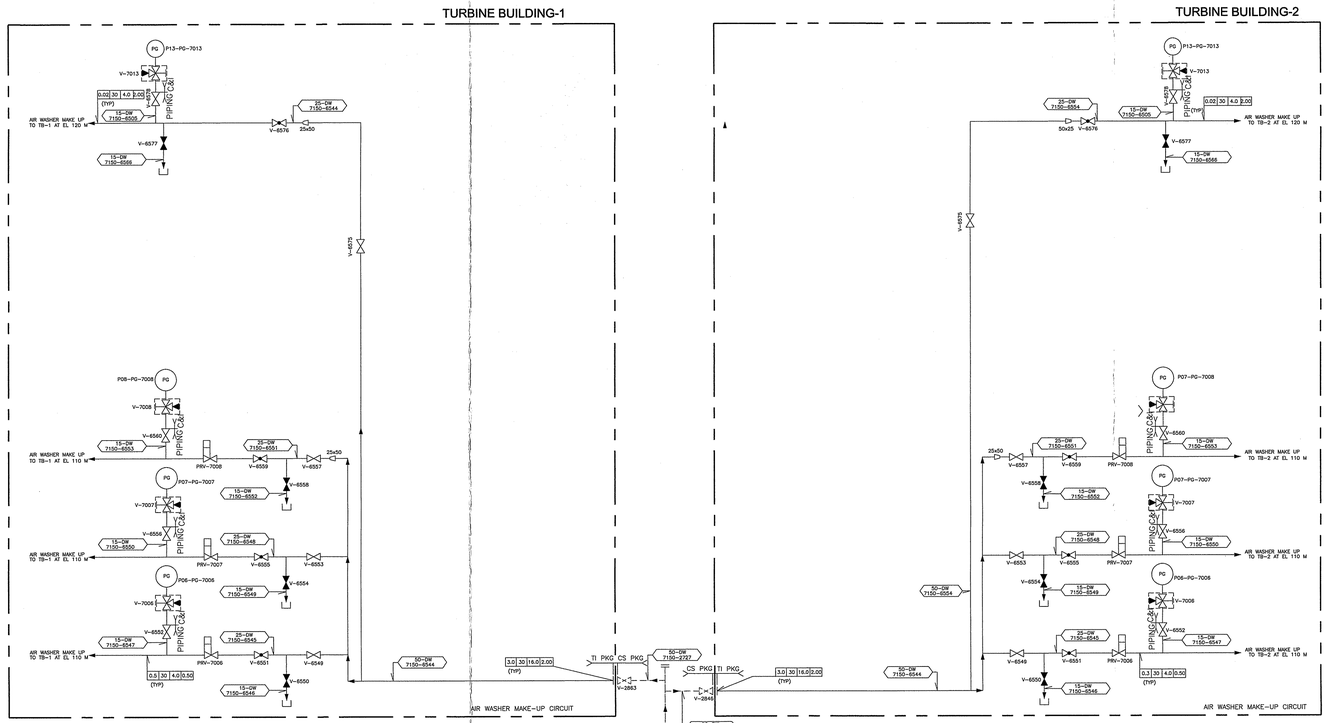
DRG. No. GHAVP-1&2/71200/5201/GA
REV. No. 0
FILE NAME: GHAVP-1&2_71200_5201_GA

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

DRG. No.	REFERENCE DRAWINGS	DRG. No.	REFERENCE DRAWINGS	DRG. No.	REFERENCE DRAWINGS
GHAVP-1&2/71200/5201/GA	CCW SYSTEM TUNNEL LAYOUT PLAN & SECTIONS	GHAVP-1&2/71200/5203/GA			
	CCW SYSTEM PIPING LAYOUT PLAN & SECTION	GHAVP-1&2/71200/5202/GA			
	CCW SYSTEM PIS	GHAVP-1&2/71200/5001/PIS/ROA(SH1.1 OF2)			
	PLANT WATER SYSTEM PIS	GHAVP-1&2/71120/5001/PIS			
	COMPOSITE PLANT LAYOUT UNIT 1&2 WITH ALL SERVICES	GHAVP-1&2/10000/2004/GA	EQUIPMENT GA FOR COOLING WATER PUMP HOUSE FOR UNIT 1&2	GHAVP-1&2/71200/5200/GA	

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

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LEGEND:–

FOR SYMBOLS AND ABBREVIATION REFER REPORT NO. ED–PROC.53 PART II

BW – BATTERY WASH
CL – CHEMICAL LAB
WB – WASH BASIN
TL – TOILET
BOTIP – BALANCE OF TURBINE ISLAND PACKAGE
FW – FLOOR WASH
WC – WATER CLOSET
DW – DOMESTIC WATER
– SWING CHECK VALVE
– SCREW COUPLING
– ELECTRIC SIGNAL LINE
– DOMESTIC WATER LINE
– TRANSMITTER/INSTRUMENT LOCALLY MOUNTED
– TRANSMITTER/INSTRUMENT MOUNTED ON LOCAL PANEL
– INDICATING LAMP MOUNTED ON LCP
– HAND SWITCH MOUNTED ON LCP
– PRESSURE GAUGE
– PRESSURE SWITCH
– PRESSURE LOW ALARM ON LOCAL CONTROL PANEL
– TG DDCMIS CONSOLE ANNUNCIATION
PNL – PANEL TROUBLE

– HARDWIRED RELAY LOGIC EXECUTED FROM LCP/BLCP.

OPERATING PRESSURE kg/cm²(g)	OPERATING TEMP. °C	FLOW m³/hr	VELOCITY m/sec

GENERAL NOTES:–

1 THIS PIS IS INDICATIVE ONLY. PACKAGE CONTRACTOR HAS TO DESIGN THE SYSTEM BASED ON THIS PIS AND PREPARE THE P&ID AND SUBMIT FOR NPCIL APPROVAL
2 ALL DIMENSIONS ARE IN MM AND ELEVATIONS ARE IN METER.
3 VENT AND DRAIN POINTS WILL BE PROVIDED AT APPROPRIATE LOCATIONS. VENTS AND DRAIN SHALL BE PROVIDED WITH TOE NIPPLE AND THREADED CAP.
4 ALL EQUIPMENTS, PIPING, VALVES NOS. WILL HAVE PREFIX 1 & 2 FOR GHAVP–1 & GHAVP–2 RESPECTIVELY.
5 ALL INSTRUMENTS & INSTRUMENT VALVES ARE PREFIXED BY "67150" UNLESS OTHERWISE SPECIFIED. ALL PROCESS VALVES WILL BE PREFIXED BY "7150" UNLESS & OTHERWISE SPECIFIED.
6 ISOLATION VALVES ON INLET LINES SHALL BE LOCATED AT OPERABLE LEVEL (MAX 1.8 M FROM FLOOR LEVEL).
7 PG ROOT VALVES ARE OF SOCKET WELDED TYPE. PG TAPPING SHALL BE TERMINATED WITH FULL SCREW COUPLING.
8 PG'S ARE TO BE PROVIDED AFTER PRV.
9 PIPES SHALL BE OF CS MATERIAL AS SPECIFIED IN 700 MWe/71500/PMS/01.
10 DOMESTIC WATER OF 16 M3/HR WILL BE PROVIDED UP TO THE TERMINAL POINT, FOR AIR WASHERS MAKEUP WATER REQUIREMENT. HOWEVER AT THE TERMINAL POINT, THE PRESSURE HEAD OF DOMESTIC WATER SHALL BE SUCH THAT IT CAN CATER AIR WASHER MAKEUP WATER REQUIREMENT UP TO APPROX EL 120 M, IF THE AIR WASHERS ARE LOCATED ABOVE EL 120 M IN TB, CONTRACTOR SHALL PROVIDE SUITABLE BOOSTER PUMPS ARRANGEMENT (ONE WORKING + ONE STANDBY PUMP) TO MEET THE AIR WASHER MAKEUP WATER REQUIREMENTS ALONG WITH PUMP BYPASS PROVISIONS.
11 DOMESTIC WATER SYSTEM DESIGN PRESSURE IS 10.0 kg/cm²(g) AND DESIGN TEMPERATURE IS 50°C.
12 ALL PIPING WILL BE OF WELDED JOINTS CONSTRUCTION. INTERNAL DISTRIBUTION PLUMBING WORK NEAR WB,TL,FW,WC,COOLERS WILL BE OF SCREWED JOINTS.

TABLE NO.:– 1

SL NO.	DESCRIPTION	NOS. ALLOTED	NOS. USED	NOS. DELETED
1	PRESSURE GUAGE	7001–7020	7001–7013	–
2	UTILITY LINE	6501–7000	6501–6585	–
3	VALVES	6501–7000	6501–6588	–
4	INSTRUMENT ISOLATION VALVE	7001–7020	7001–7017	–
5	PRESSURE SWITCH	7001–7020	7001–7004	–
6	PRV	7001–7020	7001–7008	–
7	INSTRUMENT TUBING NO.	12T–1 TO 12T–40	12T–1 TO 12T–4	–

THIS PIS IS INDICATIVE ONLY. PACKAGE CONTRACTOR HAS TO DESIGN THE SYSTEM BASED ON THIS PIS AND PREPARE ITS OWN P&ID AND SUBMIT FOR NPCIL APPROVAL

REV. No.	DESCRIPTION	DATE	APP'D.
0	TENDERING	18/07/2018	

DRAWING ISSUED FOR

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

TITLE :– GORAKHPUR HARYANA ANU VIDHUT PARIYOJNA
DOMESTIC WATER DISTRIBUTION IN TURBINE BUILDING PROCESS & INSTRUMENTATION SCHEMATIC

DRN	DRG.CHK'D	DES'D	DES.CHK'D	REV'D	APP'D
		16-07-2018	16-07-2018	18/07/2018	

SCALE - N.T.S.
PROJECTION
AVP-1&2
/P-1&2/71500/2201/PIS
REV. No. 0
FILE NAME: GHAVP12_71500_2201_PIS_R0

DO NOT SCALE THE DRAWING.
UNLESS OTHERWISE STATED :–
ALL DIMENSIONS ARE IN mm.
MACHINE ALL OVER.
SURFACE FINISH TO BE 3.2/ OR BETTER. *
REMOVE ALL BURRS.
REMOVE ALL EXTERNAL SHARP CORNERS AND EDGES BY CHAMFERING TO 0.1 X 45°.

TOLERANCES ON LINEAR DIMENSIONS (IS:2102) * *

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

TOLERANCES ON LINEAR DIMENSIONS *

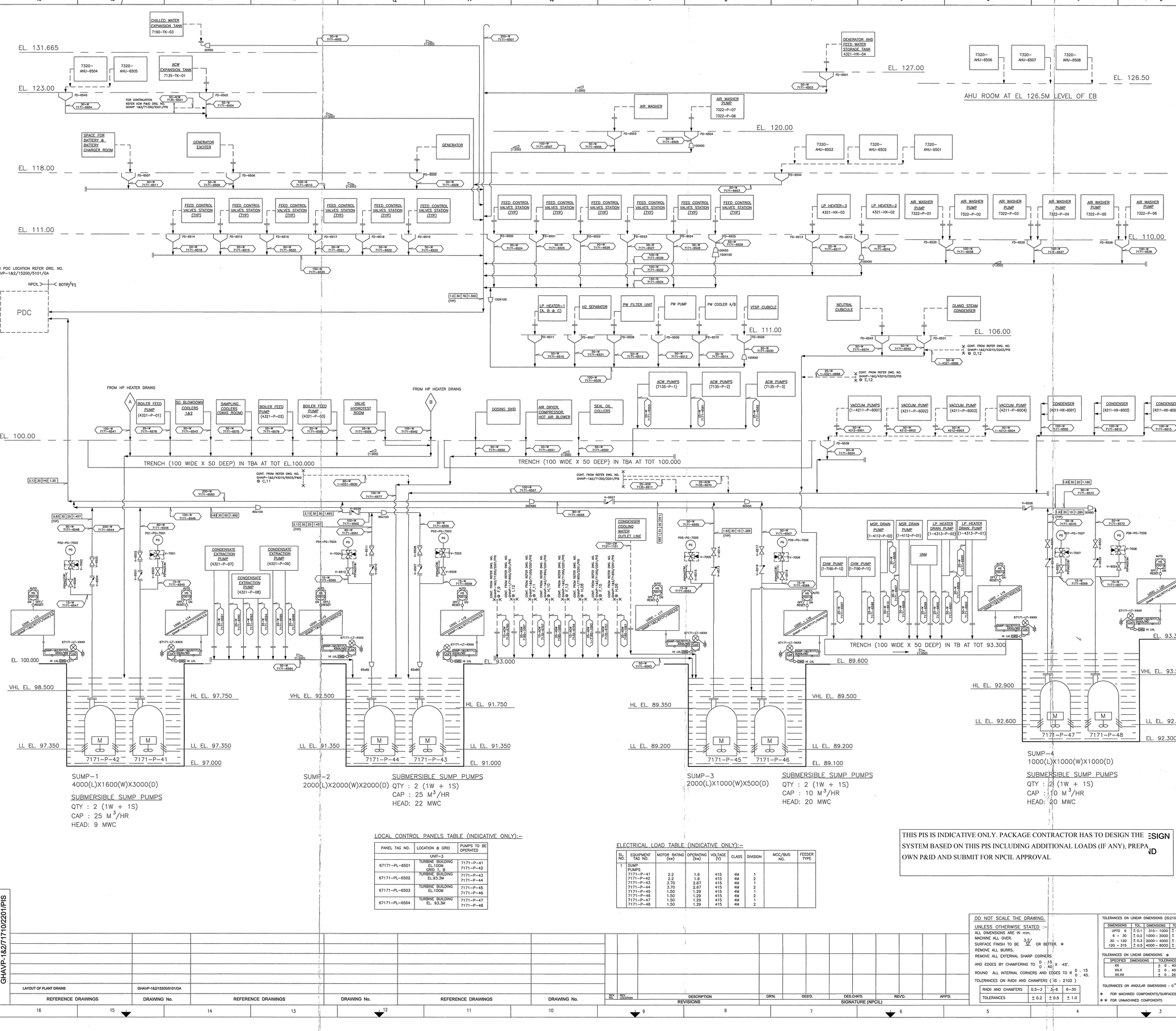
SPECIFIED DIMENSIONS	TOLERANCE
XX	± 0 . 40

THIS PIS IS INDICATIVE ONLY. PACKAGE CONTRACTOR HAS TO DESIGN THE SYSTEM BASED ON THIS PIS INCLUDING ADDITIONAL LOADS (IF ANY), PREPARE ITS OWN P&ID AND SUBMIT FOR NPCIL APPROVAL

DRG. No.	REFERENCE DRAWINGS	DRAWING No.	REFERENCE DRAWINGS	DRAWING No.	REFERENCE DRAWINGS	DRAWING No.
GHAVP–1&2/71500/2201/PIS	TURBINE ISLAND PACKAGE CONTRACT TERMINAL POINT DETAILS FOR LIGHT WATER SYSTEMS	GHAVP–1&2/70000/2201/GA.				
	DOMESTIC WATER SYSTEM DISTRIBUTION IN SAB, WMP MISC. BLDG. PIS	GHAVP–1&2/71500/5004/P&ID.				
	DOMESTIC WATER SYSTEM DISTRIBUTION IN CB,TB & MISC BLDGS. PIS	GHAVP–1&2/71500/5003/P&ID				

REV. No.	REC. LOCATION	DESCRIPTION	DRN.	DES'D.	DES.CHK'D.	REV'D.	APP'D.
		REVISIONS	SIGNATURE (NPCIL)				

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LEGEND:-

A. FOR SYMBOLS & ABBREVIATIONS REFER ED PROC-53 PART II.

- LOGIC INTERLOCK HARD WIRED (OPERATED FROM LOCAL CONTROL PANEL)
- INSTRUMENT MOUNTED LOCAL CONTROL PANEL
- REPRESENTATION OF DATA COMMUNICATION THROUGH FIBRE OPTIC LINE
- ELECTRICAL SIGNAL LINE
- PROCESS LINE
- REPRESENTATION OF CONNECTIONS FROM SENSOR/DEVICE TO DUMMY BLOCK OF I/O DRG. NO.
- FLOOR DRAIN('D')
- SUBMERSIBLE PUMP
- RADAR TYPE LEVEL TRANSMITTER
- PDC – PLANT DRAIN CHAMBER
- BOTIP – BALANCE OF TURBINE ISLAND PACKAGE
- TOT – TOP OF TRENCH
- ANN – ANNUNCIATION
- TGDCS – TURBINE GENERATOR DISTRIBUTED CONTROL SYSTEM
- HL – HIGH LEVEL
- LS – LEVEL SWITCH
- P – PUMP
- PG – PRESSURE GAUGE
- LL – LOW LEVEL
- IL – INDICATING LAMP
- S – SUMP

OPERATING PRESSURE kg/cm²(g)	OPERATING TEMP. °C	FLOW m³/hr	VELOCITY m/sec

- BALL TYPE LIFT CHECK VALVE
- SWING TYPE CHECK VALVE

GENERAL NOTES :-

1 THIS PIS IS INDICATIVE ONLY. PACKAGE CONTRACTOR HAS TO DESIGN THE SYSTEM BASED ON THIS PIS AND PREPARE THE P&ID AND SUBMIT FOR NPCIL APPROVAL.
2 ALL ELEVATIONS ARE IN METERS AND ALL DIMENSION ARE IN MM UNLESS NOTED.
3 TAG NOS. FOR PIPES, VALVES, PUMPS & FLOOR DRAINS HAVE PREFIX-7171 & I&C HAVE PREFIX-67171.
4 PUMP FLOWS AND HEADS ARE TENTATIVE AND WILL BE FINALIZED BY PACKAGE CONTRACTOR.
5 ALL EQUIPMENT, PIPING, VALVES NOS. AND FLOOR DRAINS WILL HAVE PREFIX 1 FOR GHAVP-1 AND PREFIX 2 FOR UNIT 2.
6 PIPES SHALL BE OF CS MATERIAL AS SPECIFIED IN 700 MWe/71710/PMS/01.
7 SUMP DIMENSIONS ARE DEFINED AS LENGTH(L) X WIDTH(W) X DEPTH(D). SUMP DIMENSIONS ARE MINIMUM INDICATIVE ONLY. PACKAGE CONTRACTOR TO DESIGN THE SUMPS BASED ON SYSTEM REQUIREMENTS
8 DRAIN FROM EMERGENCY BLOW DOWN FLASH TANK, BLOW DOWN BOOSTER PUMPS, SG BLOW DOWN COOLERS-1&2 WILL NOT BE CONSIDERED FOR NAD SYSTEM. HOT DRAINS WILL BE COLLECTED TO 2.0 M DEEP PIT LOCATED ADJACENT TO SG BLOW DOWN COOLERS.
9 NON ACTIVE DRAINAGE FROM ELECTRICAL BAY ARE NOT SHOWN IN THIS PIS. HOWEVER THESE ARE TO BE PREPARED BY PACKAGE CONTRACTOR, ALONG WITH ITS AND PIS & FABRICATION DRAWINGS
10 NAD SYSTEM DESIGN PRESSURE IS 5.0 kg/cm²(g) FOR PRESSURISED LINE AND 1.0 kg/cm²(g) FOR GRAVITY LINE AND DESIGN TEMPERATURE IS 50°C.
11 ALL INSTRUMENT TAG NOS PROVIDED IN PIS ARE INDICATIVE ONLY. VENDOR SHALL TAG ALL THE C&I INSTRUMENTS AND DRAWINGS IN 6501 TO 6999 SERIES DURING THE PREPARATION OF NADS P&ID.
12 VENTS SHALL BE PROVIDED AT APPROPRIATE LOCATIONS. VENTS SHALL BE PROVIDED WITH TOE NIPPLE AND THREADED CAP.

INSTRUMENTATION, LOGIC AND ALARM NOTES :-

1 ALL SUMP PUMPS ARE CONNECTED TO CLASS IV DIV I & DIV II POWER SUPPLY AND CONTROLLED FROM TG-DCS.
2 ALL LOGICS ARE EXECUTED BY USING SOFT CONTROLS PROVIDED ON TG-DCS.
3 FOR SUMP LEVEL MEASUREMENT, RADAR TYPE LEVEL TRANSMITTERS ARE TO BE PROVIDED ON EACH SUMP.
4 EACH SUMP TO BE PROVIDED WITH FOLLOWING PUMPS & LEVEL TRANSMITTERS:

SR. NO.	SUMP TAG NO.	PUMP TAG NO.	NO. OF LEVEL TRANSMITTERS	LEVEL SETTINGS
	UNIT-1			
1	SUMP-1	7171-P-41 7171-P-42	02	HL, LL VHL, LL
2	SUMP-2	7171-P-43 7171-P-44	02	HL, LL VHL, LL
3	SUMP-3	7171-P-45 7171-P-46	02	HL, LL VHL, LL
4	SUMP-4	7171-P-47 7171-P-48	02	HL, LL VHL, LL

ALL PUMPS ARE PROVIDED WITH FOLLOWING :-
i) HAND SWITCH: OFF/RESET/AUTO/ON.

FOLLOWING LOGIC IS PROVIDED FOR OPERATION OF SUMP PUMPS:-

SR. NO.	LOGIC NO.	PUMP TAG NO.	LOGIC FOR OPERATION	OPERATED FROM PANEL
1	L13, L15, L17, L19	7171-P-41, 7171-P-43, 7171-P-45, 7171-P-47,	PUMP WILL START WHEN: a) PUMP HAND SWITCH IS IN "ON" POSITION. AND b) MOTOR OVERLOAD IS NOT ACTUATED. AND c) SUMP LEVEL ABOVE LOW LEVEL. OR { a) PUMP HAND SWITCH IS IN "AUTO" POSITION. AND b) SUMP LEVEL IS "HIGH" AND c) MOTOR OVERLOAD IS NOT ACTUATED. PUMP WILL TRIP WHEN: a) PUMP HAND-SWITCH IS IN "OFF/RESET" POSITION. OR b) [PUMP HAND-SWITCH IS IN "AUTO/ON" POSITION AND { SUMP LEVEL IS "LOW" OR MOTOR OVERLOAD IS ACTUATED.}]	TG-DCS
2	L14, L16, L18, L20	7171-P-42, 7171-P-44, 7171-P-46, 7171-P-48	PUMP WILL START WHEN: a) PUMP HAND SWITCH IS IN "ON" POSITION. AND b) MOTOR OVERLOAD IS NOT ACTUATED. AND c) SUMP LEVEL ABOVE LOW LEVEL. OR { a) PUMP HAND SWITCH IS IN "AUTO" POSITION. AND b) SUMP LEVEL IS "VERY HIGH" AND c) MOTOR OVERLOAD IS NOT ACTUATED. PUMP WILL TRIP WHEN: a) PUMP HAND-SWITCH IS IN "OFF/RESET" POSITION. OR b) [PUMP HAND-SWITCH IS IN "AUTO/ON" POSITION AND { SUMP LEVEL IS "LOW" OR MOTOR OVERLOAD IS ACTUATED.}]	TG-DCS

5 WHEN PUMP TRIPS AUTOMATICALLY ON MOTOR OVERLOAD, IT GETS LATCHED UNTIL RESET MANUALLY BY PUTTING HAND SWITCH IN OFF/RESET POSITION.

FOR EACH SUMP, FOLLOWING ANNUNCIATION IS PROVIDED :-
1) "DRAINAGE SUMP TROUBLE" ANNUNCIATION/LOGGING IS PROVIDED ON TG DCS. ANNUNCIATION WILL APPEAR WHENEVER THE RESPECTIVE SUMP LEVEL REACHES "HIGH LEVEL," AND PUMP IS NOT STARTED WITHIN 30 SECONDS OR SUMP LEVEL REACHES "LOW LEVEL" AND PUMP IS NOT TRIPPED WITHIN 30 SECONDS OR PUMP TRIPS ON MOTOR OVERLOAD.
2) NON ACTIVE DRAINAGE SUMP MOTOR CONTROL POWER SUPPLY FAIL IS ALSO LOGGED/ANNUNCIATED IN TG DCS

TABLE NO.:- 1

SL. NO.	DESCRIPTION	NOS. ALLOTED	NOS. USED	NOS. DELETED
1	PRESSURE GUAGE	7001-7020	7001-7008	–
2	UTILITY LINE	6501-7000	6501-6610	6585-6590
3	VALVES	6501-7000	6501-6528	6525
4	3 WAY VALVES	7000-7020	7001-7008	–
5	LEVEL TRANSMITTER	7000-7020	7001-7008	–
6	FD	6501-7000	6501-6545	6532-6538,6541,6543

LOCAL CONTROL PANELS TABLE (INDICATIVE ONLY):-

PANEL TAG NO.	LOCATION & GRID	PUMPS TO BE OPERATED
	UNIT-3	
67171-PL-6501	TURBINE BUILDING EL.100M GRID 1, B	7171-P-41 7171-P-42
67171-PL-6502	TURBINE BUILDING EL.93.3M	7171-P-43 7171-P-44
67171-PL-6503	TURBINE BUILDING EL.100M	7171-P-45 7171-P-46
67171-PL-6504	TURBINE BUILDING EL. 93.3M	7171-P-47 7171-P-48

ELECTRICAL LOAD TABLE (INDICATIVE ONLY):-

SL. NO.	EQUIPMENT TAG NO.	MOTOR RATING (kw)	OPERATING (kw)	VOLTAGE (V)	CLASS	DIVISION	MCC/BUS NO.	FEEDER TYPE
1	SUMP PUMPS							
	7171-P-41	2.2	1.6	415	4M	1		
	7171-P-42	2.2	1.6	415	4M	2		
	7171-P-43	3.70	2.67	415	4M	1		
	7171-P-44	3.70	2.67	415	4M	2		
	7171-P-45	1.50	1.29	415	4M	1		
	7171-P-46	1.50	1.29	415	4M	2		
	7171-P-47	1.50	1.29	415	4M	1		
	7171-P-48	1.50	1.29	415	4M	2		

THIS PIS IS INDICATIVE ONLY. PACKAGE CONTRACTOR HAS TO DESIGN THE SYSTEM BASED ON THIS PIS INCLUDING ADDITIONAL LOADS (IF ANY), PREPARE OWN P&ID AND SUBMIT FOR NPCIL APPROVAL

REV. No.	DESCRIPTION	DATE	APP'D.
0	TENDERING	15/6/18	

DRAWING ISSUED FOR

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

TITLE :-
GORAKHPUR HARYANA ANU VIDHUT PARIYOJNA
NON ACTIVE DRAINAGE SYSTEM (NADS) IN TURBINE BUILDING
PROCESS & INSTRUMENTATION SCHEMATIC

DRN	DRG.CHK'D	DES'D	DES.CHK'D	REV'D	APP'D

PROJECT GHAVP-1&2
SCALE - N.T.S.
PROJECTION
DRG. No. GHAVP-1&2/71710/2201/PIS
REV. No. 0
FILE NAME: GHAVP1&2_71710_2201_PIS_R0

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

DO NOT SCALE THE DRAWING.
UNLESS OTHERWISE STATED :-
ALL DIMENSIONS ARE IN mm.
MACHINE ALL OVER.
SURFACE FINISH TO BE 3.2 OR BETTER. *
REMOVE ALL BURRS.
REMOVE ALL EXTERNAL SHARP CORNERS
AND EDGES BY CHAMFERING TO 0.15 X 45°.
0.40
ROUND ALL INTERNAL CORNERS AND EDGES TO R 0.15 0.40.
TOLERANCES ON RADII AND CHAMFERS (IS : 2102)

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

TOLERANCES ON LINEAR DIMENSIONS (IS:2102) * *

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

TOLERANCES ON LINEAR DIMENSIONS *

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

TOLERANCES ON ANGULAR DIMENSIONS : 0°- 30'

* FOR MACHINED COMPONENTS/SURFACES
* * FOR UNMACHINED COMPONENTS

| LAYOUT OF PLANT DRAINS | GHAVP-1&2/15300/5101/GA | | | | | | |

Section C-2-4-15: SPECIFIC REQUIREMENT OF CIVIL STRUCTURE AND LOCAL CONTROL ROOMS (LCRs)

1. GENERAL REQUIREMENTS:

The cabling of Fire Alarm System (FAS), Public Address System (PAS), Intercom Telephone System & Manual Supplementary Telephone systems (MSTS) will be done inside GI conduit & these conduits will run on walls/ceilings. For cabling from one floor to another, floor openings shall be required. The vendor shall provide floor openings in each floor for routing of cables of the systems as detailed below:

Fire Alarm System: 2 openings of 50 mm. at each corner. This will be exclusively used for (FAS).
PAS : One opening of 50mm. at each corner. (This will be exclusively used for PA System.
Intercom system : Two opening of 50mm. at each corner. This will be used for Intercom & MSTS.

The floor openings sought above will be needed only if there is no provision to route cables from one floor to another by way of vertical cable shaft openings etc. or if these vertical shaft openings are present but cannot be used for routing the cables of the subject systems.

The required nos. & size of metallic conduits shall be embedded in the full length of turbine deck top, for routing of the C&I cables on deck area. In addition, required nos, & size of floor openings shall be provided on the operating floor for taking the cables from operating floor to nearest cable trays, running below the operating floor.

Engineering, supply and erection of all Embedded Parts (EP) for TIP supplied items (e.g. ISS, JBs, local panels etc) is in scope of TIP vendor.

2. Requirements of LOCAL CONTROL ROOMs (LCRs):

LCRs consists of: (1) SWAS room (2) Test, calibration and panel room (3) Local control center (4) Battery rooms (5) UPS rooms (6) DCPS (Battery Charger) rooms

The specific technical requirements of Control Room Area of Local Control Center are covered under clause 2.12, below.

2.1 Location and Mounting arrangement:

The LCRs shall be located in a structure which protects the Local control room equipment and its operators from external hazard such as flammable, corrosive & toxic substances, fire, noise, radiation, electromagnetic interference, mechanical vibrations, strong winds & storms, floods, vehicular traffic, missiles & unauthorized access etc. The local control rooms shall also be located outside of internally generated missile zones.

The Local control centre shall be structurally separated from Turbine building to protect the electronic cabinets and sensitive electronic items from induced vibration.

The Local control center shall have two areas, one area shall be used for mounting of cabinets/panel and other area (Control Room Area) shall be used for mounting the Operator consoles (OC), computers, servers, Large Video Screen (LVS), etc. The layout of operator consoles, LVS shall be as per the enclosed figure-1. Suitable Glass partition shall be provided between these two areas.

Sufficient space shall be provided for accommodating equipment, furniture and amount of operator traffic to be handled during startup, normal operation, shut-down and accident conditions. Also sufficient clearance shall be provided for access of fire-fighting equipment, service equipment etc.

Minimum 1.5 meters free space shall be provided between rows of panels/racks, also, minimum 1.5 meters free space between panels/rack and walls/doors shall be provided in each of LCRs.

In local center around 10 nos of cabinets/panels shall be mounted in a row. 5 nos of cabinets/panels shall mounted adjacent to each other and after that 1.5 meter free space shall be left for personnel/equipment movement after that other 5 nos of panels mounted adjacent to each others. The front side of panels in adjacent row shall face each other (i.e front sides of panels in row no. 1&2 shall face each other, similarly front sides of panels in row no. 3&4 shall face each other, like wise to be followed for other rows)

The equipment entry doors size shall be 2.5 m (W) x 2.5 m (H). The dismountable type of glass panel (0.5 m height) shall be provided above the entry door, which can be opened during equipment entry, if required.

2.2 Illumination:

For LCRs, the lighting conditions both its intensity and distribution is of prime importance as critical tasks are performed. The design of lighting system shall be done to provide flicker-free, uniform light intensity and avoid shadows, glare and reflections. The lighting colour shall be near white so that various colours in equipment, displays, indications & labels are distinguishable.

Lighting fixtures on top of LCRs Panels (LCRPs) and Operator Information Console (OICs) shall be fed from battery backed up power supply to ensure continuous lighting on the panels. Supply for these emergency fixtures shall be from two different groups. Illuminance range 200-300-500 Lux as per IS-3646 (part I) 1992 shall be provided.

Energy efficient lighting fixtures shall be used. However, care shall be taken in selecting and locating light fixtures which do not generate appreciable EMI to affect the functioning of C&I equipment in the vicinity.

A portable battery operated emergency lighting shall be provided. This will provide illumination on extended failure of power supply.
The lighting fixtures shall be general purpose.

Power supplies to the lighting fixtures for illumination of Unit-1 & Unit-2 LCRs shall be from the respective units.

2.3 Air Conditioning and Ventilation

The required design temperature and humidity conditions for LCRs are 22 ± 1 ^{o}C at 50% ± 5% relative humidity. This requirement is for normal equipment operation and the operating personnel in the LCRs. However the equipment shall be designed to operate at 40^{0} C temperature and relative humidity of up to 95% (non-condensing).

Adequate capacity/number of air handling units shall be been provided to meet cooling requirement of Local control rooms. The cooled and dehumidified air shall be supplied through properly designed supply air ducting to the conditioned space. The makeup air shall be filtered by high efficiency filters, having efficiency 95% down to 5 micron size of particles, provided on air handling unit outlet. Number of air changes per hour in LCRs shall be around 1.6. For operator comfort the air velocities in the main operating area shall not exceed 15 m/min and there should not be noticeable draft.

Separate air conditioning systems with independent air intakes for Unit-1 & Unit-2 LCRs shall be provided. Outlet of air to atmosphere from one unit shall be away from the other unit so that smoke in one LCRs will not enter into the other local control room. Also, provision shall be made in each unit to switch off ventilation intake dampers and fans from respective LCRs.

2.4 Earthing and Grounding

Each instrument or device having an electrical grounding terminal shall be connected through an insulated wire to a common ground bus provided in the panel for connection to the nearest station ground pad on the floor. The Turbine island (TI) ground consists of grid of copper strips/wire embedded in the concrete floor with copper pads flush with the floor provided near the rows of panels and connected to the embedded grounding grid. The TI grounding grids in various floors are finally connected to the separate grounding pit, having resistance less than 0.5 Ohm. Signal ground of panel instruments shall be single, multiple grounded or kept floating based on the type & characteristics of system. If a separate grounding pit for C&I systems/equipments is required, then the design, engineering, material procurement, construction and commissioning shall be in scope of TIP contractor. For grounding design of C&I systems, NPCIL's Engineering Standard on Instrumentation & Control System Grounding shall be followed.

2.5 Safety against Fire

LCRs is classified as non-hazardous area as per IEEE-384. The LCRs shall meet the following requirements.

2.5.1. LCRs shall not contain high energy equipment such as switchgear, transformers, rotating equipment, or potential sources of missiles or pipe failure hazards or fire hazards.

2.5.2. Power circuit cables in LCRs shall be installed in enclosed raceways.

2.5.3. Portable fire extinguishers shall be provided to extinguish local fire. Smoke venting fans shall be provided to vent out the smoke. Fire detection system shall be provided in LCRs.

2.5.4. Emergency exit doors shall be provided in each of the LCRs

2.6 Installation of LCRs Panels

In the LCRs Embedded Parts shall (EPs) be provided in the floor. After the alignment, the panels/racks shall be firmly fixed to these embedded sections by welding.

The EPs shall also provided for Instrument Support Stands (ISSs), Junction Boxes (JBs) any other C&I equipments located in the field. The mounting brackets/frame for above items shall be welded on the respective EPs and equipments shall be fixed with help of nuts, bolts and mounting accessory.

All the above mentioned EPs shall be engineered, supplied and erected by TIP vendor for all systems/equipments supplied by TIP vendor

2.7 Flooring of LCRs

To limit ESD, fire retardant electrostatic conductive flooring along with conductive footwear shall be used in the above-mentioned areas. This shall limit the electrostatic potential on walking human to less than 30 Volts. The nominal resistance between any locations on the conductive floor to the TI-earth pad shall be between 104-106 ohms. Anti static flooring shall be provided in all the areas except staircases.

For installation of Electrostatic Conductive flooring the concrete floor surface shall be smooth and flat with maximum variation of 3 mm in 3 m.

Cleaning shall be possible with neutral detergent. Damp mopping, machine cleaning and dry vacuum cleaning shall be possible. The cleaning detergents and cleaning and maintenance instructions recommended by the conductive flooring supplier shall be used to avoid degradation of electrostatic conductive properties. The common detergents or waxes shall not be used as it creates an insulating film & the dissipative qualities of surface deteriorates.

For detailed specification on Electrostatic Conductive Flooring NPCIL standard may be referred.

Anti-static flooring having electrical resistance in the range of 15-35 Mega-ohms per square meter shall be provided in each Local control rooms.

2.8 False Ceiling in LCRs

False ceiling shall be provided at a height of 3 meters from the floor for aesthetic reasons. Light fittings and ventilation louvers shall be flush with the false ceiling. Aluminum frame and panel shall be used for false ceiling.
False ceiling electrical layout will be coordinated with the Architect and the Civil Engineer so that reflected drawing provides for symmetrical and aesthetic layout of the following:

- Fans
- Light fittings
- A/C Diffuser
- Fire detectors
- Sprinklers
- Speakers etc.

2.9 **Alternative routes for access to LCRs:** There shall be adequate alternate routes through which the control room staff can leave or reach the LCR.

2.10 **Space Requirement:**

Tentative requirement of space for local control rooms in turbine building is given below.

Sr. No	Description	Elevation in turbine building	Room size	Air conditioning with false ceiling and Anti-static flooring
1	SWAS room	Vendor to specify	Vendor to specify	Required for SWAS dry panel room
2	Test and calibration room	Vendor to specify	Vendor to specify (minimum 6m X 8m)	YES
3	Battery rooms (at least two separate rooms shall be provided. One for 'NSR-N' battery banks & another for 'NSR-X' battery banks)	Vendor to specify	Vendor to specify	For battery room dry And cool air shall be circulated in such that the temperature does not increase beyond 35^{o}C.
4	UPS/DCPS rooms (at least two separate rooms shall be provided. One for 'NSR-N' UPSs & DCPSs and another for 'NSR-X' UPSs & DCPSs)	Vendor to specify	Vendor to specify	YES
5	Local control center (LCC)	Vendor to specify	Vendor to specify	YES

Height of above mentioned rooms shall be minimum 4.5m. The battery, UPS, DCPS rooms and LCC shall be located such that the cabling distance is as minimum as achievable.

2.11 **Auditory environment**

The auditory environment in the LCRs shall be such that the operators can perform their tasks effectively & comfortably.

The following Design Data base on auditory characteristics shall be used.

Range of optimum frequency: 200 Hz to 3000 Hz.
Level of intensity: 60 dB to 90dB.
Max. Ambient Noise: 45 dB.
Minimum difference of intensity to ambient noise: 10 dB
Intensity of emergency signal: 90dB to 100dB.

2.12 Specific Technical requirement of Control Room Area of Local Control Centre:

1. **Scope of Work**

The scope of the project includes designing; engineering, supply & installation of 24x7 'CONTROL ROOM AREA' Interiors. As the control room area is a significant place, it is imperative that it is designed properly in terms of Aesthetics, Ergonomics and Functionality. Various aspects should be considered while designing Control Room area to create ideal work place, considering physiological aspects such as line of sight and field of vision and cognitive factors such as concentration and perceptivity.

The design of systems, equipment and facilities shall reflect human factors requirements including the following:

1.1 Satisfactory environmental conditions for operator personnel. Including noise, air flow, temperature and humidity, and precautionary measure under uncontrolled conditions (like fire) beyond acceptable limits.

1.2 Adequate space for personnel and equipment for the movements and activities they are required to perform during operation and maintenance, under both normal and emergency conditions.

1.3 Adequate illumination for the performance of operation, control, maintenance and training.

1.4 The control room shall be built as per the criteria of "Human Factor Engineering" to improvise the efficiency utilization of the operators and provide them Fatigue free working environment.

1.5 Objective: -

a. Ensure maximum standard of safety.
b. Allow Flexibility
c. Minimize maintenance
d. Improve operator's efficiency & alertness.

1.6 Designing, manufacturing, testing, integration etc., all complete, preparation of the related drawings, documents, etc. of the 'control room area' shall be in the supplier's scope. The Controls design shall confirm the requirements & specifications of this bid document.

1.7 In broad, the scope of work and supply shall consist of the following parts: -

a. Interior Design and engineering.
b. All related services for supply, installation, testing.
c. Spares & Documentation

1.8 Detailed scope of work and supply shall include but not be limited to the following: -

a. Data Collection: Gather all information related to design of the 'control room area'.

b. Design Proposal: - Submission of various options of Control room layout for client's approval, complying to ISO 11064.

1.9 General: -

a. The tentative 'control room ' dimentions shall be provided to the Control room designer to develop the various options.
b. Supply of the product catalogue, technical proposals including but not limited to drawings, documentation, 3D views, colour pallets, for the complete solution.
c. Spares: -A list of manufacturer's recommended spares for operation and maintenance shall be provided.
d. Provide commissioning & warranty spares (Contractor shall utilize these spares of all the equipment that may be required during commissioning & warranty period separately).
e. Manufacturer shall be responsible for safety and security of the installed items till commissioning and final acceptance by Owner (before start of warranty period).
f. Quality assurance & commissioning of the complete system at site to the complete satisfaction of the Owner.

2. Acoustic Requirements of 'CONTROL ROOM AREA'

2.1 Control room being dead zone in acoustical terms, threshold should be lower than the normal.

2.2 Use of Acoustics measurements are desirable. Vendor to highlight the same in drawings.

2.3 Selection of fire retardant/rated material is must.

3. Mandatory Requirement:

The project demands for a contemporary, aesthetically appealing, ergonomically designed safe and 24x7 working facility. Conventional wooden cladding, painting, gypsum, POP ceilings, etc. are not acceptable.

This facility being the first of its kind, scale & prestige it is mandatory for the bidder to provide Designer 'control room area' interiors without compromising the safety and functionality of the facility. Materials having the adverse impact on the environment and nature shall not be accepted. To ensure the quality of the execution and integrity of the components it is mandatory for the main bidder that they get some qualified agency with an experience in turnkey control room project's supply and installation of Control Rooms including but not limited to Illumination, Floorings, ceilings, wall treatment and doors, order copy/copies to be submitted by the OEM along with the bid.

3.1 Submittals: - (Bidder to ensure that OEM shall submit the following documents along with technical Bid to obtain project level approval).

a. Certificate for ISO 9001-2015 quality certification.9001 certificates to be submitted as a proof of quality system implementation in manufacturing processes.
b. Ergonomic compliance report for control room layout as per ISO 11064

3.2 Warranty:

a. Five year's warranty against any manufacturing defect on 'control room area' design including but not limited to Illumination, Floorings, Custom designer metal ceilings, wall claddings and doors.

3.3 Design Criteria: -

a. The ceiling, Paneling and partition shall be of modular design, facilitating future equipment retrofits and full reconfigurations without requiring any major modification to the structure.

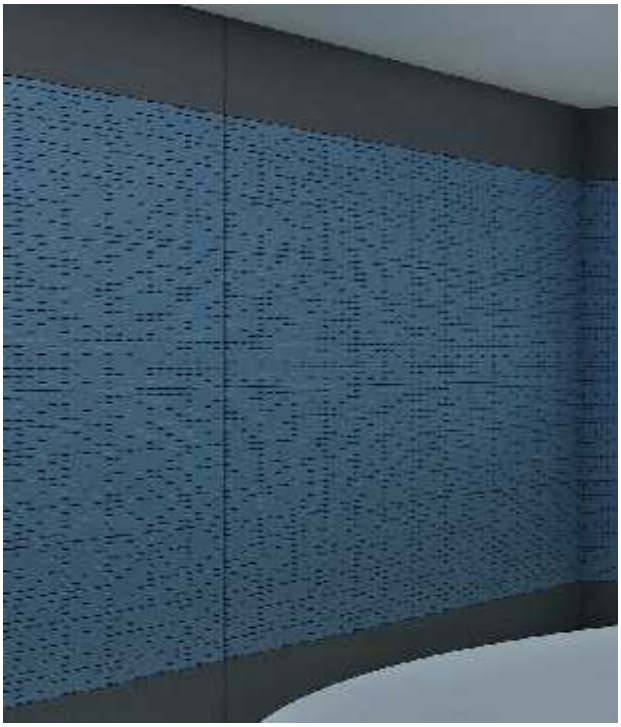
3.4 Product Specific Mandatory Requirement

Copy of Test certification for the surface burning characteristics of wall Paneling tiles and ceiling tiles to be submitted along with the technical Bid.

3.5 Quality Criteria: -

a. To ensure uniformity, consistency & quality in final product the 'control room area' & Control manufacturer preferably shall have In-house Powder Coating Plant, metal manufacturing and wood processing plant.

4. PANELING



4.1 Design & Material Specification for Paneling

a. Factory made removable type self inter lockable metal panels of Preformed textured hot dip galvanized strips and sheets of low carbon steel. Panel shall be of 0.75mm thick galvanized metal of NPCIL approved colour. Panels shall be designed to achieve shape and design as per the NPCIL approved design. Overall system thickness for panelling shall be 70mm to 85mm and for partition shall be 85mm to 110mm.
b. Panel shall be design in such a manner that it takes care of undulation of civil walls and gives perfect flat surface finish and compile easy service & maintenance procedure.
c. Sound transmission class (STC) value of 35 for Wall Paneling & Partition. Test report from NPCIL approved agency to be submitted during drawing approval stage before commencement of the job.

4.2 Design:

a. The cladding panels may be made up of combination of two sheets locked and riveted together and suitably infilled to achieve strength and acoustics. The front tile may be perorated/ non-perforated as per the design requirement. These tiles shall be bend, punched & cut to achieve perfect accuracy.
b. Structure shall be made from heavy duty powder coated modular steel frame (minimum sheet thickness 1 to 1.6mm) and shall allow uninterrupted flow of wires/cable/tubes of max. dia. 25mm.
c. Structure shall be securely grouted from wall, roof and floor. Grid of desired dimension shall be formed by Vertical and horizontal sections.

4.3 Surface Finish:

a. For Panels:

i. Front Panel: Fire retardant pre-coated GI sheet (sheet thickness: 0.6mm and coating: 0.15mm)
ii. Back Cover: Powder coated GI sheet. (sheet thickness: 0.6mm with powder coating:)

b. For Structure:

i. **Powder coated sheet. (sheet thickness: 1.0mm to 1.6mm with powder coating)** The metal sheet be able to undergo stretching up to 100% and therefore follow bend with the steel in all its deformation. The sheets shall have specific fire-retardant additives as an important barrier to slow down the combustion process. It shall have electrical insulation property and shall be sustainable and easy to maintain.

Panel shall provide better thermal, electrical insulation as compared to normal GI panels. It shall be non-reflective/glare free.

4.4 Material Testing/Certification (all certificates to be submitted during drawing approval stage before commencement of the job):

a. Fire retardant pre-coated sheet:

Fire rating and Low flame spread: EN ISO 11925-2, EN 13823 and ASTM E-84

b. Core material:

Acoustic test: 9301/ ISO: 140/ASTM 413, ASTM C 578.

c. Powder coating

i. Adhesion test: EN ISO 2409 (2 mm)
ii. Impact resistance test: ASTM D 2794 (5/9' ball)
iii. Flexibility test: EN ISO 1519
iv. Salt spry test: 600 hrs.
v. Resistance to humid atmosphere test: DIN 50017.

Supplier can submit available test report or certificate from the reputed labs and as per the international standards for purchaser's verification and acceptance.

4.5 Component Specification:

a. Floor Mounting: -

i. C channels of suitable thickness (around 3mm) are welded together to form an 'I' section having minimum height of 150mm. This 'I' section shall be welded on MS grouting plate.
ii. This assembly shall be grouted on the floor with the help of suitable Anchor Fasteners.
iii. These Floor Mountings shall be the base support to the vertical uprights spaced at a center to center distance of 1200mm maximum.
iv. Contractor must ensure proper marking and levelling before proceeding with any floor grouting.

b. Panel:

i. The panels shall be hooked/mounted on the uprights.
ii. Panels shall have integrated hooks.
iii. The panels shall have suitable gap between two tiles so that the tiles can be replaced and installed easily.
iv. The hooks of the Panels shall ensure that they firmly held on the uprights.
v. The panel shall have hook-in arrangement (with gravity lock).

c. Corner Cap:

i. On extreme ends of control room the wall connector (L- profile) may be fixed on the perimeter walls. This L-section may be snap fitted and then bolted to the walls.

d. Door Profile:

i. Door frame shall be fixed with these profile so as to have proper integration of doors with the overall system.

e. **Feature:**

i. Raw material for tile & powder coating should not affect environment, vendor to provide necessary test certificate.
ii. Colour should not fade over 10 years.
iii. No sagging
iv. Easy and quick installation
v. Easily cleanable
vi. Vendor to demonstrate one portion at wall paneling & ceiling at their premises before dismantling & shipping to site. In short a FAT (Factory acceptance test) to be carried out at vendors works for ceiling & paneling.
vii. 100 % modular design. At site, no cutting, chipping work is allowed.
viii. The tile shall be bend resistant

5. Straight Metal paneling

Paneling with factory made removable type self inter lockable metal panels of preformed fire retardant coated GI sheet panels. The metal panels fixed on structure made of 1.6 mm thick MS channels. Their properties shall be as follows:-

a. Resistance to extremes of weather exposure and temperature.
b. Very low coefficient of expansion.
c. Can be cleaned using detergents.
d. Superior flatness – ideal of creating smooth, monolithic surface.

All the properties and material of construction shall be like Metal paneling.

6. Cladding for Mounting the LVS/Screen

a. Suitable cladding with sturdy metal under-structure. The top finish must be fire retardant, Insulated, Water & Scratch resistance and shall have high hardness.
b. The material must be homogeneous throughout the depth with compliance to Green-Guard.
c. Thickness of the cladding shall be 12mm / 6mm, the ends shall have curvilinear design duly filleted / rounded.
d. The structure shall be modular to ensure easy maintenance and replacement.
e. All the fasteners should be hidden, and nuts/bolts shall not be visible on the exposed surface.
f. The top finish of material shall be Green guard Certified, and it shall be homogeneous throughout the depth.
g. It shall have Flame Spread Index FSI <25 as per ASTM E-84 surface Burning Characteristics of Building Materials.

7. DOORS

7.1 Metallic Door

With door spring and locking arrangements and both way handle. Specification: 0.6mm thick Metal panel sheets, cavity filled with glass wool insulation of sufficient density in roll form inside adequate quantity. Material of the partition and that of metal door will remain the same.

7.2 Metal door with Toughened Glass Vision Panel: -

a. The door shall have 100mm frame (made of same material as that of wall Paneling /partition) and shall have 12mm thick glass pane in between.
   i. 12mm thick tempered clear glass door with door spring and locking arrangements and both way handle and patch fittings.
   ii. Glass Properties:Safety (tempered): when broken, must split into tiny harmless pieces.

8. Ceiling – The ceiling can be made with the suitable combination of the options given below. The final design will be approved by purchaser.

8.1 Stretch Ceiling



a. The ceiling shall be supplied with demountable translucent stretch ceiling, corners ready to install. Ceiling shall transmit around 80% light and absorb around 20% of light. Material shall be fire rated with long life. It should not get discoloured & sag. All joints shall be provided with appropriate interface trims to be able to demount the ceiling to access the lights.
b. The ceiling must be installed using ceiling suspension system, complete as per manufacturer's installation guidelines and as per approved drawings in line with the design intent and approval by purchaser.
c. The LED Modules shall be supplied with appropriate drivers and dimming system. LED strips shall be installed and longevity of the installation shall be ensured. Necessary test report to be submitted along with the technical Bid.
d. The ceiling shall have following features and properties: -
   i. Simple and maintenance friendly: Installable in a few hours and finished product shall not require any taping, speckling or painting and shall be easily cleanable.
   ii. Durable: The systems shall resist shocks and shall not crack with movement or under stretch conditions.
   iii. Safe: The material and profiles shall have passed the fire and safety tests.
   iv. The material must have been classified as non-toxic upon burning.
   v. Green: material must be 100% recyclable.

8.2 Grid Type Ceiling



a. Factory made acoustic modular metal false ceiling of powder coated panels, comprising of perforated and non-perforated metal panels. Panel shall be of galvanized metal of approved colour. Panels shall be designed to enhance visual feel, with provision for easy installation and maintenance, integrated lighting and scope for integration of building services like ventilation, fire detection/ fighting system.

b. As per design, panel shall comprise of micro perforation for making false ceiling acoustically sound with fire rated acoustic fleece.

i. Ceiling Plank:

1. Plank shall be made from GI powder coated sheet of approved thickness, shade and sizes.
2. Light fitting can be defined as per the LUX requirement.
3. It shall have circular hole for light fixing as per defined lux requirement and approved layout.
4. Non-perforated tile slots to be punched to accommodate AC grills.

ii. Properties:-

1. High NRC (Noise Reduction Co-efficient)
2. Better Light reflectance & Fire performance.
3. Humidity Resistance.

8.3 Calcium Silicate Board:



a. Plain Calcium Silicate Acoustic Boards for false ceiling with 08mm approx. thick, structure for underside of suspended grid formed of GI perimeter channels. Wood screws and metal expansion raw plugs for fixing with wall. Plastic emulsion paint of approved make and shade for finishing surface of Calcium Silicate Boards.

b. General Specification of Calcium Silicate Board: this board is manufactured from a mixture of Portland cement, fine silica, special cellulose fibres and selected fillers to impart durability, toughness, fire and moisture resistance.

9. Lighting and Illumination of Control Room.

9.1 LED lights

i. Brief: - The lights shall be available in flat panels. These shall be designed and developed with slim shape for stylish look. The product shall have better colour rendering index for interior illumination.

ii. In LED shall have three basic choice of colours like cool white, warm white and neutral white. The LED lights shall have uniform light distribution without any spots on surface of panel, to make it highly luminous.

iii. **Features: -**

a. Round LED Lights

i. Temperature- 3000 K to 6500K
ii. CRI >70
iii. Power Consumption 12W to 24W
iv. Aesthetically designed enclosures
v. Highly efficient constant current LED drivers
vi. Ideal replacement for traditional PAR/CFL lamp
vii. Up to 80% energy saving.
viii. LED's life >25,000 hrs @ L70

b. LED based Square Light

i. Light source: LED
ii. Lumen output: 2800 – 3500
iii. Light color: 3000K - 6500K
iv. Power consumption: 29 to 38 W
v. Voltage: 220-240V AC 50Hz
vi. Color: White
vii. LED's life >25,000 hrs @ L70

c. LED based Strip Light

i. Light source: LED
ii. Lumen output: 840 lm/Mtr.
iii. Light color: 3000K/6000K
iv. Power consumption: 9.8 W/Mtr.
v. Voltage: 12V AC 50Hz
vi. Optics: Sand-blasted matt finish reflector
vii. Color: White
viii. LED's life >25,000 hrs @ L70

9.2 Wiring for Ceiling Light

a. Wiring for Ceiling Light:

i. Wiring for ceiling lights: For ceiling wiring inter looping will be done and switches will be provided.

ii. The system of wiring shall consist of Low Halogen Low Smoke (LHLS) copper conductor stranded flexible wires of 1100 volts grade of insulation, in metallic conduits for all exposed wiring and concealed wiring. Minimum size of copper conductor shall be 1.5 sq. mm for lighting and 2.5 sq.mm for power. Color code shall be maintained for the entire wiring installation.

iii. Appropriate ferrule will be used at both the ends.

9.3 SWITCHES & SOCKETS

a. Dual shutter mechanism for easy & better fitment Wide & flat switch knob for easy operation. FR grade polycarbonate with high impact resistance, shock proof & UV rays stabilized.

9.4 MCBs

a. For the control and protection of low voltage installations against overload and short circuits.

b. Ripping characteristic: C Curve – 5 to 10 x In

c. Isolation function

d. Double entry points, separate bus bar entry, open mouthed terminal and lift clamps.

10. FLOORING-

10.1 Acoustic & Antistatic Flooring: -



Acoustic flooring (shall reduce impact sound by 14dB) and an electrical resistance of more than 30M . Flooring shall be decorative type of approved shade, pattern, texture and design and of approved manufacturer. Dimensions shall be as per the final approved design and site requirement. Flooring shall be laid over concrete floor with laying compound strictly as per manufacturer's specification.

Mandatory requirement: The Floor Surface material shall be Green guard (UL) certified to avoid VOC free / low emitting surface.

The Flooring material shall be Green guard (UL) Certified.

10.2 Granite Stone for floor Highlighter/steps: - Providing 18 mm Pre-polished Granite stone for Floor Highlighter/steps, in required design and pattern, with 12 mm (average) thick cement mortar 1:3 (1 cement: 3 coarse sand) laid and joint with white cement slurry including pointing with white cement slurry admixed with pigment of matching shade, all as per Architectural drawings.

11. MISCELLANEOUS:

11.1 Film for glass Partition/glass Door

11.2 Shoe Rack: Made up with 0.8 mm thick CRCA sheet powder coated finish/Pre-laminated Particle Board 18mm thick.

11.3 Coat & Helmet Stand made up of matt finish SS

11.4 Chair: - 3 nos. of High back executive chair with synchronized tilting mechanism with multiple locking systems, ABS for seat, mesh back with Silver Epoxy Backbone with extra lumber Support with fine tuning for depth adjustment, with four way adjustable armrest, gas lift for height adjustment, nylon base with castors. Upholstery: Black fabric seat & mesh backrest & Black Leatherette headrest

12. Below given Figure-1 is applicable for layout of Operator Consol & LVS.

13. Below given figure-2 shall be referred for guidance of architecture of 'control room area'

14. GENERAL NOTES: -

1. **Warranty (for the entire CCR):**
   - **a. Lifetime warranty on structural stability.**
   - **b. Five years' warranty against any manufacturing defect on all modular/ removable system.**
   - c. **Three year's warranty on all the consumables like Ceiling light, MCB's etc.**

FIGURE-1: LAYOUT OF OC & LVS

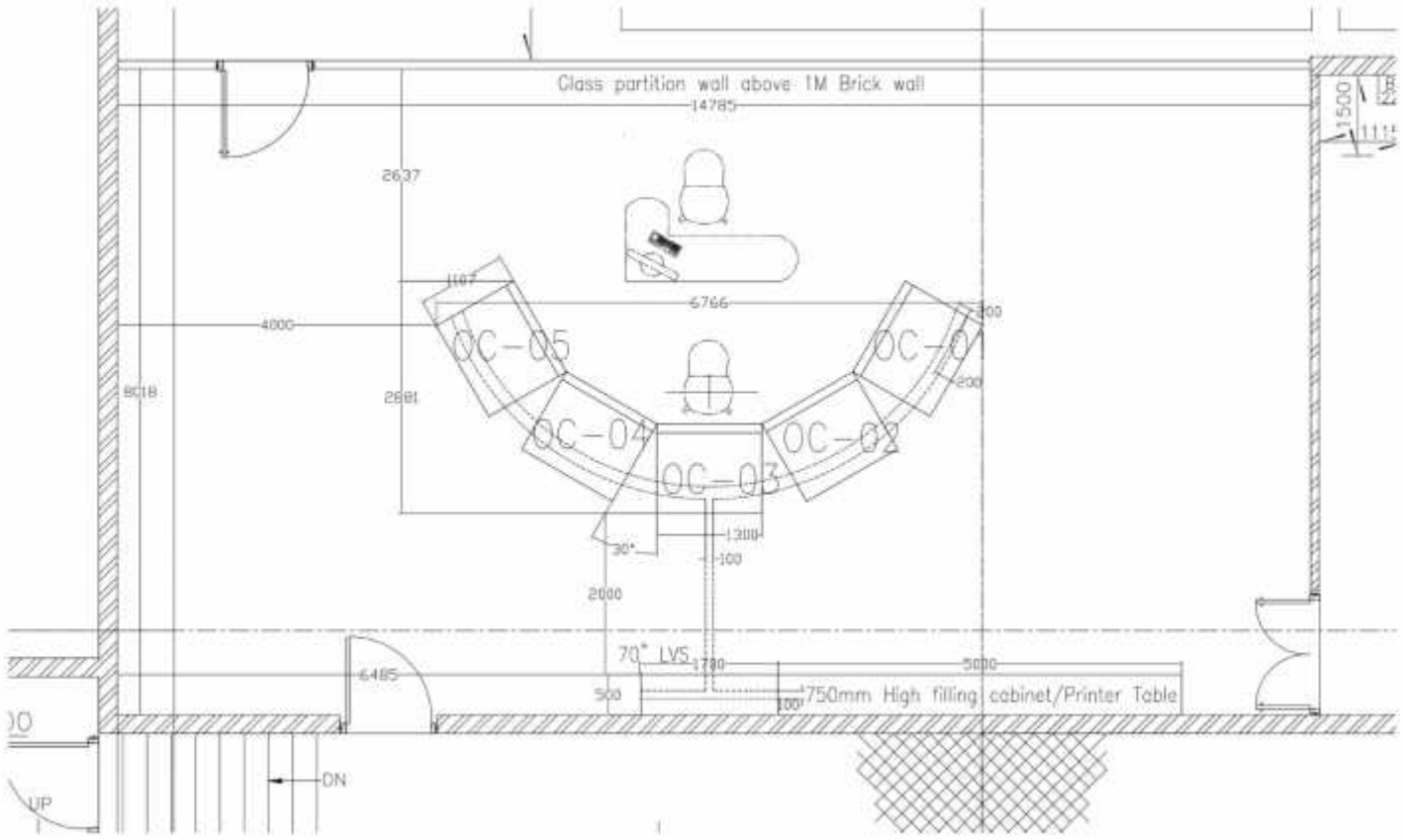


FIGURE-2(1): ARCHITECTURE OF 'CONTROL ROOM AREA'



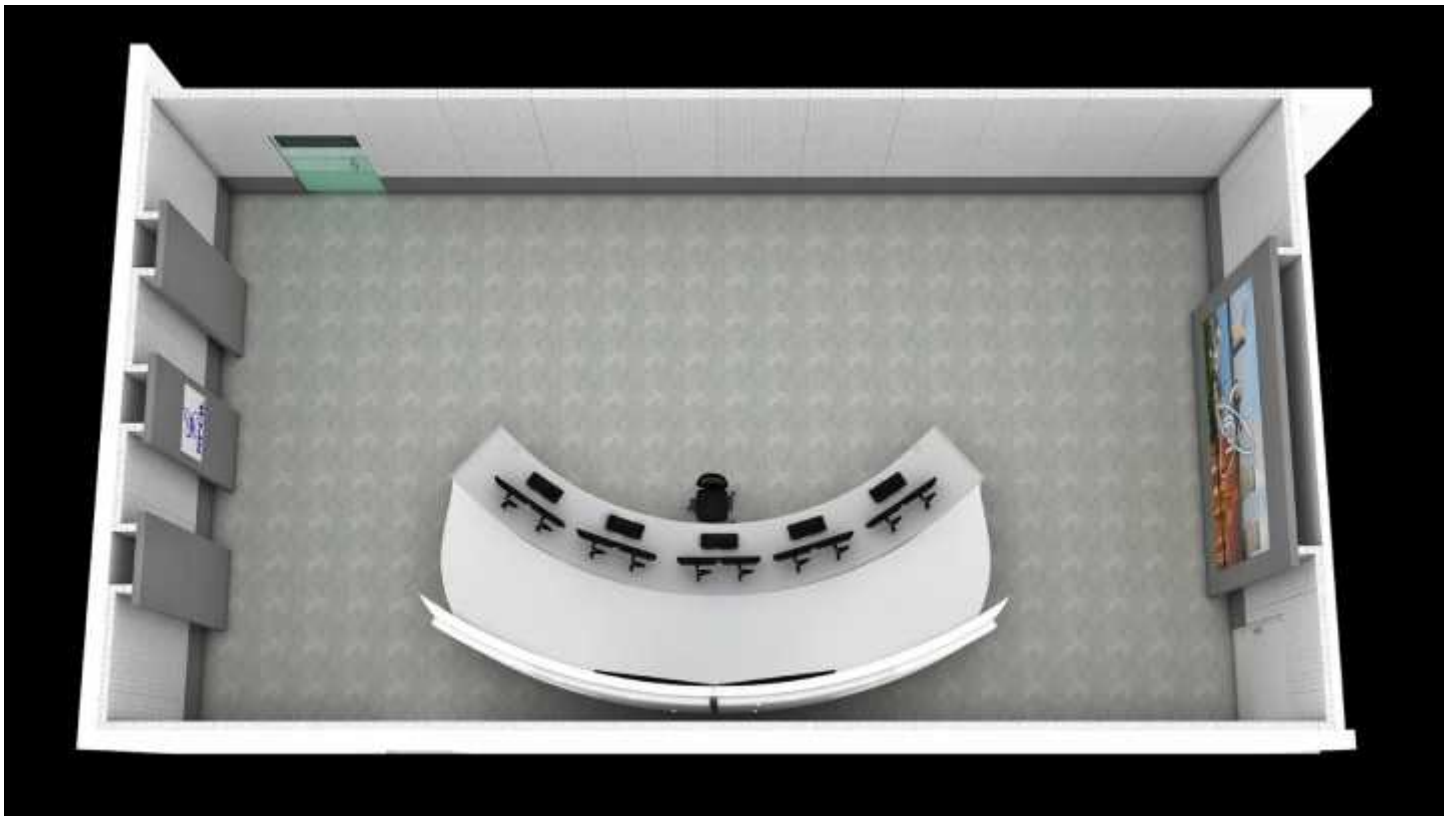
FIGURE-2(2): ARCHITECTURE OF 'CONTROL ROOM AREA'



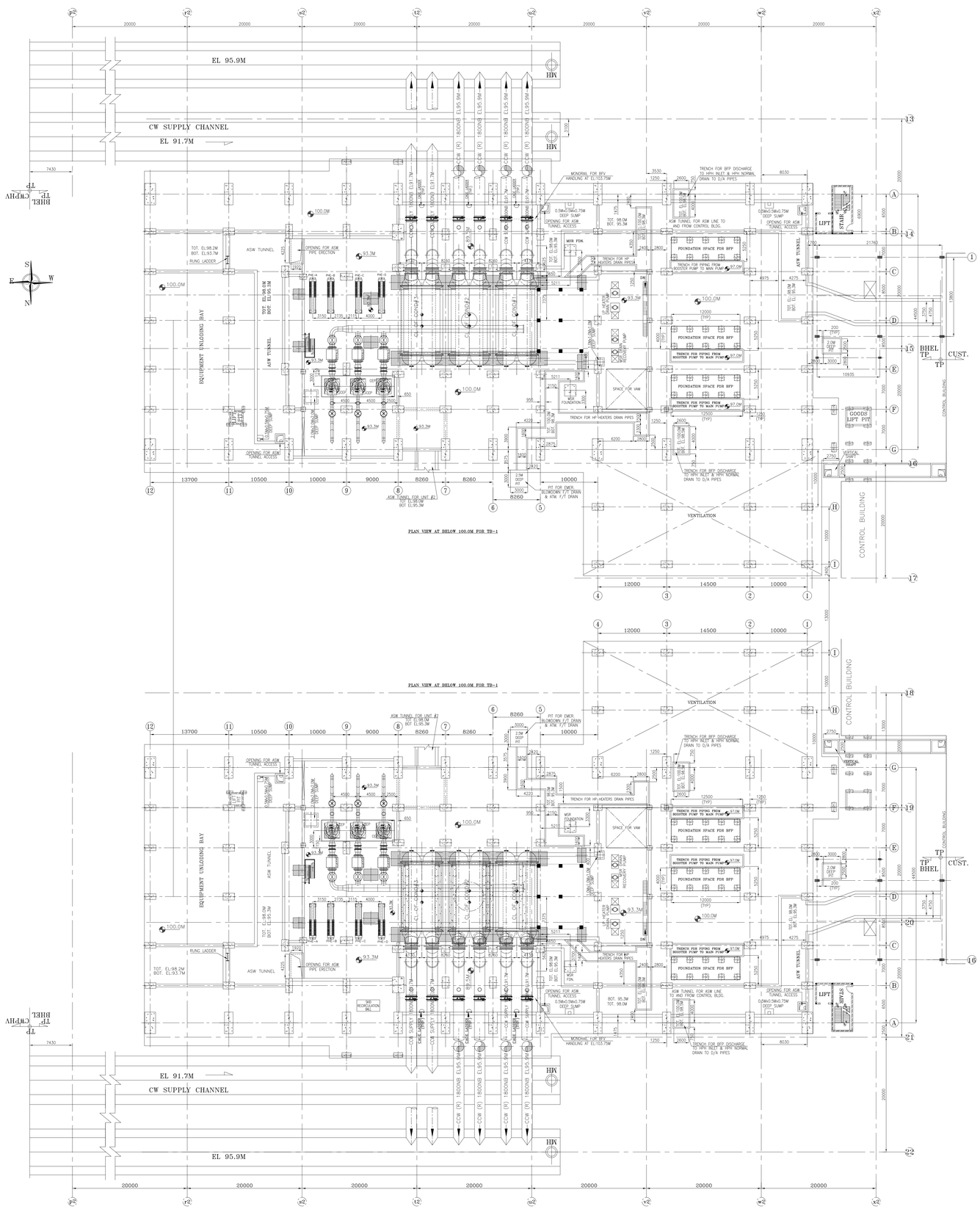
FIGURE-2(3): ARCHITECTURE OF 'CONTROL ROOM AREA'



FIGURE-2(4): ARCHITECTURE OF 'CONTROL ROOM AREA'



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3. LAYOUT OF TG HALL & VARIOUS EQUIPMENT/FACILITIES IS TENTATIVE ONLY AND SHALL BE FINALISED DURING DETAIL ENGINEERING.

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

2 x 700 MWe NPCIL GHAVP 1 & 2
(NUCLEAR POWER PROJECT- TG Island Pkg)

JOB NO.	486
STATUS	CONTRACT
DISTRIBUTION	

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

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M	DRN	ROHIT AGGARWAL		01.07.2021
	DESN	ROHIT AGGARWAL		01.07.2021
	CHD	G.SINGH PARTHAL		01.07.2021
	APPD	PRINCE MALIK		01.07.2021

TITLE
GENERAL ARRANGEMENT DRAWING – TURBINE BUILDING BELOW 100.0M FOR TB-1 & TB-2

DEPT. | SCALE 1:275 | DRAWING NO. PE-DG-486-100-M003
SIGN | SHEET 01 OF 01 | REV. 0P

SIZE-A0

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DRAWING No. PE-DG-486-100-M004

CUSTOMER'S DRAWING No.

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

PLAN VIEW AT EL 100.0M FOR TB-1

PLAN VIEW AT EL 100.0M FOR TB-1

PLAN VIEW AT EL 100.0M FOR TB-1 & 2 BELOW IPBD & GCB

NOTES

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(NUCLEAR POWER PROJECT- TG Island Pkg)

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	APPD	PRINCE MALIK		01.07.2021

TITLE: GENERAL ARRANGEMENT DRAWING – TURBINE HALL
PLAN VIEW AT 100.0M FOR TB-1 & 2

DEPT. | SCALE 1:250 | DRAWING NO. PE-DG-486-100-M004

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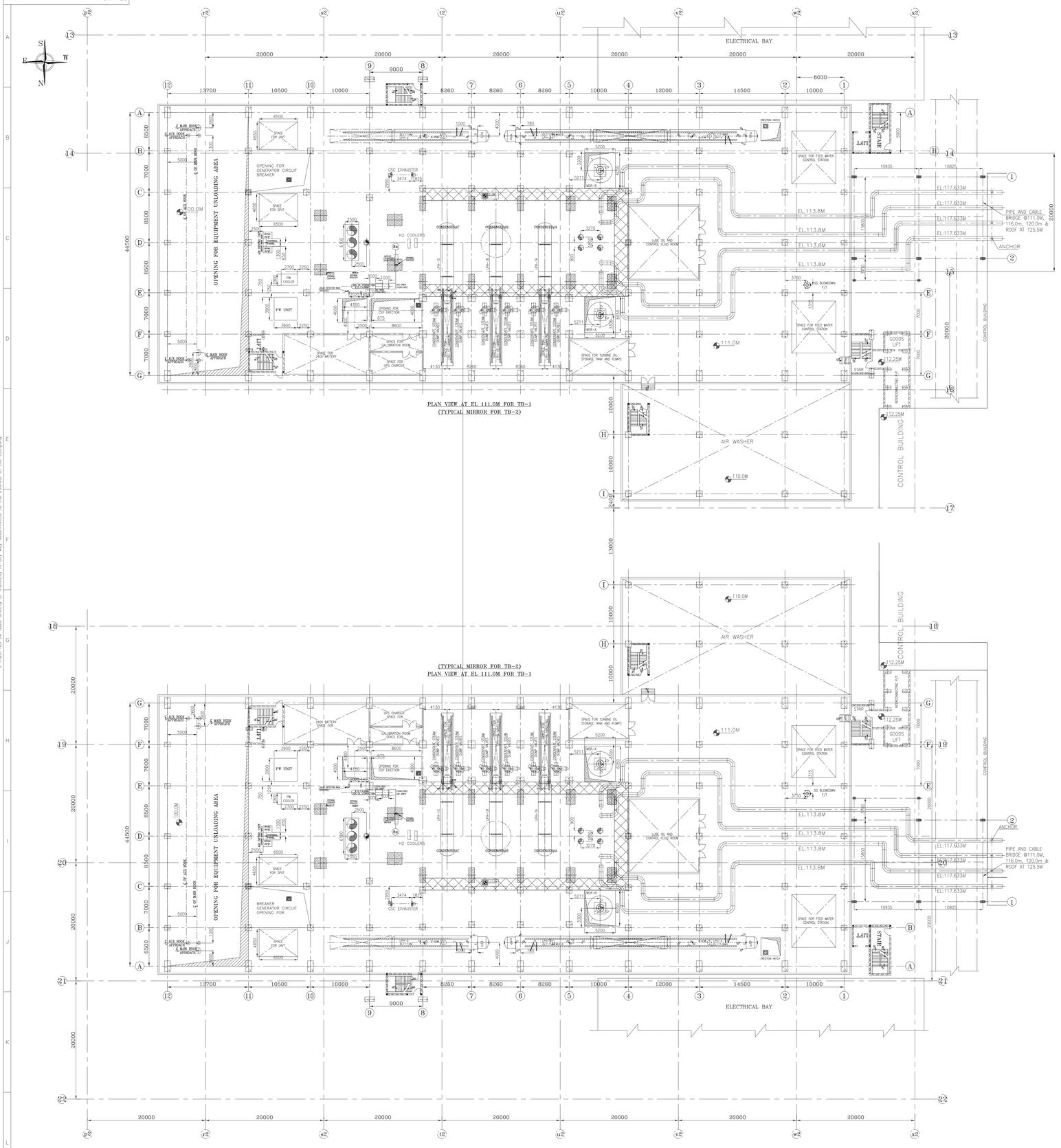
COMPUTER FILE NAME:

DRAWING No. PE-DG-486-100-M005

CUSTOMER'S DRAWING No.

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM



PLAN VIEW AT EL 111.0M FOR TB-1
(TYPICAL MIRROR FOR TB-2)

(TYPICAL MIRROR FOR TB-2)
PLAN VIEW AT EL 111.0M FOR TB-1

NOTES

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(NUCLEAR POWER PROJECT- TG Island Pkg)

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	APPD	PRINCE MALIK		01.07.2021

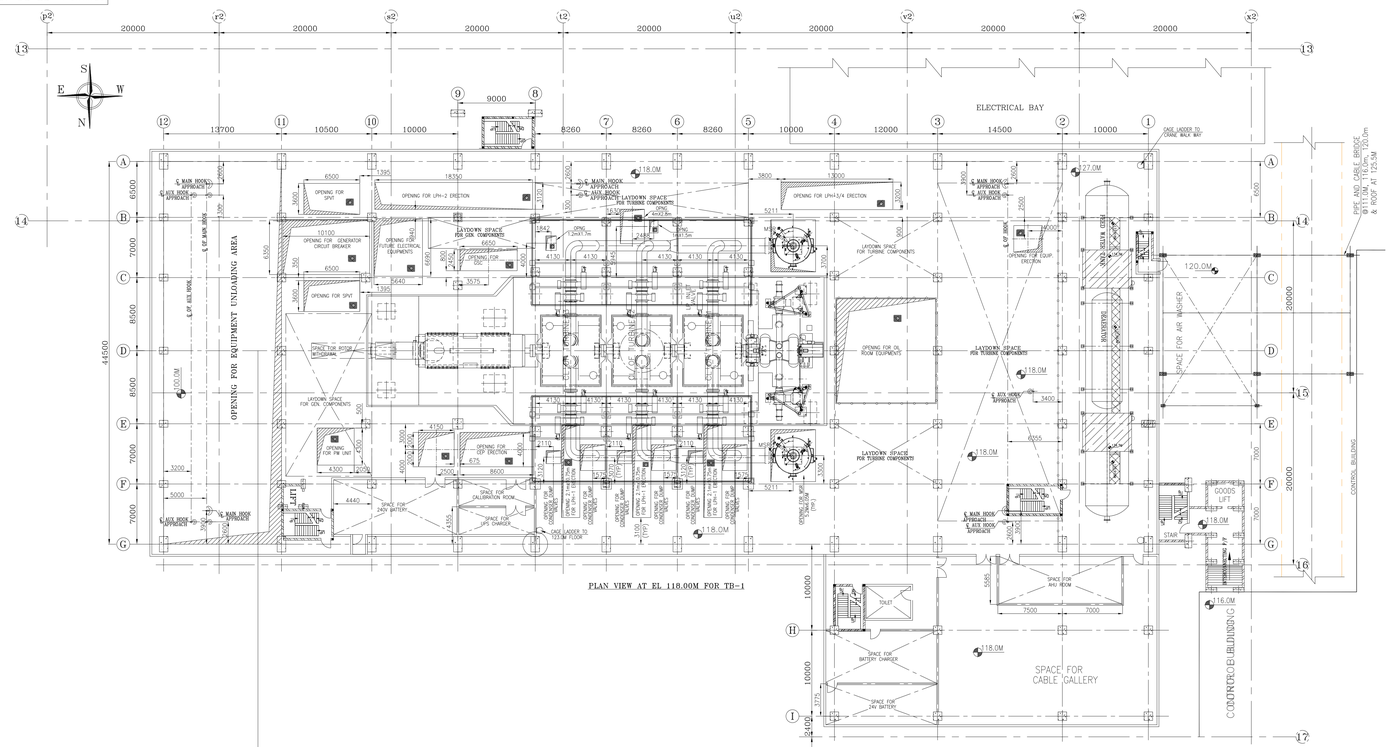
TITLE: GENERAL ARRANGEMENT DRAWING - TURBINE HALL
PLAN VIEW AT 111.0M FOR TB-1 & 2

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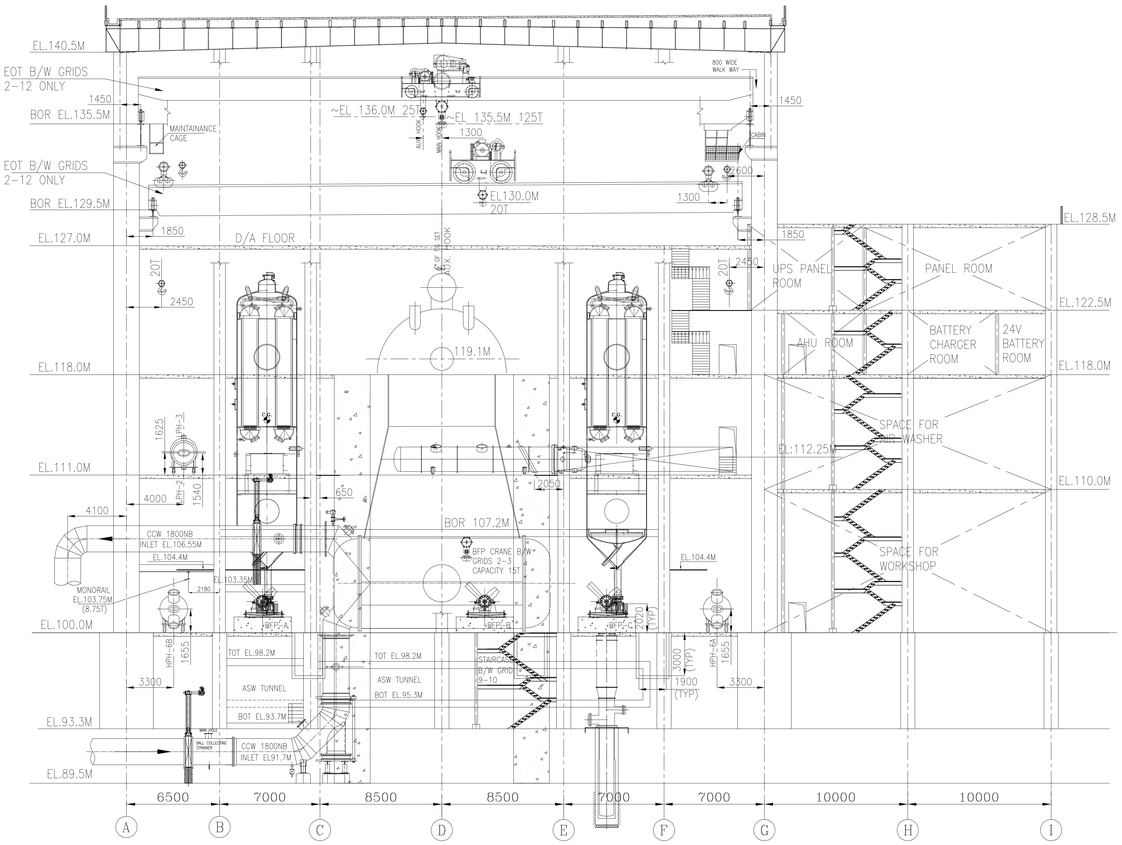

ELECTRICAL BAY
OPENING FOR EQUIPMENT UNLOADING AREA
CONTROL BUILDING
SPACE FOR CABLE GALLERY
SPACE FOR AIR WASHER
GOODS LIFT
STAIR
TOILET
SPACE FOR BATTERY CHARGER
SPACE FOR 24V BATTERY
SPACE FOR UPS CHARGER
SPACE FOR CALIBRATION ROOM
SPACE FOR AHU ROOM
LAYDOWN SPACE FOR TURBINE COMPONENTS
LAYDOWN SPACE FOR GEN. COMPONENTS
OPENING FOR OIL ROOM EQUIPMENTS
OPENING FOR EOT ERECTION
OPENING FOR PM UNIT
OPENING FOR SPVT
OPENING FOR UPH-2 ERECTION
OPENING FOR UPH-1/4 ERECTION
OPENING FOR GENERATOR CIRCUIT BREAKER
OPENING FOR FUTURE ELECTRICAL EQUIPMENTS
OPENING FOR ISVT
SPACE FOR BUSH WITHDRAWAL
OPENING FOR DUCTS
OPENING FOR CONTROL CABLE
OPENING FOR GENERATOR CIRCUIT BREAKER
OPENING FOR GENERATOR NEUTRAL CUBICLE
OPENING FOR EXCITATION TRANSFORMER
OPENING FOR GENERATOR PHASE BUS DUCT
OPENING FOR GENERATOR NEUTRAL BUS DUCT
OPENING FOR EXCITATION TRANSFORMER
OPENING FOR MAIN TRANSFORMER
OPENING FOR UNIT AUXILIARY TRANSFORMER
OPENING FOR STATION AUXILIARY TRANSFORMER
OPENING FOR STARTUP TRANSFORMER
OPENING FOR STARTUP TRANSFORMER
OPENING FOR STARTUP

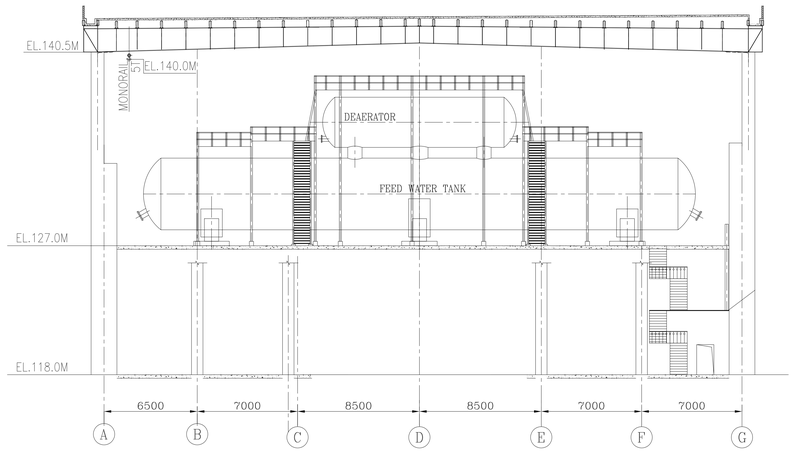
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CUSTOMER'S DRAWING No.





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JOB NO. 486
STATUS CONTRACT
DISTRIBUTION

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(A GOVERNMENT OF INDIA ENTERPRISE)

2 x 700 MWe NPCIL GHAVP 1 & 2
(NUCLEAR POWER PROJECT- TG Island Pkg)

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
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	DESN	ROHIT AGGARWAL		23.08.2021
	CHD	G.SINGH PARTHAL		23.08.2021
	APPD	PRINCE MALIK		23.08.2021

TITLE
CROSS SECTION OF TURBINE HALL

DEPT. SCALE 1:250
SIGN
DRAWING NO. PE-DG-486-100-M007
SHEET 01 OF 01 REV. 0P
SIZE-A0

NUCLEAR POWER CORPORATION OF INDIA LIMITED

(A Government of India Enterprises)

PROCUREMENT SPECIFICATION NUMBER:

GHAVP- 1&2/40000/PROCUREMENT SPECIFICATION/ MS-1
GHAVP- 3&4/40000/PROCUREMENT SPECIFICATION/ MS-1
KAIGA- 5&6/40000/PROCUREMENT SPECIFICATION/ MS-1

PROCUREMENT SPECIFICATION
FOR
TURBINE ISLAND PACKAGE

SECTION C -2-1: SPECIFIC TECHNICAL REQUIREMENTS OF CIVIL STRUCTURES: ADDENDUM -1

Revision No	R0			
Date Of Issue (Month / Year)	07/2019			
Total No of Pages (Including Cover Sheet)	7			

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	(Name & Designation)	(Signature)	(Date)

REVISION CONTROL SHEET

PROCUREMENT SPECIFICATION NUMBER:

GHAVP- 1&2/40000/PROCUREMENT SPECIFICATION/ MS-1
GHAVP- 3&4/40000/PROCUREMENT SPECIFICATION/ MS-1
KAIGA- 5&6/40000/PROCUREMENT SPECIFICATION/ MS-1

FOR
TURBINE ISLAND
SECTION C -2-1: SPECIFIC TECHNICAL REQUIREMENTS
OF CIVIL STRUCTURES: ADDENDUM - 1

REV. NO. / DATE	DESCRIPTION	PREPARED BY	CHECKED BY	REVIEWED BY	APPROVED BY

Specific Technical requirements of Civil Works: Addendum -1

S. No.	Project	Clause No.	Existing Provision	Revised Provision
1.	GHAVP – 1&2	10.9.1	These specifications cover coating of reinforcement bars with fusion bonded epoxy coating (FBEC) to be provided as corrosion protection measure, in construction of Nuclear Power plant. This coating shall be used, wherever specified so in the drawings.	Fusion Bonded Epoxy Coated reinforcement bars not to be used.
2.	KAIGA – 5&6	10.9.1	These specifications cover coating of reinforcement bars with fusion bonded epoxy coating (FBEC) to be provided as corrosion protection measure, in construction of Nuclear Power plant. This coating shall be used, wherever specified so in the drawings.	Fusion Bonded Epoxy Coated reinforcement bars not to be used.
3.	GHAVP – 1&2	1.11	• Backfilling: A) Area Grading: i) Upto EL 98.70m: Using soil (at OMC) with 5% cement (by weight of dry soil) and compacting the same as per relevant specifications for Backfilling /ground improvement unless approved otherwise. PCC may be used, only if specifically approved by the engineer without financial implication.	• Backfilling: C) Area Grading: i) Upto EL 95.4m: Using soil (at OMC) with 5% cement (by weight of dry soil) and compacting the same as per relevant specifications for Backfilling /ground improvement unless approved otherwise. PCC may be used without financial implication. ii) Above EL 95.4m upto EL98.7m: Using compacted soil as per technical specification (as per clause no. 4). PCC may

			ii) Above EL 98.70m: Soil suitable for land escaping/ Soil Cement mix as approved by the Engineer. B) Within Foot Print of structure/ equipment Foundation: PCC shall be used, unless specifically approved by the Engineer. The properties of the back fill material used shall be suitably accounted in the design.	be used without financial implication. iii) Above EL 98.70m: Compacted Soil/Soil suitable for land escaping as required and as approved by the Engineer. D) Within Foot Print of structure/ equipment Foundation: Soil-cement shall be used, unless specifically approved by the Engineer. The properties of the back fill material used shall be suitably accounted in the design. PCC may be used without financial implication.
4.	GHAVP – 1&2	1.6.7	The construction of 10 m wide road between grid 17-18 within terminal point is excluded from the scope of the bidder. However the bidder shall fill the area up to subgrade i.e. EL 98.0m, with soil cement mix as per the specification. The typical cross section to be followed for the road is given in Sketch No. GHAVP 1&2/15600/5001/SK attached with the tender.	The construction of 10 m wide road between grid 17-18 within terminal point and Hard Stand "C" is excluded from the scope of this tender. However, the bidder shall fill the area up to EL 95.4m with soil cement mix as per detailed technical specifications. From EL 95.4m to EL97.4m, compacted soil shall be used as per technical specification (as per clause no. 4).
5.	GHAVP – 1&2	1.6.8	The Hard Stand "C" is excluded from the scope of this tender. However, the area below the Hard stand within terminal point shall be graded upto EL 98.00 with soil cement mix as per detailed technical specifications.	The Hard Stand "C" is excluded from the scope of this tender. However, the area below the Hard stand within terminal point shall be graded upto EL 95.4m with soil cement mix as per detailed technical specifications. From EL 95.4m to EL97.4m,

				compacted soil shall be used as per technical specification (as per clause no. 4).
6.	GHAVP – 1&2	1.11	Structure above Raft: Reinforced Cement Concrete (RCC), unless approved otherwise by the Purchaser. RCC slabs and roofs shall be constructed using Galvanized deck sheets as left in shuttering, unless specifically approved otherwise.	Structure above Raft: The roof of Turbine buildings shall be cast in situ RCC over Steel Deck Span Sheets. The roof of Turbine Buildings shall be laid over steel roof trusses and purlins. Bidder may please note the specific requirements towards removal of generator stator as given in clause 1.6.1 of section C-2-1. The use of Steel Deck Span Sheets for construction of RCC slabs other than roof is optional. Secondary steel beam may be permitted in specific cases subject to approval of Purchaser, if this meets all the structural and functional requirements including the fire rating.
7.	GHAVP – 1&2	2.5.1.2	Similarly dynamic analysis shall be performed using dynamic modulus of elasticity, $E_{dynamic}$ (using correction factor of G/G_{max} = 0.4, where Gmax corresponds to low strain shear modulus) under sustained load plus Earthquake loading to obtain dynamic springs as $Kx_{dynamic}$, $Ky_{dynamic}$ and $Kz_{dynamic}$.	$E_{dynamic}$ data for soil is enclosed herewith. (Annexure -1)
8.	KAIGA – 5&6	2.5	ANALYSIS AND DESIGN	Soil Structure Interaction shall be done using ABAQUS methodology as given in clause no. 2.5 of GHAVP-1&2 specification.

9.	KAIGA – 5&6	1.7.2	The bidder has to carry out at least following confirmatory geological tests for both the buildings independently, to demonstrate the suitability of geotechnical parameters considered, in his design within the area covered in the scope of the bidder unless approved otherwise by the Engineer. • minimum one bore hole of nx size (As required, but not lesser than 60m depth from founding level), • analyzing & arriving at safe bearing capacity using RMR & Unconfined compressive strength of core (having a minimum factor of safety of 10) approach. and a lesser of these 2 values shall be considered in the design in case of rock. • cyclic plate load tests under TG foundation area & • Geological mapping at the founding level of foundation & its side area, The bidder shall also carry out the ground improvement by consolidation grouting as per IS 6066 & conduct the water loss test as per IS 5529(Part 2), unless	Following confirmatory test shall be conducted (for each unit): 1. Field Tests: a) 1 Plate load test (for SBC and E value) at founding level b) 2-borehole upto 70m depth. • For Soil portion– SPT shall be carried out at every 3 m interval • For Rock portion– RQD, CR at every 3m interval or change in strata c) 1 Borehole upto 70m depth (for E value by Pressuremeter test) at every 5m interval or change in strata 2. Lab tests: a) Dry Density b) Specific Gravity c) UCS (Soaked) for rock portion at every 3m interval d) Triaxial shear Test (in soil portion for both drained & undrained condition) at every 3m interval. 3. SBC & E value to be used in analysis and design, shall verified based on confirmatory test 4. Geological mapping at the founding level of foundation & its side area, The bidder shall also carry out the ground improvement by consolidation grouting as per IS 6066 & conduct the water loss test as per IS 5529(Part 2), unless approved otherwise by the Engineer. All the above activities shall be executed as

			approved otherwise by the Engineer. All the above activities shall be executed as per the relevant technical specifications detailed in subsequent clauses of this tender.	per the relevant technical specifications detailed in subsequent clauses of this tender.
10.	GHAVP-1&2	2.3.1.2	The value of subgrade reaction for both static and dynamic analysis shall be worked out as per detailed soil structure analysis using ABAQUS or equivalent software. The detailed approach for the same is given in clause 2.4 below.	The value of subgrade reaction for both static and dynamic analysis shall be worked out as per detailed soil structure analysis using ABAQUS or equivalent software. The detailed approach for the same is given in clause 2.5 below.
11.	GHAVP-1&2	2.4.1.3	Using spring values calculated by above approach further structural analysis shall be carried out using any standard Finite Element software like NISA, ANSYS, ABAQUS, and SAP etc.	Clause 2.4.1.3 shall be read as clause 2.5.1.3.

ANNEXURE – I

MEAN					
Elevation of Bottom of layer from FGL	Depth (m) of Bottom of Layer from EGL	Depth (m) of Bottom of Layer from FGL	Poisson's ratio μ = (Vp2-2Vs2)/(2*(Vp2-Vs2))	Ed=2G(1+ν) kN/m2	Mean Unit weight (kN/m3)
100					
95	0	5			
93.6	1.4	6.4	0.38	7.30E+06	19.61
92.2	2.8	7.8	0.38	7.02E+06	19.61
90.8	4.2	9.2	0.38	6.79E+06	19.61
89.4	5.6	10.6	0.38	6.53E+06	19.61
87.9	7.1	12.1	0.38	6.34E+06	19.61
86.4	8.6	13.6	0.38	6.05E+06	19.61
84.9	10.1	15.1	0.38	5.88E+06	19.61
83.4	11.6	16.6	0.38	5.63E+06	19.61
81.9	13.1	18.1	0.33	2.56E+05	18.3
80.4	14.6	19.6	0.33	2.77E+05	18.47
79	16	21	0.32	3.17E+05	18.18
78	17	22	0.32	3.06E+05	18.04
76.5	18.5	23.5	0.32	2.96E+05	18.12
75	20	25	0.32	3.08E+05	18.33
73.5	21.5	26.5	0.32	3.22E+05	18.44
72	23	28	0.31	3.23E+05	18.27
70.5	24.5	29.5	0.32	3.14E+05	18.28
69	26	31	0.32	3.20E+05	18.47
67.5	27.5	32.5	0.32	3.42E+05	18.44
66	29	34	0.31	3.65E+05	18.56
64.5	30.5	35.5	0.32	4.12E+05	18.56
63	32	37	0.32	4.19E+05	18.45
61.5	33.5	38.5	0.32	3.71E+05	18.45
60	35	40	0.32	3.77E+05	18.42
58.5	36.5	41.5	0.30	3.70E+05	18.38
57	38	43	0.29	3.82E+05	18.21
55.5	39.5	44.5	0.30	3.95E+05	18.22
54	41	46	0.31	4.30E+05	18.19
52.5	42.5	47.5	0.31	4.43E+05	18.09
51	44	49	0.30	4.74E+05	18.27
49.5	45.5	50.5	0.30	4.83E+05	18.31
48	47	52	0.31	4.76E+05	18.35
46.5	48.5	53.5	0.31	4.82E+05	18.07
45	50	55	0.35	4.01E+05	17.79
43.5	51.5	56.5	0.34	4.76E+05	17.54
42	53	58	0.34	4.52E+05	17.59
40.5	54.5	59.5	0.33	4.59E+05	17.57
39	56	61	0.34	4.67E+05	17.95
37.5	57.5	62.5	0.34	5.04E+05	18.49
36	59	64	0.34	5.40E+05	18.85
34.5	60.5	65.5	0.35	5.50E+05	18.99
33	62	67	0.34	5.36E+05	19.06
31.5	63.5	68.5	0.33	5.84E+05	19.09
30	65	70	0.33	6.20E+05	19.03
28.5	66.5	71.5	0.34	5.27E+05	19.25
27	68	73	0.33	5.54E+05	19.36
25.5	69.5	74.5	0.34	5.38E+05	19.41
24	71	76	0.35	5.51E+05	19.29
22.5	72.5	77.5	0.35	5.57E+05	19.31
21	74	79	0.35	5.68E+05	19.31
19.5	75.5	80.5	0.36	5.27E+05	19.32
18	77	82	0.35	5.57E+05	19.37
16.5	78.5	83.5	0.34	5.60E+05	19.12
15	80	85	0.36	5.42E+05	19
13.5	81.5	86.5	0.36	5.43E+05	18.94
12	83	88	0.35	6.17E+05	19.06
10.5	84.5	89.5	0.35	6.03E+05	19.04
9	86	91	0.36	5.94E+05	19.03
7.5	87.5	92.5	0.35	6.00E+05	19.03
6	89	94	0.36	5.95E+05	18.73
4.5	90.5	95.5	0.36	5.59E+05	18.54
3	92	97	0.36	5.47E+05	18.44
1.5	93.5	98.5	0.37	5.64E+05	18.39
-2.84217E-14	95	100	0.37	5.94E+05	18.66

-1.5	96.5	101.5	0.36	6.52E+05	18.65
-3	98	103	0.37	6.34E+05	18.64
-4.5	99.5	104.5	0.37	6.45E+05	18.64
-6	101	106	0.38	6.20E+05	18.34
-7.5	102.5	107.5	0.37	6.32E+05	18.66
-9	104	109	0.38	6.16E+05	18.82
-10.5	105.5	110.5	0.38	6.49E+05	18.9
-12	107	112	0.38	6.75E+05	19.08
-13.5	108.5	113.5	0.38	7.38E+05	19.12
-15	110	115	0.37	1.16E+06	19.12
-19	114	119	0.36	1.13E+06	19.12
-23	118	123	0.36	1.14E+06	19.12
-27	122	127	0.36	1.17E+06	19.12
-31	126	131	0.36	1.18E+06	19.12
-35	130	135	0.36	1.20E+06	19.12
-39	134	139	0.36	1.35E+06	19.12
-43	138	143	0.36	1.45E+06	19.12
-47	142	147	0.36	1.49E+06	19.12
-51	146	151	0.36	1.53E+06	19.12
-55	150	155	0.36	1.54E+06	19.12
-59	154	159	0.36	1.55E+06	19.12
-63	158	163	0.36	1.57E+06	19.12
-67	162	167	0.36	1.60E+06	19.12
-71	166	171	0.36	1.63E+06	19.12
-75	170	175	0.36	1.66E+06	19.12
-79	174	179	0.36	1.71E+06	19.12
-83	178	183	0.37	1.75E+06	19.12
-87	182	187	0.37	1.77E+06	19.12
-91	186	191	0.37	1.79E+06	19.12
-95	190	195	0.37	1.82E+06	19.12
-99	194	199	0.37	1.84E+06	19.12
-103	198	203	0.37	1.86E+06	19.12
-107	202	207	0.37	1.88E+06	19.12
-113	208	213	0.37	1.92E+06	19.12
-119	214	219	0.37	1.96E+06	19.12
-125	220	225	0.36	1.99E+06	19.12
-135	Half Space		0.37	1.99E+06	19.12

UPPER BOUND					
Elevation of Bottom of layer from FGL	Depth (m) of Bottom of Layer from EGL	Depth (m) of Bottom of Layer from FGL	Poisson's ratio $\mu = (V_p^2-2V_s^2)/(2*(V_p^2-V_s^2))$	Ed=2G(1+ν) kN/m^2	Mean Unit weight (kN/m3)
100					
95	0	5			
93.6	1.4	6.4	0.38	1.49E+07	19.61
92.2	2.8	7.8	0.38	1.45E+07	19.61
90.8	4.2	9.2	0.38	1.41E+07	19.61
89.4	5.6	10.6	0.38	1.39E+07	19.61
87.9	7.1	12.1	0.38	1.37E+07	19.61
86.4	8.6	13.6	0.38	1.35E+07	19.61
84.9	10.1	15.1	0.38	1.31E+07	19.61
83.4	11.6	16.6	0.38	1.27E+07	19.61
81.9	13.1	18.1	0.33	8.08E+05	18.3
80.4	14.6	19.6	0.33	8.75E+05	18.47
79	16	21	0.32	1.04E+06	18.18
78	17	22	0.32	1.00E+06	18.04
76.5	18.5	23.5	0.32	9.72E+05	18.12
75	20	25	0.32	1.01E+06	18.33
73.5	21.5	26.5	0.32	1.06E+06	18.44
72	23	28	0.31	1.06E+06	18.27
70.5	24.5	29.5	0.32	1.03E+06	18.28
69	26	31	0.32	1.05E+06	18.47
67.5	27.5	32.5	0.32	1.11E+06	18.44
66	29	34	0.31	1.16E+06	18.56
64.5	30.5	35.5	0.32	1.29E+06	18.56
63	32	37	0.32	1.32E+06	18.45
61.5	33.5	38.5	0.32	1.10E+06	18.45
60	35	40	0.32	1.12E+06	18.42
58.5	36.5	41.5	0.30	1.11E+06	18.38
57	38	43	0.29	1.15E+06	18.21
55.5	39.5	44.5	0.30	1.18E+06	18.22
54	41	46	0.31	1.30E+06	18.19
52.5	42.5	47.5	0.31	1.34E+06	18.09
51	44	49	0.30	1.46E+06	18.27
49.5	45.5	50.5	0.30	1.48E+06	18.31
48	47	52	0.31	1.46E+06	18.35
46.5	48.5	53.5	0.31	1.44E+06	18.07
45	50	55	0.35	1.17E+06	17.79
43.5	51.5	56.5	0.34	1.52E+06	17.54
42	53	58	0.34	1.45E+06	17.59
40.5	54.5	59.5	0.33	1.46E+06	17.57
39	56	61	0.34	1.49E+06	17.95
37.5	57.5	62.5	0.34	1.59E+06	18.49
36	59	64	0.34	1.69E+06	18.85
34.5	60.5	65.5	0.35	1.72E+06	18.99
33	62	67	0.34	1.68E+06	19.06
31.5	63.5	68.5	0.33	1.83E+06	19.09
30	65	70	0.33	1.95E+06	19.03
28.5	66.5	71.5	0.34	1.55E+06	19.25
27	68	73	0.33	1.65E+06	19.36
25.5	69.5	74.5	0.34	1.60E+06	19.41
24	71	76	0.35	1.65E+06	19.29
22.5	72.5	77.5	0.35	1.66E+06	19.31
21	74	79	0.35	1.70E+06	19.31
19.5	75.5	80.5	0.36	1.58E+06	19.32
18	77	82	0.35	1.67E+06	19.37
16.5	78.5	83.5	0.34	1.68E+06	19.12
15	80	85	0.36	1.64E+06	19
13.5	81.5	86.5	0.36	1.63E+06	18.94
12	83	88	0.35	1.84E+06	19.06
10.5	84.5	89.5	0.35	1.80E+06	19.04
9	86	91	0.36	1.78E+06	19.03
7.5	87.5	92.5	0.35	1.78E+06	19.03
6	89	94	0.36	1.77E+06	18.73
4.5	90.5	95.5	0.36	1.66E+06	18.54
3	92	97	0.36	1.62E+06	18.44
1.5	93.5	98.5	0.37	1.66E+06	18.39
-2.84217E-14	95	100	0.37	1.74E+06	18.66

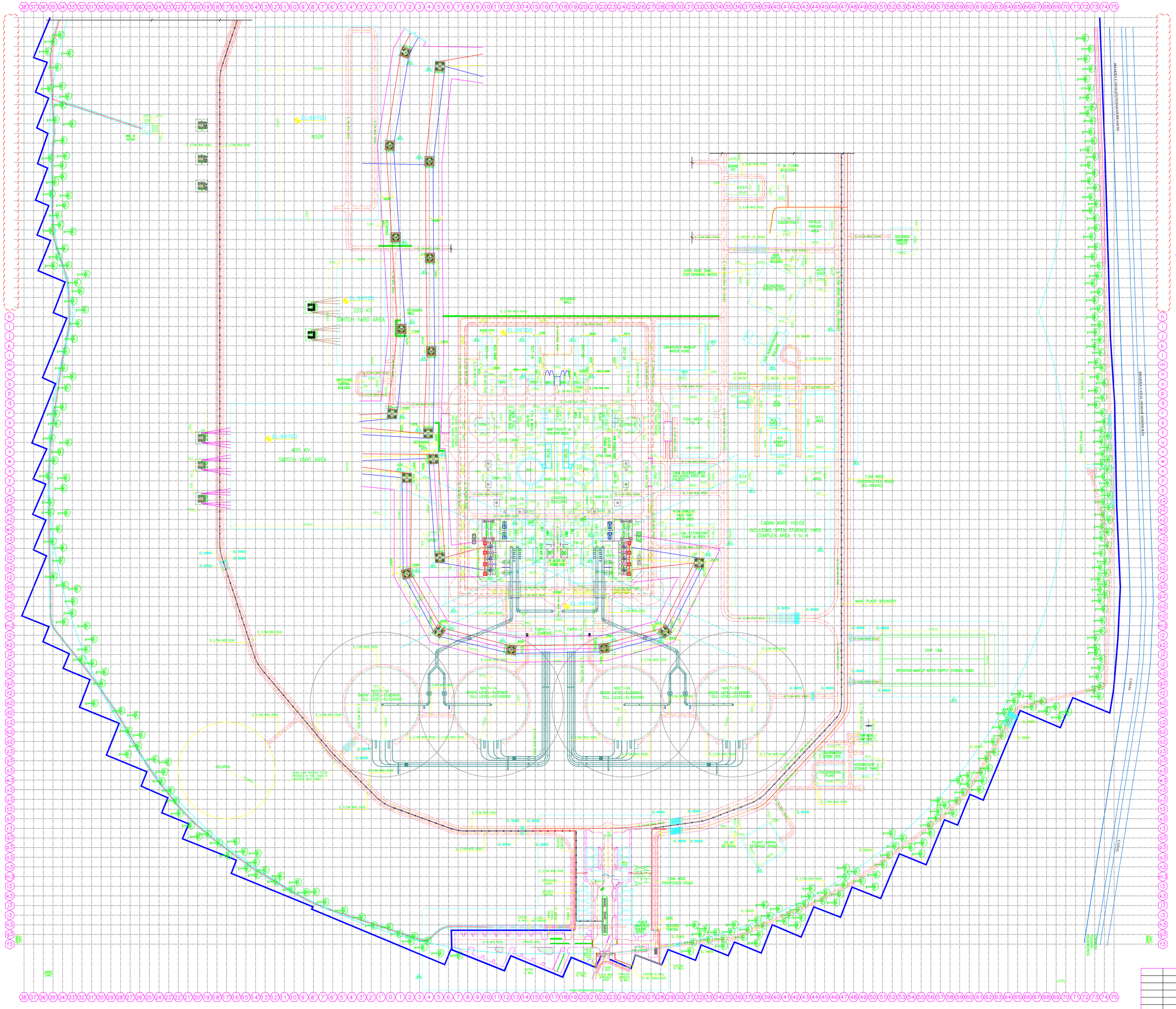
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-3	98	103	0.37	1.84E+06	18.64
-4.5	99.5	104.5	0.37	1.87E+06	18.64
-6	101	106	0.38	1.79E+06	18.34
-7.5	102.5	107.5	0.37	1.82E+06	18.66
-9	104	109	0.38	1.76E+06	18.82
-10.5	105.5	110.5	0.38	1.86E+06	18.9
-12	107	112	0.38	1.91E+06	19.08
-13.5	108.5	113.5	0.38	2.07E+06	19.12
-15	110	115	0.37	2.75E+06	19.12
-19	114	119	0.36	3.05E+06	19.12
-23	118	123	0.36	3.08E+06	19.12
-27	122	127	0.36	3.15E+06	19.12
-31	126	131	0.36	3.19E+06	19.12
-35	130	135	0.36	3.22E+06	19.12
-39	134	139	0.36	3.31E+06	19.12
-43	138	143	0.36	3.54E+06	19.12
-47	142	147	0.36	3.60E+06	19.12
-51	146	151	0.36	3.66E+06	19.12
-55	150	155	0.36	3.74E+06	19.12
-59	154	159	0.36	3.82E+06	19.12
-63	158	163	0.36	3.87E+06	19.12
-67	162	167	0.36	3.93E+06	19.12
-71	166	171	0.36	3.98E+06	19.12
-75	170	175	0.36	4.03E+06	19.12
-79	174	179	0.36	4.12E+06	19.12
-83	178	183	0.37	4.20E+06	19.12
-87	182	187	0.37	4.24E+06	19.12
-91	186	191	0.37	4.29E+06	19.12
-95	190	195	0.37	4.33E+06	19.12
-99	194	199	0.37	4.38E+06	19.12
-103	198	203	0.37	4.42E+06	19.12
-107	202	207	0.37	4.46E+06	19.12
-113	208	213	0.37	4.54E+06	19.12
-119	214	219	0.37	4.61E+06	19.12
-125	220	225	0.36	4.68E+06	19.12
-135	Half Space		0.37	4.69E+06	19.12

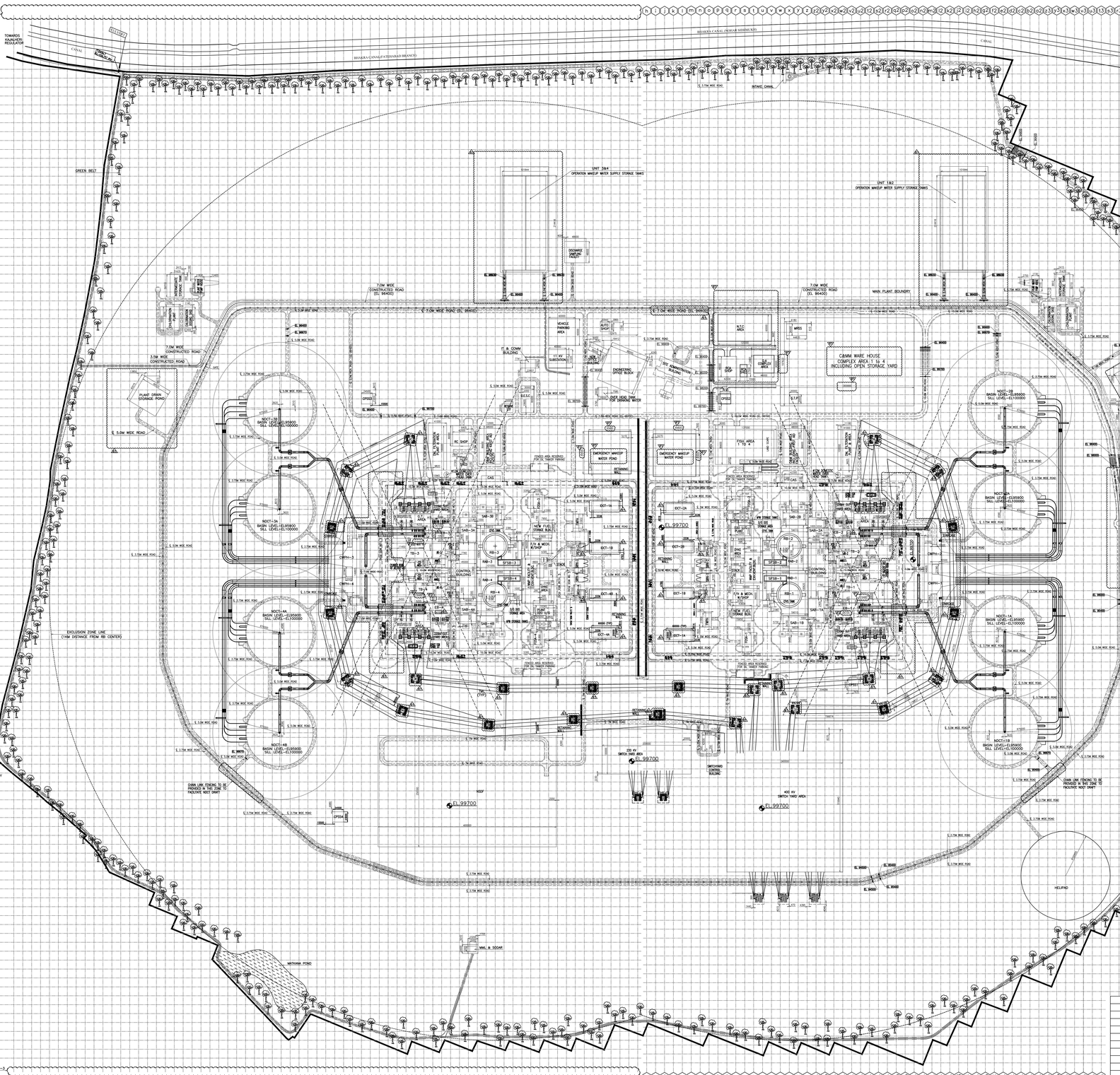
LOWER BOUND					
Elevation of Bottom of layer from FGL	Depth (m) of Bottom of Layer from EGL	Depth (m) of Bottom of Layer from FGL	Poisson's ratio $\mu = (V_p^2-2V_s^2)/(2*(V_p^2-V_s^2))$	Ed=2G(1+v) kN/m^2	Mean Unit weight (kN/m3)
100					
95	0	5			
93.6	1.4	6.4	0.38	3.59E+06	19.61
92.2	2.8	7.8	0.38	3.41E+06	19.61
90.8	4.2	9.2	0.38	3.26E+06	19.61
89.4	5.6	10.6	0.38	3.12E+06	19.61
87.9	7.1	12.1	0.38	2.96E+06	19.61
86.4	8.6	13.6	0.38	2.78E+06	19.61
84.9	10.1	15.1	0.38	2.69E+06	19.61
83.4	11.6	16.6	0.38	2.53E+06	19.61
81.9	13.1	18.1	0.33	8.41E+04	18.3
80.4	14.6	19.6	0.33	8.86E+04	18.47
79	16	21	0.32	8.37E+04	18.18
78	17	22	0.32	7.95E+04	18.04
76.5	18.5	23.5	0.32	7.64E+04	18.12
75	20	25	0.32	7.82E+04	18.33
73.5	21.5	26.5	0.32	8.25E+04	18.44
72	23	28	0.31	8.25E+04	18.27
70.5	24.5	29.5	0.32	8.05E+04	18.28
69	26	31	0.32	8.27E+04	18.47
67.5	27.5	32.5	0.32	8.76E+04	18.44
66	29	34	0.31	9.60E+04	18.56
64.5	30.5	35.5	0.32	1.10E+05	18.56
63	32	37	0.32	1.11E+05	18.45
61.5	33.5	38.5	0.32	1.19E+05	18.45
60	35	40	0.32	1.22E+05	18.42
58.5	36.5	41.5	0.30	1.21E+05	18.38
57	38	43	0.29	1.26E+05	18.21
55.5	39.5	44.5	0.30	1.28E+05	18.22
54	41	46	0.31	1.38E+05	18.19
52.5	42.5	47.5	0.31	1.44E+05	18.09
51	44	49	0.30	1.55E+05	18.27
49.5	45.5	50.5	0.30	1.58E+05	18.31
48	47	52	0.31	1.56E+05	18.35
46.5	48.5	53.5	0.31	1.58E+05	18.07
45	50	55	0.35	1.33E+05	17.79
43.5	51.5	56.5	0.34	1.27E+05	17.54
42	53	58	0.34	1.21E+05	17.59
40.5	54.5	59.5	0.33	1.22E+05	17.57
39	56	61	0.34	1.25E+05	17.95
37.5	57.5	62.5	0.34	1.34E+05	18.49
36	59	64	0.34	1.45E+05	18.85
34.5	60.5	65.5	0.35	1.48E+05	18.99
33	62	67	0.34	1.43E+05	19.06
31.5	63.5	68.5	0.33	1.57E+05	19.09
30	65	70	0.33	1.64E+05	19.03
28.5	66.5	71.5	0.34	1.70E+05	19.25
27	68	73	0.33	1.78E+05	19.36
25.5	69.5	74.5	0.34	1.72E+05	19.41
24	71	76	0.35	1.78E+05	19.29
22.5	72.5	77.5	0.35	1.78E+05	19.31
21	74	79	0.35	1.82E+05	19.31
19.5	75.5	80.5	0.36	1.69E+05	19.32
18	77	82	0.35	1.81E+05	19.37
16.5	78.5	83.5	0.34	1.81E+05	19.12
15	80	85	0.36	1.76E+05	19
13.5	81.5	86.5	0.36	1.76E+05	18.94
12	83	88	0.35	2.01E+05	19.06
10.5	84.5	89.5	0.35	1.97E+05	19.04
9	86	91	0.36	1.96E+05	19.03
7.5	87.5	92.5	0.35	1.98E+05	19.03
6	89	94	0.36	1.97E+05	18.73
4.5	90.5	95.5	0.36	1.85E+05	18.54
3	92	97	0.36	1.83E+05	18.44
1.5	93.5	98.5	0.37	1.89E+05	18.39
-2.84217E-14	95	100	0.37	2.00E+05	18.66
-1.5	96.5	101.5	0.36	2.15E+05	18.65
-3	98	103	0.37	2.10E+05	18.64

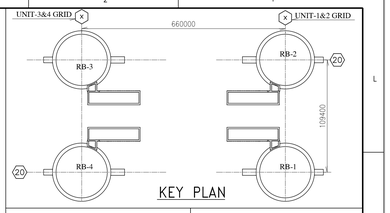
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-6	101	106	0.38	2.08E+05	18.34
-7.5	102.5	107.5	0.37	2.11E+05	18.66
-9	104	109	0.38	2.05E+05	18.82
-10.5	105.5	110.5	0.38	2.18E+05	18.9
-12	107	112	0.38	2.27E+05	19.08
-13.5	108.5	113.5	0.38	2.48E+05	19.12
-15	110	115	0.37	3.99E+05	19.12
-19	114	119	0.36	3.90E+05	19.12
-23	118	123	0.36	3.95E+05	19.12
-27	122	127	0.36	4.04E+05	19.12
-31	126	131	0.36	4.10E+05	19.12
-35	130	135	0.36	4.16E+05	19.12
-39	134	139	0.36	4.31E+05	19.12
-43	138	143	0.36	5.01E+05	19.12
-47	142	147	0.36	5.27E+05	19.12
-51	146	151	0.36	5.48E+05	19.12
-55	150	155	0.36	5.48E+05	19.12
-59	154	159	0.36	5.34E+05	19.12
-63	158	163	0.36	5.38E+05	19.12
-67	162	167	0.36	5.62E+05	19.12
-71	166	171	0.36	5.72E+05	19.12
-75	170	175	0.36	5.83E+05	19.12
-79	174	179	0.36	6.26E+05	19.12
-83	178	183	0.37	6.56E+05	19.12
-87	182	187	0.37	6.60E+05	19.12
-91	186	191	0.37	6.67E+05	19.12
-95	190	195	0.37	6.83E+05	19.12
-99	194	199	0.37	6.94E+05	19.12
-103	198	203	0.37	6.98E+05	19.12
-107	202	207	0.37	7.06E+05	19.12
-113	208	213	0.37	7.25E+05	19.12
-119	214	219	0.37	7.45E+05	19.12
-125	220	225	0.36	7.65E+05	19.12
-135	Half Space		0.37	7.66E+05	19.12

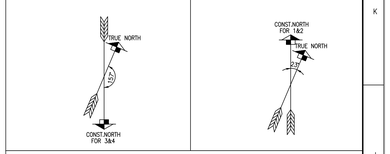
Pre- bid queries and response (Technical, Lot-8) Annexure-I
ENGINEERING, PROCUREMENT AND CONSTRUCTION OF TURBINE ISLAND PACKAGE FOR GHAVP-1&2, GHAVP-3&4 AND KAIGA-5&6 (Tender No. CMM/ETM/00/40/11/0005)

Name of the Bidder	Query No.	Tender Section No.	Reference Clause No.	Technical Specification No./Commercial Ref No.	Description of the Query	Response from NPCIL
Civil						
L&T	1	Volume II, Section C, Part 2, Gorakhpur and Kaiga	24.9.2, Page 1377 24.9.3.2	**HDPE pipes for Roof drains works (Above ground)** HDPE pipes conforming to IS: 4984, grade PE 100, pressure rating PN 6 shall be used for elevated roof drain works. **Supply, erection, fixing UPVC pipes at** various elevations of main plant buildings including UPVC/ heavy cast iron roof drain and floor drain,	**GHAVP 1&2, GHAVP 3&4 and KAIGA-5&6** Contradiction in clause. Bidder shall consider UPVC pipes for Roof drains and rain water down comers for all structures in TIP scope of work. Please confirm.	Rainwater downcomers shall be PVC pipes. However, these pipes shall be connected to main roof drainage network of HDPE pipes (for rainwater harvesting) leading to Operation Storage Pond.
L&T	2	Volume II, Section C, Part 2, Gorakhpur and Kaiga	1.11, Page 1084 19.18.5.5.3.2.2 a) 19.18.5.5.3.2.2 b)	1200micron thick Self-Leveling Epoxy coating on Turbine operating floor. On all other floors except for Turbine operating floor**, 500 micron thick epoxy paint shall be used.** For Epoxy on concrete floors: The Epoxy shall be high build solvent free, selfsmoothing, 4 component (Base, Hardener, Filler & Pigment) material. The DFT of coating **(Excluding Primer)** shall be minimum **1200 micron for its use on floors unless specified otherwise.** For Epoxy on concrete walls & structural steel: The Epoxy shall be high build solvent free, 3 component (Base, Hardener & Pigment) material. The **DFT of coating (Excluding Primer) shall be 250 micron** for concrete walls & 200 micron on structural steel, unless specified otherwise.	**GHAVP 1&2, GHAVP 3&4 and KAIGA-5&6** a) Purchaser to furnish the DFT of epoxy coating thickness **including primer** for Turbine Operating floor, various other floors, concrete walls and structural steel as DFT thickness is specified without primer. b) Contradiction in clause i.e. **500 micron** mentioned in clause no. 1.11 and **1200 micron** specified in clause no. 19.18.5.5.3.2.2 a). Purchaser to clarify the thickness of Epoxy coating including primer applicable for Other floors except Turbine operating floor. c) **Based on Bidder's previous experience in past NPCIL projects, Bidder shall consider 250 micron epoxy paint including primer** for Turbine Operating floor, various other floors and concrete walls wherever required. Please confirm.	a) The given thicknes is exclusive of primer thickness. b) For thickness of Epoxy paint clause 1.11 shall be followed. c) No change. Technical specification shall be followed.
L&T	3	VOLUME-II- Section-C PART-2 GHAVP-1&2, GHAVP - 3&4 and KAIGA 5 & 6	2.3.1.5, Page 1092	Loads & Load Combinations e) Concetrated Loads Except for offices, toilet blocks etc. all floor slabs, secondary beams and girders etc. (other than the operating platforms near the equipments) shall be designed for a concentrated load of 10000 N acting simultaneously **with the uniform live load as given in (i)** to take care of any unforeseen exigent loads.	**GHAVP 1&2, GHAVP 3&4 and KAIGA-5&6** Bidder is unable to locate the reference clause "(i)" as specified in the tender Specification. Please furnish the same.	e) Concetrated Loads Except for offices, toilet blocks etc. all floor slabs, secondary beams and girders etc. (other than the operating platforms near the equipments) shall be designed for a concentrated load of 10000 N acting simultaneously **with the uniform live load as given in (d)** to take care of any unforeseen exigent loads.
***	***	***	***	***	***	


EL 99700
220 KV SWITCH YARD AREA
400 KV SWITCH YARD AREA
NSDF
CAMM WARE HOUSE INCLUDING OPEN STORAGE YARD COMPLEX AREA 1 to 4
UNIT 1&2
MAIN PLANT BOUNDARY
7.0M WIDE CONSTRUCTED ROAD EL 98400
7.0M WIDE PROPOSED ROAD
PLANT GRAIN STORAGE ZONE
CANAL
RELIP&D
CHAR GHAT TEMPLE
IT & COMM BUILDING
VEHICLE PARKING AREA
OVER HEAD TANK FOR DRINKING WATER
ENGINEERING OFFICE BLOCK
EMERGENCY MAKEUP WATER POND
FISH AREA 1-TO-4
MWP FACILITY & CONVEYING BOX
CFVS TANK
DM PLANT BUILDING AND CHEMICAL LAB FACILITY
DM FILTERATION PLANT & AREA
OPERATION MAKEUP WATER SUPPLY STORAGE TANKS
CHLORINATION BUILDING
CHLORINATION PLANT
INTERMEDIATE STORAGE TANK
NDCT-1A BASIN LEVEL=EL95900 SILL LEVEL=EL100000
NDCT-1B BASIN LEVEL=EL95900 SILL LEVEL=EL100000
NDCT-2A BASIN LEVEL=EL95900 SILL LEVEL=EL100000
NDCT-2B BASIN LEVEL=EL95900 SILL LEVEL=EL100000
CHAN EMERGENCY SPILLWAY
CHAN DIK (TIDING TO BE PROVIDED IN THE ZONE TO RESERVE MOISTURE)







ANNUAL WIND ROSE DIAGRAM (0830HRS)
(NORTH SHOWN HERE IS ALIGNED TO TRUE NORTH)

LEGENDS:-

FGL	=	FINISHED GRADE LEVEL			ROAD
IL	=	INVERT LEVEL			MAIN PLANT BOUNDARY
NB	=	NUCLEAR BUILDING			FENCING
RB	=	REACTOR BUILDING			PROPERTY BOUNDARY
RAB	=	REACTOR AUXILIARY BUILDING			RETAINING WALL
SAB	=	STATION AUXILIARY BUILDING			EXCLUSION ZONE BOUNDARY
CB	=	CONTROL BUILDING			DOUBLE FENCING FOR PHYSICAL PROTECTION
NFSB	=	NEW FUEL STORAGE BUILDING	EL	=	ELEVATION
TB	=	TURBINE BUILDING	TYP	=	TYPICAL
ET4	=	400 KV TRANSMISSION LINE TOWER	℄	=	CENTERLINE
GT	=	GENERATOR TRANSFORMER			
SUT	=	START UP TRANSFORMER			
UT	=	UNIT TRANSFORMER			
TML	=	TURBINE MISSILE LINE			
FOSA	=	FUEL OIL STORAGE AREA			
EMWP	=	EMERGENCY MAKEUP WATER POND			
PWPH	=	PLANT WATER PUMP HOUSE			
FWPH	=	FIRE WATER PUMP HOUSE			
SRPH	=	SAFETY RELATED PUMP HOUSE			
CWPH	=	CONDENSER COOLING WATER PUMP HOUSE			
ODP	=	OIL DRAIN PIT			
NDCT	=	NATURAL DRAFT COOLING TOWER			
IDCT	=	INDUCED DRAFT COOLING TOWER			
DG	=	DIESEL GENERATOR			
SRSH	=	SAFETY RELATED ELECTRICAL HOUSE			
CAS	=	CENTRAL ALARM STATION/CONTROL ACCESS SYSTEM			
BOP	=	BURNT OIL PIT			
PPS	=	PHYSICAL PROTECTION SYSTEM			
STP	=	SEWAGE TREATMENT PLANT			
MPB	=	MAIN PLANT BOUNDARY			
CTVS	=	CONTAINMENT FILTERED VENTILATION SYSTEM			
OESC	=	ON SITE EMERGENCY SUPPORT CENTER			
MML	=	MICROMETEOROLOGICAL LAB			
MGH	=	MAIN GUARD HOUSE			
SG	=	SWITCH GEAR ROOM			
CPSS	=	CONSTRUCTION POWER SUPPLY STATION			
MRSS	=	MAIN RECEIVING SUB-STATION			

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE. ALL CO-ORDINATES ARE IN METERS WITH RESPECT TO PLANT GRID SYSTEM. CENTER OF REACTOR BUILDING 2 LOCATED AT INTERSECTION OF GRID 20 & X HAS COORDINATES E-0.00, E-0.00.
2. EL 99700 CORRESPONDS TO RL 219300.
3. IN ORDER TO RETAIN THE GRID NUMBERING SYSTEM FOR UNITS-3&4 SAME AS UNITS-1&2, A SEPARATE GRID SYSTEM HAS BEEN INTRODUCED FOR UNITS-3&4 WHICH IS INDICATED IN THE NPCIL DRAWING NO. GHAVP-3&4/10000/2002/GA.
4. ACCESS ROADS IF NOT SHOWN IN THE LAYOUT, SHALL BE CONSTRUCTED TO SUIT THE BUILDING ENTRY/EXIT.
5. OUTER TO OUTER DIMENSIONS OF BUILDINGS SHOWN IN THIS DRAWING ARE AT EL 100M UNLESS NOTED OTHERWISE.
6. IN THE DRAWING, WHEREVER THE STRUCTURES ARE SHOWN TOUCHING EACH OTHER WITHIN THE OPERATING ISLAND A MINIMUM CLEAR GAP OF 1000MM SHALL BE MAINTAINED BETWEEN THESE STRUCTURES UNLESS NOTED OTHERWISE.
7. THE DISTANCE BETWEEN THE CENTRE LINE OF RB AND LAST STAGE OF FIRST LP TURBINE IS MAINTAINED AS 160.95M WHICH IS MORE THAN THE MINIMUM DISTANCE REQUIRED FROM TURBINE MISSILE CONSIDERATIONS.
8. SIZES OF BUILDINGS/STRUCTURES SUCH AS NDCT, IDCT, DM/FILTRATION PLANT, TURBINE BUILDING VENTILATION, STORAGE AREA, CWPH, SEWAGE TREATMENT PLANT, PWPH, CHLORINATION PLANT & INTERMEDIATE STORAGE TANK ARE SHOWN AS INDICATIVE AND THE SAME SHALL BE FINALIZED AFTER GETTING INFORMATION FROM RESPECTIVE VENDORS/ PACKAGES.
9. IF THE TIME GAP IN EXECUTION BETWEEN UNITS-1&2 AND UNITS-3&4 IS LESS THAN 5 YEARS, CONSTRUCTION INFRASTRUCTURE LAND SHALL BE REQUIRED DURING THE CONSTRUCTION OF GHAVP 1&2. THE ADDITIONAL LAND REQUIRED FOR CONSTRUCTION INFRASTRUCTURE WILL HAVE TO BE ARRANGED. THE TENTATIVE REQUIREMENT OF LAND FOR CONSTRUCTION INFRASTRUCTURE IS 32.70 HECTARES. THIS WILL BE ESSENTIALLY NEEDED DURING CONSTRUCTION OF UNITS-3&4
10. THE PROPERTY BOUNDARY WALL SHOWN IN THIS DRAWING SATISFIES THE EXCLUSION ZONE BOUNDARY REQUIREMENTS AND HENCE NO SEPARATE EXCLUSION ZONE BOUNDARY WALL IS ENVISAGED.
11. GREEN BELT LOCATION IS SHOWN TENTATIVELY. IT SHALL BE MODIFIED AS PER THE SITE REQUIREMENT.
12. IN CASE, MPB IS CONSTRUCTED SEPARATELY FOR UNITS-1&2 AND IS DIFFERENT FROM THAT OF COMPOSITE MPB OF UNITS-1 TO 4, THIS DRAWING SHALL BE RE-SUBMITTED TO SECURITY COMMITTEE FOR CLEARANCE/APPROVAL.
13. CONSTRUCTION SEQUENCE SHALL BE UNIT-1, UNIT-2 IN THAT ORDER.
14. ALL INFRASTRUCTURE FACILITIES IN MAIN PLANT AREA ARE PROVIDED AS PER HQI 8002/RO.
15. PATROLLING ROAD OUTSIDE MPB REQUIRED IS 3.75M HOWEVER FOR CATERING TO CONSTRUCTION REQUIREMENTS OF UNITS-3&4 IT HAS BEEN SHOWN AS 7.0M WIDE.
16. • THE LENGTH OF TURBINE BUILDING INDICATED IS FROM COLUMN CENTER TO CENTER.
17. TREE PLANTATION SHALL NOT BE DONE IN VICINITY OF NDCTS (150m ALL AROUND THE TOWERS) AND IDCTs (WITHIN PPS FENCE ALL AROUND THE TOWERS) TO AVOID OBSTRUCTION TO AIR FLOW.
18. THE AREA NEAR OPEARTION STORAGE PONDS SHALL BE RESERVED FOR FUTURE EXPANSION OF THE PONDS. PRESENT CAPACITY OF EACH POND IS FOR ABOUT HALF DAY OPERATIONAL MAKE UP REQUIREMENT FOR TWIN UNITS.
19. A GRADED PLANTATION OF TREES AT PLANT BOUNDARY SHALL BE DONE TO REDUCE WIND VELOCITY, SAND DRIFTS AND HELP REDUCE DUST ENTERING THE SITE DURING STORM SEASON. THE FIRST ROW SHALL BE OF POPLAR TREES OF HEIGHT 60~80', SECOND ROW SHALL BE OF EUCALYPTUS TREES OF HEIGHT 60'~85', THIRD ROW OF SHESAM/KANER TREES OF 45'~65' HEIGHT, FOURTH ROW SHALL BE SHRUBS OF 10'~15' AND IN OPEN AREAS GRASS SHALL BE PLANTED. THE ROWS OF TREES SHALL BE STAGGERED SO AS TO COVER THE GAPS OF TREES OF ADJACENT ROWS IN PRECEDING ROWS. THIS IS TO ENSURE A ZIG-ZAG FLOW PATH OF INCOMING DUST LADEN AIR AND FILTRATION OF DUST BY TREES.

SPECIAL NOTES FOR MAIN PLANT BOUNDARY WALL:-

1. SPECIFICATION OF MPB AND OI DOUBLE FENCE SHALL CONFORM TO AERB MANUAL "NUCLEAR SECURITY REQUIREMENTS FOR NPP"(DATED 24/05/2012).
2. MINIMUM HEIGHT OF MPB SHALL BE 12" INCLUDING BARBED OVERHANG ON TOP.
3. MPB SHALL BE OF RR MASONRY WALL 10' HIGH WITH 2' BARBED OVERHANG AND IF NOT POSSIBLE CHAIN LINK FENCE WITH OVERHANG AND SECOND LAYER OF CONCERTINA SHALL BE PROVIDED.
4. MINIMUM DISTANCE BETWEEN MPB AND OI DOUBLE FENCE SHALL BE 400M AT MAIN ENTRY PORTAL (MGH) ON MPB AND 300M FOR ALL OTHER AREAS.
5. ALL OPENINGS BELOW THE GROUND LEVEL (NALLAHAS, DRAINS, DITCHES) SHALL BE PROTECTED BY GRILLS.
6. WATCH TOWERS SHALL BE PROVIDED ALONG THE MPB IN LINE WITH DAE MANUAL ON SECURITY.
7. IF ANY CHANGE IS REQUIRED IN THE LAYOUT OF MPB DUE TO SITE CONDITIONS, CONCURRENCE FROM HQ SHALL BE TAKEN.

ISSUE No.	REV. No.	DESCRIPTION		
2	R1	FOR INFORMATION	JRM 30/08/2019	
1	R0	FOR INFORMATION	JRM 31/07/2018	
			TCE	NPCIL
			SIGNATURE WITH DATE	

DRAWING ISSUED FOR

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

GROUP	ENGR	SIGN	GROUP	ENGR	SIGN	GROUP	ENGR	SIGN	GROUP	ENGR	SIGN
R3			R2			R1			R0		

DES'D. | CHK'D. | REV'D. | APP'D.

ENGINEERING CONSULTANT
TATA CONSULTING ENGINEERS LIMITED
MUMBAI
JOB_REF._No. 10590A

DO NOT SCALE THE DRAWING.

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

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

NOT APPLICABLE

TOLERANCES ON LINEAR DIMENSIONS (IS-2102)

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

TOLERANCES ON LINEAR DIMENSIONS

SPECIFIED DIMENSIONS	TOLERANCE
XX	±
XX.X	±
XX.XX	±

TOLERANCES ON ANGULAR DIMENSIONS : ± 0° - 30'

TITLE :- GORAKHPUR HARYANA ANU VIDYUT PARIYOJANA
MAIN PLANT LAYOUT UNITS 1 TO 4

DES'D.	DR'N.	REV'D.
DATE -	DATE (23/01/2018)	DATE (23/01/2018)
DES. CHK'D.	DRG. CHK'D.	APP'D.
DATE -	DATE (23/01/2018)	DATE (23/01/2018)

PROJECT:- GHAVP-1 TO 4
SCALE - 1:1
PROJECTION

DRG. No. GHAVP-1T04/10000/5001/GA
REV. NO. R1
FILE NAME: GHAVPT1004_10000_5001_GA_R1

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

REV. NO.	REV. LOCATION	REVISIONS DESCRIPTION	DR'N.	DES'D.	DES.CHK'D.	REV'D.	APP'D.
R1	"	GENERALLY REVISED	AFN (01-08-2019)		YMC (01-08-2019)	JRM (01-08-2019)	

SIGNATURE WITH DATE (TCE) | SIGNATURE (NPCIL)

REFERENCE DRAWINGS	DRAWING No.	REFERENCE DRAWINGS	DRAWING No.	REFERENCE DRAWINGS	DRAWING No.
MAIN PLANT LAYOUT(UNIT 3&4)	GHAVP-3&4/10000/2002/GA				
COMPOSITE PLANT LAYOUT UNIT 1 TO 4	GHAVP-1T04/10000/2001/GA				

DRG. No. GHAVP-1T04/10000/5001/GA
A0

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A0

DRG. No.
GHAVP-1/51210/2001/GA

REFERENCE DRAWINGS	DRAWING No.
PLOT PLAN	GHAVP-1/100000/2002/GA
KEY ONE LINE DIAGRAM	GHAVP-1/500000/2110/ED
CL-IV 6.6kV SWITCHGEAR & BUSDUCT LAYOUT	GHAVP-1/52440/2102/GA
GENERAL ARRANGEMENT FOR GENERATOR ISOLATED PHASE BUSDUCT	GHAVP-1/51130/5001/GA
OUTDOOR AREA CABLE TRENCH LAYOUT (SH-3)	GHAVP-1&2/53330/5078/GA
400KV POWER LINES INSIDE PLANT AREA-KEY PLAN	GHAVP-1&2/51330/5013/GA
OUTDOOR AREA CABLE TRENCH LAYOUT (SECTIONS)	GHAVP-1&2/53330/5088/GA
OUTDOOR AREA CABLE TRENCH LAYOUT FOR TRANSFORMER YARD 1&2	GHAVP-1&2/53330/5083/GA
ELECTRICAL BAY BUILDING	GHAVP-1/52440/2102/GA

REFERENCE DRAWINGS	DRAWING No.
TRANSFORMER YARD LIGHTING LAYOUT	GHAVP-1/53130/2167/GA
GENERATOR ISOLATED PHASE BUSDUCT	GHAVP-1/51130/6501/GA
TRANSFORMER YARD CABLE TRAY LAYOUT	GHAVP-1/53330/2167/GA

| REVISIONS | | |

NUCLEAR POWER CORPORATION OF INDIA LTD.

(A Government of India Enterprise)

Directorate of Quality Assurance

Phone: 022 – 2599 5045, Fax 022 – 2556 5354

1) LIST OF APPROVED CARBON STEEL & LOW ALLOY STEEL WELDING ELECTRODES (2 pages)

As on 07-01-2019

Sr. No.	Manufacturers	Brand name	AWS No.	Valid up to
1.	ADOR Welding Ltd., Silvassa	SUPABASE X PLUS	E7018	FEB2019*
2.	ADOR Welding Ltd., Silvassa	MOLYTEN	E7018-A1	APR2020
3.	ADOR Welding Ltd., Silvassa	TENALLOY Z PLUS	E7018-1	JUN2022
4.	ADOR Welding Ltd., Silvassa	CHROMOTEN	E8018 B2	APR2020
5.	ADOR Welding Ltd., Silvassa	CHROMOTEN-C	E9018 B3	APR2020
6.	D&H SECHERON, Indore	MOLYTHERME	E7018-A1	JUN2022
7.	D&H SECHERON, Indore	MEDIO	E6013	JUN2020
8.	D&H SECHERON, Indore	EXOBEL	E6013	JUN2020
9.	D&H SECHERON, Indore	SUPERTHERME	E7018	JUN2020
10.	D&H SECHERON, Indore	SUPERTHERME(SPL)	E7018-1	NOV2023
11.	D&H India Ltd., Indore	SUPER –LH (SPL)	E7018-1 (DCEP Only)	FEB2021
12.	D&H India Ltd., Indore	STANDARD	E6013	FEB2021
13.	D&H India Ltd., Indore	SUPER LH	E7018 (DCEP Only)	FEB2021
14.	D&H India Ltd., Indore	SUPER -CR-1	E8018 B2	DEC2020
15.	D&H India Ltd., Indore	SUPER -CR-2	E9018 B3	DEC2020
16.	ESAB INDIA LTD, AMBATTUR, CHENNAI	ESAB 28	E6013	SEP2019
17.	ESAB INDIA LTD, AMBATTUR, CHENNAI	ESAB 36H	E7018	SEP2019
18.	ESAB INDIA LTD, AMBATTUR, CHENNAI	ESAB 36H(SPL)	E7018-1	SEP2019
19.	ESAB INDIA LTD, AMBATTUR, CHENNAI	ESAB PIPEWELD 6010R	E6010	SEP2019
20.	HONAVAR ELECTRODES, THANE	REGULAR S	E6013	JAN2020
21.	HONAVAR ELECTRODES, THANE	ULTIMATE - 18	E7018	JAN2020
22.	HONAVAR ELECTRODES, THANE	ULTIMATE – 18 SPL	E7018-1	JAN2020
23.	MAILAM INDIA LTD., PUDUCHERRY	MAILARC -13R	E6013	SEP2020
24.	MAILAM INDIA LTD., PUDUCHERRY	MAILARC -18	E7018	SEP2020
25.	MAILAM INDIA LTD., PUDUCHERRY	MAILARC -18 PLUS	E7018-1	SEP2020
26.	MAILAM INDIA LTD., PUDUCHERRY	MAILARC -1 CR	E8018-B2	DEC2018*
27.	MAILAM INDIA LTD., PUDUCHERRY	MAILARC -2 CR	E9018-B3	DEC2018*
28.	ROYAL ARC ELECTRODES, VASAI	ROYAL THERME	E7018	SEP2018*
29.	ROYAL ARC ELECTRODES, VASAI	ROYAL S	E6013	SEP2018*
30.	ROYAL ARC ELECTRODES, VASAI	ROYAL THERM SPL.	E7018-1	SEP2021
31.	ROYAL ARC ELECTRODES, VASAI	ROYAL THERM MOLY	E7018-A1	MAR2023
32.	ROYAL ARC ELECTRODES, VASAI	ROYAL CHROM 1	E8018-B2	FEB2023
33.	ROYAL ARC ELECTRODES, VASAI	ROYAL CHROM 2	E9018-B3	FEB2023
34.	RAJ KESARI ELECTRODES, UDAIPUR	SUPERLET 18	E7018	AUG2022
35.	RAJ KESARI ELECTRODES, UDAIPUR	SUPERLET 18 (SPL.)	E7018-1	AUG2022
36.	RAJ KESARI ELECTRODES, UDAIPUR	RAJCORD 13S	E6013	AUG2022
37.	RAJRATNA ELECTRODES, AHEMEDABAD	RATNA 7018	E7018	NOV2023

Sr. No.	Manufacturers	Brand name	AWS No.	Valid up to
38.	RAJRATNA ELECTRODES, AHEMEDABAD	RATNA 7018 SPL.	E7018-1	MAR2020
39.	SUPERON SCHWEISSTECHNIK INDIA LTD. DELHI	GARANT MO	E7018-A1	SEP2020
40.	SUPERON SCHWEISSTECHNIK INDIA LTD. DELHI	SUPERCITO	E7018	SEP2019
41.	SUPERON SCHWEISSTECHNIK INDIA LTD. DELHI	SUPERCITO 7018-S	E7018-1	SEP2019
42.	SUPERON SCHWEISSTECHNIK INDIA LTD. DELHI	OVERCORD S	E6013	SEP2019
43.	SUPERON SCHWEISSTECHNIK INDIA LTD., DELHI	SUPER CROMO 1B	E8018-B2	DEC2020
44.	SUPERON SCHWEISSTECHNIK INDIA LTD., DELHI	SUPER CROMO 2B	E9018-B3	DEC2020
45.	VIJEY ELECTRODES & WIRES PVT. LTD., CHENNAI	VJ 6013 X	E6013	SEP2020
46.	VIJEY ELECTRODES & WIRES PVT. LTD., CHENNAI	VJ 7018	E7018	SEP2020
47.	VIJEY ELECTRODES & WIRES PVT. LTD., CHENNAI	VJ 7018 - 1	E7018-1	SEP2020
48.	WELD FAST ELECTRODES, NAGPUR	WELDFAST LH 18	E-7018	MAR2020
49.	WELD FAST ELECTRODES, NAGPUR	WELDFAST LH-18-1	E-7018-1	MAR2020
50.	WELD FAST ELECTRODES, NAGPUR	WELDFAST CROMO 0500	E7018-A1	FEB2023
51.	WELD FAST ELECTRODES, NAGPUR	WELDFAST CROMO 1500	E8018-B2	FEB2023
52.	WELD FAST ELECTRODES, NAGPUR	WELDFAST CROMO 2251	E9018-B3	FEB2023

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

* Indicates renewal of approval is under progress.

G. Badri Narayana 5/1/19

(G. Badrinarayana)
Associate Director (QA), Gr.3

NUCLEAR POWER CORPORATION OF INDIA LTD.

(A Government of India Enterprise)

Directorate of Quality Assurance

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2) LIST OF APPROVED STAINLESS STEEL & OTHER NI ALLOY ELECTRODES (2 Pages)

AS ON 07-01-2019

Sr. No.	MANUFACTURERS	BRAND NAME	AWS No.	VALID UPTO
1.	ADOR WELDING LTD., SILVASSA	BETANOX-DL	E 309L-16	SEP2020
2.	ADOR WELDING LTD., SILVASSA	SUPERINOX-2C	E 316-16	SEP2020
3.	ADOR WELDING LTD., SILVASSA	SUPERINOX-1C	E 308L-16	SEP2020
4.	D&H INDIA LTD., INDORE	SV-308L	E 308L-15	DEC2022
5.	D&H INDIA LTD., INDORE	SV-309L	E 309L-15	DEC2022
6.	D&H INDIA LTD., INDORE	CROMALLOY-B	E 308L-16	DEC2022
7.	D&H INDIA LTD., INDORE	CROMALLOY 309L	E 309L-16	DEC2020
8.	ADOR FONTECH, BENGALURU	LH 511	E Ni Cu7	OCT2020
9.	ADOR FONTECH, BENGALURU	LH 521	E Ni Cr Fe 3	OCT2020
10.	D&H SECHERON, INDORE	CRONITHERME 25/12	E 309-16	JUN2022
11.	D&H SECHERON, INDORE	RUTOX-D	E 316L-16	JUN2022
12.	D&H SECHERON, INDORE	BATOX-B	E 308L-15	JUN2020
13.	D&H SECHERON, INDORE	RUTOX-B	E 308L-16	JUN2020
14.	D&H SECHERON, INDORE	D&H 309L	E 309L-16	NOV2023
15.	D&H SECHERON, INDORE	D&H 1250	E NiCu-7	JAN2021
16.	D&H SECHERON, INDORE	D&H 1212NS	E NiCr Fe-3	JAN2021
17.	D&H SECHERON, INDORE	RUTOX-A	E 308-16	NOV2023
18.	D&H SECHERON, INDORE	RUTOX-A St	E 347-16	NOV2023
19.	D&H SECHERON, INDORE	RUTOX-Mo	E 316-16	NOV2023
20.	HONAVAR ELECTRODES, THANE	SILVER SHINE 308L-15	E 308L-15	SEP2018*
21.	HONAVAR ELECTRODES, THANE	SILVER SHINE 308L	E 308L-16	SEP2019
22.	HONAVAR ELECTRODES, THANE	SILVER SHINE 309L	E 309L-16	SEP2019
23.	HONAVAR ELECTRODES, THANE	SILVER SHINE 316L	E 316L-16	NOV2018*
24.	RAJRATNA ELECTRODES, AHEMEDABAD	RATNA 308L	E 308L-16	MAR2020
25.	RAJRATNA ELECTRODES, AHEMEDABAD	RATNA 316 L	E 316L-16	MAR2020
26.	SUPERON SCHWEISSTECHNIK INDIA LTD. DELHI	SUPER OPTIMAL 309L	E 309L-16	OCT2019
27.	SUPERON SCHWEISSTECHNIK INDIA LTD. DELHI	SUPER OPTIMAL 316L	E 316L-16	OCT2019
28.	SUPERON SCHWEISSTECHNIK INDIA LTD. DELHI	SUPER OPTIMAL 309 MoL	E 309MoL	OCT2019
29.	SUPERON SCHWEISSTECHNIK INDIA LTD. DELHI	SUPER STAINLESS 347	E 347-16	OCT2019
30.	SUPERON SCHWEISSTECHNIK INDIA LTD. DELHI	SUPER OPTIMAL 308L	E 308L-16	OCT2019
31.	MAILAM INDIA LTD., PUDUCHERRY	MAILEX-A	E 308-16	DEC2018*
32.	MAILAM INDIA LTD., PUDUCHERRY	MAILEX-AL	E 308L-16	DEC2018*
33.	MAILAM INDIA LTD., PUDUCHERRY	MAILEX-AL-15	E 308L-15	DEC2018*

Sr. No.	MANUFACTURERS	BRAND NAME	AWS No.	VALID UPTO
34.	MAILAM INDIA LTD., PUDUCHERRY	MAILEX-25/12	E 309-16	DEC2018*
35.	MAILAM INDIA LTD., PUDUCHERRY	MAILEX-25/12-L	E 309L-16	DEC2018*
36.	MAILAM INDIA LTD., PUDUCHERRY	MAILEX-25/12-Mo	E 309 Mo-16	DEC2018*
37.	MAILAM INDIA LTD., PUDUCHERRY	MAILEX Mo	E 316-16	DEC2018*
38.	MAILAM INDIA LTD., PUDUCHERRY	MAILEX MoL	E 316L-16	DEC2018*
39.	ROYAL ARC ELECTRODES, VASAI,	ROYAL 1C	E 308L-16	SEP2019
40.	ROYAL ARC ELECTRODES, VASAI,	ROYAL 2C	E 316L-16	SEP2019
41.	ROYAL ARC ELECTRODES, VASAI,	ROYAL-D2L	E 309L-16	SEP2019
42.	WELD FAST ELECTRODES, NAGPUR	WELDFAST 308L	E 308L-16	JAN2021
43.	WELD FAST ELECTRODES, NAGPUR	WELDFAST 316L	E 316L-16	JAN2021
44.	WELD FAST ELECTRODES, NAGPUR	WELDFAST 309L	E 309L-16	JAN2021
45.	WELD FAST ELECTRODES, NAGPUR	WELDFAST 309MoL	E 309LMo-16	JAN2021

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

* Indicates renewal of approval is under progress.

(G. Badrinarayana)
Associate Director (QA), Gr.3

NUCLEAR POWER CORPORATION OF INDIA LTD.

(A Government of India Enterprise)

Directorate of Quality Assurance

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3) LIST OF APPROVED BRANDS OF WIRE AND WIRE FLUX COMBINATION (1 Page)

AS ON 07-01-2019

Sr. No.	MANUFACTURERS	BRAND NAME	AWS No.	VALID UPTO
1.	ANAND ARC, THANE	ANAND TIG-308L	ER 308L	SEP2019
2.	ANAND ARC, THANE	ANAND TIG-309L	ER 309L	SEP2019
3.	ADOR FONTECH, BENGALURU	TIG 120	ER 308L	JUL2019
4.	ADOR FONTECH, BENGALURU	TIG 121	ER 316L	JUL2019
5.	ADOR FONTECH, BENGALURU	TIG 123	ER 309L	JUL2019
6.	ADOR FONTECH, BENGALURU	TIG 120S	ER 347	JUL2019
7.	ADOR FONTECH, BENGALURU	TIG 521	ER NiCr3	JUL2019
8.	ADOR WELDING LTD., SILVASSA	TIGFIL 70S-2	ER 70S-2	FEB2022
9.	ADOR WELDING LTD., SILVASSA	TIGFILL 90S-B3	ER 90SB3	JUL2019
10.	ADOR WELDING LTD., SILVASSA	TIGINOX-308L	ER 308L	SEP2020
11.	ADOR WELDING LTD., SILVASSA	TIGINOX-309L	ER309L	SEP2020
12.	ADOR WELDING LTD., SILVASSA	AUTOMIG 70-S6	ER 70S-6	DEC2023
13.	ADOR WELDING LTD., SILVASSA	AUTOMELT-B71 AUTOMELT-EH 14 WIRE	F7A2-EH14	DEC2018*
14.	DWEKAM ELECTRODES, INDORE	MERGE ARC GRADE A	F7AZ/PZ-EL8	JUL2019
15.	DWEKAM ELECTRODES, INDORE	MERGE ARC GRADE C	F7AZ/PZ-EH14	JUL2019
16.	D&H INDIA LTD., INDORE	SUPER TIG 308L	ER 308L	DEC2020
17.	D&H INDIA LTD., INDORE	SUPER TIG 309L	ER 309L	DEC2020
18.	D&H SECHERON, INDORE	FILLER WIRE FW 308L	ER 308L	FEB2021
19.	D&H SECHERON, INDORE	FILLER WIRE FW 309L	ER 309L	FEB2021
20.	D&H SECHERON, INDORE	F 70 S2	ER 70S-2	JUN2022
21.	RAJRATNA ELECTRODES, AHEMEDABAD	RAAJTIG ER 308L	ER 308L	MAR2020
22.	RAJRATNA ELECTRODES, AHEMEDABAD	RAAJTIG ER 316L	ER 316L	MAR2020
23.	VENUS WIRES, KHOPOLI	VENUS 308L	ER 308L	SEP2021
24.	VENUS WIRES, KHOPOLI	VENUS 316L	ER 309L	SEP2021
25.	VENUS WIRES, KHOPOLI	VENUS 309L	ER 316L	SEP2021
26.	VENUS WIRES, KHOPOLI	VENUS 347	ER 347	SEP2021
27.	WELD FAST ELECTRODES, NAGPUR	TIG FAST-3	ER 70S-2	JAN2021
28.	WELD FAST ELECTRODES, NAGPUR	MIG FAST-1	ER 70S-6	JAN2021

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

* Indicates renewal of approval is under progress

G. Badrinarayana 7/1/19

(G. Badrinarayana)
Associate Director (QA), Gr.3

Subject: : Clarification w.r.t. PC-E-549

Following minimum acceptance criteria is applicable for lining works covered under PC-E-549. EPC contractor based on his experience shall add the other parameters, which are required to ensure the design intent.

SN	Parameter	Acceptance Norms
1	Lining Thickness Requirement. (Encasement is not part of coating)	Min. 24 mm Max. 30 mm
2	Cement	Conforming to IS: 12330 or OPC- 43 grade conforming to IS: 269
3	Aggregates	Grading shall be between 1.18 mm to 150 microns as per AWWA C 602, sand particles passing through 150-micron sieve size shall not be more than 5%
4	Water	Water used for cement mortar mixing and curing shall be as per IS: 456. Salt water shall not be used for mixing under any circumstances.
5	Reinforcement	Reinforcement for lining 3 mm diameter wire @ 40 c/c. The mesh wires shall overlap each other by a minimum of 10 mm and be tied with mild steel wire at 200 mm intervals. The reinforcement shall be held off the pipe wall by a series of equally spaced (250 mm c/c distance) 5 mm diameter bars (which shall run the full length of the lining and coating.
6	Compressive strength (min.)	7 days strength 17 MPa. 28 days strength 30 MPa
7	Defect less smooth Surface Finish	No defects like Sand pockets, Dummy area, Blisters/Undulations
8	Maintaining temperature of the pipe during lining.	Wet gunny bags shall be used.
9	Crack Width acceptance	Cracks up to 0.25 mm width and not over than 300 mm in length are acceptable
10	Hazen-Williams Coefficient	130 ± 5

Annexure-2

SPECIFICATION FOR ELECTROSTATIC CONDUCTIVE FLOOR AND OTHER ACCESSORIES

1.0 SCOPE:

The scope of this specification covers the design, shop testing, guarantee, supply, delivery and installation & testing of the Electrostatic Conductive Floors and Conductive Footwear (6 pairs) for 2 units of 220 MWe PHWRs.

The Flooring system shall consist of floor tiles/sheets, appropriate conductive adhesives, tools and accessories for installation at site and conductive footwear ready for use at Purchaser's premises, as specified herein and to the satisfaction of the purchaser.

2.0 CONTENTS:

Requirements of this specification are presented under the following section headings:

Description	Clause
Reference specifications and drawings	3
Materials & Workmanship	4
General Function and Description	5
Design requirements	6
Inspection, Tests and Reports	7
Shop Tests	8
Packing and Shipment	9
Quality Assurance Plan	Annexure-A

3.0 REFERENCE STANDARDS, SPECIFICATIONS AND DRAWINGS:

3.1 Reference Standards:

ANSI ESD S20.20	Standard for the development of an ESD control program for protection of electrical and electronic parts, assemblies and equipment.
IEC 61340-5-1	Protection of electronic devices from electrostatic phenomena—General requirements.
BS/EN 100015-1	Basic Specification. Protection of electrostatic sensitive devices -General requirements
ESD STM 97.1	Standard test method for the protection of electrostatic discharge susceptible items-floor materials and footwear-resistance measurement in combination with a person.
ESD STM 97.2	Standard test method for the protection of electrostatic discharge susceptible items-floor materials and footwear - voltage measurement on a person.
IS 2500 Part 1	Sampling Inspection Procedures-Attributes sampling plans indexed by AQL for lot-by-lot inspection

4.0 MATERIALS AND WORKMANSHIP:

4.1 Materials:

It is preferable that design, materials used and methods of fabrication shall be such that the equipment is fungus and corrosion resistant.

4.2 Workmanship:

The design, manufacture and workmanship shall be of high industrial quality to ensure the product to be uniform in quality and free from all defects so as to perform its required function satisfactorily in the specified environment as mentioned in the specification for estimated life of 40 years.

In the event that the requirements mentioned herein conflict with those of the standards listed in section-3 of this specification, then the requirement of this specification shall govern.

5.0 GENERAL FUNCTION AND DESCRIPTION:

5.1 The Electrostatic conductive floors shall be used in Local Control Rooms for limiting the tribo-electric charge generation due to human movement and its dissipation. This will limit the magnitude of Electrostatic Discharge (ESD) below the

susceptibility level of sensitive electronic circuits and reduce the probability of malfunction & failure of ESD sensitive Control & Instrumentation system.

All the materials used shall be of first class industrial standard conforming to the requirements of this specification. The electrostatic conductive system shall be able to perform satisfactorily under the environmental conditions mentioned below:

5.2 Environment Conditions:

a) Ambient Air Temperature : Min 5^0C to Max 50^0C
b) Relative Humidity : Min 25% & Max. 95%

6.0 DESIGN REQUIREMENTS:

All materials used shall be of first class industrial standard conforming to the requirements of this specification.

6.1 General:

Instrumentation and control equipment located in Local Control Rooms use state of the art high-speed low voltage level microprocessors and integrated circuits. The above areas are characterized by regular human movement for operation and maintenance purposes. The human movement leads to tribo-electric charge generation and electrostatic potential and subsequent ESD in these areas. Direct ESD, overstress due to ESD and EMI due to ESD in the sensitive devices may create system upsets or damage. To limit ESD, electrostatic conductive flooring along with conductive footwear shall be used in the above-mentioned areas. This shall limit the electrostatic potential on walking human to less than 30 Volts.

6.1.1 Electrostatic Conductive Floor Tiles:

The floor tiles shall be electrostatic conductive type. The electrostatic conductive floor tile shall be square, industrial grade made of homogeneous, single-layered Vinyl based material. It shall be flexible, resilient, dimensionally stable, wear resistant & slip resistant. The floor tile shall be fire retardant, fungus & bacteria, water & chemical resistant. The tile shall be colourfast with non-directional pattern. The supplier shall furnish the range of size and design pattern of the floor tiles and the purchaser shall have the freedom of selecting the required type for final procurement. The colour of tile shall be preferably light gray, however the purchaser shall have the freedom of selecting the required type for final procurement. The tile shall be installed on leveled, clean concrete floor with the help of conductive adhesive. To make the tiled floor watertight during washing & cleaning, heat welding of tiles with matching or contrasting colour fillers shall be possible. The tiles shall be repairable at site in-situ. The required physical, electrical properties of tiles are given in this specification.

6.1.2 Conductive Adhesive:

The adhesive for fixing the conductive floor tiles on concrete floor shall be stable, conductive acrylic dispersion type. The supplier shall indicate the physical, chemical & electrical properties of the adhesive. The quantity of adhesive required per square meter of flooring, the procedure for application and precaution against personnel hazard shall be provided by the supplier. The standing time and the curing time for the

adhesive shall be specified. The supplier shall arrange all the tools & accessories required for application of adhesive during installation. The supplier shall indicate the installed life of the adhesive without degradation and peel-off under the specified environment conditions.

6.1.3 Conductive Footwear:

Six pairs of reusable rubber based or equivalent conductive footwear shall be provided along- with the conductive floor tiles. The conductive footwear shall be worn over the shoes and shall be comfortable in walking. The conductive footwear shall be capable of minimizing generation of static electric charge and shall be able to dissipate the static charge from the human body to ground. The conductive footwear shall be washable. The supplier shall indicate the normal usable life of the conductive footwear without degradation of the properties. Free size conductive footwear shall be provided. The supplier shall provide the details of the conductive footwear.

6.1.4 Tools & Accessories:

Appropriate tools for cutting the floor tiles, surface preparation & application of adhesive, tile fixing, trimming & seam welding, pressing and finish shall be arranged by supplier during installation & performance testing. The supplier shall provide the complete list of recommended tools and accessories for cleaning of the conductive floor.

6.1.5 Grounding:

Appropriate copper strips, self-adhesive or embedded in the concrete floor shall be provided in suitable network form for draining the accumulated charge on the conductive flooring to station ground. The top surface of the copper strip shall be exposed and flush with the concrete floor so that it is conductively connected to the conductive floor tile with help of conductive adhesive. The copper strip network shall be suitably connected to the nearest available station-earthing pad already provided at site. The copper strip network shall be designed & installed such that the nominal resistance between any locations on the conductive floor to the station-earthing pad is between 10^4-10^6 ohms. The supplier shall indicate the details of copper strip and the network for installation at site.

6.2 Properties:

6.2.1 Conductive Floor Tiles:

1.	Type	:	Homogeneous, single layered, flexible, Electrostatic conductive, vinyl based, industrial grade, washable.
2.	Tile Size	:	600(L) x 600(W) mm minimum
3.	Thickness	:	2.00 mm minimum
4.	Dimensional Stability	:	0.05% max. (Lengthwise/Widthwise)
5.	Residual Indentation	:	0.06 mm maximum
6.	Static Load Limit	:	10 Kg/sq.cm (1500 psi) minimum
7.	Wear Resistance	:	0.20mm maximum
8.	Slip Resistance	:	Coefficient of friction 0.6 minimum
9.	Flexibility	:	No crack or break under specified flexing.
10.	Electrical Resistance	:	Electrostatic Conductive: Surface resistance 10^4 -- 10^6 ohm/square
11.	Human Body Voltage Generation	:	30 Volts max. (With ESD Footwear)
12.	Static Charge Decay Time	:	0.01 sec. max. With 5 KV decay to zero
13.	Bacteria, Fungus & Termite Resistance	:	Resistant
14.	Chemical Resistance	:	No appreciable dulling and stains on surface & Change in dimension and shape.
15.	Fire Resistance	:	Resistance to ignition
16.	Smoke Density	:	450 maximum
17.	Out gassing	:	1.8 % CVCM maximum
18.	Colour Fastness	:	7 minimum

6.3 Installation:

The electrostatic conductive floor shall be installed in the Local Control Rooms under the scope of this Package. The flooring shall be done after the complete erection of all control panels in the abovementioned areas. However system commissioning and operation activities may be in progress during

installation of the flooring. The supplier shall prepare the available concrete floor as required for the installation of tiles. Therefore flooring shall be done only in the exposed concrete floor areas. As the flooring is not continuous, suitable copper grounding strips shall be installed in various zones of the floor to obtain the floor resistance mentioned in clause no. 6.1.5 from any point of the floor. The supplier shall provide the details of copper grounding strip network required to achieve the specified floor resistance to station ground point on the floor. The copper grounding strip network shall be bonded appropriately to the nearest station ground pads already provided on the floors. The supplier shall supply the complete materials for installation of copper strip grounding network and conductive flooring and install the electrostatic conductive flooring to the satisfaction of the purchaser. All details regarding materials and installation process shall be provided by the supplier for purchaser's approval prior to commencing the installation job.

6.4 Maintenance:

The Electrostatic conductive flooring shall be easily maintainable in-situ. The flooring shall be washable and shall be easily decontaminated. Cleaning shall be possible with neutral detergent. Damp mopping, machine cleaning and dry vacuum cleaning shall be possible. The supplier shall provide the list of recommended cleaning detergents and cleaning and maintenance instructions to avoid degradation of electrostatic conductive properties.

The electrostatic conductive flooring shall be repairable in-situ. Mechanical & chemical damage shall be easily repairable by homogenous welding and abrasive techniques without leaving any trace and restoring the original appearance and properties. Surface repair shall not impair the electrostatic conductive properties of the flooring.

6.5 Information, etc. required after the award of contract:

The bidders shall have to give the following information after the award of contract.

6.5.1 Contractor's Drawings:

The Contractor shall forward drawings of the flooring material and copper grounding strip network to the purchaser within 8 weeks from the time an order is placed. These drawings shall include general arrangement, weights, outline dimensions, schematic and wiring diagrams. The Contractor before commencing with installation shall prepare and submit to the purchaser for approval TWO (2) complete sets of installation drawings, which shall show the installation in detail. These drawings, when approved in writing by the purchaser, shall form part of this specification. After said drawings have been approved, the contractor shall furnish TWO (2) additional complete sets of all final drawings, including all subsequent revisions approved by the purchaser.

One copy of all drawings shall be in reproducible form. All drawings shall be clearly marked.

"Electrostatic Conductive Floors", and the title block shall describe Section and part of Electrostatic Conductive Floors.

6.5.2 Test Procedure:

Contractor shall submit test procedure for approval. The equipment shall be tested as per approved test procedure.

6.5.3 Instruction Manual:

The Contractor shall furnish at no additional cost 10(ten) copies of the maintenance instruction manual for the flooring which shall include:

1. General information
2. Principal technical data
3. Description of components
4. Description of various tools and accessories
5. Maintenance instructions

5.1 **General**

5.1.1 Safety precautions to be observed during installation and maintenance.

5.1.2 Life of various flooring components

5.1.3 Maintenance including suggested routine inspection and maintenance periods for the various components

5.1.4 Adjustment

5.1.5 Material and Parts list sufficiently detailed for maintenance and replacement purposes.

5.1.6 Reference drawing sufficiently detailed for maintenance purpose.

5.1.7 Precautions to be taken during storage and installation.

The maintenance manual shall be supplied prior to the specified delivery date for the equipment.

6.5.4 Test reports shall be submitted as explained in clause 7.0 of this specification.

6.6 Spares:

The Spare shall be supplied on the following basis:

a) 5 % of the floor tiles, adhesives and flooring accessories.

The bidder shall give a list of spares with the offer based on the above.

7.0 INSPECTION, TESTS & REPORTS:

7.1 Quality Surveillance & Inspection:

The Supplier or approved Sub-Contractor shall allow access to the purchaser or his authorized representative at all reasonable time, during manufacture, assembly, testing and inspection to premises in which work is being carried out.

The inspection shall be carried out in a manner satisfactorily and shall be subject to approval by the Purchaser. A Quality Assurance Plan (QAP) is enclosed as Annexure- C. Supplier shall prepare QAP based on the QAP enclosed herewith and submit to purchaser for approval.

Manufacturer shall carryout all inspection and tests, apart from that all work covered by this specification shall be subject to quality surveillance by the purchaser or his authorized representative. Quality surveillance by the Purchaser or his authorized representative shall not relieve the supplier of the inspection duties called herein. In addition to the tests performed by the supplier, the purchaser shall have the right to ask for additional inspection or testing as deemed necessary and the additional cost of such tests will be borne by the purchaser.

In the event of any failure to meet the inspection or test requirements specified herein, the supplier shall notify the purchaser or his authorized representative. The supplier must obtain permission from the purchaser before repair is undertaken. If repairs, including redesign, are likely to affect the results of tests previously completed appropriate re-inspection and re-testing shall be carried out. The quality control procedure to be followed to ensure a satisfactory repair shall be subject to approval by Purchaser.

The supplier shall provide the purchaser's representative with complete set of detailed drawings which will be used by them to assist in the inspection during manufacture of the flooring components and which will be returned after the completion of the contract.

Inspection shall not be limited to the end product only. Facilities shall be provided for inspection during various stages of manufacture and as agreed between the supplier and the purchaser or his representative at the time the contract is placed.

Tests as required under clause 8.0 of this specification shall be performed. Three copies of the test reports shall be submitted to NPCIL. Shipping release will be issued only after receipt of test reports. Supplier shall keep a record for a period of five years after completing the job.

8.0 SHOP TESTS

The manufacturer shall carryout tests to show that the equipment has been satisfactorily designed and manufactured and installed and will perform to the standards required by this specification. If some tests mentioned cannot be carried out at supplier's works the same shall be carried out at site. In such a case, the supplier shall indicate the procedure of the test. If the equipment does not pass the test, it will be the supplier's responsibility to bring the equipment to the guaranteed figure or replace the faulty equipment at his cost. Any special equipment required for testing, like meters etc. if not available at purchaser's site office shall be supplied by the supplier.

8.1 Testing at Supplier's Works:

All components/assembly to be used in electrostatic conductive flooring shall be subjected to visual, mechanical, electrical and functional tests. The test results shall be documented and submitted to customer QA engineer for review. Details of the tests to be conducted shall be listed in "Quality Assurance Plan" to be submitted by the supplier after award of contract. The components to be tests are shown below. Supplier shall test all the components used and not necessarily only the components listed below.

8.1.1 List of Components to be tested:

8.1.1.1 Electrostatic conductive floor tiles

8.1.1.2 Conductive footwear

8.1.2 Type Tests:

The Test certificates for following tests on electrostatic conductive floor tiles shall be submitted for purchaser's approval as per standards given below or equivalent (after prior approval of purchaser).

1. Type of tile	DIN/EN-685
2. Size of tile	DIN/EN-427
3. Thickness of tile	DIN/EN-428
4. Dimensional stability	DIN/EN-434
5. Residual Indentation	DIN/EN-433
6. Static load limit	ASTM-F-970
7. Wear resistance	DIN/EN-660-1
8. Slip resistance	DIN-51131

9. Flexibility	ASTM-F-137
10. Electrical resistance (Surface)	IEC-61340
11. Human body voltage generation (with conductive footwear)	ESD-STM-97.2
12. Static Charge Decay Time	FED STD-101C Method 4046
13. Chemical resistance	DIN/EN-423
14. Fire resistance	DIN-4102
15. Smoke density	ASTM-E-662
16. Out gassing	ASTM-E-595
17. Colour fastness	ISO-105-B02

8.1.3 **Acceptance Tests:**

The following acceptance tests shall be carried out on electrostatic conductive floor tile samples taken from a lot as per standards given below or equivalent after prior approval of purchaser. Total no. of electrostatic conductive floor tiles of one type shall be treated as lot size. The sample size for acceptance tests shall be as per general inspection level II of IS-2500 (Part-1). The sampling plan followed shall be single sampling plan. The value of AQL (Acceptance quality levels) shall be 1.0 and acceptance number shall be selected as per table-III-A of IS-2500 (Part-1).

1.	Type of tile (Visual)	DIN/EN-685
2.	Colour/Shade of tile (Visual)	
3.	Size of tile	DIN/EN-427
4.	Thickness of tile	DIN/EN-428
5.	Dimensional stability	DIN/EN-434
6.	Electrical resistance (Surface)	IEC-6340
7.	Human body voltage generation (with conductive footwear)	ESD-STM-97.2
8.	Static Charge Decay Time	FED STD-101C Method 4046

8.2 Tests at Site after Installation:

The following tests shall be conducted on the complete installed ESD protective flooring.

1. Electrical resistance (Surface)	IEC-61340
2. Human body voltage generation (with conductive footwear)	ESD-STM-97.2
3. Static Charge Decay Time	FED STD-101C Method 4046

9.0 PACKING AND SHIPMENT

The electrostatic conductive floor tiles and accessories shall be so packed as not to suffer deterioration, damage or breakage during shipment. Packing should be such that the ingress of moisture, dirt and other foreign material can be avoided. Packing method shall be adequate to withstand a period in transit for more than two months and storage at site under a tropical climate for minimum period of one year without suffering any damage or deterioration. Each package shall be properly labeled to indicate the type and quantity of material it contains, purchase order number, dimensions, weight, and any other necessary data to identify the equipment and relate it to the contract.

Contractor shall not ship the material without the prior approval of the purchaser or his authorized representative and subsequent instruction to do so.

Bidders shall note that packing for shipment shall be in accordance with the instructions outlined below.

All small parts shall be shipped in separate boxes.

All projection connections shall be adequately blocked and protected to prevent damage during shipment.

Complete instructions relating to shipping and documentation will be furnished with the P.O.

ANNEXURE-A

SAMPLE QUALITY ASSURANCE PROGRAM FOR ELECTROSTATIC CONDUCTIVE FLOORING

SL. NO	COMPONENTS & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REF. DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY			REMARK
									P	W	V	
1.	Test on Electrostatic conductive floor tiles. Type tests	Type of Tile	C	Performance		DIN/EN-685	NPCIL SPECIFICATION	COC	2,3		1	
		Size of Tile	C	Measurement		DIN/EN-685	NPCIL SPECIFICATION	COC	2,3		1	
		Thickness of Tile	C	Measurement		DIN/EN-685	NPCIL SPECIFICATION	COC	2,3		1	
		Dimensional Stability	B	Measurement		DIN/EN-685	NPCIL SPECIFICATION	COC	2,3		1	
		Residual Indentation	C	Measurement		DIN/EN-685	NPCIL SPECIFICATION	COC	2,3		1	
		Static Load Limit	C	Measurement		ASTM-F-970	NPCIL SPECIFICATION	COC	2,3		1	
		Wear Resistance	B	Measurement		DIN/EN-660-1	NPCIL SPECIFICATION	COC	2,3		1	
		Slip Resistance	C	Measurement		DIN-51131	NPCIL SPECIFICATION	COC	2,3		1	
		Flexibility	B	Performance		ASTM-F-137	NPCIL SPECIFICATION	COC	2,3		1	
		Electrical Resistance (Surface)	C	Measurement		IEC-61340	NPCIL SPECIFICATION	COC	2,3		1	
		Human Body Voltage Generation (with Footwear)	C	Measurement		ESD-STM-97.2	NPCIL SPECIFICATION	COC	2,3		1	
		Static Charge Decay time	C	Measurement		FED-STD-101C Method 4046	NPCIL SPECIFICATION	COC	2,3		1	
		Chemical Resistance	B	Performance		DIN/EN-423	NPCIL SPECIFICATION	COC	2,3		1	
2.	Acceptance Tests	Type of Tile	C	Measurement	Sample as per NPCIL SPEC.	DIN/EN-685	NPCIL SPECIFICATION	TR	2,3	2,1	1	
		Colour/Shade/ Pattern	B	Visual	Sample as per NPCIL SPEC.	As per approved Spec. sheet	NPCIL SPECIFICATION	TR	2,3	2,1	1	
		Size of Tile	C	Measurement	Sample as per NPCIL SPEC.	DIN/EN-427	NPCIL SPECIFICATION	TR	2,3	2,1	1	
		Thickness of Tile		Measurement	Sample as per NPCIL SPEC.	DIN/EN-428	NPCIL SPECIFICATION	TR	2,3	2,1	1	
3.	Test at Site	Electrical Resistance	C	Measurement	Installed	IEC-61340	NPCIL SPECIFICATION	TR	2	2,1	1	

	after	(Surface)			Floor							
	Installation	Human body voltage generation (with ESD foot wear)	C	Measurement	Installed Floor	ESD-STM 97.2	NPCIL SPECIFICATION	TR	2	2,1	1	
		Static Charge Decay Time	C	Measurement	Installed Floor	FED STD-101C Method 4046	NPCIL SPECIFICATION	TR	2	2,1	1	

LEGEND:

P	:	Performed by	A:	Minor	1:	NPCIL
W	:	Witnessed by	B:	Major	2:	EPC Package vendor
V	:	Verified by	C:	Critical	3:	External Laboratory/ Sub Vendor
			TC:	Test Certificate		
			TR:	Test Report		
			CHP:	Customer Hold Point		