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PART-A (TECHNICAL BID)

1. PROJECT INFORMATION

Steady state Superconducting Tokamak (SST-1) machine is equipped with a Neutral Beam Injector (NBI) to raise the plasma ion temperature ~ 1 keV. This injector has a capability of injecting hydrogen beam with power of 0.5 MW at 30 keV and 1.7 MW at 55 keV. To fulfill this requirements NBI need to extract 1 MW at 30 kV and 5 MW at 55 kV from ion source which is heart of the system. Other sub-systems are Neutralizer, Magnet Coil (MC), Magnet Liner (ML), Ion Dump (ID), V-Target (VT), Pre Duct Scraper (PDS), Beam Transmission Duct (BTD) and Shine Through (ST). All the sub-systems (except Ion source) are kept inside vacuum vessel shown in fig.1. Other sub-systems are: Power Supply, Data Acquisition and Control System (DACs), Cooling Water System (CWS), Cryogenic System and Vacuum System. In this tender document we shall discuss CWS from concept to delivery.

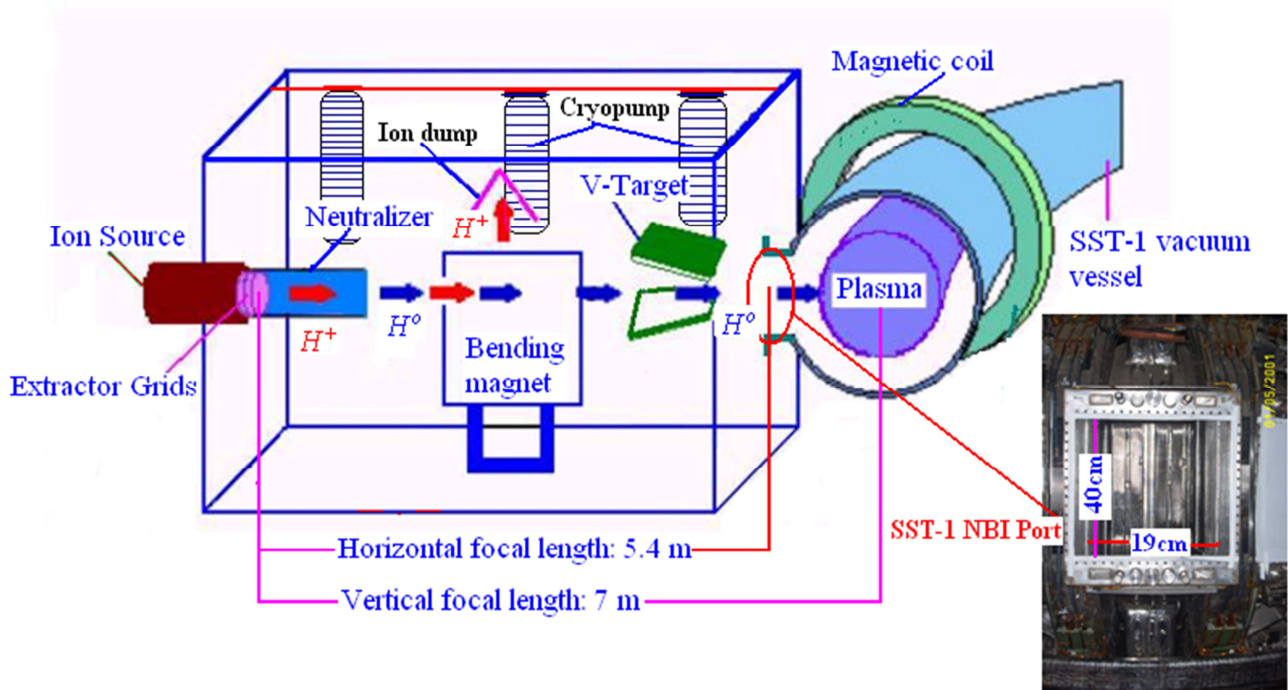


Fig.1 Schematic view of various subsystem of Neutral Beam Injection System

Since intense power is to be transported to SST-1 situated at a distance of several meters from the ion source. During beam operation several subsystems mentioned above received heat load which need to be removed by providing efficient network of water distribution in each subsystem.

Hence, to meet the above objective, the system offered must be ease of operation and maintenance, minimum noise level, reliability, simplicity, compactness, modularity, and Interchangeability.

The system offered with better parameters as mentioned above and satisfying all functional aspects shall be preferred.

1.1 INSTRUCTION TO VENDORS:

- The Bidder shall have studied in detail the site conditions, scope of work, specifications, tender drawings, labor and other respective terms and conditions as applicable, each system complication to make piping layout specified in the tender.
- The Vendors are requested to visit the IPR NBI site to have a better understanding of work and site conditions. Site visit is mandatory.

The Bidder shall enclose following with the offer:

- a.* The entire original tender documents and drawings duly endorsed.
- b.* Technical data sheet duly filled in without missing any details.
- c.* Sealed price bid with Schedule of Quantity with all the unit rates for all the items. The quantities specified in the SOQ are provisional. IPR reserves the right to increase or decrease the quantities or to totally omit any items. The vendor shall not be entitled to claim any extras or damages on these grounds. These variations shall be permitted until such time Vendors shop drawings are approved.
- d.* The Vendors should submit the list of skilled manpower and qualified / certified welders.
- e.* The Bidder shall provide preliminary Bar chart along with the offer to justify the specified completion period.
- f.* Documentary evidence for having executed similar works. They should include performance certificate from client clearly indicating full details of nature of work, work order no. and date, client address, value of work as per work order and period of completion as per work order and as per actual.

1.2 VENDOR SCOPE OF WORK

NBI cooling Water Distribution System (WDS) consists of two parts the water distribution system for PINI ion source and the water distribution system for injector. Drawing of PID for both the parts of the WDS is shown in fig.2. Vendors shall visit the IPR site for a complete understanding of the scope of work before submitting the quotation- Site visit is mandatory. Vendor scope includes design, procurement of required materials, fabrication, installation, testing and commissioning. The design of WDS shall be carried out according to the PID diagrams.

The given drawing is conceptual and prior to the execution of work the vendor shall visit the site to make an assessment of the site conditions and dimensions. Based on this assessment the vendor needs to submit the final drawings including the PID diagram to IPR for approval. The procurement of the required materials shall be in accordance with the technical specifications and preferred makes listed in sections 4 and 5. For the materials to be supplied by the vendor, the rates should be submitted in the format given in the schedule of quantities (SOQ) of the Part-B (Price Bid) of the tender document. All the welded joints should be carried out GTAW process only. The details of GTAW process is mentioned in section 2.3.1.

(a) The Water Distribution System for PINI Ion Source

In this distribution system there are 5 components e.g. Acceleration grid (AG), Deceleration Grid (DG), Earth Grid (EG), Plasma Box (PB) and Magnet Coil (MC) respectively, all are connected to common inlet header which supplies water at temperature of $\sim 25^{\circ}$ C shown in the drawing. Similarly all outlets are connected to common outlet header so that water exit from each components return to this header. The inlet and outlet lines of this distribution system should be connected to the PINI ion source through non-conductive parker make hoses (1 inch inner diameter nonconductive hose pipe, Part No. 518C-16) with weld-neck ends. Distribution of instrumentation air by PU tubes for pneumatic valves from source point is in scope of vendor. The vendor should supply the necessary lines for shorting the inlet and outlet lines-required during the process of acceptance tests.

(b) The Water Distribution System for Injector

Water distribution systems for NBI Injector are shown in PID (fig.2) which consists of following components e.g. Neutralizer, Magnet Liner (ML), V Target (VT), Ion Dump (ID), Pre Duct Scrapper (PDS), Beam Transmission Duct (BTD), and Shine Through (ST) etc. Inlet of each component is connected to common header which supplies water at temperature of $\sim 35^{\circ}$ C. It is to be noted that outlet from each is connected to common main return header.

The inlet and outlet lines of this distribution system should be connected to the Injector through SS braided flexible hoses welded to welding neck RF flanges mentioned in the drawings --. The mating of these flanges to the ports of injector should be done using Teflon gaskets and FRP (G-10) bushes. The technical specifications for the hoses, flanges, gaskets and bushes are given in drawing no. **SST-1/NBI/CWS/Flange Connection, Sheet 1 - 6**. Distribution of instrumentation air by PU tubes for pneumatic valves from source point is in scope of vendor The vendor should supply the necessary lines for shorting the inlet and outlet lines-required during the process of acceptance tests.

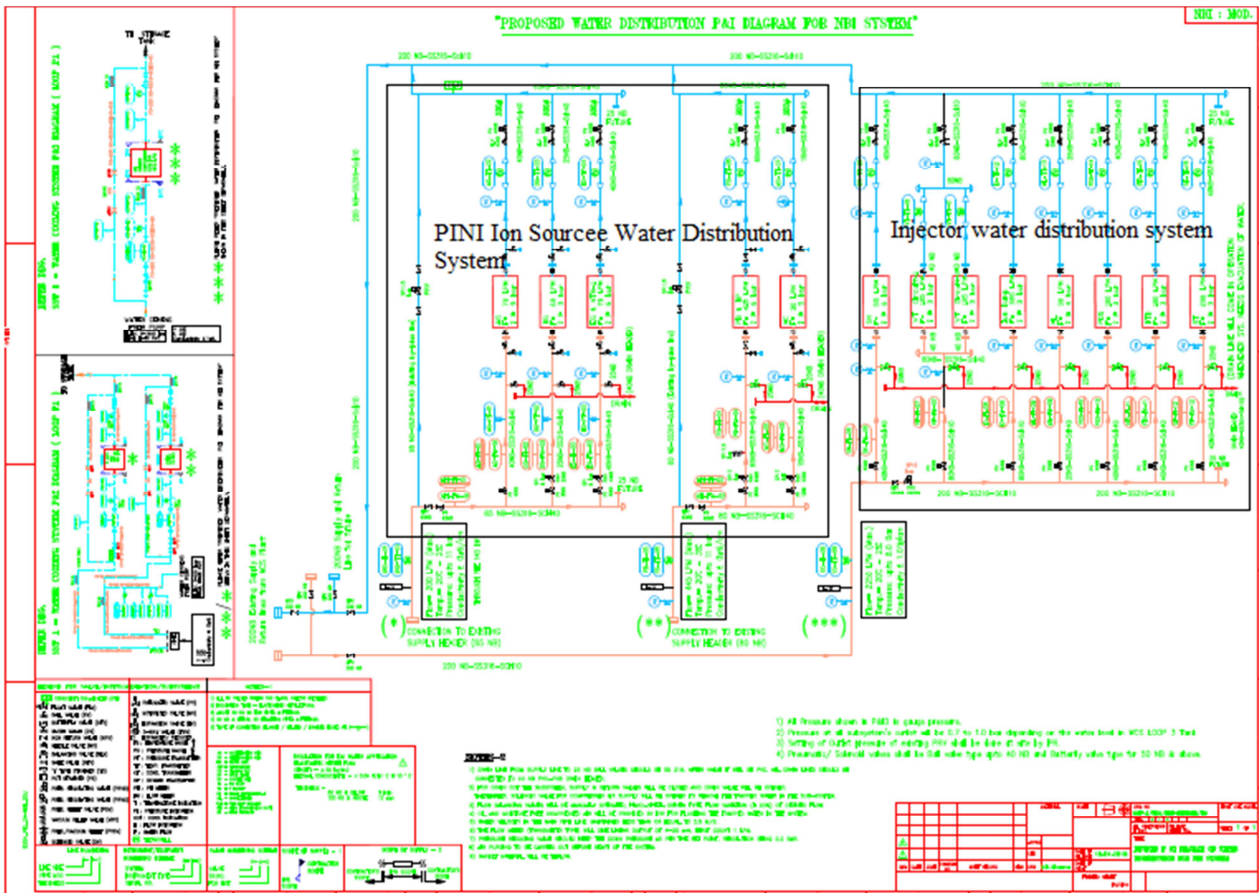


Fig. 2 Cooling Water Distribution System (WDS) for NBI system. PINI ion source and Injector WDS are shown separately. Enlarged view of this PID is available in the enclosed DWG No. SST-1/WDS/NBI-RREVISED/R2

(c) MS Platform

A metallic platform (Mild Steel) over main water header line at the location of door provided on wall (NBI Test Stand and designated NBI assembly area at SST hall interface wall) is required. The conceptual drawing for the MS platform is given in DWG No. IPR/15/A3/NBI/4032 Sheet 1 to 3. The platform is for facilitating human access and could carry a load of 600 kg. The vendor needs to submit the detailed drawings to IPR for approval.

(d) The DAQ Junction Box, Cables

Appropriate DAQ junction boxes should be installed both for PINI water distribution system and the Injector water distribution system. The procurement and installation of these junction boxes is in the scope of vendor. The locations for installation of these junction boxes shall be indicated by IPR. The vendor needs to procure both signal cables (mentioned in section 4.5) and power cables. Also assemble and layout of the same in the scope of vendor. Vendor needs to demonstrate the cooling parameters in the display of the junction box. The specifications for the DAQ are given in section 4.6.

1.3 IPR SCOPE OF WORK FOR DACS

- (i) Interfacing Cabling work of Signals from the junction boxes of WDS to the termination of NBI-PLC.

- (ii) Assignment of CWS channels to the PLC system with the Engineering values and process values.
- (iii) Development of logic control for cooling water system.
- (iv) Development of Graphical User Interface (SCADA) for the cooling water system.
- (v) Implementation of Interlocks.
- (vi) PLC powering

1.4 **FREE ISSUE MATERIALS/ FACILITIES AND EXCLUSIONS**

A. Free issue materials (FIM): Valves, Pressure gauges, Flow Meters, Temperature Transmitters etc.

The following lists of instruments and valves with accessories are available at existing of CWS of SST NBI. IPR shall provide the same to the vendor at SST NBI lab and use them as per CWS requirements.

Note: All the FIM supplied by IPR shall have calibration/repair certificate with validation period. During assembly if the performance of any instruments found not Ok then IPR shall liable to do the re-calibration/repair work through the external agency/vendor who has done this calibration/repair work for IPR without any cost to the contractor. However, vendor who is doing CWS assembly damage any instrument (supplied by IPR) shall liable to repair/calibrate and cost for the same shall be bear the vendor itself. Depending on the degree of damage occurred in the instrument IPR may request vendor to replace the same and in this case vendor again shall bear the cost of the instrument.

Description	Size (NB)	Class	Rate (Rs.)	Qtn.	Cost (Rs.)
Balancing Valve (BLV)	80	300	60,000	1	60,000
Pressure Reducing Valve (PRV)	65	300	70,000	1	70,000
	40	300	30,000	1	30,000
	25	300	33,500	1	33,500
	15	300	29,000	1	29,000
Pressure Safety Valve (PSV)	65	300	85,000	1	85,000
Butterfly Valve (BFV)	80	300	30,000	1	60,000
	65	300	22,000	1	22,000
Solenoid cum Pneumatic Valve (SPV)	80	300	40,000	2	80,000
	65	300	35,000	4	1,40,000
	40	300	25,000	10	2,50,000
	25	300	16,800	2	33,600
	15	300	10,000	2	20,000
Y Type Strainer	80	300	65,000	1	65,000
	65	300	50,000	1	50,000
Flow Meter (FM)	80	300	96,000	2	1,92,000
	65	300	75,000	3	2,25,000
	40	300	58,000	5	2,90,000

	25	300	48,000	1	48,000
	15	300	40,000	1	40,000
Pressure Gauge (PG)	4"	0 – 16 bar	7,000	26	1,82,000
Temperature Transmitter (TT)	0 – 100°C		10,000	15	1,50,000
Conductivity meter	0 – 10 µS/cm		30,000	1	30,000
pH meter	0 - 10		25,000	1	25,000
Total					22,10,100

B. Free issue materials: SS316/304L pipes

Sr. No.	System Name	Pipe size (NB)	Pipe OD (mm)	Sch.	Pipe length approx. (m)	Rate per 'm' in (Rs.)	Cost (Rs.)
1	Plasma Box & Back Plate (SS316)	65	73	40	4	4315	17260
3	Accel Grid (SS316)	40	48.3	40	4	2017	8068
4	Decel Grid (SS316)	25	33.4	40	4	1250	5000
5	Earth Grid (SS316)	40	48.3	40	4	2017	8068
6	Magnet Coil (SS316)	15	21.34	40	4	2017	8068
7	In/Out Main Header (SS304L)	200	219.1	10	15	6200	93000
Total							1,39,464

C. Free facilities:

- IPR shall provide free power and water (except for manufacturing or producing of any item at site, which will be charged and recovered at the prevailing market rates) for the requirement of this project.
- IPR shall provide free instrument air, other purging gases required during testing & commissioning.
- IPR shall provide main incoming power supply.
- IPR shall provide instrumentation air for pneumatic valves at one point.
- IPR shall provide power supply to field instruments at junction box as required.
- IPR will not provide covered site office cum stores for the execution of the project.
- All the insurance after delivery of materials at the site will be in the contractor's scope.

D. In addition to above, a separate insurance policy also to be taken in favour of IPR to cover the unforeseen damages to the surrounding equipment for a worth of Rs.3 crores (Rupees Three crore only) during the entire work execution period.

The vendor should employ required man power till the final commissioning of the project.

1.5 COMPLETION PERIOD:

The total completion period is **9 months**. Vendor should submit all detailed drawings including PID drawing within 2 months from the date of LOI/P.O. Work execution (material and instruments procurement, fabrication, welding, installation, assembly and commissioning etc.) should be completed within 6 months from the date of final drawing approved by IPR. The work in totality must be completed within the completion time period as per approved Bar chart / Project schedule. The Bidder shall provide preliminary Bar chart along with the offer to justify the specified completion period.

1.6 DRAWINGS:

3D and 2D drawings of NBI CWS, pipe connection scheme with electrical isolation and PID Drawings are enclosed with tenders are schematic only and indicate the extent of work covered in the contract. The drawings broadly suggest the concept and routes to be followed. Under no circumstances shall dimensions be scaled from these drawings. Any modifications / changes required to coordinate installation work as per site conditions, shall be made in consultation with and approval of IPR.

After the award of the contract, the Bidder shall furnish three sets of detailed drawings, including overall system flow diagram (P ID), Piping & instrument layout, foundation/ support details etc. with necessary sectional views as required for the approval of IPR within 2 months time from the date of PO/WO. The 3-D and or isometric views shall be prepared as per the instruction of the Engineer-in- charge. **For the list of drawings refer tender Section-9.**

All drawings (as built) shall be submitted for approval in hard as well as soft copies in the size as desired by the IPR. However preliminary soft copies prepared by IPR will be furnished to the successful bidder. Where drawings are approved, said approval does not mean that drawings supersede the contract requirements nor does it in any way relieve the Bidder of the responsibility or requirement to furnish material or perform work as required by the contract.

1.7 SUB-CONTRACTORS / SUPPLIERS:

List of sub-contractors, vendors and suppliers proposed for any part of work, system components, must be submitted to IPR for approval before placing the WO/ PO by the main vendor. The decision of the IPR to approve or reject sub-contractors, vendors and suppliers proposed for any part of work, system components shall be final. After getting approval of IPR Engineer In-charge, Copy of such orders shall be submitted for confirmation along with all specifications thereafter.

1.8 DEVIATIONS:

The Bidder shall attach separate sheets containing the techno-commercial deviations if any, in the following format.

Sr. no.	Tender condition	Deviation	Remark.
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IPR reserves the right to include additional terms and conditions in the Contract documents and it will be binding on the vendor.

Place:

Date:

Signature and seal of Bidder

2 INSPECTION, TESTING AND ACCEPTANCE:

All materials and equipment shall confirm to the relevant Indian / equivalent standards and shall be of the approved make (Refer sections 6 & 7). All the equipment / system components specifications shall be approved before placing the order to suppliers / sub-contractors. A copy of purchase / work order with specifications must be submitted for confirmation to IPR.

2.1 TEST CERTIFICATES:

The vendor shall furnish following Test certificates.

- Material testing of various components of the equipment before beginning the fabrication from Govt. approved Laboratory.
- Welder's qualification certificate before beginning the fabrication.
- Performance test certificates carried out by manufacturer.
- Performance guarantees certificate / calibration certificate/ balancing certificate.

2.2 INSPECTION AND TESTING:

All the tests shall be carried out **in the presence of the representative of IPR**. The vendor shall provide services, required for the tests all instruments. All the system components will be physically inspected and tested before and after installation according to approved specifications and drawings. For detail procedure, refer the following.

1. All the system / equipments shall be checked before / after satisfactory commissioning, at site as may be required for the approved technical specifications, performance data provided by supplier / manufacturer. Performance acceptance is subject to comparison of test results with supplier / manufacturer's performance data and contract specification. Acceptance is subject to satisfactory Installation, commissioning and performance testing with respect to technical specifications. Rejected items must be replaced or rectified for the defects. In case of system modification / rectification complete performance tests are to be repeated. Site test readings shall be jointly recorded.
2. In general, following Inspection / tests are involved. Type of test, duration of test, testing procedure / parameters, will be as per the applicable codes. However, the detailed inspection and test procedure shall be worked out jointly by the IPR and the vendor along with the approval of drawings.
 - a. Physical at site.
 - b. Inspection / Pre-installation at site.
 - c. Welding joint inspection at site.
 - d. Pressure testing at site.
 - e. Performance testing at site. (Load, Signal input/output, Pressure drop, Vibration, etc.)
 - f. Valve ON/OFF checking, Signal input/output check with power.

Sr. No.	Item/ Equipment	Inspection /Test Involved.
1	Piping and fittings	a, c, d
2	Valves & Strainer	a, e
3	Instruments and controls	a, b, e, f
4	Insulation	a
5	MS structural work	c, d

Imported valves / instruments shall be accepted against the production of internal test reports of the manufacturer. However, it is left to the vendor to show the satisfactory performance of the valve / instrument at the site.

- All the arrangement for the said inspection and testing must be made and vendor shall absorb charges. The purchaser shall be intimated sufficiently in advance for 'a' and 'b'.
- Pre-dispatch inspection and clearance issued by purchaser / representative of purchaser, will not relieve the contractor from responsibility of showing the performance of the integrated system at IPR.
- Loop checking of all instruments at the site.

2.3 WELDING: INSPECTION & ACCEPTANCE STANDARDS:

Welding samples shall be prepared by the vendor to qualify the welding (e.g. GTAW) and tests (list of required tests are mentioned below) certificated to IPR. Some sample (number of required samples to be decided by mutual discussion between vendor and IPR) vendor needs to hand over to IPR.

The vendor shall submit detailed welding process and following control specifications before welding work begin.

- Base material details: grade, thickness
- Welding procedure (GTAW)
- Type and preparation of joint
- Filler material
- Welding sequence
- Tests during and after welding

Use of electrodes: Advani / ESAB / D & H should be used for carrying out welding. Welding will be carried out by certified welders only.

Following Inspection and testing shall be carried out on weld joint

- Root and final run for Butt-welds, Nozzle welds, Structural attachment weld, Hanger, Support welds, socket welds etc. shall be checked with
 - 100 % Visual examination + 100 % DP (Dye Penetration) examination + 10 % Radiography (SS piping- 25 NB and above) randomly selected by IPR representative.

- Visual checkup includes: Base metal defects (surface condition) rectification, Edge preparation, Joint - Fit-up checking for both longitudinal and circumferential welding, Check of pipe –dia., Cleanliness, Tacking, Root pass & subsequent pass appearance, Cleaning between the passes, Completed weld appearance, Condition of the base metal in the area adjoining the welds, Excessive distortion if any due to welding.
- DP examination: Procedure shall be as per Pr. Vessel code. However it includes Check for any crack or linear indication, porosity, or slag inclusion.
- Tolerances for Fabrication of pipes and fittings given below

Pipes:

Dia: Tolerance: ± 0.5 % of OD (Check by measurement of circumference), Length: < 5 mm for 3 m length.

Roundness: 1 % of Pipe Dia.

Fittings:

Angular Dimension: $\pm 1/8$ ” degree.

OD at Bevel: Nominal + 6.25 mm - 4.5 mm.

ID at Bevel: Nominal ± 2.25 mm

Reinforcement Pads for Structural attachment: with gap < 1.5 mm.

- Radiography: For pipe 25 mm and above, selection of the location and dia. of the pipe and sample size shall be at the discretion of quality supervisor from Purchaser. If a joint or weld length is acceptable, the remaining length by same welder or group length shall be acceptable. In case of rejection two more length from the same lot / group shall be examined at the discretion of quality supervisor from Purchaser. If weld joints found defective after second radiography examination, all the remaining group joints shall be rejected. However the vendor shall have option of 100 % radiography. Welds with the crack, slag inclusions, cavity and incomplete fusion shall be rejected.
- Repair of Welds: new weld joint to be done for deficient quality. Cracks can be removed by grinding, chipping, arc or flame gouging with DP test.
- All weld joints shall be subject to hydro test at-least 1.5 times the working pressures as per ASME guide lines.
- Vendor shall submit certificates of the above mentioned tests carried out on actual weld work done on cooling lines to IPR for approval.
- **Valves:**
Physical, material, machining check shall be carried out stage-wise as required.
Hydro-pneumatic leakage test for Body, seat shall be carried out for the time duration as per BIS code, including shop torque test. All technical performance parameters shall be checked within the allowable tolerance.

The vendor shall also demonstrate the proper operation of all controls, instruments, and other equipment. Hydrostatic test for all pressure piping shall be carried out. Water piping, fittings shall be tested to hydraulic test pressure of at-least one and half (1.5) times the maximum operating pressure, but not less than 10 bar as per ASME guide lines. Any leaks, defects shall be rectified and re-tested in same manner. After completion of the installation, all water system shall be adjusted and balanced to deliver the water flow parameters as per specifications.

2.3.1 GTAW WELDING INFORMATION

All welding should be carried out by GTAW with argon gas environment. Full penetration shall be done wherever possible as per IPR's design requirement. All GTAW welded joints should be cleaned thoroughly with wire brush then with K2 paste for passivation. After installation of assembled systems, all welds should be cleaned with acetone wherever possible. In case of defective welding/product, vendor is responsible for the corrective action on the same. The vendor shall prepare written procedures and methods for distortion control for weld joint giving sequence of welding; heat input to weld etc. Welding parameters, distortion etc. shall be noted and record of the same shall be submitted to IPR at regular intervals during execution of work.

Weld consumable (Weld filler material, inserts): All welding consumable for type SS304/SS304L welding are **AWS SFA A5.9 ER 316LMnNF (Nil Ferrite)**. Vendor should strictly adhere to this weld consumable.

Size of Weldment of each weld should be at-least equal to the thickness of the material being welded.

2.4 HANDING OVER:

- **Site clearance:**

The Scope of work includes site clearance, after completion of job. Hence all the area shall be cleared of debris and excess material left due to the contract and related work.

- **Handing over documents:**

On completion of the work in all respects, the vendor shall furnish 4 Nos. handing over documents in a good quality box - file containing minimum of:

- Complete set of detail as-built drawings on approved scale (**both hardcopy and softcopy**)
- Equipment technical data, Material test reports, rating charts, Performance curves etc.
- Inspection and performance test reports
- List of recommended spares.

2.5 SITE TESTING:

The following aspects shall be considered for performance testing.

- Prevailing conditions shall be as close as to design conditions.

- Type, quantity, location, duration of test parameters shall be decided and recorded accordingly during the test.
- Rated capacity and other operating parameters shall be checked.

All piping shall be tested to hydrostatic test pressure of at least one and half times the maximum operating pressure, but not less than 10 kg/cm² gage for a period of not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified and gotten approved at site. All the required arrangements for carrying out flow test and pressure test purpose any additional arrangements are in the vendor's scope of works.

The performance of the instrumentation (gauges, sensors and valves) shall be checked and the corresponding display on the DAQ box shall be verified.

Piping repaired subsequent to the above pressure test shall be re-tested in the same manner. System may be tested in sections and such sections shall be securely capped, then re-tested for entire system.

The vendor shall give sufficient notice to all other agencies at site of his intention to test a section or sections of piping and all testing shall be witnessed and recorded by vendor's site representative.

The vendor shall make sure that proper noiseless circulation of fluid is achieved through all coils and other heat exchange equipment in the system concerned. If proper circulation is not achieved due to air bound connection, the vendor shall rectify the defective connections. He shall bear all expenses for carrying out the above rectification including the tearing up and re- finishing of floors and walls as required.

The vendor shall provide all materials, tools, equipment, instruments, and services and labour required to perform the test and to remove water resulting from cleaning and after testing.

2.6 COMPLETION OF ERECTION & COMMISSIONING

All equipment shall be installed to have ease of operation and maintenance.

- Painting:

All MS parts shall be supplied with approved finish, shop coat of paint that have become marred during transportation or erection, shall be cleaned off with mineral, spirits, wire brushed and spot primed over the affected areas, then coated with enamel paint (Grey colour) to match the adjoining areas or as directed by IPR.

2.7 ACCEPTANCE

System components or system as a whole shall be tested for performance as per the approved technical specifications. System can be accepted and taken-over by IPR for regular operation only after satisfactory performance testing including electrical isolation test in all respect. Flow balancing and flow test will be completed with shorting the supply and return lines of each subsystem by appropriate size and length of Rubber hose pipes /nylon braided flexible PVC hose pipes and worm type hose clamps. The hose pipes and clamps shall be retained by IPR, therefore

these items are in scope of supply of vendor. Values of water pressure, flow rate, temperature etc. shall be checked at IPR make Data Acquisition and Control System (DACS) during online test. All the system components shall meet the guaranteed performance requirements to the satisfaction of IPR.

Necessary replacement / modification / rectification shall be carried out with the approval of IPR. The installation shall be tested again after removal of defects and shall be commissioned only after approval by the IPR. After short circuit test, vendor needs to complete all the cooling lines to the sub-systems of NBI mentioned in PID.

2.8 GUARANTEE

The vendor shall guarantee that all the equipment installed shall maintain the specified performance at least for 12 months after SITC (Supply, Installation, Testing and Commissioning) and satisfactory acceptance. During warranty period, all complaints shall be attended within 24 hours of receiving call from user. Any repair / replacement / services shall be provided at no extra cost to IPR during this period. Any replacement of the pipes, instrument shall be made within 3 weeks.

2.9 MEASUREMENT OF WORKS

- For all payment purposes physical measurements will be taken by vendor as per respective method as specified in the tender and relevant code, in presence of IPR representative, in units indicated in SOQ. Payment shall be made on actual measurements.
- Measurement of weights will be in metric tons corrected to the nearest kilogram.
- Linear measurement will be in meters corrected to the nearest Centimeter.
- Measurement for supply of items shall be made as per units and quantities indicated item-wise in SOQ.
- All materials / equipments issued by the IPR shall be stored properly. Any damage to free issue material shall be recovered from the vendor.

Measurement for Piping:

Unless otherwise specified, measurement for piping for the project shall be on the basis of centre line measurements described herewith. Piping shall be measured in units of length along the centre line of installed pipes including all pipe fittings, flanges (with gaskets, nuts, and bolts for jointing), unions, bends, elbows, tees, concentric and / or eccentric reducers, inspection pieces, expansion loops etc. The above accessories shall be measured as part of piping length along the centre line of installed pipes, and no special multiples of pipe lengths for accessories shall be permitted. Measurement of expander/ reducer shall be taken in bigger dia. size category. The quoted rates for centre line linear measurements of piping shall include all wastage allowances, pipe supports including hangers, MS channel, wooden haunches, nuts, check nuts, vibration isolator suspension where specified or required, and any other item required to complete the piping installation as per the specifications. None of these items will be separately measured nor paid for. However, all

valves (globe / check / butterfly / ball), thermometers, pressure gauges shall be separately counted and paid as per their individual unit rates, which shall also include their insulation as per specifications. Piping measurements shall be taken before application of the insulation. Fabrication of all types of pipe supports, provided as per the instruction of IPR, will be paid on weight basis, excluding weight of fasteners. All temporary lines or equipment required for flushing, testing, draining or drying should be provided, installed and dismantled by the vendor within his quoted rates. Open end of the pipes shall be blanked within his quoted rates.

Radiography charges shall be borne by vendor. Additional radiography required due to poor quality of vendor's welder, will be done at vendor's cost.

Measurement for Insulation:

Unless otherwise specified measurement pipe insulation for the project shall be on the basis of centerline measurements described herewith:

Pipe insulation: Shall be measured in units of length along the centerline of the installed pipe, strictly on the same basis as the piping measurements described earlier. The linear measurements shall be taken before the application of the insulation. It may be noted that for piping measurement, all valves, orifice plates and strainers are separately measurable by their number and size. It is to be clearly understood that for the insulation measurements, all these accessories including cladding and valves shall be considered strictly by linear measurements along the centerline of pipes and no special rate shall be applicable for insulation of any accessories, fixtures or fittings whatsoever.

2.10 PAINTING - COLOUR CODE;

All equipments shall be supplied with approved finish. Shop coat of paint that have become marred during shipment or erection shall be cleaned off with mineral spirits, wire brushed and spot primed over the affected areas, then coated with two coats of enamel paint. Painting of all MS support structure shall be done by one coat of primer and two coat of enamel paint. Also the flow direction marking by standard size of arrow on all pipes included in the scope. All painting colour code shall be approved before execution. No separate payment shall be made for painting work. Reputed make like Asian/Berger etc. are only to be used.

2.11 MARKING/TAGGING OF COOLING LINES WITH STICKER;

All the water cooling lines (including inlet and outlet water flow direction) mentioned in PID should be marked / tagged with suitable front size letters and long life stickers.

3 DESIGN BASIS

The main objective of NBI Cooling Water System (CWS) is effective utilisation and distribution of cooling water according to the requirement of the experiments. Basically, this water distribution system taps water from the main supply & return headers of NBI CWS. The flow requirements are given in Table 1.

Following systems included in the NBI Cooling Water Distribution System:

1. Positive Ion Neutral Injector (PINI) ion source CWS consists of following sub-systems

- (i) Plasma Box (PB)
- (ii) Acceleration Grid (AG)
- (iii) Deceleration Grid (DG)
- (iv) Earth Grid (EG)
- (v) Magnet Coil (MC)

2. Other NBI sub-systems are

- (i) Stage Neutralizer (SN)
- (ii) V Target (VT)
- (iii) Ion Dump (ID)
- (iv) Magnet Liner (ML)
- (v) Pre Duct Scraper (PDS)
- (vi) Beam Transmission Duct (BTD)
- (vii) Shine Through (ST)

Each subsystems requirement & description mentioned below. Please refer enclosed P& I drawings and equipment layout 2D/ 3D furnished with the tender document before proceeding further.

3.1. NBI COOLING WATER SYSTEM (CWS):

Table-1 shows power load on different sub-system of NBI and required water flow rate to remove such power load from sub-systems. Other hydraulic parameters, pipe diameter and required conductivity of water of each sub-system are also mentioned in this Table.

The proposed water distribution system shall receive water from the main header of IPR Cooling Water System and outlet water shall return to the main outlet header. The details of NBI cooling water distribution system are mentioned in this tender.

Fig.2 depicts 3D CATIA model of NBI system with piping layout of CWS. There are two cooling water supplies, one for PINI ion source (indicated by 7, in fig.1) with inlet temperature of ~ 25° C

and other for all NBI sub-systems (inlet and outlet of this water supply is indicated by 8 and 9 respectively in fig.1) e.g. Neutralizer, ML, VT, ID, PDS, BTM, and ST etc. with inlet water temperature of $\sim 35^{\circ}$ C. It is to be noted that outlet water from both supply are connected to common main header and return to SST CWS tank. PINI ion source (1) is connected to vacuum vessel (2) which is placed on support structure (3). The vacuum vessel is connected to SST machine (4) through BTM (5). The Main inlet and outlet header (6) are laid down below the support structure.

Table – 1

Design Data sheet for NBI Cooling Water System

Sr. no.	System name	Heat load (kW)	Max. flow (LPM)	Load type (C / P)* Pulse (s)	Inlet temp. ($^{\circ}$ C)	In / out press. (bar)	Press. drop (bar)	Design press. max. (bar)	Water coduc. (μ S/cm)	Pipe Size (NB)	Pipe OD (mm)
A	Grid										
1	Acceleration Grid	120	70	1	20 - 25	11/2	9	12	0.1	40	48.3
2	Deceleration Grid	35	60	1	20 - 25	6/2	4	12	0.1	25	33.4
3	Earth Grid + Neut-1	100	70	1	20 - 25	8/2	6	12	0.1	40	48.3
B	PB+MC										
4	Plasma Box	200	415	1	20 - 35	8/2	6	8	0.1	65	73
5	Back Plate	280		1	20 - 35	8/2	6	8	0.1		
6	Magnet Coil	42	30	1	20 - 35	7/2	5	10	0.1	15	21.34
C	Other Sub-systems										
7	Neutralizer - 2	85	55	1	20 - 35	8/2	6	10	1	40	48.3
8	Magnet Liner	42	30	1	20 - 35	6/2	4	10	1	25	33.4
9	Ion Dump	500	320	1	20 - 35	5/2	3	10	1	80	88.9
10	V-Target (closed)	433	210	1	20 - 35	5/2	3	10	1	80	88.9
11	Pre Duct Scraper	50	50	1	20 - 35	5/2	3	10	1	40	48.3
12	Beam Trans Duct	50	100	1	20 - 35	5/2	3	10	1	40	48.3
12	Shine Through	200	150	1	20 - 35	5/2	3	10	1	65	73
13	Inlet/Outlet Main Header									200	219.1

* C- Continuous, P- Pulse. If Pulse type, please mention the ON and OFF time durations.

Cooling water system for supply of water (of inlet temperature $\sim 25^{\circ}$ C) to PINI ion source and magnet coil is shown in fig.3. There are two water supply lines; one is connected to three extractor grid system e.g. Acceleration Grid (AG), Deceleration Grid (DG) and Earth Grid (EG) with separate inlet and outlet header. The other line is connected to Plasma Box (PB) and Magnet Coil (MC) has separate inlet and outlet headers. Placement of instruments e.g. Valves, Flow Meter (FM), Pressure Gauge (PG) and Temperature Transmitter (TT) are shown in fig.3. There are additional T-branches with isolation valves in all supply and return line of subsystems of Grid & PB-MC section (5 supply and 5 return branches) for usage of water supply for both Test Stand experiment and SST operation. Drainage line is connected to all inlet headers for removing water from any system during maintenance and other purpose e.g. if water leakage occurs in any system. PINI ion source is subjected to High Voltage power supply and MC is also connected to power supply. Due to this reason water is supplied to these systems through Parker make one inch inner diameter non-conductive hose pipe shown in fig.3. One end of drainage line connected to all inlets and other end is connected to main outlet header.

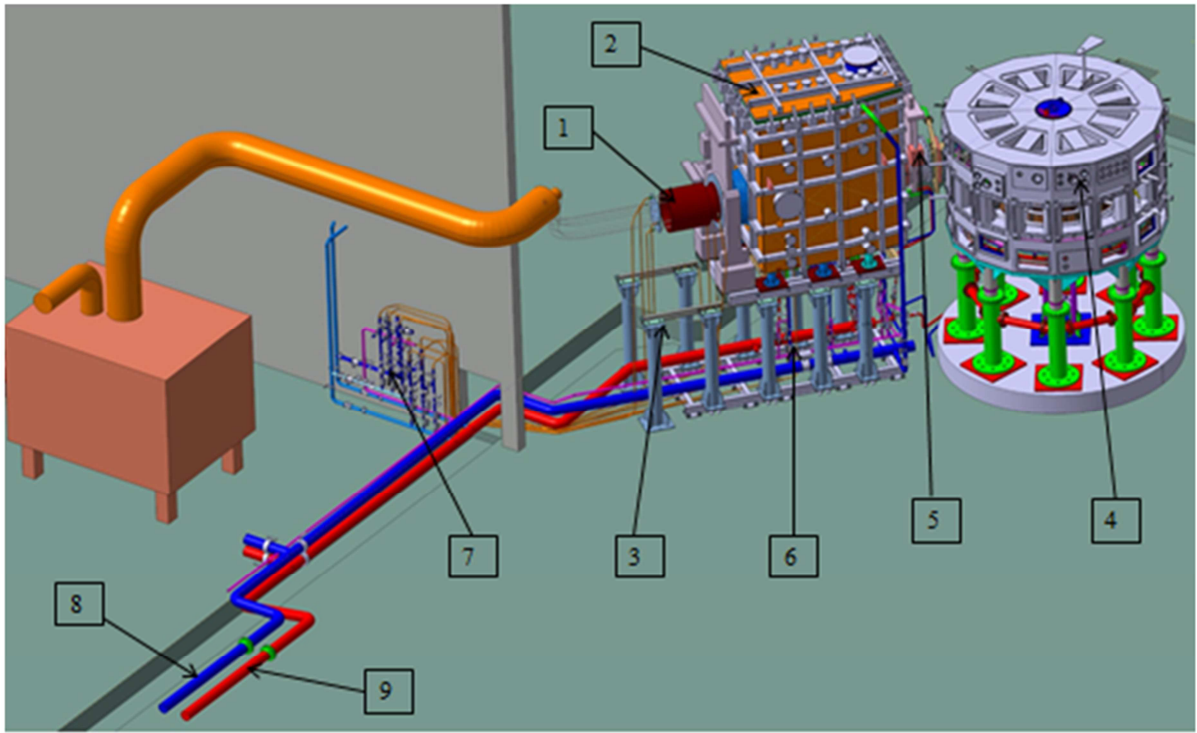


Fig.2 Three dimensional CATIA model of actual Water Cooling System for NBI: 1: PINI ion source, 2: Vacuum vessel, 3: Support structure, 4: SST machine, 5: Beam Transmission Duct, 6: Piping layout for water supply to various NBI sub-systems, 7: Water supply to Grid, Plasma Box (PB) & Magnet Coil (MC), 8: Main water Inlet header (200 NB) for sub-systems, 9: Main water Outlet header (200 NB) for sub-systems.

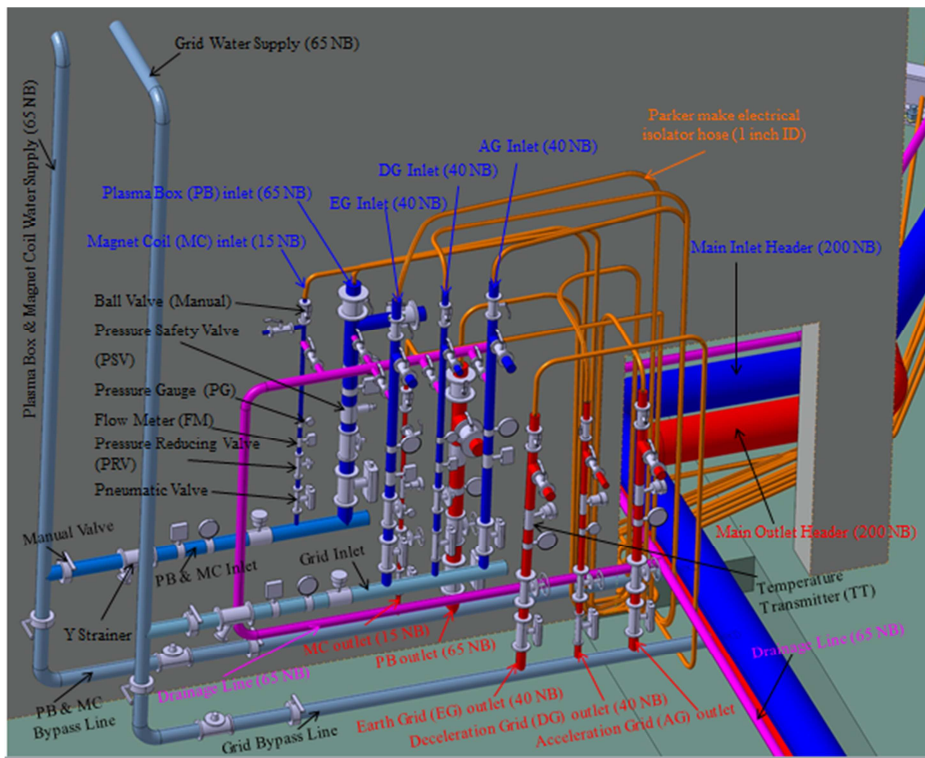


Fig.3 Three dimensional view of piping layout for PINI ion source water cooling system

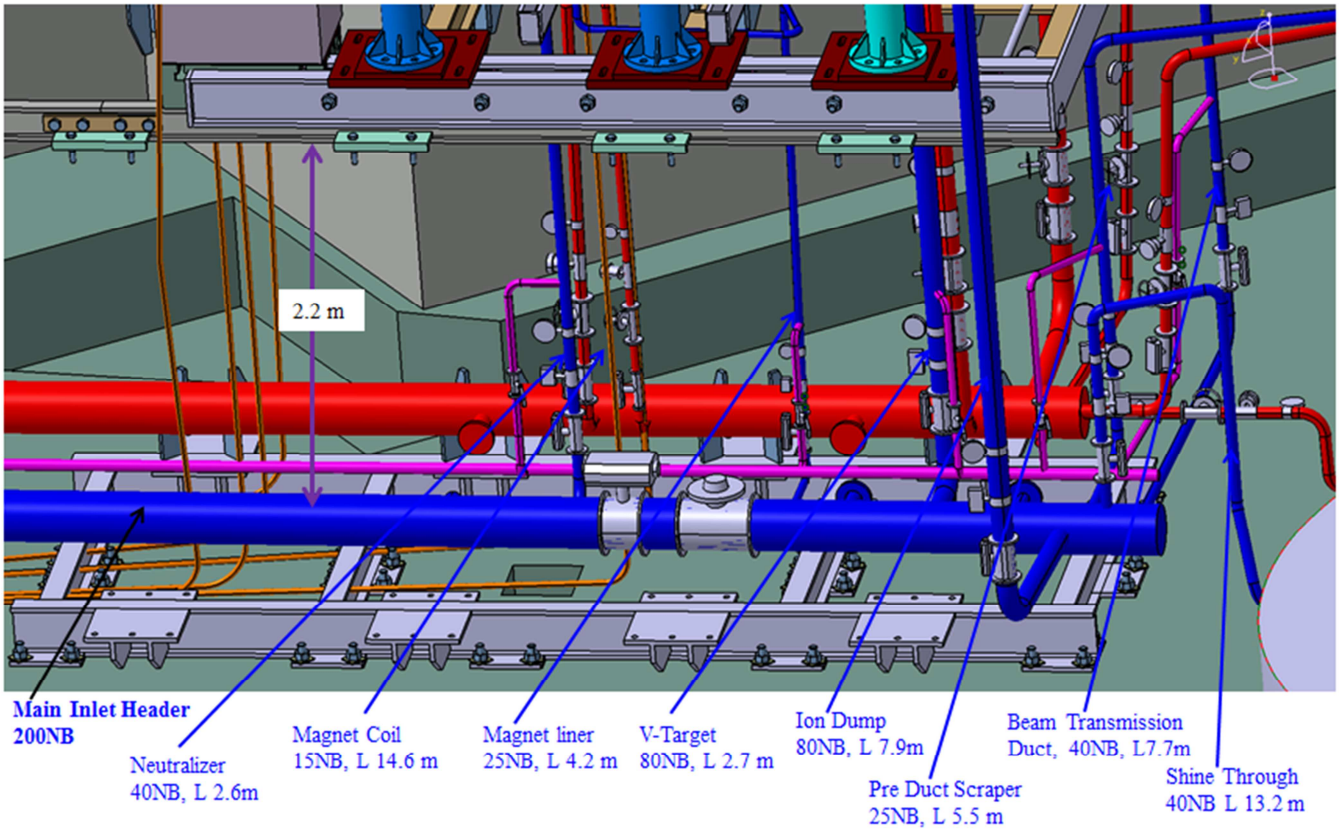


Fig.4 Three dimensional view of piping layout of inlet water supply to various NBI sub-systems

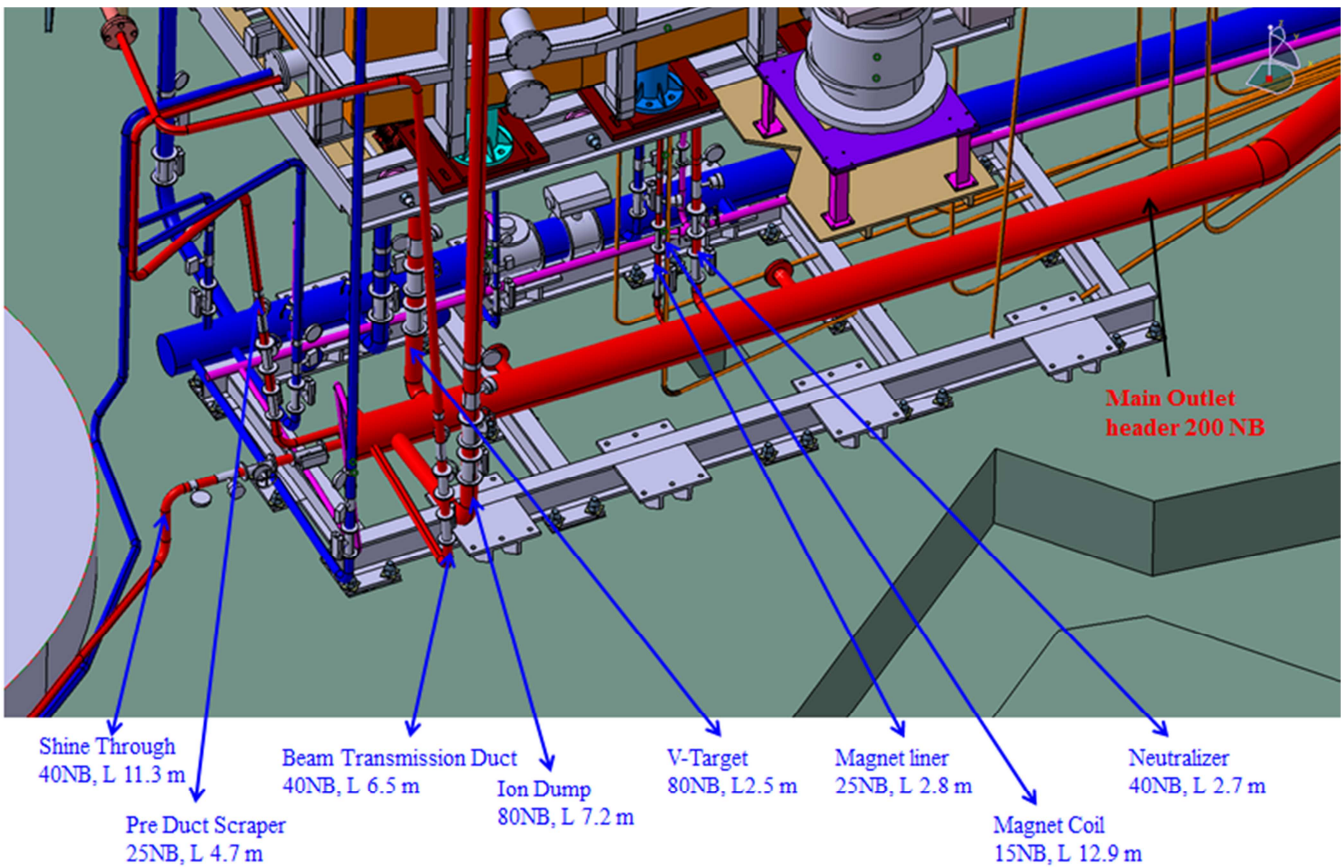


Fig.5 Three dimension view of piping layout of outlet of water cooling line connected to NBI sub-system

Fig.4 illustrates 3D CATIA model of piping layout with instruments connected to various sub-systems inlet (e.g. Neutralizer, MC, ML, VT, ID, PDS, BTD and ST) viewed from main inlet (200 NB) header side. Dimension of pipe connected to each sub-system is mentioned in the model. Similarly piping and instruments which connected to outlet of sub-systems are shown in 3D CATIA model in fig.5.

To understand clearly about complete NBI CWS, IPR shall provide 3D, 2D CATIA drawing and P&ID to vendor and these are part of the tender document. Based on these drawing Vendor is requested to make their own drawings and submit to IPR for approval.

NBI cooling water system has two distribution systems, (i) PINI Ion source & Magnet Coil (MC) system which consists of Plasma Box (PB), Magnet Coil, Acceleration Grid (AG), Deceleration Grid (DG) and Earth Grid (EG) (ii) NBI sub-systems which includes Stage Neutralizer (SN), Magnet Liner (ML), V-Target (VT), Ion Dump (ID), Pre Duct Scraper (PDS), Beam Transmission Duct (BTD) and Shine Through (ST).

The system has to be operated for different flow rates within the above mentioned flow ranges (Table-1). The operation cycle of water circulating is for 12 hrs ON and OFF during the remaining 12 hrs of the day.

ON operation: Prior to actual ON operation, the whole piping system will be air-purged using the vent valves so as to ensure there is no air trapped inside the system. During normal ON operation, the bypass line is closed. The isolation walls remain open. The water with required hydraulic parameters (shown in Table - 1) is flow through the component. After passing through the components the water enters the common outlet header, which has to be maintained at 1.5 bar (gauge) irrespective of different pressure drops across various components.

Draining operation: For Draining purpose, the drain lines with vent valve shall be provided at appropriate places. Also, whenever the components need servicing, the water contained in them shall be removed through drain lines after isolating the components from the branch lines. Each header is having its own drain line with vent valve and the draining is done by the common drain line of 40 NB. Vent of 15 NB and drain of 25 NB/ suitable size thread end ball valves should be provided at all top and bottom points of pipe lines respectively. The other free end of ball valve fitted should be with dummy SS plug. **There is no any extra payment for drain / vent provision with isolation valves in the pipe lines. The cost is included in piping works.**

Please refer DWG. No: SST-1/WDS/NBI-REVISED/R2 for process flow and refer component wise requirement in the above mentioned Table-1.

4 TECHNICAL SPECIFICATIONS

Following components are to be interconnected to satisfy the system requirements. **Bidder has to provide a separate sheet confirming to the following specifications. Change in the specifications will not be accepted.**

4.1 SPECIFICATIONS OF COMPONENTS

PIPES & FITTINGS/ ACCESSORIES AND VALVES:

For DM water application:

Pipes:

To be used to interconnect the system components for circulation of DM water through the water loops. It is proposed to install SS 304L Sch. 40/10 piping with accessories as per system requirements mentioned in SOQ as per standards.

The pipe sizes shall be as required for the individual fluid flows. Various pipe sizes have been indicated in the drawings, these are for vendor's guidance only and shall not relieve responsibility of vendor for providing smooth noiseless balanced circulation of fluids.

The SS piping should be as per following specification.

Sr.No.	Process Requirements	Fulfilment Criteria
1.	Material	Strictly as per ASTM A 312 TP 304L/ 316
2.	Type	ERW
3.	Schedule	Sch 40/10
4.	Unit (single) Length of pipe	4m or above
5.	Dimensional tolerance	As per ANSI B 36.19M
6.	End finish	PE/BE
7.	Mechanical test	As per applicable ASTM or ASME standards
8.	Surface conditions (inside and outside)	All pipes shall be free of laps, laminations, seams visible cracks, tears, grooves, scale, pits, dirt, grease, paint and other foreign materials. All pipes shall be uniform in quality and condition as well as surface finish.
9.	Marking (in English)	Each length of the pipe shall be legibly marked with the manufactures name, brand, specification, grade, Heat number, Nominal pipe size, wall thickness, marking shall begin approximately 12 inch (300mm) from the end of pipe.

Pipe Joints:

All joints in the pipe system shall be done by welding GTAW process with argon purging (mentioned in section 2.3.1), unless otherwise mentioned, or directed at site. All welding shall be done by qualified welders and shall strictly conform to Code of practice. First butt weld of each welder shall be fully radiographed for testing purposes. Upon approval of welding joints the concerned welder shall be allowed to carry further welding of the pipes. Rest of the welds shall have 100% visual inspection. Before welding of pipes, make proper 'V' notch at the joints by chamfering the end of pipe with surface grinder. All electrodes shall be selected to match the mechanical and chemical properties of the parent material. The welding rods shall be selected as per AWS-E-7018 or Equivalent BIS code, subject to Purchaser's approval.

Pipe flanges, fastener, gaskets and SS304L braided hose:

All flanges including flanges of valves are to be slip on serrated raise face (SORF) finished flanges of respective pressure class. Set of fasteners will be **metric thread stud** type with nuts and washer of Stainless Steel. All gaskets are of Teflon of 3 / 5 mm thick. All bushes (for electrical isolation) are made up of FRP/G10. Please refer to DWG. No. SST-1/NBI/CWS/Flange Connection SH 1 to 6 for detail scheme for flange connection. SORF flange shall be welded to SS304L braided hose as mentioned in this drawings and specification of the same is given below.

4.2 SPECIFICATIONS FOR SS304L BRAIDED HOSE:

Vendor shall use SS30L single braid doubly ply weld neck end hoses. These braided hose needs to be welded to SS pipe, expander and reducer as per DWG No. SST-1/NBI/CWS/FLANGE CONNECTION, SH 1 to 6. Required size and other specifications are given below

Size (NB)	Max. water pressure (bar)	Working pressure (bar)	Fluid	Temperature range
25	20	10	Water	25°C – 100°C
40	20	10	Water	25°C – 100°C
65	20	10	Water	25°C – 100°C
80	20	10	Water	25°C – 100°C

Vendor should consider the following points for procurement of SS304L braided hose and welding to the designated NBI cooling lines mentioned in DWG No. SST-1/NBI/CWS/FLANGE CONNECTION, SH 1 to 6

1. Material test certificate should be provided to IPR.

2. Before welding work begins IPR representative shall do visual check of all SS304L braided hose.
3. Vendor should submit water pressure test (at 20 bar) certificates to IPR before carrying out welding work.
4. Repair of Defects is not allowed. Welding is not permitted to repair the formed hoses.
5. Hoses should not contain any chemical, hydrocarbon, dust or any organic chemical. It should be properly cleaned by appropriate cleaning method. Scratch marks or dents on the hoses are not acceptable.
6. The metallic braiding wire should not come out at junction/joint. There should not be any cut over the braiding length.
7. All the defective braided hose shall be replaced at free of cost.
8. All the welded joints should be carried out by TIG welding process only.

INSULATION

Insulation shall be applied only after the piping system has been satisfactorily tested for leaks at 1.5 times the working pressure or at minimum 10-kg/mm²-test pressure.

Each lot of insulation material delivered at site shall be accompanied with manufacturer' test certificate for thermal conductivity values and density. Samples of insulation material from each lot delivered at site shall be selected at random for approval and shall be got tested for thermal conductivity values.

The insulation shall be continuous over the entire run of piping, fittings and valves. Insulation shall be finished in neat and clean manner to achieve true surface. Skilled workmen specially trained in this kind of work shall carry out all insulation work.

All water piping shall be insulated in the manner specified herein. Before applying insulation, all pipe work and fittings shall be brushed and cleaned, and dust, dirt, mortar and oil removed. Thermal insulation shall then be applied as follows:

Lines for "DM water" applications

Specification of Insulation

The insulation shall be flexible and lightweight elastomeric nitrile foam material. The thermal conductivity of the material shall not exceed 0.04 W/m°C. at 10 °C mean temperature and density should not be less than 60 kg/ m³. Thickness of the insulation shall be as specified below for the individual applications. The insulation material can be readymade pipe section upto 3” pipe sizes. Above 3” pipelines, the insulation can be of precut sheets. Cold adhesive or equivalent can be used for setting the insulation on the pipes.

<u>Pipe size (mm)</u>	<u>Thickness of insulation (mm)</u>
3” (80 NB) and below	9
4” (100 NB) and above	13

Pre-molded/ extruded pipe sections shall be placed over the pipes, the joints of these pipe sections shall be sealed with cold adhesive compound and self-adhesive rubber tape as per manufacturer's recommendation.

Butterfly Valves (Manual):

Butterfly valves are to be used for isolation of equipments / components in DM water lines.

- The valves should be of wafer type with total SS 316/SS304 L constructions, pressure class 150/ class 300 as per the details in SOQ. Design standard: API 609
- The valves shall have mounting flange as per ISO 5211, centering lugs, locking lever handle. Preferably, the valves will be of single-piece body.
- The disc should provide bubble tight shut off (class VI leak tightness) in both flow directions with minimum torque and longer seat life.
- The valves should give higher specific heat at constant volume (C_v) values. The valves should be with SS 316 disc & stem, replaceable EPDM seat.

ON/OFF Ball/ Butterfly Solenoid operated Valves:

ON / OFF / Ball / Butterfly Solenoid operated Valves are to be used for isolation of equipments /components.

- The valves can be of 'Butterfly type' for sizes 50 NB and above, 'Ball type' for sizes below 50 NB.
- The valves should be of pneumatic type, SS 316/SS304L construction, class 150 / 300 as per the details in SOQ with actuator (Quarter turn pneumatic spring type, construction – double rack and pinion), Solenoid valve, limit switch box, Air filter regulator including mounting brackets coupling & tubing etc.
- The actuator should be single acting spring return type with extruded aluminum body hard anodized and stroke adjustment facility. Minimum available air pressure for actuator sizing will be 5 bar.
- The valves should have fast response, opening and closing time.
- The valves should provide bubble tight shut off in both flow directions with minimum torque and longer seats life.
- The valves should give higher C_v values. The valves should be with SS disc & stem, replaceable Teflon / EPDM seat.
- All ball valves should be of full-bore design only.
- The solenoid valves should be 3/2 way with 1/4" NPT (F) connection and anodized Aluminum/ Brass body. The coil voltage shall be 230V AC/ suitable and housing shall be weatherproof to IP65. The junction box should be with 1/2" NPT cable entry.
- The limit switch shall be rotary type with dome indicator for local ON/OFF indication and two SPDT micro switches with contact rating 10 Amps., 230 V AC. The cable entry should be 1/2" NPT.
- Air filter regulator required with metal bowl and manual drain and 5 microns filter element.
- All tubing/ fitting SS304L/ SS316 material

Ball Valves (Manual):

a. Ball valves are to be used in process pipeline.

- The valves should be of flange ended (class 150/ class 300) with total SS 316/ SS 304L construction.
- End connections shall be as per ANSI/ ASME B16.5, 150 # R.F (SORF).
- The valves should be of 3-Piece Design for easy In-line Maintenance, full bore design only and the seat will be of PTFE.
- The disc should provide bubble tight shut off (class VI leak tightness) in both flow directions with minimum torque and longer seat life.
- MOC of handle should be MS/ MI with plastic cover.
- The valve design shall be as per BS: 5351/ API: 6D

b. Ball valves are to be used for drain and vent the pipelines.

- The valves should be of female thread end (class 150) with total SS 316/ SS 304 L constructions.
- The valves shall be of full bore design only and the seat will be of PTFE.
- MOC of handle should be MS/ MI with plastic cover.
- The valve design shall be as per BS: 5351/ API: 6D

Globe Valves :

Globe valves are used for manual flow control and should provide bubble tight throttling.

- The valves should be of SS 316/SS 304 L constructions, class 150/300 as per the details in SOQ.
- End connections shall be as per ANSI/ ASME B16.5, 150 # /300 # R.F (SORF).
- The disc should provide bubble tight shut off (class VI leak tightness) with minimum torque and longer seat life.
- The bonnet / disc should be of SS 316/SS 304L as per the details in SOQ. Preferably, the bonnet will be of removable type.
- The valve design shall be as per BS: 1873/ API: 600/ ASME / ANSI B16.34

Self-acting non-return valves :

Self-acting non-return valves are used to prevent reverse flow.

- The body should be of SS 304L/SS 316 constructions, class 150 / 300 as per the details in SOQ.
- The valves shall be of 'lift type' for sizes 50 NB and below, 'flapper / swing / dual plate spring type' for sizes above 50 NB.
- The body / Bonnet / Stem / gland / hinge / disc will of SS material and seat O-ring / gasket shall be of 3 mm thick PTFE and / or EPDM. The spring and hinge/stop pin shall be SS and bearing PTFE material.
- The valves should be of flange ended.

Self-acting pressure reducing valves :

Self-acting pressure reducing valves are used for protecting the system components against higher supply / inlet pressure by controlling / maintaining the downstream pressure at desired level.

- The controlled downstream pressure should remain constant irrespective of changes in the inlet pressure and / or flow rate.
- The valve should be of self-acting, pilot operated type.
- The valves should be of flange end connections as per ANSI/ ASME B16.5, 150 # R.F (SORF).
- The body and trim should be of SS 304L/SS 316 construction respectively and pressure rating class 150/ 300 as per the details in SOQ. The disc/ diaphragm should be of EPDM/ Teflon/BUNA-N.
- The internal parts like valve disc, trim parts may be of easily replaceable type without removing the whole body from the line.
- The valves should be delivered with 'built-in safety provision' against high-pressure build-up in the inlet side, also '1/4 inch pressure gauge connection' with one set of 2" dial size pressure gauge connected for downstream pressure measurement.
- The valves should provide class VI leak tightness.
- Valve should be fitted with suitable Y-Strainer (1/2" size) in controlling tubing interconnection line.
- The set pressure as per in SOQ and should be easily adjustable by adjusting the spring setting.

Pressure relief valves :

The relief valves are provided to release excess pressure in the line, when pressure in the water line exceeds the set value.

- The valves should be of SS 304L/ SS 316 construction, class 150 or PN 10 as per the details in SOQ.
- The valves should be of flange end connections as per ANSI/ ASME B16.5, 150 # R.F (SORF).
- The valves should be of self-actuated quick release, close discharged type.
- The spring / pallet / piston / trim should be of SS. The seating can be of neoprene / EPDM / PTFE / equivalent
- The valves should ensure bubble tight shut off.
- The set pressure as per in SOQ and should be easily adjustable by adjusting the spring setting

INSTRUMENTS AND CONTROLS:

Necessary instruments (new required and existing installed), sensor- transmitters, are to be used for the purpose of process measurement, indication, providing required output signals for data acquisition- monitoring and control system for the integrated operation of water distribution system with communication to the system control rooms.

Temperature gauges:

Necessary dial type bimetallic temperature gauges are to be installed to measure the water temperature at the locations shown in the P & I diagram.

- Thermometers shall be dial type 100 mm dia. in aluminum white background with black markings.
- Thermometers should have SS 316 thermowell attachment.
- The case should be of SS 304L with screwed bezel rotatable on stem 90 degree to adjust at different angle.
- The windows should be of shatterproof glass.
- The pointer should be of aluminum, coated with black colour.
- The weather proof protection should be provided as per IP-65 (IS:2147)
- Stem material / diameter / length: SS 316 / 6-8 mm / 180 mm long (or to suit the pipeline). The gauge should be installed on lines as shown on the drawings and included in Schedule of Quantities. (Type/shape of capillary / stem to be selected as per the design requirement)
- The sensing element should be of chrome molybdenum.
- The mounting connection will be "all - angle" type to suit the piping.
- Range of scales can be 0- 100°C with 1°C scale spacing.
- The accuracy should be $\pm 1\%$ FSD with over-range 125% FSD
- The connection shall be 1/2" NPT (M) SS 316 with adjustable three piece compression fitting.
- The reset should be external.

Pressure gauges:

Necessary dial type pressure gauges are to be installed to measure the water pressure at the locations shown in the P & I diagram.

- Pressure gauges shall be dial type 100 mm dia. in aluminum white background with black markings.
- The gauges shall be connected to the pipes by SS siphon and needle valve for isolation.
- The bourdon should be of phosphor bronze/SS 316 Ti, socket should be of brass/SS 316.
- The case (glycerin filled type) can be of SS 304L/ SS 316 with screwed bezel.
- The weather proof protection should be provided as per IP-65 (IS:2147)
- Range of scales should be 0-10 bar with 0.2/0.1 bar scale spacing
- The accuracy should be $\pm 1\%$ FSD with over-range 125% FSD
- Working temperature range can be 0- 100°C.
- The connection shall be 1/2 " NPT (M) / as per design requirement.
- Blow out disc should be provided.
- There should be zero point adjustment.
- Refer standard EN - 837.

Temperature transmitters:

Necessary two wires, PT 100 temperature sensors – transmitters can be installed for necessary data acquisition required for overall monitoring and control system in the water distribution system.

- The instrument should be of 4 - 20 mA current output transmitter type as mentioned in the SOQ.
- Signal cable laying with termination from field instruments to junction box.
- The sensor can be of SS 304 L of diameter 6 to 8 mm and should be aluminum head mounted type and easily removable from head.
- SPAN-ZERO adjustments should be provided from outside.
- Range of scales should be 0-50 / 80 / 100 degree C depending on design requirements.
- The accuracy should be ± 0.5 % FSD with over-range 125% FSD.
- The thermos-well should be compact type of SS as per requirement and can be of fabricated / barstock type.
- The weather proof protection should be provided as per IP-65 (IS:2147)
- The connection should be of screwed type / as per requirement.
- The transmitter should be compatible with 24 V DC supply with built -in electronic voltage stabilizer.
- Refer standard DIN - 43760, also CMRS certificate.

Pressure transmitters:

Necessary pressure sensors – transmitters can be installed for necessary data acquisition required for overall monitoring and control system in the water distribution system.

- The instrument should be of 4 - 20 mA current output transmitter type as mentioned in the SOQ.
- Signal cable laying with termination from field instruments to junction box.
- The sensor should be with ceramic / SS with viton / EPDM sealing.
- The connection should be of threaded nipple type.
- The response time should be less than 5 msec.
- The weather proof protection should be provided as per IP-65 (IS:2147)
- Range of scales should be 0-10 bar.
- The accuracy should be ± 0.5 % FSD.
- The sensor should have negligible sensitivity to temperature fluctuations and high resistance to extreme temperatures.
- The transmitter should be compatible with 24 V DC supply with built -in electronic voltage stabilizer.
- The sensor should be mounted with needle valve for process isolation.

Flow meters:

Necessary water flow meters (sensor cum transmitter) of turbine type are to be installed to measure the water flow mainly at inlet or out let of each system loads as indicated in P&I diagrams.

- The instrument should be of 'transmitter with display type'
- The instrument should be of 4-digit LCD display, backlit type and suitable for 4 – 20 mA current output to Data Acquisition and Control System (DACS) for sizes & flow range (lpm) mentioned in SOQ. Flexible signal cable from field instruments to junction box, length up to 15 m (or more) is to be included with each instrument / sensor.

- The body should be of SS 316, **rotor should be of Stainless steel**, bearing should be tungsten carbide/ stellite/ceramic/ bush and bearing support should be SS 316.
- The accuracy should be ± 0.5 % FSD.
- Working temperature range can be 0- 100°C and DM water will be the working media.
- The protection should be provided as per IP-65 (IS:2147)
- The maximum pressure drop should be ≤ 0.5 kg/cm² at 100% flow range.
- The connection should be flange ended as per ANSI/ ASME B16.5, 150 # R.F (SORF).
- The display unit should be compatible with 230 ± 10 % V, 50 Hz single phase AC supply with built -in electronic voltage stabilizer.

Calibration and Testing:

All automatic controls and instruments shall be factory calibrated and provided with necessary instructions for site calibration and testing. Various items of the same type shall be completely interchangeable and their accuracy shall be guaranteed by the manufacturer. All automatic controls and instruments shall be tested at site for accuracy and reliability before commissioning the installation. The vendor should submit the calibration certificates with all instruments.

4.3 SPECIFICATION FOR PIPING INSTALLATION:

Tender drawings indicate schematically the size and location of pipes. The vendor, on award of the work, shall prepare detailed fabrication drawings, showing the cross- section, longitudinal sections, details of fittings, locations of various valves, and all pipe supports. He must keep in view the various equipments installed nearby.

Piping shall be properly supported on, or suspended from, stands, clamps, and hangers as specified and as required. The vendor shall adequately design all the brackets, saddles, anchors, clamps and hangers and be responsible for their structural sufficiency. **All pipes shall be supported with MS structural steel like C-channel, I-Beam, angle and M S Class 'C' pipes, supported from floor or column.** Where pipe and clamps are of dissimilar materials, a gasket shall be provided in between. Spacing of pipe supports shall not exceed the following:

Pipe size	Spacing between supports
Up to 12 mm	1.5 Meter
15 to 25 mm	2.0 meter
30 to 150 mm	2.0 meter
Over 150 mm	2.5 meter

All piping work shall be carried out in a workman like manner, causing minimum disturbance to the existing services, buildings and structure. The entire piping work shall be organized, in coordination with other agency's work, so that laying of pipe supports, pipes and pressure testing for each area shall be carried out in one stretch.

The vendor shall make sure that the clamps, brackets, clamp saddles and hangers provided for pipe supports are adequate. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints wherever required.

All pipes shall be accurately cut to the required size in accordance with relevant BIS Codes and burrs removed before assembly. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reducers shall be used for the piping to drain freely. In other locations, concentric reducers may be used. The provision for vent and drain should be provided at all top and bottom point of pipelines respectively with ball valve for isolation. The cost of provision for vent and drain should be included in piping works. The size of ball valves for vent and drain will be 15 NB and 25 NB/ suitable sizes respectively and free end of ball valves fitted with dummy plug.

4.4 SPECIFICATIONS FOR FLOW BALANCING:

After completion of the installation, all systems shall be adjusted and balanced to deliver the water quantities as specified, quoted, or as directed. Water circuit shall be adjusted by balancing the valves, these shall be permanently marked after balancing is completed so that they can be restored to their correct positions, if disturbed. Complete certified balancing report shall be submitted for evaluation and approval. Upon approval, four copies of the balancing report shall be submitted with the as- installed drawings and completion documents.

4.5 SPECIFICATIONS FOR CONTROL CABLES:

Control cables shall be of 1100 Volts grade, annealed copper conductor, PVC insulated, extruded FRLC PVC inner sheathed, overall FRLS PVC sheathed conforming to IS 1554/Pt.I/1988.

Cables laid on trays and risers shall be neatly dressed and clamped at an interval of 1500 mm and 900 mm for horizontal and vertical cable runs. The vendor shall supply the required cable trays of suitable size. The cable trays shall be of suitable size and material.

Each cable run shall be tagged with number that appears in the cable schedule. Cables shall be tagged at their entrance, every 30 m and exit from any equipment, junction box. The tags shall be of aluminum with number punched on it and securely attached to the cable by not less than two turns of 16 SWG GI wire.

The termination and connection of cables shall be done strictly in accordance with drawing and/ or directed by the IPR. The work shall include all clamping, glanding, fitting, fixing, tapping, crimping and grounding as required. The vendor shall perform all drilling, cutting on the gland plate and any other modification required and plugging the extra holes. The vendor shall provide on control cable cores at all terminations. Termination and connections shall be carried out in such a manner as to avoid strain on the terminals.

The vendor shall supply the required cable glands of suitable type and size. Cable glands shall be of heavy duty, tinned brass, and single/ double compression type complete with necessary armor,

clamp and tapered washer etc. Cable gland shall match with the size of different control cables. They shall provide dust and leak proof terminations. The vendor shall make every effort to minimize wastage during erection work. In any case, the wastage shall not exceed 2.5 % for total quantity of cable supplied.

The scope of the EMS vendor shall also include:

- a. Submission of cable schedules, wiring schedules, test reports, final “AS BUILT” drawings etc.
- b. Handing over the system as a whole after becoming fully operational to IPR.

Although it may not be specified here, but all other work required for successful installation, testing and commissioning shall be in vendor’s scope. The system shall be deemed to have been handed over only after IPR's final acceptance.

No.	Equipment	Cable Size
1	Transmitters like Pressure, Temperature, pH, Conductivity, Flow transmitters (2 wire type).	2C x 1.5 sq. mm Cu screened & shielded (armoured) cable (includes power signal also).
2	Temperature sensors (RTD Ni-1000).	2C x 1.5 sq. mm Cu screened & shielded (armoured) cable.
3	Solenoid Valves and for ON/OFF status signals from Panel and Controller.	2C x 1.5 sq. mm Cu armored cable for each signal.

4.6 SPECIFICATIONS FOR DAQ :

The specification of DAQ and other requirements are given below

- (i) Description of each signal like type: AC/DC or voltage output or current output
- (ii) Range of each signal: 4-20mA, 0-5V etc.
- (iii) Engineering value (e.g. 4-20mA) and process value (e.g. 0-100 *lpm*) for each signal calibration of all the instrumentation needed
- (iv) Cabling work from the field instrument (i.e. cooling water system) to the junction box.
- (v) Signal output at junction box for all instruments.
- (vi) Relay card for all the required control logics.
- (vii) Displays for all the flow meters, temperature transmitters, etc. if required.
- (viii) Vendor needs to carry out an acceptance test (e.g. pressurized with water in whole CWS line) at IPR to check the CWS instrumentation with PLC (i.e. control, status and values).

5 TECHNICAL DATA SHEETS

(List of technical information's to be furnished by the bidder to IPR)

Notes:

- Separate technical data sheets shall be furnished by vendor for different type/ model/ configuration for different items.
- Take copies of the data sheet for different sizes/ category and furnish the information asked for.
- All the data sheets shall be endorsed with stamp and signature by the vendor.
- Bidder has to provide minimum technical details as enclosed herewith, however shall also provide remaining / additional details. Attach Technical leaflets, performance curves, etc. for all products / system parts offered.
- Please refer technical specifications asked for before filling the blank data sheets.
- Vendor shall proceed for procurement of these components only after obtaining approval from IPR.

➤ BUTTERFLY VALVES (manual):

• Type / Class	
• Make / Model	
• Material of all body parts: (Enclose details)	
Body / Bonnet	
Flange specifications	
Seat / Disc	
Stem / Trim	
Bearing/ sleeve	
Operating lever.	
Fasteners:	
• Operating range & limits: Pressure (Bar) / Temp. (°C).	
• Cv value	
• Max. Shut of pressure	
• Test Pressure (Hydro – air) Shell / seat	
• Leakage class	
• Local indication	
• Additional features if any:	

Description	Confirmation	Deviation
<ul style="list-style-type: none"> • The valves should be of wafer type with total SS 304L/ SS 316 construction, disc & stem should be SS 316, pressure class PN 10 or class 150 as per the details in SOQ. • The valves shall have mounting flange as per ISO 		

<p>5211, centering lugs, locking lever handle. Preferably, the valves will be of two-piece body.</p> <ul style="list-style-type: none"> • The disc should provide bubble tight shut off in both flow directions with minimum torque and longer seat life. • The valves should give higher Cv values. <p>The valves should be with SS disc & stem, replaceable Teflon / EPDM seat.</p>		
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➤ **BALL VALVES (manual):**

• Type / Class	
• Make / Model	
• Material of all body parts: (Enclose details)	
Body / Bonnet	
End connection	
Seat / Ball	
Stem / Trim	
Stem seals/ Body seals	
Operating lever.	
Fasteners:	
• Operating range & limits: Pressure (Bar) Temp. (°C).	
• Bore	
• Cv value	
• Max. Shut of pressure	
• Test Pressure (Hydro – air) Shell / seat	
• Leakage	
• Local indication	
• Additional features if any:	

Description	Confirmation	Deviation
<ul style="list-style-type: none"> • The valves should be of flanged end (class 150) three piece construction; socket welded (or) screwed type (class 400) three piece construction, with total SS 304L/ SS 316 construction, as per the details in SOQ. •The valves may have ISO 5211 mounting pad and double body sealing arrangement •The valves shall be of full-bore design only. •The seat will be of PTFE. •The valve design shall be as per BS: 5351/ API: 6D 		

➤ **GLOBE VALVES (manual) :**

• Type / Class	
• Make / Model	
• Material of all body parts: (Enclose details)	
Body / Bonnet	
Flange specifications	
Seat / Disc	
Bearing/ sleeve	
Gland	
Operating lever.	
Fasteners:	
• Operating range & limits: Flow LPM Pressure (Bar) / Temp. (°C).	
• Cv value	
• Max. Shut of pressure	
• Test Pressure (Hydro – air) Shell / seat	
• Leakage class	
• Local indication	
• Additional features if any:	

Description	Confirmation	Deviation
<ul style="list-style-type: none"> Globe valves are used for manual flow control and should provide bubble tight throttling. The valves should be of SS 304L/ SS 316 construction, class 150 as per the details in SOQ. The bonnet / disc should be of SS. Preferably, the bonnet will be of removable type. 		

➤ **NON-RETURN VALVES:**

• Type / Class	•
• Make / Model	•
• Material of all body parts: (Enclose details)	•
Body / Bonnet	
Flange specifications	
Seat / Disc	
O-ring / Seal	
Seal	
Fasteners:	

• Operating range & limits: Pressure (Bar) / Temp. (°C).	•
• Cv value	•
• Max. Shut of pressure	•
• Test Pressure (Hydro – air) Shell / seat	•
• Leakage	•
• Additional features if any:	•

Description	Confirmation	Deviation
<ul style="list-style-type: none"> The body should be of SS 304L / 316 constructions, class 150 / 300 as per the details in SOQ. The valves shall be of 'lift type' for sizes 50 NB and below, 'flapper / swing / dual plate spring type' for sizes above 50 NB. The body / Bonnet / Stem / gland / hinge / disc will of SS material and seat O-ring / gasket shall be of 3 mm thick PTFE and / or EPDM. The spring and hinge/stop pin shall be SS and bearing PTFE material. The valves should be of flange ended. 		

➤ **ON/OFF Ball/ Butterfly PNEUMATIC/ SOLENOID OPERATED VALVES:**

• Type / Class	•
• Make / Model	•
• Material of all body parts: (Enclose details)	•
Body / Bonnet	
Flange specifications/ End connections	
Seat / Disc / Ball	
Stem / Trim	
Bearing/ sleeve	
Seals	
Operating lever.	
Fasteners:	
• Bore (for ball valves)	•
• Operating range & limits: Pressure (Bar) / Temp. (°C).	•
• Cv value	•

• Max. Shut of pressure	•
• Actuator details (fill details with accessories)	•
• Test Pressure (Hydro – air) Shell / seat	•
• Leakage	•
• Local indication	•
• Additional features if any:	•

Description	Confirmation	Deviation
<ul style="list-style-type: none"> • The valves can be of 'Butterfly type' for sizes 50 NB and above, 'Ball type' for sizes below 50 NB. • The valves should be of pneumatic type, SS 304L / SS 316 construction, class 150 / 300 as per the details in SOQ with actuator (Quarter turn pneumatic spring type, construction – double rack and pinion), Solenoid valve, limit switch box, Air filter regulator including mounting brackets coupling & tubing etc. • The actuator should be single acting spring return type with extruded aluminum body hard anodized and stroke adjustment facility. Minimum available air pressure for actuator sizing will be 5 bar. • The valves should have fast response, opening and closing time. • The valves should provide bubble tight shut off in both flow directions with minimum torque and longer seats life. • The valves should give higher Cv values. The valves should be with SS disc & stem, replaceable Teflon / EPDM seat. • All ball valves should be of full-bore design only. • The solenoid valves should be 3/2 way with 1/4" NPT (F) connection and anodized Aluminum/ Brass body. The coil voltage shall be 230V AC, 50 Hz and housing shall be weatherproof to IP65. The junction box should be with 1/2" NPT cable entry. • The limit switch shall be rotary type with dome indicator for local ON/OFF indication and two SPDT micro switches with contact rating 10 Amps., 230 V AC. The cable entry should be 1/2" NPT. • Air filter regulator required with metal bowl and manual drain and 5 microns filter element. • All tubing/ filling SS304L/ SS316 material 		

➤ **PRESSURE REDUCING VALVES:**

• Type / Class	
• Make / Model	
• Material of all body parts: (Enclose details)	
Body / Bonnet	
Flange specifications	
Seat / Diaphragm	
Stem / Trim	
Bearing/ sleeve	
Fasteners:	
• Operating range & limits: Flow LPM Pressure (Bar) / Temp. (°C).	
• Cv value	
• Max. Shut of pressure	
• Test Pressure (Hydro – air) Shell / seat	
• Leakage	
• Local indication	
• Additional features if any:	

Description	Confirmation	Deviation
<ul style="list-style-type: none"> • The controlled downstream pressure should remain constant irrespective of changes in the inlet pressure and / or flow rate. • The valve should be of self-acting, pilot operated type. • The body & trim should be of SS 304L/SS 316 construction respectively, class 150 as per the details in SOQ. The disc / diaphragm should be of neoprene / EPDM / Teflon. / equivalent • The internal parts like valve disc, trim parts may be of easily replaceable type without removing the whole body from the line. • The valves should be delivered with 'built-in safety provision' against high-pressure build-up in the inlet side, also '1/4 inch pressure gauge connection' with one set of pressure gauge (2” dial size) connected on downstream pressure measurement • The valves should be of flange ended. • The valves should provide class VI leak tightness. • The set pressure should be easily adjustable by adjusting the spring setting. 		

➤ **NEEDLE VALVES:**

• Type / Class	
• Make / Model	

• Material of all body parts: (Enclose details)	
Body / Bonnet	
Flange specifications	
Seat	
Stem /Trim	
Bearing/ sleeve	
Seals	
Operating lever.	
Fasteners:	
• Operating range & limits: Pressure (Bar) Temp. (°C).	
• Cv value	
• Max. Shut of pressure	
• Test Pressure (Hydro – air) Shell / seat	
• Leakage	
• Local indication	
• Additional features if any:	

➤ **PIPING FOR DM WATER APPLICATION:**

• Material:	
• Make:	
• Schedule:	

➤ **INSULATION FOR DM WATER LINES:**

• Type	•
• Make	•
• Density	•
• Thermal conductivity.	•

➤ **INSTRUMENTS & CONTROLS:** (Enclose Leaflets)

TEMPERATURE SENSOR CUM TRANSMITTER:

• Type	
• Make / Model / Size	
• Material of construction of all parts	
• Type of sensor & Transmitters.	
• Measuring & Operating Range	
• Accuracy	
• Repeatability	

• Response time	
• Type of Indication – No. Of digits	
• Working limits	
• Type of enclosures	
• Mounting detail	
• Signal out put (Preferably 4 -20 mA)	
• Calibration requirement	
• Connection type and size.	
• Power supply required	
• Accessories Included (like terminal box, flange etc)	
• Optional accessoires Etc.	
• Dimension (mm)	
• Weight (kg)	

PRESSURE SENSOR CUM TRANSMITTER:

• Type	
• Make / Model / Size	
• Material of construction of all parts	
• Type of sensor & Transmitters.	
• Measuring & Operating Range	
• Accuracy	
• Repeatability	
• Response time	
• Type of Indication – No. of digits	
• Working limits	
• Type of enclosures	
• Mounting detail	
• Signal output (Preferably 4 -20 mA)	
• Calibration requirement	
• Connection type and size.	
• Power supply required	
• Accessories Included (like terminal box, flange etc)	
• Optional accessoires Etc.	
• Dimension (mm)	
• Weight (kg)	

PRESSURE GAUGES:

• Type	
• Make / Model / Size	
• Material of construction of all parts	
• Type of sensor & Transmitters.	
• Measuring & Operating Range	
• Accuracy	
• Repeatability	
• Response time	
• Working limits	
• Dial size	
• Type of enclosures	
• Mounting detail	
• Calibration requirement	
• Connection type and size.	
• Accessories Included	
• Optional accessoires Etc.	
• Dimension (mm)	
• Weight (kg)	

TEMPERATURE GAUGES:

• Type	
• Make / Model / Size	
• Material of construction of all parts	
• Type of sensor & Transmitters.	
• Measuring & Operating Range	
• Accuracy	
• Repeatability	
• Response time	
• Working limits	
• Type of enclosures	
• Dial size	
• Mounting detail	
• Calibration requirement	
• Connection type and size.	
• Accessories Included	
• Optional accessories Etc.	
• Dimension (mm)	
• Weight (kg)	

FLOW METER CUM TRANSMITTERS:

• Type	
• Make / Model / Size	
• Material of construction of all parts	
• Material of construction of rotor/ turbine	
• Type of sensor & Transmitters.	
• Measuring & Operating Range	
• Accuracy	
• Repeatability	
• Response time	
• Type of Indication – No. of digits	
• Working limits	
• Type of enclosures	
• Mounting detail	
• Signal out put (Preferably 0 / 4 -20 mA)	
• Calibration requirement	
• Connection type and size.	
• Power supply required	
• Accessories Included (like terminal box, flange etc)	
• Optional accessories Etc.	
• Dimension (mm)	
• Weight (kg)	

6 APPROVED MAKES

The following makes are approved by IPR. Deviations in the approved make will not be allowed. So, the vendor has to consider this while submitting price bid. Also, refer technical specifications, accordingly select approved makes.

Description of item	Approved makes
1. Piping	
▪ SS pipe (Seamless/ERW)	Prakash Tubace/Subhalaxmi/Ratnamani/ Remi/SAIL/Jindal/Indian seamless/R. Natverlal/*
▪ Braided PVC pipe / Rubber hose pipe / flexible braided metal hose fittings	Semsonex/ Samson/Jay Industries/Abcoflex/Sakhi/ Libra Flex / Micron (Legris) / Duplon/Parkar/ Witzenmann India Pvt Ltd./ *
2. PARKER make 1 inch diameter non conductive hose (part no. 518C-16) pipe	M/s Shah Enterprise, Surat, Gujrat
3. Valves (DM water applications)	
▪ Butterfly (manual/ Pneumatic)	Intervolve / BDK /Virgo/ Fisher control / AMRI/ Technova / Advance Saunders / Audco /
▪ Globe (manual)	Audco / Advance / Saunders / BDK/ Trishul
▪ Ball Valves (manual)	Virgo/ Velan / Saunders / Audco/ Accuflow / BDK/Trishul
▪ Pressure reducing valves	Nirmal / Darling Muesco / Crescent / Forbes Marshall
▪ Needle valves	Altop instruments / Laptop instruments / Trishul/ Accuflow
▪ Pressure relief valves	Nirmal / Darling Muesco / Forbes Marshall
▪ Y-Strainer	Trishul/ Triveni/Advance/Flowtech/ Crescent valves/ Flairs/ *
4. Insulation materials	
▪ Expanded polystyrene	Llyods / Beardsell / Cooline
▪ Elastomeric EPDM foam	Superlon / Armaflex / Arcoflex/*
5. Instruments & Controls (Only DM water applications)	
▪ Temperature / Pressure gauges	WIKA / Bell Controls / IRA / Forbes Marshall/ WAREE
▪ RTD / Pressure Transmitter	WIKA/ Siemens/ E+H/ Honeywell/ Rosemount/IRA
▪ Conductivity meter	Indion / Cole-Parmer / Forbes Marshall / Weller
▪ Flow meter (Turbine)	Rockwin / Sanvij / Hoffer/ RR/ Honeywell

* Subject to IPR approval

7 STANDARDS/ CODES

The following latest IS specifications / equivalent applicable codes are applicable for the proposed work.

IS: 2379 - 1963	▪ Colour code for identification of pipelines.
IS : 3656	▪ Welds testing by DP
IS : 6392 - 1971	▪ Steel pipe flanges.
IS : 628	▪ Rubber gasket, Teflon gasket for SS piping.
IS : 554 – 1975	▪ Dimensions for pipe threads for pressure tight joints
IS : 7240 - 1981 7413 - 1981	▪ Code for practice for application and finishing of thermal insulation material at temp. From -80°C to 40°C. & 40°C to 700°C.
IS : 1367	▪ Bolts, nuts, and studs./ threaded fasteners.
ANSI - B36.19	▪ Stainless Steel pipes.

8 QUALITY ASSURANCE PLANS

Following sample quality assurance plans are enclosed for maintaining quality of procurement items. These are guidelines. The final QAPs will be prepared based on the above for execution.

Before proceeding for manufacture of these items bidder must get approval from IPR for these items within 3 weeks.

- 1) QAP for SS Butterfly valves
- 2) QAP for SS Globe valves
- 3) QAP for SS Needle valves
- 4) QAP for SS Balancing valves
- 5) QAP for SS Pressure reducing valves
- 6) QAP for SS Pressure relief safety valves
- 7) QAP for Instruments & controls
- 8) QAP for SS pipes

IPR		CONTRACTOR		MANUFACTURING QUALITY PLAN				Job.: NBI Cooling Water System				
		SUB-CONTRACTOR :		ITEM: SS BUTTERFLY VALVES				Contract No:				
								Contractor:				
No.	COMPONENT OPERATION	CHARACTERISTICS	CLASS	TYPE CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			R
									M	C	I	
1			4	5	6	7	8	9	10			11
1	MATERIALS: BODY, SEAT, DISC SPINDLE, BONNET STUDS & NUTS TESTING 1) BODY 2) SEAT	PHYSICAL CHEMICAL PROPERTIES LEAK TIGHTNESS LEAK TIGHTNESS	MAJOR CRITICAL CRITICAL	PHYSICAL & CHEMICAL TESTS HYDRAULIC TEST HYDRAULIC TEST	100 % 100 % 100 %	TECHNICAL SPEC TECHNICAL SPEC TECHNICAL SPEC	TECHNICAL SPEC NO LEAKAGE NO LEAKAGE	TEST CERTIFICATE TEST CERTIFICATE TEST CERTIFICATE	P P P	V V V	W1 W2 W2	
2	FINAL INSPECTION (ASSEMBLED VALVE)	CLEANLINESS OVER ALL DIAMENSIONS COMPLETENESS WORKMANSHIP	MAJOR	VISUAL	100 %	APPROVED DRG TECHNICAL SPEC	APPROVED DRG TECHNICAL SPEC	INSPECTION REPORT	P	V	W2	
			REV - 0					P - Performer V - Verifier M - Manufacturer C - Contractor I - IPR		DOCUMENT NO.		
MANUFACTURER		CONTRACTOR						REVIEWED BY				
SIGNATURE		SIGNATURE								NAME AND SIGN OF APPROVING AUTHORITY		

W1 = No CHP, W2 = 100 % CHP, W3 = 10 % CHP, (CHP = CUSTOMER HOLD POINT)

IPR		CONTRACTOR		MANUFACTURING QUALITY PLAN				Job.: NBI Cooling Water System				
		SUB-CONTRACTOR :		ITEM: SS BALL VALVES				Contract No:				
								Contractor:				
No.	COMPONENT OPERATION	CHARACTERISTICS	CLASS	TYPE CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT :	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			R
									M	C	I	
1			4	5	6	7	8	9	10			11
1	MATERIALS: BODY, SEAT, DISC SPINDLE, BONNET STUDS & NUTS TESTING 1) BODY 2) SEAT	PHYSICAL & CHEMICAL PROPERTIES LEAK TIGHTNESS LEAK TIGHTNESS	MAJOR CRITICAL CRITICAL	PHYSICAL & CHEMICAL TESTS HYDRAULIC TEST HYDRAULIC TEST	100 % 100 % 100 %	TECHNICAL SPEC TECHNICAL SPEC TECHNICAL SPEC	TECHNICAL SPEC NO LEAKAGE NO LEAKAGE	TEST CERTIFICATE TEST CERTIFICATE TEST CERTIFICATE	P P P	V V V	W1 W2 W2	
2	FINAL INSPECTION (ASSEMBLED VALVE)	CLEANLINESS OVER DIMENSIONS COMPLETENESS WORKMANSHIP	MAJOR	VISUAL	100 %	APPROVED DRG TECHNICAL SPEC	APPROVED DRG TECHNICAL SPEC	INSPECTION REPORT	P	V	W2	
			REV - 0				P - Performer V - Verifier M - Manufacturer C - Contractor I - IPR	DOCUMENT NO.				
MANUFACTURER		CONTRACTOR					REVIEWED BY					
SIGNATURE		SIGNATURE						NAME AND SIGN OF APPROVING AUTHORITY				

W1 = No CHP, W2 = 100 % CHP, W3 = 10 % CHP, (CHP = CUSTOMER HOLD POINT)

IPR		CONTRACTOR		MANUFACTURING QUALITY PLAN ITEM: SS GLOBE VALVES				Job.: NBI Cooling Water System				
		SUB-CONTRACTOR :						Contract No:		Contractor:		
No.	COMPONENT OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT :	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			R
1	2	3	4	5	6	7	8	9	10			11
									M	C	I	
1	MATERIALS: BODY, SEAT, DISC SPINDLE, BONNET STUDS & NUTS TESTING 1) BODY 2) SEAT	PHYSICAL CHEMICAL PROPERTIES LEAK TIGHTNESS LEAK TIGHTNESS	MAJOR CRITICAL CRITICAL	PHYSICAL & CHEMICAL TESTS HYDRAULIC TEST HYDRAULIC TEST	100 % 100 % 100 %	TECHNICAL SPEC TECHNICAL SPEC TECHNICAL SPEC	TECHNICAL SPEC NO LEAKAGE NO LEAKAGE	TEST CERTIFICATE TEST CERTIFICATE TEST CERTIFICATE	P P P	V V V	W1 W2 W2	
2	FINAL INSPECTION (ASSEMBLED VALVE)	CLEANLINESS & OVER ALL DIAMENSIONS COMPLETENESS WORKMANSHIP	MAJOR	VISUAL	100 %	APPROVED DRQ. TECHNICAL SPEC	APPROVED DRQ. TECHNICAL SPEC	INSPECTION REPORT	P	V	W2	
			REV - 0				P - Performer V - Verifier M Manufacturer C - Contractor I - IPR	DOCUMENT NO.				
MANUFACTURER		CONTRACTOR					REVIEWED BY					
SIGNATURE		SIGNATURE						NAME AND SIGN OF APPROVING AUTHORITY				

W1 = No CHP, W2 = 100 % CHP, W3 = 10 % CHP, (CHP = CUSTOMER HOLD POINT)

IPR		CONTRACTOR		MANUFACTURING QUALITY PLAN ITEM: NEEDLE VALVES				Job.: NBI Cooling Water System				
		SUB-CONTRACTOR :						Contract No:		Contractor:		
No.	COMPONENT OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT :	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			R
1	2	3	4	5	6	7	8	9	M	C	I	11
									10			
1	MATERIALS: BODY, SEAT, DISC SPINDLE, BONNET STUDS & NUTS TESTING 1) BODY 2) SEAT	PHYSICAL CHEMICAL PROPERTIES LEAK TIGHTNESS LEAK TIGHTNESS	MAJOR CRITICAL CRITICAL	PHYSICAL & CHEMICAL TESTS HYDRAULIC TEST HYDRAULIC TEST	100 % 100 % 100 %	TECHNICAL SPEC TECHNICAL SPEC TECHNICAL SPEC	TECHNICAL SPEC NO LEAKAGE NO LEAKAGE	TEST CERTIFICATE TEST CERTIFICATE TEST CERTIFICATE	P P P	V V V	W1 W2 W2	
2	FINAL INSPECTION (ASSEMBLED VALVE)	CLEANLINESS & OVER ALL DIAMENSIONS COMPLETENESS WORKMANSHIP	MAJOR	VISUAL	100 %	APPROVED DRQ. TECHNICAL SPEC	APPROVED DRQ. TECHNICAL SPEC	INSPECTION REPORT	P	V	W2	
			REV - 0				P - Performer V - Verifier M Manufacturer C - Contractor I - IPR	DOCUMENT NO.				
MANUFACTURER		CONTRACTOR				REVIEWED BY						
SIGNATURE		SIGNATURE					NAME AND SIGN OF APPROVING AUTHORITY					

W1 = No CHP, W2 = 100 % CHP, W3 = 10 % CHP, (CHP = CUSTOMER HOLD POINT)

IPR		CONTRACTOR:		MANUFACTURING QUALITY PLAN				Job.: NBI Cooling Water System				
		SUB CONTRACTOR:		ITEM: SS PRESSURE REDUCING VALVES				Contract No:		Contractor:		
No.	COMPONENT OPERATION	CHARACTERISTIC	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			R
1	2	3	4	5	6	7	8	9	M	C	N	11
										10		
1.1	BODY MATERIAL	COMPOSITION	MAJOR	CHEMICAL ANALYSIS	ONE /HEAT	APPROVED G.A DRG.	APPROVED G.A DRG.	TEST CERTIFICATE	P	V	W1	
1.2	TRIM MATERIAL	MECHANICAL	MAJOR	MECH. TEST	ONE /HEAT	APPROVED G.A DRG.	APPL.MATERIAL SPEC.	TEST CERTIFICATE	P	V	W1	
1.2		COMPOSITION	MAJOR	CHEMICAL ANALYSIS	ONE / LOT	APPROVED G.A DRG.	APPROVED G.A DRG.	TEST CERTIFICATE	P	V	W1	
2.1	PRESSURE TEST	BODY	CRITICAL	VISUAL	100 %	APPROVED TECH SPEC.	NO LEAKAGE	INSPECTION REPORT	P	V	W2	
2.2	LEAK TEST	SEAT LEAKAGE	CRITICAL	VISUAL	100 %	APPROVED TECH SPEC.	NO LEAKAGE	INSPECTION REPORT	P	V	W2	
3.1	LEAK TEST	WITH SOAP WATER AT MAX. INLET PRESSURE	CRITICAL	VISUAL	100 %	APPROVED DRG.	NO LEAKAGE	INSPECTION REPORT	P	V	W2	
3.2	FUNCTIONAL TEST	SET POINT TEST	CRITICAL	VISUAL	100 %	APPROVED DRG.	APPROVED G.A DRG.	INSPECTION REPORT	P	V	W2	
3.3	DOCUMENT	HISTORY DOCKET	MAJOR	RECORDS VERIFICATION	100 %	APPROVED SPEC.	APPROVED SPEC.	HISTORY DOCKET	P	V	W2	
MANUFACTURER		CONTRACTOR		REV - 0								
SIGNATURE							REVIEWED BY	P - Performer V - Verifier M - Manufacturer C - Contractor I - IPR				
									NAME AND SIGN OF APPROVING AUTHORITY			

W1 = No CHP, W2 = 100 % CHP, W3 = 10 % CHP, (CHP = CUSTOMER HOLD POINT)

IPR		CONTRACTOR:		MANUFACTURING QUALITY PLAN				Job.: NBI Cooling Water System				
		SUB CONTRACTOR:		ITEM: SS PRESSURE SAFETY VALVES				Contract No: Contractor:				
No.	COMPONENT OPERATION	CHARACTERISTIC	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			R
1	2	3	4	5	6	7	8	9	M	C	N	11
									10			
1.1	BODY MATERIAL	COMPOSITION	MAJOR	CHEMICAL ANALYSIS	ONE /HEAT	APPROVED G.A DRG.	APPROVED G.A DRG.	TEST CERTIFICATE	P	V	W1	
1.2	TRIM MATERIAL	MECHANICAL	MAJOR	MECH. TEST	ONE /HEAT	APPROVED G.A DRG.	APPL.MATERIAL SPEC.	TEST CERTIFICATE	P	V	W1	
1.2		COMPOSITION	MAJOR	CHEMICAL ANALYSIS	ONE / LOT	APPROVED G.A DRG.	APPROVED G.A DRG.	TEST CERTIFICATE	P	V	W1	
2.1	PRESSURE TEST	BODY	CRITICAL	VISUAL	100 %	APPROVED TECH SPEC.	NO LEAKAGE	INSPECTION REPORT	P	V	W2	
2.2	LEAK TEST	SEAT LEAKAGE	CRITICAL	VISUAL	100 %	APPROVED TECH SPEC.	NO LEAKAGE	INSPECTION REPORT	P	V	W2	
3.1	LEAK TEST	WITH SOAP WATER AT MAX. INLET PRESSURE	CRITICAL	VISUAL	100 %	APPROVED DRG.	NO LEAKAGE	INSPECTION REPORT	P	V	W2	
3.2	FUNCTIONAL TEST	SET POINT TEST	CRITICAL	VISUAL	100 %	APPROVED DRG.	APPROVED G.A DRG.	INSPECTION REPORT	P	V	W2	
3.3	DOCUMENT	HISTORY DOCKET	MAJOR	RECORDS VERIFICATION	100 %	APPROVED SPEC.	APPROVED SPEC.	HISTORY DOCKET	P	V	W2	
MANUFACTURER		CONTRACTOR		REV - 0					P - Performer V - Verifier M - Manufacturer C - Contractor I - IPR			
SIGNATURE							REVIEWED BY					
									NAME AND SIGN OF APPROVING AUTHORITY			

W1 = No CHP, W2 = 100 % CHP, W3 = 10 % CHP, (CHP = CUSTOMER HOLD POINT)

IPR		CONTRACTOR		MANUFACTURING QUALITY PLAN ITEM: INSTRUMENTS & CONTROLS			Job.: NBI Cooling Water System				
							Contract No:				
							Contractor:				
No.	COMPONENT & OPERATION	CHARACTERISTICS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			R
								M	C	I	
								9			
1	2	3	4	5	6	7	8				
1	COMPLETED ASSEMBLY	A) SPECIFICATION	VERIFICATION	100%	PURCHASE ORDER	PURCHASE ORDER	TEST CERTIFICATE	P	V	V	
		B) APPEARANCE	VISUAL	100%	PURCHASE ORDER	PURCHASE ORDER	TEST CERTIFICATE	P	V	V	
		C) DIMENSIONS	MEASUREMENT	100%	PURCHASE ORDER	PURCHASE ORDER	TEST CERTIFICATE	P	V	W3	
		E) RANGE CALIBRATION	MEASUREMENT	100%	PURCHASE ORDER	PURCHASE ORDER	TEST CERTIFICATE	P	V	W3	
		F) ACCURACY	PERFORMANCE	100%	PURCHASE ORDER	PURCHASE ORDER	TEST CERTIFICATE	P	V	W3	
		G) OTHER FUNCTIONAL OPTIONAL	PERFORMANCE	100%	PURCHASE ORDER	PURCHASE ORDER	TEST CERTIFICATE	P	V	W3	
		REV - REV .0				P-PERFORMER V-VERIFIER W-WITNESS M-MANUFACTURER C-CONTRACTOR I-IPR		DOCUMENT NO. REV - 0			
MANUFACTURER		CONTRACTOR				REVIEWED BY					
SIGNATURE								NAME AND SIGN OF APPROVING AUTHORITY			

W1 = No CHP, W2 = 100 % CHP, W3 = 10 % CHP, (CHP = CUSTOMER HOLD POINT)

IPR		CONTRACTOR		MANUFACTURING QUALITY PLAN			Job.: NBI Cooling Water System				
		SUB CONTRACTOR / SUPPLIER		ITEM: SS 304L / SS 316 PIPES			Contract No: Contractor:				
No.	COMPONENT & OPERATION	CHARACTERISTICS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			R
								M	C	I	
1	2	3	4	5	6	7	8	9			10
1	Identification of Raw Material	Chemical composition	Tests	100%	ASTM A312, TP304, Mill TC	ASTM A312, TP304	TEST CERTIFICATE	P	V	W1	Test Report Review
2	Final Heat Treatment & temperature Record	Temperature & RPM	Heat treatment	100%	ASTM A312, TP304, Mill TC	ASTM A312, TP304	TEST CERTIFICATE	P	V	W1	-
3	Final pickling & Passivation	Bath Concentration & Surface cleanliness	Visual	100%	SSSL Procedure	ASTM A312, TP304	TEST CERTIFICATE	P	V	W1	-
4	Sampling & Mechanical Test	Tension Flattening	Mechanical	Sample	ASTM A312, TP304, Mill TC	ASTM A312, TP304	TEST CERTIFICATE	P	W3	W3	-
5	Hydro Testing	Pressure & Leak Testing	Pressure Test	100%	ASTM A312, TP304	ASTM A312, TP304	TEST CERTIFICATE	P	W3	W3	-
6	Chemical Composition Test & Product Analysis	Chemical Element	Chemical	Sample / Heat	ASTM A312, TP304	ASTM A312, TP304	TEST CERTIFICATE	P	W3	W3	-
7	Dimensional, Visual and Marking	OD, Weight, Length & Cleanliness & Marking	Visual	100%	ASTM A312, TP304	ASTM A312, TP304	TEST REPORT	P	W2	W3	-
			REV 0				P-Performer V-Verifier W-Witness	DOCUMENT NO.			
MANUFACTURER		CONTRACTOR				REVIEWED BY	M-Manufacturer C-Contractor I-IPR				
SIGNATURE							NAME AND SIGN OF APPROVING AUTHORITY				

W1 = NO CHP, W2 = 100% CHP, W3 = 10% CHP, (CHP = CUSTOMER HOLD POINT)

9 DRAWINGS

The following drawings are enclosed with this tender document.

Sl. No.	Drawing Description	Drawing number
1	NBI Cooling Water System (CWS)	SST-1/NBI/WCS/3D MODEL
2	NBI CWS Piping Layout	SST-1/NBI/WCS/PIPE
3	Revised P&ID diagram of water distribution system for NBI system	SST-1/WDS/NBI-REVISED/R2
4	PINI water connection line	SST-1/NBI/WCS/PINI&MC CWS
5	Inlet of sub-system	SST-1/NBI/WCS/SUBSYSTEM/FRONT VIEW
6	Outlet of sub-system	SST-1/NBI/WCS/SUBSYSTEM/OUTLET
7	NBI CWS connection side V-Target	SST-1/NBI/CWS/FLANGE CONNECTION SHEET 1 OF 6
8	NBI CWS connection side Ion Dump (ID)	SST-1/NBI/CWS/FLANGE CONNECTION SHEET 2 OF 6
9	NBI CWS connection side Neutralizer-2	SST-1/NBI/CWS/FLANGE CONNECTION SHEET 3 OF 6
10	NBI CWS connection side Beam Transmission Duct	SST-1/NBI/CWS/FLANGE CONNECTION SHEET 4 OF 6
11	NBI CWS connection side Pre Duct Scrapper (PDS) Shine Through (ST)	SST-1/NBI/CWS/FLANGE CONNECTION SHEET 5 OF 6
12	NBI CWS connection side Magnet Liner (ML)	SST-1/NBI/CWS/FLANGE CONNECTION SHEET 6 OF 6
13	MS Checker Plate Detail	IPR/15/A3/NBI/4032 SHEET 1 OF 3
14	MS Platform Assembly	IPR/15/A3/NBI/4032 SHEET 2 OF 3
15	MS Platform Support Structure Assembly	IPR/15/A3/NBI/4032 SHEET 3 OF 3